The relationship between oral language ability, non-verbal ability, socio-economic status and academic attainment with reading comprehension: a longitudinal study in mainstream secondary school-age students

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List of Abbreviations

ALCL	Association of School and College Leaders
CAT4	Cognitive Abilities Test, Fourth Edition (Smith et al., 2003)
CELF4	Clinical Evaluation of Language Fundamentals, Fourth Edition (Semel et al., 2006)
COVID-19	Coronavirus Disease 2019
DFE	Department for Education
DLD	Developmental language disorder
EHCP	Education, Health and Care Plan
ESL	English-as-a-Second-Language speaker
FSM	Free School Meals
GCSE	General Certificate of Secondary Education
GMRT	Gates-MacGinitie Reading Test
GORT	Gray Oral Reading Test
GRADE	Group Reading Assessment Diagnostic Evaluation
IDACI	Income Deprivation Affecting Children Index
IQ	Intelligence Quotient
JB1	Joanna Briggs Institute
KS2	Key Stage Two (four years of school education in England and Wales known as Year 3, Year 4, Year 5 and Year 6, when students are aged between 7 and 11 years of age)
KS3	Key Stage Three (three years of school education in England and Wales known as Year 7, Year 8 and Year 9, when students are aged between 11 and 14 years of age)
KS4	Key Stage Four (two years of school education in England and Wales known as Year 10 and Year 11, when students are aged between 14 and 16 years of age)
LAC	Looked After Children
LM	Language Minority student
LRRC	Language and Reading Research Consortium
NGRT	New Group Reading Test (Burge et al., 2014)

NHS	National Health Service
NICHD	National Institute of Child Health and Human Development
PISA	The Programme for International Student Assessment
PP	Pupil Premium
PRU	Pupil Referral Unit
SATs	Statutory Assessments Tests, taken in Year 2 and Year 6
SEN	Special Educational Needs
SEND	Special Educational Needs and Disability
SES	Socio-economic status
SLT	Speech and Language Therapist
STA	Standards and Testing Agency
SVR	Simple View of Reading
RS	Recalling Sentences subtest
TA	Teacher Assessment
TD	Typically Developing
TOSREC	Test of Silent Reading Efficiency and Comprehension
TOWRE2	Test of Word Reading Efficiency, Second Edition
TP1	Time point one
TP2	Time point two
UK	United Kingdom
USA	United States of America
USP	Understanding Spoken Paragraphs subtest
YO	Young Offender

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Declaration

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Abstract

This study aimed to explore the relationships between oral language ability, non-verbal ability, socio-economic status and academic attainment with reading comprehension in adolescents in a mainstream secondary school, and to understand the influence of oral language on reading comprehension.

Four hundred and forty-three students, aged 11-14 years in three cohorts (C7, C8 and C9) participated in the two-year study. Thirty-eight percent of the students lived in significant deprivation. Data was collected in the first year of the study for each cohort and the following year for the C7 and C8 cohorts (C7+1 and C8+1). Retrospective data was collected on C8 and C9 cohorts (C8-1 and C9-1, C9-2).

Data was collected from three sources for all cohorts: Statutory Assessment Tasks at the end of primary education (Year Six); data routinely collected in the secondary school (including assessments of reading comprehension (New Group Reading Test) and non-verbal ability (Cognitive Abilities Test)) and academic outcomes for a single cohort in the General Certificate of Secondary Education for English, Mathematics and Science (C9 in Year Eleven); thirdly, standardised language (Clinical Evaluation of Language Fundamentals Recalling Sentences and Understanding Spoken Paragraphs) and word reading tests (Test of Word Reading Efficiency) specifically collected for the study.

Cross-sectional and longitudinal analyses were used. The mixed study design allowed the exploration of changes in the oral ability, non-verbal ability, academic attainment and reading comprehension for these students as they moved through key academic stages in their education.

Cross sectional analysis showed that students in each cohort performed at the lower end of the age range for Recalling Sentences and below average on Understanding Spoken Paragraphs suggesting that most students experienced difficulties with listening comprehension. Reading comprehension and academic data showed that students in each cohort performed within their ability range, although word reading indicated a declining performance.

Longitudinal analysis showed that verbal reasoning made an increasing contribution to reading comprehension as children got older, and improvements in reading comprehension were supported by improvements in listening comprehension. Deprivation negatively influenced verbal reasoning and was associated with poorer reading outcomes over time.

In support of reciprocal models of reading (Nation, 2019; Tunmer and Hoover, 2019), fewer opportunities to practise reading skills and fewer opportunities to read new, challenging texts may be further depriving students' chances to develop word recognition and language skills.

The current findings that oral language ability is an important factor in students' reading and literacy success suggest that oral language needs to be supported by a whole-school language approach. Teaching implications include the importance of collaborative working practice between Speech and Language professionals and teachers in order to share skills and knowledge.

Chapter One

The Development of Reading

1.1 Overview

The aim of this thesis is to explore the relationships between oral language ability, non-verbal ability, socio-economic status and academic attainment with reading comprehension in adolescents in a mainstream secondary school, and to understand the influence of oral language on reading comprehension with this population. Understanding how reading comprehension develops in early adolescence is essential, as access to the curriculum and future academic success is dependent on effective reading comprehension, which in turn is founded on oral language. Becoming a skilled reader enables the learning of new knowledge through understanding the concepts and ideas embedded in written material, conveyed through increasingly advanced vocabulary and complex syntax (Nippold 2007). Research shows that younger children living in more deprived areas may be at risk for language and reading comprehension difficulties and this thesis seeks to explore these themes within adolescence. The first chapter describes the development of reading, focusing specifically on comprehension, and the importance of successful reading for academic attainment. Different theoretical models explaining reading comprehension are explored in order to understand the process of comprehending text. Finally, the skills necessary for typical reading development are discussed, alongside the association of socio-economic factors, special educational needs (SEN), gender and language with reading.

Reading is a learnt skill (Olson et al., 2014). It is a complex process drawing on a range of cognitive and linguistic processes (Nation, 2019) and can be difficult to teach, learn and measure (Elleman and Oslund, 2019). The aim of reading is to build meaning from print to understand what has been written by another person. This requires the ability to decode or read words accurately, to understand their meaning and understand the interactions between sentences and the whole text (Storch and Whitehurst, 2002). In order to do this successfully, the reader needs to continually integrate new understanding with what has been read previously and along with their own background knowledge, create an ongoing mental model of what is being read, while constantly monitoring meaning and misunderstanding (Denton et al., 2017).

The coordination of word recognition, working memory, inference generation, comprehension monitoring, vocabulary and prior knowledge are all required to make sense of the overall text (Elleman and Oslund, 2019; Ricketts, 2011).

1.1.1 Word recognition

Word recognition is defined as the ability to read words accurately and quickly in order to understand their meaning (Hoover and Tunmer, 2019). This means that not only do proficient readers accurately decode and recognise words, but they also access and use word meaning to read fluently (Language and Reading Research Consortium, 2017). The skills underlying word recognition are explored further in section 1.4.1.

The first step in learning to read is to understand the writing system, and how to decode print (Nation, 2019). There are three main developmental stages in learning how to read: logographic, alphabetic and orthographic (Frith, 1986). In the logographic stage, children associate meaning from visual shapes, such as the golden '*M*' representing McDonald's fast-food outlets. Children are then taught to link alphabetic print to sounds, and word recognition develops through phonological processing. This alphabetic stage represents a slow and laborious way to read, and can be difficult in the English spelling system where for example, /'-w-o-z/' in spoken language is represented by 'w-a-s' in written language. Finally, reading the same words again and again allows the storage of sight words and the proficient reader can bypass the more laborious alphabetic stage. This final orthographic stage does not entirely replace the alphabetic stage but as the reader becomes more proficient in orthographic processing, less alphabetic knowledge is used. According to Archibald (2017), the storage and processing of alphabetic and orthographic knowledge is associated with working memory.

1.1.2 Working memory

Working memory describes the cognitive skills needed to store and manipulate information whilst 'thinking, reasoning and remembering' (Henry and Botting, p20, 2017). These cognitive skills are part of the executive function. In a recent review of working memory and language learning, Archibald (2017) found that difficulties with working memory may limit language learning and conversely, difficulties with language knowledge may limit working memory processing. As working memory is implicated in understanding oral and written language, poor working memory limits some individual students in learning to read (Spencer et al., 2020).

As students move through their school years, the texts they are expected to read become longer, more complex and consequently more difficult to read (Nippold, 2017). When children read difficult texts aloud, they tend to make mistakes such as omitting a word or substituting another, for example 'bought' with 'b**r**ought'. A cross-sectional study by Nguyen et al., (2020) involving 143 participants aged nine to fifteen years of age examined the relation between oral reading and executive functioning profile using passages of varying text difficulty. Nine baseline experimental texts about science and animals were created. A further eight were manipulated on decoding, vocabulary, syntax and cohesion giving a total of seventeen unique non-fiction texts of approximately 300 words, each with different levels of difficulty. Each participant read nine of the 17 passages aloud, including four baseline texts and four manipulated texts, one from each construct. The study found that students with poorer executive functioning, as measured by a battery of tests, made more mistakes in their reading regardless of text manipulations, but having better executive functioning was associated with a higher probability of participants self-correcting their mistakes when reading the experimentally-manipulated passages. Although, the study could not show developmental performance, the results suggest that executive function is associated with readers' ability to minimise mistakes and maintain the overall meaning of a text when reading aloud.

Nouwens et al., (2016), in a cross-sectional study, explored the contribution of working memory to reading comprehension performance in 117 Dutch children, with a mean age 11;01. Working memory, storage, inhibition, cognitive flexibility and planning were assessed, along with measures of reading comprehension, non-verbal ability, word recognition and vocabulary. Working memory, as measured by a listening span task indirectly contributed to reading comprehension after controlling for non-verbal cognitive ability, word recognition and vocabulary. Since this study was based on a single time point, it is difficult to show any causal relationships. However, the findings point to the importance of working memory in both storing and processing sentences in effective reading comprehension.

A later longitudinal study examined if 290 Greek children with different reading and spelling abilities in Grade Two could be identified retrospectively from kindergarten, based on their executive function (planning, attention and working memory) and linguistic (phonological and naming speed) skills (Papadopoulos et al., 2020). Drawing on Frith's orthographic processing stage, participants were split into four groups: poor readers/poor spellers, good readers/poor spellers, poor readers/good spellers and a control group who were good readers and spellers. Results showed that that children in the good reader/ good speller group demonstrated better working memory and linguistic performances in kindergarten, and a greater improvement in their working memory over the time of the study. Those children in the poor reader/ poor speller group demonstrated lower linguistic performances and a decline in their working memory. Although, the Greek language is considered to be easier to read (more transparent) than the English language which is more difficult (opaque) it highlights the inter relationship between working memory and linguistic skills. The study would need to be replicated in English for the findings to be generalised. However, the findings point to difficulties in working memory occurring along with difficulties in linguistic understanding for the poorest readers, and the need for support in both domains.

The above studies point to the need for teachers to be aware of the relationship between working memory, language learning and reading development in order to further develop literacy skills (Filipe, Castro and Limpo, 2020). A key skill in reading comprehension is the ability to process inferences which require information to be held in working memory, whilst processing implied information (Yeari, 2017).

1.1.3 Inference generation

This higher order language skill is essential in working out information that is not explicitly written on the page but instead implied within a text. Good readers use inferencing skills to read between the lines for information and draw upon prior knowledge, in addition to understanding the information presented in the text. These skills can be defined as a form of 'verbal reasoning' (Stothard et al., 2010, p129).

Trabasso and Suh (1993) considered how readers might create a 'coherent, functional mental representation of the text' through the integration of a variety of inferences (1993, p4). The following passage was devised by Trabasso and Suh (1993, p4) showing how to link clauses with a motivational inference:

"(1) Betty wanted to give her mother a present. (2) She went to the department store. (3) She found out that everything was too expensive. (4) Betty decided to knit a sweater."

From the perspective of a reader, the passage shows the level of reasoning required to work out the overall meaning from a very simple text. In order to understand *who* went to the department store, it is necessary to generate a cohesive device that 'she' is Betty; in order to understand *why* Betty went to the department store, the reader needs to generate a knowledge-based inference that department stores contain items to purchase. To do this, the reader must first access the knowledge that Betty wanted to give her mother a present which might trigger a predictive inference of what could happen next. The knowledge that everything was 'too expensive' demands a further knowledge-based inference that Betty probably did not have enough money. This leads to a bridging inference needed to link pieces of information; because Betty did not have enough money, she decided to knit a sweater. A final knowledge-based inference is required to deduce that the sweater is for Betty's mum. The example illustrates that students who find it hard to make inferences may have difficulties with reading comprehension.

1.1.4 Comprehension monitoring

The reader also needs to check if what is being read matches the meaning of the text through comprehension monitoring (Cain and Oakhill, 2006; Ricketts, 2011). Skilled readers constantly check, and adjust their understanding as the text is being read. This could involve, for example re-reading the text or using background knowledge. Working memory is necessary to store the information whilst it is being processed and then integrated into new knowledge (Diamond, 2013; Oakhill et al., 2005). Comprehension monitoring therefore, relies on both a level of understanding of what has been read, and efficient working memory processes.

A longitudinal study UK by Oakhill and Cain (2012) investigated the predictors of reading comprehension and word reading accuracy. One hundred and two participants were tested three times over four school years: Year Three, Year Four and Year Six. All participants were assessed on reading comprehension, vocabulary, phonological awareness, working memory, grammatical awareness, general intellectual ability plus measures of comprehension skills: inference, comprehension monitoring and knowledge and use of story structure. The authors found that reading comprehension at Year Three predicted comprehension monitoring at Year Four, which is turn predicted unique variance in later reading comprehension at Year Six. The evidence shows that understanding the meaning of a text helps comprehension monitoring, which in turn further supports older readers to understand the meaning of a text. If comprehension monitoring, and inference making, are important skills for older or better readers reading more challenging texts, then the Language and Reading Research Consortium (LARCC) and Logan (2017) suggest these skills may only be seen among those with better reading comprehension abilities. Vocabulary was not reported as a predictor of reading comprehension in this study and this may be due to comprehension- related skills in the regression-based path models sharing variance which have gone to the vocabulary factor. Nonetheless, vocabulary knowledge is strongly associated with reading (Oakhill and Cain, 2015).

1.1.5 Vocabulary

Some studies suggest that the more words a reader can recognise, the better their reading comprehension. For example, a longitudinal USA study by Quinn et al., (2015) investigated the relationship between vocabulary knowledge and reading comprehension for 316 students from First Grade (six to seven years of age) to Fourth Grade (nine to ten years of age). They found that annual growth in reading comprehension was due to vocabulary knowledge: the more vocabulary a student knew, the better their reading comprehension. Although the study looked for evidence that reading also supports the learning of vocabulary, the results only confirmed the influence of vocabulary on reading. These findings may be due to the limited measures of vocabulary (two subtests of expressive vocabulary: the Stanford-Binet Intelligence Scales and the Weschler Abbreviated Scales of Intelligence) and the reading comprehension tasks' reliance on word reading (two cloze procedures in which missing words are identified from short passages of two – three sentences). The cloze format reading comprehension measure is closely linked to decoding and vocabulary knowledge, and does not reflect wider reading experiences (Keenan et al., 2008).

Other studies suggest that verbal aptitude or verbal reasoning supports the relationship between vocabulary and reading comprehension. For example, Lawrence et al., (2019) suggests that verbal reasoning, including inference and morphological awareness, allows readers to think about the structure of spoken language and helps explain individual differences in vocabulary.

1.2 The importance of reading

Once children learn to read, they can read to learn (Chall, 1983) and reading is directly involved with becoming literate. Literacy is "the ability to identify, understand, interpret, create, communicate and compute using printed and written materials associated with varying contexts" (Montoya, 2018, p1). Becoming literate is more than a cognitive achievement as literacy 'develops knowledge, potential and participation in society' (Cambridge Assessment, 2013, p11).

Conversely, children who have difficulties in developing literacy skills are at an academic, social and economic disadvantage (Law, McBean and Rush, 2011). Low levels of literacy have been associated with the probability of being unemployed, or with earning less. Low literacy and low levels of education are associated with poorer outcomes in health, well-being and social cohesion (The Organisation for Economic Co-operation and Development programme for the International Assessment of Adult Competencies (OECD), 2016). This means that individuals, schools, society and governments all have a stake in literacy.

At present, one in five of the adult population in the UK has poor levels of literacy (Mallows and Litster, 2016). Internationally, the youngest adults in England, Northern Ireland and Norway perform significantly worse in literacy than the oldest adults, compared with all other countries participating in the International Survey of Adult Skills (Department for Business, Innovation and Skills, 2012, p61). Evidence points to the fact that some students are leaving education unable to read: 29.7% of sixteen-year-old students did not gain a standard pass of 4/C for their English Language GCSE in 2019, (Office of Qualifications and Examinations

Regulation (OFQUAL), 2019). Understanding what causes a third of the student population to fail in reading and writing is a key issue at child, family, school and government level. From the perspective of a teacher in a mainstream secondary school, the need to understand literacy failure in adolescence is the driving force behind this thesis.

How an individual learns to read revolves around the three main domains of literacy acquisition: cognitive, psychological and ecological (Tunmer and Chapman, 2012). The cognitive domain directly influences reading comprehension due to the demands on thought processes: language learning and working memory are both essential for the fluent and accurate reading of texts (Seigneuric and Ehrlich, 2005). The psychological domain (including motivation, attention, pleasure in reading and gender) and the ecological domain (involving the home and school environments) tend to influence reading development indirectly. In this study, some key factors from all three domains were investigated: oral language, non-verbal ability (including SEN) and word reading skills, gender and socio-economic context.

1.3 Theoretical models of reading comprehension

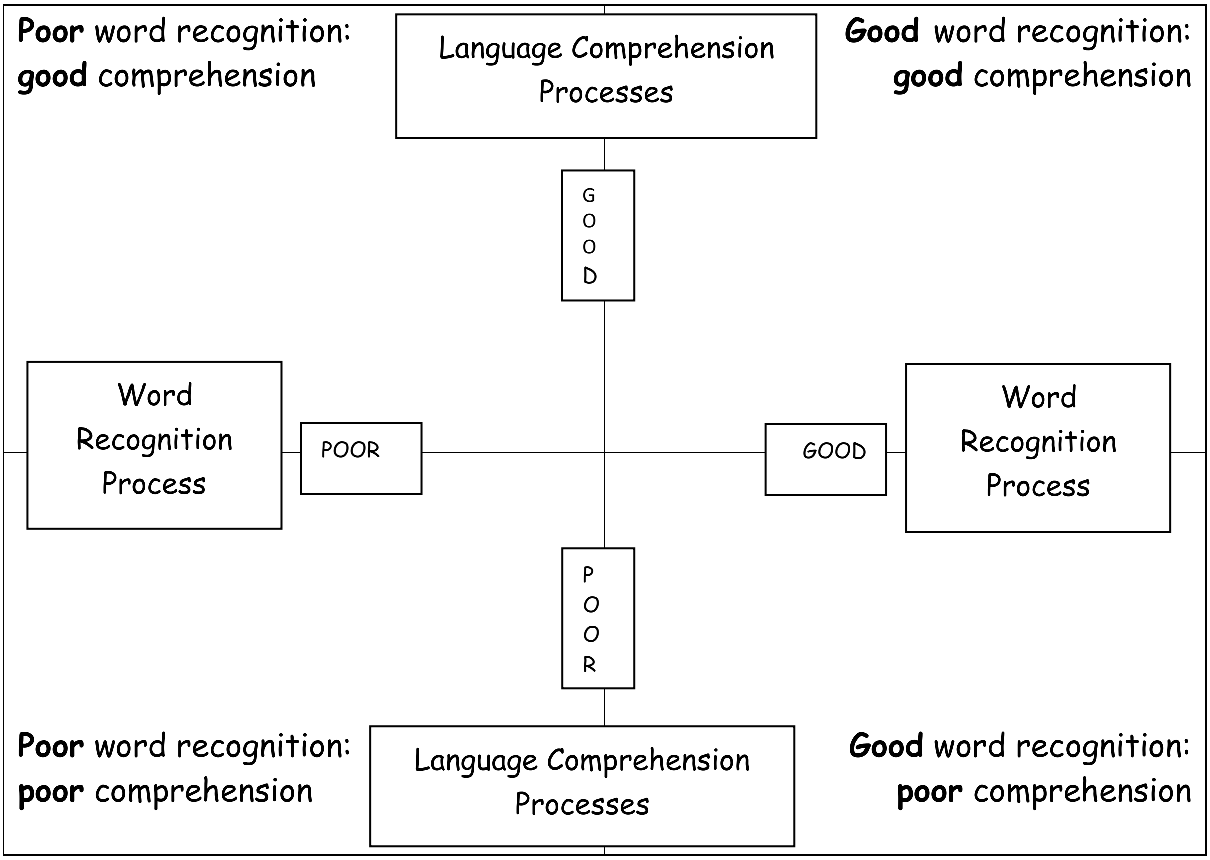
Researchers have attempted to conceptualise the complexity of reading comprehension though various frameworks or models. These range from showing the processes underpinning reading comprehension, to modelling the components influencing reading comprehension, to the actual process of reading comprehension itself, the continuous mental image.

1.3.1 Processes underpinning reading comprehension

1.3.1.1 The Simple View of Reading (SVR)

The Simple View of Reading (SVR) is a theoretical framework for understanding the processes underpinning reading comprehension. Introduced by Gough and Tunmer in 1986, it argues that skilled reading, or reading for meaning, is the product of two sets of skills: word recognition and language comprehension. Gough and Tunmer proved their simplified concept of reading comprehension by showing the separate contributions of decoding and linguistic comprehension. Their study tracked 254 children over five years, from kindergarten to Fourth Grade (age nine to ten years). Results from hierarchical multiple regression showed weaknesses in either component led to poorer reading, and reading comprehension was a product of both skills. Therefore, this simplified view of the complexities of reading comprehension was based on individual differences in reading performance. Figure 1.1 shows the two continuous and separate skills along two axes (Bishop and Snowling, 2004).

Figure 1.1 The Simple View of Reading (adapted from Bishop and Snowling, 2004, p859)



By isolating the processes of word recognition and language comprehension as separate dimensions, the SVR can predict the reading comprehension of skilled readers but also identify underlying reading difficulties. An inability to orally decode, an inability to comprehend or a combination of both leads to poorer reading comprehension. Therefore, the implications for the classroom become apparent: the need to teach accurate and fluent word reading skills and oral language skills. Whilst some researchers (Adolf et al., 2006; Hoffman, 2009; Kirkby and Savage, 2008;) argue that this model simplifies the complexities of reading, the inclusion of language comprehension ensures that oral language is given a central focus in the reading process. The SVR is used widely in schools (DFE, 2021) and is the model of choice for this study.

Research has provided strong evidence for the SVR framework. For example, a study by LARR and Chiu (2018) showed that 94% of the variance in Grade Three (age eight to nine years) reading comprehension could be explained by the two components of the SVR. Longitudinal analysis of 420 children tracked from kindergarten to Grade Three showed that early oral language and code-related skills in preschool predicted later reading comprehension in Grade Three.

Similarly, Lonigan, Burgess and Schatschneider (2018) in their cross-sectional study of 757 participants from Grades Three to Five (age seven to ten years), reported between 85% to 100% of the variance in reading comprehension was explained by decoding and language comprehension measures. Results for each grade showed that the relative contribution of decoding and language comprehension changed across grades, with decoding more important for younger children and syntax more important for older children. The study also showed a large amount of common variance shared by decoding and language comprehension (41% to 69%) indicating that both factors were related. This could have been due to the decoding measure, which used a sight-word reading test (TOWRE2, 1999) that may have been more strongly related to vocabulary than decoding.

These studies show that reading age-appropriate texts is dependent on the ability to understand the language being read and the ability to read the words. By showing that word recognition and oral language comprehension are independent processes (Catts et al., 2006; Garcia and Cain, 2014, Hogan, Adolf and Alzonzo, 2014; Kendeou et al., 2009; Lervag et al., 2017), effective reading comprehension requires the two processes to develop together. The SVR framework is embedded in texts published by the Department for Education (e.g., 'The Reading Framework, Teaching the foundations of literacy (2022)' under the title, 'The knowledge of a good reader' (DFE) p17), highlighting the key role of the SVR to UK literacy teaching. However, it is important to note limitations of this model. Some researchers have pointed to the two–component structure of the Simple View of Reading as a static model that does not show the developmental nature of reading (Castles et al., 2018; Ricketts, 2011). Other researchers have argued that although the SVR accounts for a large amount of variance in reading comprehension, there is a substantial amount unexplained (Cutting and Scarborough, 2006; Keenan et al., 2008) with reading speed, measurement of reading comprehension and background knowledge accounting for some unexplained variance. Duke and Cartwright (2021) argue that word recognition and language comprehension are not entirely separate: factors such as vocabulary, reading fluency and morphological awareness can influence both word recognition and language comprehension. Finally, as both Catts (2018) and Nation (2019) point out: visual graphics matter. When looking at the visual model of the SVR, teachers may be misled in visualising both components as separate dimensions heading in different directions, whereas language feeds into both. Nation (2019) argues that in order to show the developmental nature of reading, the visual representation of the simple view should be elaborated.

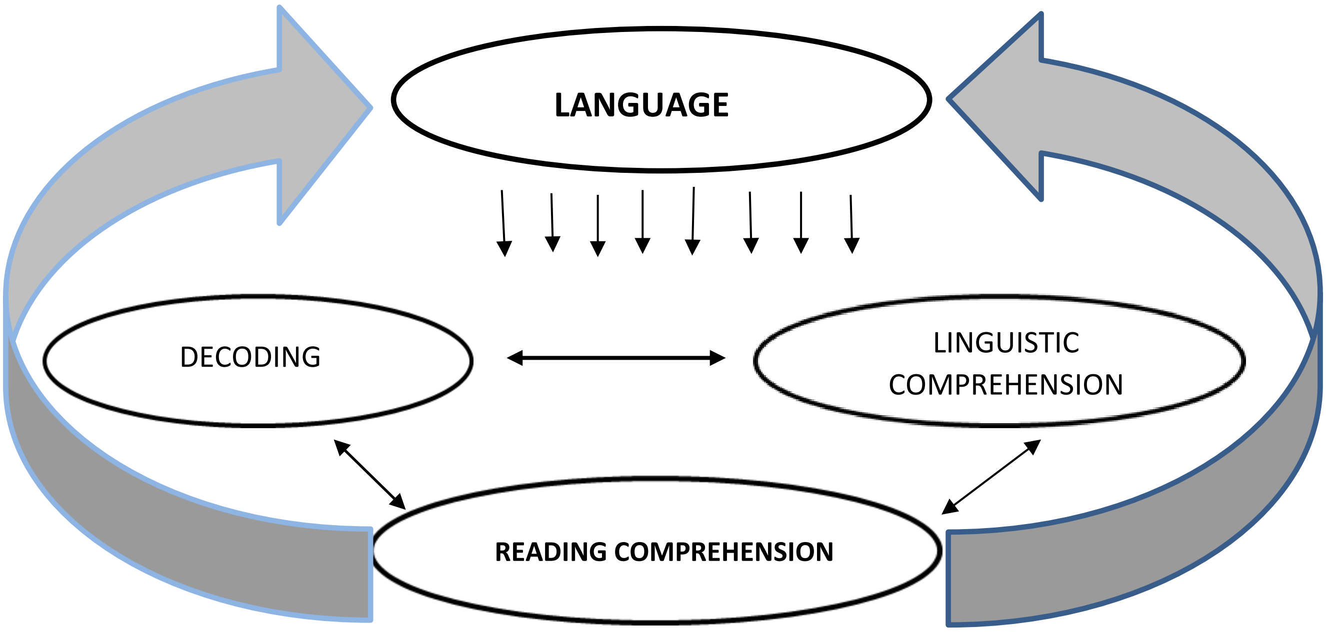
1.3.1.2 An expanded view of the Simple View of Reading

Nation (2019) recently proposed an expanded view of the Simple View of Reading, indicating that literacy itself may affect language (see Figure 1.2). Exposure to the written language of books, and understanding this 'book language' provides a unique language input into oral language, which in turn supports the development of reading and writing.

A study by Farrant and Zubrick (2012) examined if parent/carer-child book reading increased children's early vocabulary. A large sample of 2919 children tested once at 9 months of age, and two years later at 34 months of age, found that shared book reading uniquely accounted for five per cent variation in vocabulary at the second testing point. Increased vocabulary was associated with greater text exposure.

Children's literature has been shown to contain a higher proportion of syntactic structures than in adult-directed speech (Hsiao et al., 2022; Montag and MacDonald, 2015). Montag and MacDonald (2015) analysed a corpus of juvenile literature containing 2.40 million words, aimed at children aged 4 – 16 years, who were already readers. The findings showed a higher proportion of complex syntactic structures in children's independent reading material than in adult-directed speech. The authors argue that as children become readers, their exposure to complex grammar increases. In their cross-sectional, experimental study, Montag and MacDonald compared the expressive syntax of 30 eight-year-olds, 30 twelve-year-olds and 30 young adults to levels of text exposure, or prior reading comprehension experience. Although this was a small sample, results show that both older readers and those with greater levels of text exposure were more successful in producing complex sentences. Although as the study noted, it was not possible to determine if children who are better readers, have parents who read a lot and talk using a wider vocabulary and complex sentence structures. Based on reciprocal models of reading (Nation, 2019; Tunmer and Hoover, 2019), the findings suggest that as children become successful readers, their linguistic comprehension is altered by their reading habits. Conversely, lack of exposure to reading material, might limit exposure to complex grammar (Hsiao et al., 2022).

Figure 1.2. An expanded view of the Simple View of Reading (Nation, 2019, p67)



This expanded view of the Simple View of Reading (2019) illustrates the interrelations between word reading and linguistic comprehension; the underlying language of books feeding into word recognition, linguistic comprehension and reading comprehension and the importance of reading experience driving language development.

Similarly, Tunmer and Hoover (2019) proposed a Cognitive Foundations Framework showing the reciprocal relationship between linguistic comprehension, word recognition and reading comprehension. The model extends the Simple View of Reading (1986) by placing reading comprehension and language comprehension in parallel, arguing that they use the same cognitive processes except that one is through print and the other through speech. (See Figure 1.3).

Figure 1.3 The Cognitive Foundations Framework (Tunmer and Hoover (2019, p76)

<table>
<tr><td colspan="7">Reading Comprehension</td></tr>
<tr><td colspan="4">↑ ↓</td><td colspan="3">↑ ↓</td></tr>
<tr><td colspan="4">Language Comprehension</td><td colspan="3">Word recognition</td></tr>
<tr><td rowspan="3">Background knowledge and Inferencing skills</td><td colspan="3">Linguistic Knowledge</td><td colspan="3">Alphabetic Coding Skills</td></tr>
<tr><td rowspan="2">Phonological Knowledge</td><td rowspan="2">Syntactic Knowledge</td><td rowspan="2">Semantic Knowledge</td><td rowspan="2">Concepts about print</td><td colspan="2">Knowledge of the alphabetic principle</td></tr>
<tr><td>Letter knowledge</td><td>Phonetic Awareness</td></tr>
</table>

As with the Expanded View (Nation, 2019), the Cognitive Framework argues that reading comprehension drives growth in language comprehension and word recognition. Consequently, better readers benefit from reading more, and those who struggle with reading miss out on the reciprocal growth in language and word reading, leading to the Matthew effect of the rich-get-richer and the poor-get-poorer (Tunmer and Hoover, 2019).

1.3.2 Components influencing Reading Comprehension

The SVR reduces the complexities around reading comprehension to two broad processes: 'word recognition' and 'language comprehension'. However, understanding the components influencing reading comprehension, beyond the terms, 'word recognition' and 'language comprehension' (DFE, 2022) is important. If teachers are to fully understand the reading process and to support children in succeeding to read, then models breaking down individual components underpinning the SVR are also important.

1.3.2.1 The Reading Rope

The Reading Rope was designed by Scarborough (2001) to help parents understand the complexity of reading: see Figure 1.2. Unlike the SVR, this visual representation shows the components of both word recognition and language comprehension, and demonstrates how they coordinate to produce a skilled reader. The word-recognition strands (phonological awareness, decoding, sight recognition) enable accurate and eventually automatic reading. At the same time, the language comprehension strands of background knowledge, vocabulary, language structures, verbal reasoning and literacy knowledge support each other's development. Both strands then twist together to produce a skilled reader.

Figure 1.4 The Reading Rope (from Scarborough, 2001 in Neuman and Dickinson)

From a teaching perspective, The Reading Rope is a useful graphic illustrating the two components of the SVR and the challenging nature of leaning to read. However, neither the SVR or the Reading Rope show how children become increasingly strategic or automatic readers.

1.3.2.2 The Convergent Skills Model of Reading Development

Unlike the Simple View of Reading framework, the Convergent Skills Model of Reading Development (Vellutino, Tunmer, Jaccard and Chen, 2007) aimed to explain the relationships among skills and cognitive abilities underpinning word recognition and language comprehension, along with any changes between the identified skills and abilities as children develop as readers. The cross-sectional study, (Vellutino et al., (2007) assessed developing readers (n=297, Grades Two and Three) and older readers (n=171, Grades Six and Seven) on measures of word identification, language comprehension and reading comprehension, plus additional measures of working memory. The authors demonstrated that word identification ability and language comprehension ability are weighted differently for younger and older readers. Findings showed that decoding words are more important to younger or less skilled readers when reading. Learning how to read words, is an essential step in understanding written text. Semantic knowledge was associated with language comprehension and reading comprehension in both young and older readers showing the influence of vocabulary in reading comprehension. Older readers, who had acquired a proficiency in reading words, relied more on language comprehension skills to understand written text. Although the study drew upon cross-sectional data and therefore it is not possible to look at developmental changes or causal relationships between measures, the authors concluded that oral language skills played a greater role in reading comprehension once readers had acquired sufficient skill in word identification.

Application of the convergent skills model is important when understanding and assessing children's reading comprehension at different time points in their education. A longitudinal study by Chall and Jacobs (1983) described a dip in normative reading comprehension from Grade Four (age nine to ten years) in readers with low socio-economic status (SES). They tested 30 low SES children, using an individually administered reading comprehension test, along with measures of word recognition, spelling and vocabulary in Grades Two, Four and Six and a year later, in Grades Three, Five and Seven. The study reported that performance in spelling and word recognition increased in the early grades but decreased in the later grades. By Grade Four, vocabulary and reading comprehension started to show a declining performance for low SES poor readers and continued to show a slower development in all measures compared to the general population. The low SES, good readers on the other hand, showed reading development similar to the general population, showing little or no deceleration by Grade Seven. Although this was a small sample, it highlights the importance of aspects of vocabulary at different educational stages.

This slump in reading comprehension by middle primary was described as a 'failure to thrive and meet grade expectations' by Wanzek et al., (2010, p 891) in their systematic review of interventions for children with reading difficulties in Grades Four and Five (ages 9 -11). One reason given was the difficulty around the shift in learning to read based on narrative text to reading to learn using expository texts. The reading of expository texts is more challenging as it requires the reader to understand and interact with world knowledge, relying on and using memory (Synder and Caccamise, 2010). The increasing complexity of text reading could lead to an emergence of 'poor comprehenders' at the later stages of education, in addition to children with existing reading comprehension difficulties, as studies by Leach et al., (2003) and Adolf et al., (2010) have shown.

Leach et al., (2003) compared literacy, language and cognitive skills for 66 children in Grades Four and Five (age nine to 11 years) with reading difficulties, with 95 typically developing children. Based on their performance on reading and spelling measures, the participants were divided into four reading-ability groups: reading comprehension difficulties, word-level difficulties, word-level and reading comprehension difficulties and no reading difficulties. Comparison of late-identified (n = 31) with early-identified (n=35) reading difficulties showed both groups displayed a range of weaknesses. Of the late-emerging group, 35% showed word-level difficulties with adequate comprehension skills, 32% had weaker comprehension skills than word reading skills and 32% showed difficulties in both. In comparison, the readers with early identified difficulties showed 49%, 6% and 46% respectively, with fewer children showing the weaker comprehension pattern. Retrospective analysis of prior Third Grade achievement tests showed no significant differences amongst three of the reading ability groups (no reading difficulties group, reading comprehension difficulties and word-level difficulties), in measures of reading vocabulary, reading comprehension and spelling. Comparison of Third Grade with Fourth and Fifth Grade reading performance shows the late-identification of reading difficulties in 31 children, leading the authors to report that these difficulties were late-emerging. The study was cross-sectional so it cannot determine causality.

However, a later longitudinal study by Adolf et al., (2010) tracking 433 children (128 poor readers and 305 good readers) from kindergarten to Grade Eight (ages 13 to 14 years), also found that the relative contribution of phonological processing and language skills to reading comprehension, changed over time. Kindergarten measures included oral language skills (oral vocabulary, grammar and narrative), letter knowledge and non-verbal IQ. Reading comprehension was measured in Second and Eighth Grades. Results showed that the main predictors of Grade Two reading comprehension were alphabetic knowledge, through letter identification, and sentence imitation. By Grade Eight, phoneme deletion, grammatical completion, nonverbal intelligence, sentence imitation, mother's education level, narrative expression, narrative comprehension, and oral vocabulary were included in the model. These results indicate that differences in reading difficulties in second grade related to word reading difficulties and those in eighth grade to overall language and reasoning abilities.

The developmental aspect of the Convergent Skills model of reading provides a useful framework for showing how the skills underpinning word recognition and language comprehension, within the model of the Simple View of Reading, change with age and reading proficiency.

1.3.2.3 Component Models

The Simple View of Reading was never intended as a 'complete theory of the factors that contribute to reading comprehension' (Tunmer and Chapman, 2012, p454) as the model does not include the construction processes, integrative strategies and background knowledge that a reader brings to understanding a text.

Component models, such as the Direct and Inferential Mediation Model (DIME: Cromley and Azevedo, 2007; Oslund et al., 2018; Perfetti, Landi and Oakhill, 2007) take account of reading comprehension as a complex activity, acquired through the coordination of multiple skills. Studies that have modelled relationships, including background knowledge, inference strategies, word reading and reading vocabulary, show that reading vocabulary is the strongest predictor of reading comprehension (Cromley and Azevedo, 2007; Oslund et al., 2018; Perfetti, Landi and Oakhill, 2007). Having a small reading vocabulary may cause difficulties in understanding what has been read, and as Oslund et al., (2018) pointed out, inefficient word reading leads to a breakdown in comprehension.

Over and above what is necessary for reading comprehension, Perfetti et al., (2007) point to the importance of coherence in understanding text: the reader needs to attend to whether the text makes sense. This attention to the coherence of a text tends to be reciprocal: high levels of coherence support interest in reading, which in turn encourages high standards of coherence.

1.3.3 The mental representation of the text

Reading comprehension has been defined in section 1.1 as the ability to build meaning from print in order to understand what has been read. Ultimately, reading is about building a mental representation of the text in the reader's mind, integrating all sources of knowledge including word reading, language and knowledge of the world (Nation, 2019).

1.3.3.1 The Construction-Integration Model

The SVR and component models have been designed to model the underlying components of reading comprehension. The Construction-Integration model (Kintsch, 1988; Kintsch and Rawson, 2007) reflects the nature of the information being processed, or the mental representation from the text. Kintsch's (1988) construction-integration model suggests that the reader decodes and processes the text in cycles of phases; constructing the phases initially into a literal reading and subsequently integrating the meaning into a wider coherent representation.

The model first proposes that readers must read and understand at a linguistic level. They need to read and understand words and sentences from the surface or literal level of the text. Secondly, in order to build a deeper semantic understanding of the text, readers need to understand how pronouns, inferences and grammar, such as the past tense, operate. This second semantic process creates a 'microstructure' of the text, which is held in the reader's memory (Kintsch and Rawson, 2005, p210). These microstructures are then integrated into a 'macrostructure', which tend to rely on a reader's knowledge of how a narrative or expository text works. Microstructure and macrostructure together form the textbase. Finally, skilled readers construct a situation model, or mental model of the text, integrating the textbase with background knowledge and the purpose of the reading: for example, to entertain or to inform.

Building the mental model in a reader's mind can be automatic but it can also be an 'effortful, mental activity,' (Hock et al., 2009, p24) and one that develops real learning, in that new understanding is created. Based on Kintsch's Construction-Integration Model that comprehension occurs at both the microstructure and macrostructure, Hock et al., (2009) examined the reading profile of 345 adolescent readers selected from two USA cities. Half the sample (51%) received free or reduced-cost lunches. The descriptive study assessed participants on measures of word reading, vocabulary, reading fluency, reading comprehension and listening comprehension. Findings from the study showed that 59% (n=202) of the sample were shown to be struggling adolescent readers compared to 41% (n=143) proficient readers. Of the struggling reader group, 61% had difficulties on all of the measures, and a further 12% performed poorly on all measures except word reading. The authors concluded that in order to support struggling adolescent readers, teachers needed to teach a range of reading skills. Although background knowledge was not directly assessed in the study, the authors suggest that readers without background knowledge would be expected to have more problems understanding a text than those with sufficient background knowledge. Kintsch (1988) refers to background knowledge as general knowledge. In short, knowing about words, grammar or the world helps readers to build their own mental picture of what they are reading, but can also limit their comprehension.

According to Cain et al., (2001) poor comprehenders build incomplete representations of text, as they are unable to understand the text as a whole. In a study aimed at assessing the reasons for differences in inference making between skilled and less skilled comprehenders, Cain et al., (2001) compared two groups of readers, aged seven to eight years of age. As inferences use background knowledge to fill in information not explicitly stated (section 1.1), children were first taught facts about an imaginary planet. Once the children could recall the facts, they were read a six-episode story about the planet. Immediately after each episode, they were asked four questions, and after the final episode they were tested again on the facts about the planet. This knowledge around an imaginary planet was retested a week later. Results showed that even when children knew the facts about a planet, the less skilled comprehenders did not make the inferences as accurately as the skilled comprehenders. Although this may be due to the poor comprehenders having problems accessing the taught knowledge, it shows that children with comprehension difficulties have limited skills at making inferences that require integration of textual information with a taught knowledge base. Moreover, the study demonstrated that poor comprehenders' difficulties in making inferences were not just limited to reading but also to listening comprehension.

1.3.4 Summary of theoretical frameworks and models of reading comprehension

All models of reading comprehension help in understanding the processes underlying reading comprehension. The Simple View of Reading framework clarifies the skills necessary for reading development and predicts variation in reading comprehension and its development through performance in word recognition and language comprehension. Once a level of mastery in word recognition is achieved, then reading comprehension is restricted by how well individual readers understand spoken language (Perfetti et al., 2007).

Component models go further and examine the coordination of skills, including word reading ability, working memory, inference generation, comprehension strategies, vocabulary and background knowledge that influence comprehension. Such models demonstrate that developing background knowledge, inference and vocabulary is central to comprehension (Elleman and Oslund, 2019).

Cognitive models, such as the Construction-Integration Model (Kintsch, 1988), on the other hand explore the levels of processing required to form the imagined mental representation of the text. The complexity of reading comprehension challenges the concept that a single model can explain both the processes involved and individual differences in these processes.

Models of reading comprehension show that reading words and understanding language are both essential processes for effective reading to develop. We have seen that cognitive skills, such as working memory, enable the integration of print and its meaning to build an ongoing and constantly revised mental picture in the reader's mind (Johnston, Barnes and Desrochers, 2008; Nation, 2019). The following section describes in greater detail, the skills of word recognition and language comprehension that underly reading comprehension.

1.4 The skills necessary for typical reading development

1.4.1 Development of word recognition

This process of transition from early reader to expert reader who gains the meaning of words directly from the printed form is complex (Frith, 1986; Johnston et al., 2008). Building on Frith's model (1986), that was described earlier (see section 1.1.1), Kearns and Al Ghanem (2019) point to the ability to read words as a distributed process moving through a system which includes phonological, orthographic and semantic knowledge about words, and with knowledge varying from word to word. As readers practise their reading skills, the ability to read words accurately and fluently should improve (Perfetti, 2007). Longitudinal research by Storch and Whitehurst (2002) followed 626 children from preschool through to Fourth Grade (age nine and a half years) and explored how phonological awareness, print knowledge, vocabulary and narrative comprehension were related to growth in word reading and reading comprehension. In the early grades, success in reading was predicted by word reading skills, supported by phonological awareness and alphabetic or orthographic representation of words. By Grades Three and Four (ages eight to ten years), oral language skills were predictors of reading comprehension, implying that different skills play significant roles at different times during reading development.

Reading provides constant opportunities to read new words (Ricketts et al., 2008); therefore, developing efficient word recognition is an essential, first step in reading. Word recognition is bound up with knowledge of the four aspects of word forms: phonology, orthography, morpho-syntax and meaning (Perfetti, 2007). Orthographic learning refers to the process of how readers associate the way in which letters represent sounds (phonological awareness) and how the words are visually represented by letters or spelt (orthographic knowledge), (Ricketts, Bishop and Nation, 2008). Increasing exposure to print and constant reading practise supports orthographic learning (Andrews and Lo, 2012) which therefore develops over time.

Semantic knowledge refers to the meaning of words. Studies indicate that vocabulary is related to both language comprehension and word recognition. Mitchell and Brady (2013) examined the role of oral vocabulary knowledge in reading unknown words, by comparing 55 Fourth Grade students on standardised measures of word identification, decoding and receptive vocabulary, and an experimental word identification task. The experimental word identification task was designed to include words not seen in print, and included 14 word pairs matched on decoding but differing on their estimated oral use (e.g. hilarious/ nefarious with 'nefarious' expected to have a lower expected oral frequency). Results showed that students with better receptive vocabulary knowledge performed better on both the standardised and experimental measures of word reading, after controlling for decoding. This implies that understanding the meaning of words contributes directly to word recognition and hence to reading (Tunmer and Chapman, 2012). In addition, having a wide vocabulary helps readers to both persevere with reading and understand what they have read. Kearns and Al Ghanem, (2019) explored semantic effects on word reading accuracy in a study with 46 children with reading difficulties and 49 typically developing children from Grades Three to Four. Every child completed four tests (word reading, orthographic, phonological and semantic) related to 48 polysyllabic words. The results were non-significant, pointing to the difficulty in separating semantic from phonological and orthographic knowledge, but the authors argued that children read better when they understood the meaning of words.

Morphological analysis refers to the ability to identify the structure of a word to build its meaning (MacKay, Levesque and Deacon, 2017). Using examples from the National Curriculum for England (DFE, 2016, p55): the addition of the prefix, un- to words gives them a negative meaning (undo, unhappy); the addition of the suffix, - ing, or, -ed, to a verb, changes the timing of the action and is important for understanding when something happened. Morphological analysis has been shown to be a key skill for both reading words and determining their meaning, which in turn affects reading comprehension.

Deacon, Tong and Francis, (2017) investigated the joint and unique contribution of morphological decoding, morphological analysis and morphological structure awareness to the reading comprehension of 53 children in Grade Three, and 46 in Grade Five. According to the authors, morphological structure awareness refers to the awareness of the structure of a word without working out its meaning, whereas morphological analysis is related to word meaning. To test for morphological decoding, children first read aloud a set of 48 words on a computer screen, all ending with common suffixes: -ment, -ness, -ly, -ful, -able and -less; 24 experimental words had either a high or low frequency root word. Morphological structure awareness was then assessed through altering single words to fit a spoken sentence. Finally, morphological analysis included the same 24 experimental words along with four possible definitions. Nonverbal reasoning, word reading, reading comprehension and phonological awareness were also tested. Hierarchical multiple regression showed that the inclusion of morphological decoding and analysis accounted for a significant, unique contribution of 8% of the variance in reading comprehension, with children applying their morphological analysis to understand infrequent words and morphological decoding to read low frequency words. Morphological structure awareness did not make a unique contribution, but this could be due to participants not understanding the single word to be altered, or the words in the sentence.

However, when exploring differences between poor, average and good reading comprehenders, Tong et al., (2011), found that morphological awareness was implicated in reading difficulties. Their two-year retrospective longitudinal study of 132 children compared the reading comprehension performance of three groups of readers in Grade Five (poor, average and good comprehenders) and retrospectively, in Grade Three. Measures of reading comprehension, word reading, phonological awareness, orthographic processing were administered in Grades Three and Five; measures of nonverbal ability and vocabulary knowledge were administered in Grade Three only. As with the Deacon et al., (2017) study, morphological awareness was measured through a sentence completion task, but with an additional test of word analogy. The word analogy test consists of a pair of words presented orally, followed by the first word of the second pair (e.g., push: pushed; lose). The child is required to say the fourth word (lost) to complete the pattern. The findings from the study found that by Grade Five, poor comprehenders had difficulties with morphological awareness (specifically with the word analogy task), in the presence of good phonological, orthographic and naming speed skills. Furthermore, these differences in morphological awareness were not apparent in Grade Three but emerged in Grade Five, indicating that poor comprehenders were showing developmental difficulties with morphological awareness, as measured by a word analogy word test. The authors suggest that the relationship between morphological awareness and reading comprehension may be bi-directional, and that poor comprehenders may be be less able to work out the meanings of new, complex words.

Failure to read new words could thus be seen as a consequence of weak phonological, orthographic, semantic or morphological knowledge, or an inability to develop links between any of these (LARRC and Logan, 2017; Ricketts et al., 2008). Word recognition is revisited in Chapter Two where the effect of incremental word reading on adolescents' reading comprehension is examined.

1.4.2 Development of language comprehension

Language comprehension is the ability to extract and build meaning from spoken language (Tunmer and Hoover, 2019). Spoken or oral language encompasses vocabulary (receptive and expressive), syntactic and semantic knowledge and narrative discourse (listening comprehension and storytelling) (National Institute of Child Health and Development (NICHD), 2005: Rodge et al., 2019). How language is used in social contexts (pragmatics) is discussed in Chapter Two.

Reading cannot happen without effective word reading skills, and knowing the meaning of words is necessary to understanding the text. Therefore, vocabulary is a key part of language comprehension. Vocabulary can be divided into expressive or receptive vocabulary, or depth and breadth of vocabulary (Ouellette and Beers, 2010). Expressive vocabulary refers to how students verbalise their own thoughts; receptive vocabulary to how students understand spoken language. Depth of vocabulary refers to how many words a reader understands and can use in sentences; breadth of vocabulary to the range or number of words a reader knows.

Studies have shown a strong relationship between vocabulary knowledge and reading, indicating that the number of words understood by a reader is one of the strongest predictors of reading comprehension (Mitchell and Brady, 2013; Ricketts et al., 2020; Ricketts, Bishop and Nation, 2007). Mitchell and Brady explored the relationship between vocabulary knowledge and reading new words, after controlling for decoding in a sample of 55 Grade Four children. Hierarchical modelling showed that vocabulary knowledge shared 77% of variance with decoding skills, and made a unique contribution of 6%, showing it is easier to read a word if it is already familiar, or can be recognised. As the study was measuring reading accuracy, the word reading measures were not timed (the assessment finished after six consecutives mistakes). Measuring the speed of reading novel words, may also support the finding that the more a word is heard, the better the word reading performance. The authors point to the value of oral vocabulary knowledge in both language use and in reading printed words.

Longitudinal studies have shown that oral vocabulary knowledge can predict growth in reading development (Quinn, Wagner, Petscher and Lopez, 2015; Reynolds and Turek, 2012). Reynolds and Turek followed 1079 participants from the age of nine to 15 years of age investigating the development of oral vocabulary and reading comprehension. Participants were assessed on tests from the Woodcock-Johnson Psychoeducational Battery (1989): a measure of oral vocabulary (the Picture Vocabulary test), reading comprehension (Passage Comprehension Test using a cloze procedure) and sight word identification along with measures of early childhood intelligence and reading volume. At the age of nine, participants with higher word reading scores and who read more, were more likely to have higher oral vocabulary. SES (see section 1.5.1) influenced oral vocabulary, through the effect of sight word recognition and relative reading volume. This shows that deprivation, with fewer opportunities to read books and recognise words, has an effect on oral vocabulary. The study supports the SVR, rather than the Expanded View, as growth in reading comprehension was driven by higher levels of earlier oral vocabulary as opposed to higher levels of print exposure. However, as vocabulary predicts reading comprehension there is an assumption that understanding vocabulary needs to be acquired first, before knowledge can be applied to understanding what is being read, at least in the earlier stages of learning to read.

Alongside knowing the meaning of words, readers need to know how words in a sentence connect syntactically. Scott (2015, p204) refers to the sentence as being the 'carrier' of grammatical cohesive systems that enable a series of sentences to become the text. This knowledge of grammar, including awareness of syntax and morphology in spoken language is part of the language factor associated with reading comprehension (Lervag, Hulme and Melby-Lervag, 2017). Syntax is part of grammar, and refers to the way in which words are arranged within sentences to communicate meaning (Nippold, 2007). Studies have shown that readers with poor syntactic skills perform less well than their peers in establishing meaning from reading text (Nippold, 2017). Poulsen and Gravgaard (2016) explored whether the ability to understand difficult syntactic constructions at sentence level explained variance in reading comprehension after controlling for understanding simple syntactic constructions. A sample of 85 Grade Five children were measured on vocabulary, decoding fluency, verbal memory, reading comprehension and understanding of basic and difficult sentences. The experimental basic and difficult sentence comprehension was a computer-based task, with an introductory sentence, a target sentence and a choice of two comprehension questions based on the meaning of the target sentence. The total model explained 32% of the variance in reading comprehension, with difficult sentence comprehension explaining 6% unique variance beyond basic sentence comprehension. As the study used a cross-sectional sample, it is not possible to show if syntactic difficulties were a result or a cause of reading comprehension. However, the results demonstrate that individual differences in syntactic skills are related to reading comprehension.

Finally, listening comprehension refers to how well an individual understands spoken language (LARRC, 2015). Listening comprehension draws on sequencing, inference, background knowledge, semantic and grammatical skills (Babayigit, Roulstone and Wren, 2021). Listening comprehension can therefore be seen as having an essential role in understanding text, but how it is defined and measured varies across studies. It can be measured by a single test: children listen to a series of passages and answer questions (LARRC, 2017), or it can be measured through analysis involving vocabulary, grammar, verbal working memory and inference skills (Lervag et al., 2018).

Some researchers describe oral language skills as influencing listening comprehension. Hogan, Adolf and Alonzo (2014) argue that listening comprehension is an ability to understand what is heard, and therefore draws on oral language in order to formulate the mental picture relating to Kintsch's Construction-Integration Model (1988). For example, Lervag et al., (2018), examining the developmental relationship between oral language skills and reading comprehension, showed that 95% of variance in listening comprehension was explained by vocabulary, grammar, verbal working memory and inference skills. In their longitudinal study, following 198 children over five years, they reported that listening comprehension comprising of a composite language factor (vocabulary, grammatical skills [syntax and morphology], verbal working memory and inference skills) predicted the early and later growth of reading comprehension, with word reading predicting early growth.

On the other hand, it can be argued that the components of listening comprehension are distinct constructs. Metsala et al., (2021) assessed the unique contributions of three oral language skills: vocabulary, syntactic awareness and morphological awareness to improvements in reading comprehension, with listening comprehension as a control. The longitudinal study followed 116 children in Grades Two and Three over 17 months (29 dropped out, leaving 87 in the final study). Results showed unique contributions of morphological awareness (21%), vocabulary (17%) and syntactic awareness (7%) at their last testing point. Each individual language skill contributed to gains in reading comprehension. Attrition in the study reduced the sample and hence the longitudinal analyses.

These different ways of thinking about listening comprehension reflect the different models of reading comprehension. Listening comprehension can be seen as the linguistic comprehension axis of the SVR (Gough and Tunmer, 1986), or separate skills within the Component models (Scarborough, 2001; Vellentino et al., 2007).

In summary, these different dimensions of language all contribute to reading comprehension (LARRC & Logan, 2017, Lervag et al., 2018) which is itself a complex construct drawing on a range of cognitive resources.

1.4.3 Summary of the skills needed for typical reading development

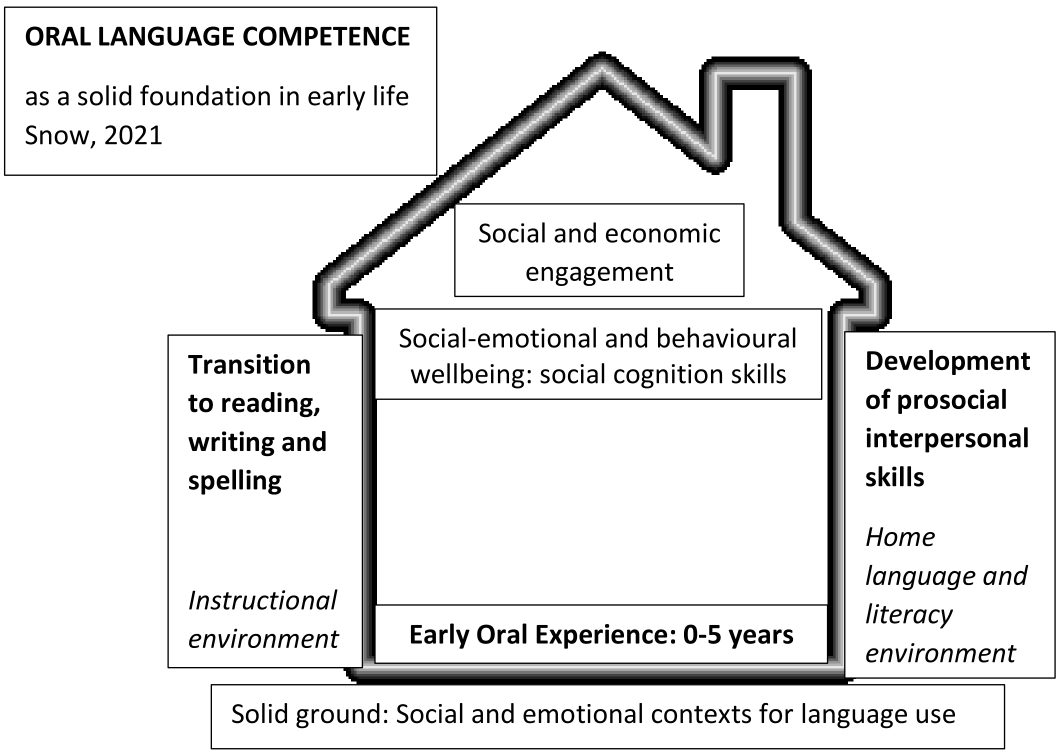
Learning to read is multifaceted and there are many 'areas of vulnerability' in how an individual learns to read: word processing differences, language processing or cognitive abilities (LARRC and Logan, 2017, p451). Different theories of reading help to make the reading process explicit. Metsala et al. (2021) argue that component models of reading show individual skills which can be targeted for successful reading comprehension whereas the SVR framework points to the importance of language-rich classrooms to develop overall understanding of spoken language. One potential disadvantage of targeting individual skills is that teachers may perceive them to be literacy based, e.g., teaching vocabulary and grammar through written exercises, as opposed to based in oral language. Reading comprehension may also be viewed simply as how children perform in a reading comprehension task, assessing the internal understanding shown by the Construction-Integration Model (Kintsch, 1988).

All the models discussed in this chapter are relevant and have implications for teaching. The SVR framework is the theoretical framework chosen to underpin this study as it shows the overall and fundamental importance of language skills to reading comprehension. Most teachers recognise the SVR framework due to its prominence in national curriculum documents (DFE 2013, 2021) and its use in assessing variation in reading development. By highlighting student profiles such as poor word readers or poor comprehenders, schools can plan the best approach to intervention. However, oral language to the knowledge and experience of the researcher, is rarely assessed in schools after the Early Years Foundation Stage, and this suggests that teachers of older children may lack an awareness and understanding of its importance in reading comprehension. Therefore, in trying to understand how language influences reading comprehension, the current study draws upon the SVR framework and assesses both the accuracy of single-word reading and listening comprehension, a discourse level oral comprehension skill. In addition, cognitive skills, both verbal and non-verbal are assessed, along with an oral language measure of syntactic complexity, reflecting the individual component skills shown to be important in reading comprehension.

1.5 The association of socio-economic status, gender and special education needs (SEN) with reading

Reading has been shown to rely on both word recognition processes and language ability. Yet many children struggle with reading (Capin et al., 2022; LARRC and Logan, 2017). Through the framework of a 'Language House', Snow (2021, p224) describes the importance of language in learning to read within a social-emotional context (See Figure 1.4). According to the framework, solid ground represents the emotional experience of early childhood and the importance of children learning to socialise and communicate with others. Strong foundations of oral language are required for the acquisition of pre-skills for reading: the ability to hear sounds (phonemic awareness), understand the logographic stage of the alphabet (Frith, 1986) and the language structure of narratives. These foundations support the development of language and reading within home and school environments, which in turn are supported by the social-emotional and well-being of the child. Finally, the roof represents the protection that well-developed language and literacy skills provide for individuals in their social and economic lives.

Figure 1.5 The Language House (Snow, P. (2021, p224)



The following section explores the association between the socio-economic background (SES), special educational needs (SEN), gender and language and reading.

1.5.1 The association between socio-economic background and language and reading

Socio-economic background affects language and reading development. Studies suggest that children living in areas with high levels of socio-economic deprivations are at increased risk of delayed language development (Law, McBean and Rush, 2011; Spencer, Clegg and Stackhouse, 2012; Locke, Ginsborg and Peers, 2002; NICHD, 2005). In addition, children who live in deprivation are likely to have: parents with low income or who are unemployed; have poor educational outcomes and skills; poor physical or mental health; experience high levels of crime; and live in poor or overcrowded housing (Department for Communities and Local Government, 2015).

As language and reading have been shown to depend on the 'solid ground' of home and childcare environments (Snow, 2021, p224), deprivation within the local area and home literacy environment may affect the foundations from which oral language and reading experiences can develop (Chiu and McBride-Chang, 2006). Scott and Dreher (2022) suggest that the local community as well as the family are part of language development: closure of libraries and bookshops in areas of deprivation reduces literacy-related activities. Lack of child enrichment factors, including visits to theatres, art galleries and museums limits background knowledge essential for reading inferences (Catts, 2021; Christensen et al., 2014). Physical and mental health issues linked to poverty affects well-being in the classroom (Lee and Jackson, 2017) and a lack of belief in academic potential influences the motivation to achieve individual aims and aspirations (Stewart, 2008; Strand, 2014).

The association between the richer language used by more highly educated mothers and the way children learn to use language (Babayigit, Roulstone and Wren, 2021; Fernald, Marchman and Weisler, 2013: Law et al., 2017) highlights the importance of environmental input to language development. Babayigit et al.'s (2021) nine-year longitudinal study tracked 716 children from five to fourteen years of age. The study used data from the Avon Longitudinal Study of Parents and Children (Golding, Pembrey and Jones, 2001), reported as a population cohort study representative of the wider population in England. Although referred to as a representative sample, the study reported a total attrition rate of 27%. Less-educated mothers were more likely to drop out at timepoint two (children aged 10 years), whereas more- educated mothers were more likely to drop out at timepoint three (children aged 14 years), in the latter case as children were removed for private schooling. Therefore, some sample bias may have occurred. Nonetheless, the study reported that as the mothers' levels of education rose, so did their child's reading ability, reflecting the importance of the 'solid ground' in Snow's language house.

Vocabulary size and grammatical development appear to be most vulnerable to the effects of deprivation (Hoff, 2013). Children coming from homes with high levels of deprivation have smaller vocabularies compared to peers coming from more affluent homes (Fernald et al., 2013). They also produce fewer complex utterances and fewer varieties of syntactic structures. Myers and Botting (2008) examined the language and literacy skills of 36 children, aged 11 years living in an area of high deprivation. Findings from the study showed that a large proportion of the sample had poorer decoding and reading comprehension abilities compared the norm. Those children with reading comprehension difficulties, experienced difficulties with spoken language skills, specifically understanding grammar, sentence complexity and receptive vocabulary.

This gap in language skills between children from less and more affluent homes appears to persist throughout a child's time in education. Spencer et al., (2017) investigated the association between SES, language ability and academic success. One hundred and fifty-one students were tested on standardised language tests at the age of 13 to 14 years of age. This language data was compared to their GCSE results in Mathematics, English Language and English Literature taken two years later, when the students were 16 years old. Results showed that deprivation, as measured through the Income Deprivation Affecting Children Index (IDACI, McLennan et al., 2011), was associated with outcomes in all three subjects. Students in the more affluent areas had a higher probability of gaining five or more A* to C Grades, including English and Mathematics, than their less affluent peers. Standard multiple regression demonstrated that SES affected English Language outcomes over and above language scores and demographic information.

It is important to note that 'socio-economic' measures are a construct based on average differences or a proportion of income-deprivation. The quality and quantity of parental education, cultural experiences, input into their children's language and reading development will vary, and it is not simply a 'have/ have-not' perspective (Rowe, 2018).

1.5.2 The association between special educational needs (SEN) and language with reading

Special Educational Needs and Disabilities (SEND) is a term given to a child who has a learning difficulty that makes it harder for them to learn than their peers. According to the SEND code of practice (DFE, 2015), there are four main areas of difficulty:

1) communication and interaction difficulties where a child finds it difficult to express or understand what is being said, or to use and follow social interactions,
2) cognition and learning difficulties ranging from moderate learning difficulties to severe through to multiple and profound difficulties where the child learns at a slower rate. There may be specific learning difficulties associated with an aspect of learning: dyslexia, dyscalculia or dyspraxia,
3) underlying social, emotional and mental health difficulties associated with child maltreatment or volatile home environments evident through challenging or withdrawn behaviours in the classroom,
4) sensory and/or physical needs, such as visual or hearing impairment where the child requires specialist input or equipment to support their learning.

The difficulties some children have in accessing the curriculum may be caused by more than one area of need. For example, Nation et al., (2010) examined if difficulties with reading comprehension at the age of eight years were associated with earlier language difficulties. The longitudinal study followed 245 children over three years, starting at five years of age. At age eight, 15 children (8.7% of the sample) were identified as showing the poor comprehender profile, i.e. the children could read the text but not with the equivalent level of understanding. Comparing poor versus skilled readers at eight years of age, the study findings indicated that students identified as poor comprehenders, showed normal word reading skills from the start of primary, with the same rate of word learning as their peers. In contrast, poor comprehenders' language skills were weaker: their performance fell at the lower end of an age-appropriate range. In addition, their reading comprehension skills showed little change over the four testing points, and they consistently scored below average. Although this was a small sample, the results were in line with the Simple View of Reading framework: some readers who have no problems with word reading but have difficulties with understanding text, can have difficulties with oral language. Difficulties with early oral language skills may result in later reading comprehension difficulties, associated with poorer school outcomes and a classification of SEN.

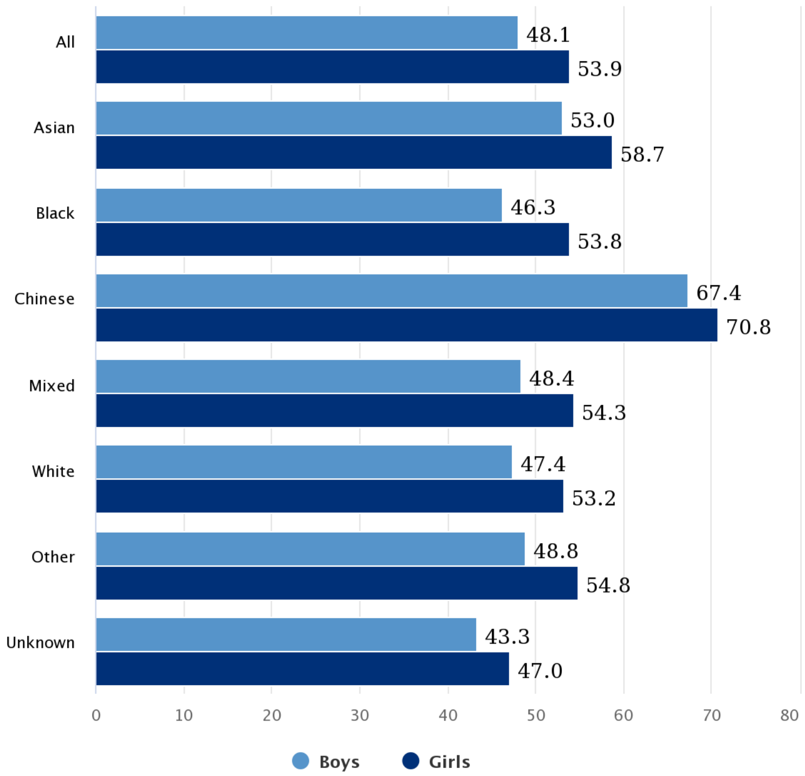
A later, larger cross-sectional study by Capin et al., (2022) examined the difficulty some children have with word reading, when they have already been identified with oral language and reading comprehension difficulties. Trained administers examined the word reading, listening comprehension, reading comprehension and cognitive abilities of 357 students from Grades One to Four, tested once within a three-year span. A large percentage of the sample (72.3%) were identified as SEN by the schools, with 19.2% identified with speech and language difficulties and 16.1% with a learning difficulty. The study reported three broad student profiles based on performances of listening comprehension and word reading. Profile One demonstrated severe difficulties with listening comprehension and moderate difficulties in word reading (10%); Profile Two with moderate difficulties in listening comprehension and mild difficulties in word reading (40%) and Profile Three with mild difficulties in both listening comprehension and word reading (50%). SEN was not associated with any single profile. All three profiles showed difficulties with word reading but as this was a group of early struggling readers displaying language difficulties, it might be expected that they would also show difficulties with word reading. However, the study also shows that all the participants had difficulties with oral language, as opposed to the 19.2% identified by schools. This highlights the importance of class teachers being aware of the importance of developing oral language skills when considering the special educational needs of children.

Both studies are examples of the interconnectedness of language, word recognition and vocabulary with reading: a difficulty with one affects the other. Children identified with SEN will receive additional support at school, but only if the difficulty is detected.

1.5.3 The association between gender and language with reading

The importance of language in learning to read is highlighted in the various theoretical models of reading comprehension, and reading is identified as a driver for learning (Chall 1983) with academic performance associated with literacy skills (Dockrell, et al., 2011). Data provided by the Office of Qualification and Examinations Regulation (OFQUAL, 2022) show that girls (76.7%) have a greater proportion of GCSE's entries at a pass grade 4, than boys (69.8%). Moreover, there is a strong relationship between ethnicity and gender, with White British and Black British boys doing less well in average GCSE attainment than other ethnic groups (See Table 1.1).

Figure 1.1 Average Attainment 8 score (out of 90.0) by ethnicity and gender for England, academic year 2020 – 2021. (OFQUAL, 2022)



Chiu and McBride-Chang (2006) looked at the associations between gender and reading using data from The Organisation for Economic Cooperation and Developments' Program for International Student Assessment (OECD-PISA, 2000). Using measures of gender, SES, number of books at home, enjoyment in reading and performance of poor readers from 199,077 students across 43 countries, results showed that girls had higher reading scores than boys in every country. Gender difference accounted for 1.9% of the variance in reading achievement.

Findings showed that reading for enjoyment explained the difference in reading performance, with children who enjoyed reading, doing better. Significantly, more girls tended to enjoy reading, raising issues around the teaching and learning of reading in schools.

Research points to the increased likelihood of boys showing language difficulties (Connolly, 2006; Reilly et al., 2019). For example, a longitudinal study by Snowling et al., (2016) examining the literacy profiles and literacy outcomes of children with resolving, emerging or persisting language difficulties, found more boys than girls in the persisting or resolving language impairment groups. Two hundred and twenty children were assessed at three time points, at the ages of three, five and eight years on measures of non-verbal ability, vocabulary, grammar, letter-sound knowledge, phoneme awareness, word reading and reading comprehension. Results showed that children with emerging and persisting language difficulties performed significantly worse on all the literacy measures at time two and three with more boys likely to be found in the persisting language group. However, there were more males in the overall sample (62%) possibly leading to sample bias.

Early childhood language environments may also be associated with gender differences. A cross-sectional study by Locke, Ginsborg and Peers (2002) investigated the association between SES and oral language skills. Two hundred and twenty-three children (106 boys) with an average age of three years, six months were assessed on measures of receptive and expressive language abilities (CELF-Preschool, Wiig, et al., 1992) and cognitive abilities (British Ability Scales II Early Years, Elliot et al., 1997). The results showed that on average, the sample showed oral language skills well-below those expected of the general population, and cognitive skills similar to the general population. Young boys in poverty (mean age of three years, six months) performed less well than girls in measures of receptive language.

Law et al., (2013) examined the relationship between gender, receptive vocabulary, literacy and non-verbal performance at five years to adulthood in a large UK birth cohort of 11,349 children. Children were assessed at the age of five years on measures of receptive vocabulary (the English Picture Vocabulary Test, Brimer and Dunn, 1962), non-verbal abilities (the Copying Test Design, Osborn et al., 1984) and word reading (the Schonell Graded Word Reading Test, Schonell and Schonell, 1960). In adulthood, literacy performance was based on GCSEs taken at 16 years of age and an adult literacy and numeracy assessment. Results showed that at five years of age, boys outperformed girls on a measure of receptive vocabulary but girls outperformed boys on a reading measure. Boys with parents who were poor readers, were also less likely to be considered readers at the age of five years. Overtime, gender was not associated with literacy outcomes, but early language ability was associated with better literacy outcomes.

Again, this raises the issue around the culture of book reading in schools and how to support under-performing boys. The difference between the two studies may lie in the size of the sample, the age of the children and the tests given. Locke et al., (2002) looked at the language skills of very young children living in poverty whereas Law et al., (2013) examined the relationships between gender, receptive vocabulary and literacy in a large birth cohort (11,349 participants) and assessed on only one measure of receptive vocabulary.

In light of the findings between gender, reading, and language skills, gender will be investigated as variable in the study of the current thesis.

1.6 Summary of Chapter One

The aim of Chapter One was to examine reading development in typically developing students. Reading is a complex activity, reliant on many skills working together to produce the mental representation of the written text. Research points to the association between effective reading and academic success. Therefore, being able to process and understand written words contributes to the literacy and academic development of individuals, and benefits society in general.

Different theoretical models of reading show the relationships and interactions underlying reading comprehension and the actual process of comprehending text. The Simple View of Reading (Gough and Tunmer, 1986) argues that reading comprehension is the product of two main skills: word recognition and language comprehension. The skills required for fluent word reading and understanding language are complex, and difficulties in any of the component skills may lead to difficulties in reading comprehension. Some problems may be evident from the start of primary schooling (Storch and Whitehurst, 2002); some may emerge in the latter half of primary education (Leach et al., 2003) or in adolescence (Nippold, 2017), reflecting shifts in the demands of the school curriculum.

The present UK educational context reflects a focus on a 'print language' whereby progress in learning or attainment is only measured through written work. School measures, such as the Cognitive Abilities Test (CAT, Smith et al., 2003) designed to test reasoning skills, require a level of reading to understand the task. However, to understand a written language is to assume proficiency in the spoken language. In England, less educational prominence and focus is given to spoken language compared with reading or writing (Alexander, 2008), reinforced through the fact that talk is not formally assessed in either primary or secondary education, unless linked to modern foreign languages. It could be argued that this misleads teachers to misunderstand and underestimate the importance of oral language skills in the reading comprehension process. However, as evidence shows a strong association between language development and academic success (Snowling et al., 2001; Conti-Ramsden et al., 2009; Dockrell. Lindsay and Palikara, 2011; Ricketts, 2014), it is important for teaching staff from secondary schools, especially those serving areas of high socio-economic deprivation, to be more aware of children with early language impairments and provide them with appropriate levels of support.

The central purpose of this thesis is to examine the reading comprehension skills of a cohort of young adolescents from an area of high social deprivation over a period of time; exploring the relationships between their oral language ability, non-verbal ability, socio-economic status and academic attainment with reading comprehension. Understanding what may influence these relationships from an educational perspective, is a step towards identifying the appropriate support needed by those adolescents who have difficulties with reading. The following chapter will describe and review what is currently known about reading and language development in adolescence.

Chapter Two
Language and Reading in Adolescence

2.0 Overview

Chapter one described early reading development in typically developing students and examined the skills required for fluent word reading and understanding text. Five main models of reading comprehension were explored: the Simple View of Reading illustrating the two foundational components of reading comprehension: decoding and listening comprehension; Reciprocal models showing how reading experience drives growth in language comprehension and word recognition; Component models examining individual skills underlying reading comprehension; Convergent models examining the developmental nature of language and word recognition and the Construction-Integration model exploring the mental processes required for building and integrating the mental representation of the text.

Beyond theories of reading comprehension, research was reviewed that showed socio-economic factors influence the language development of some individuals, with corresponding impact on how reading develops over time. By the time children leave primary education, many secondary teachers assume they can read. However, evidence shows that between 20% - 30% of adolescents are not able to read simple texts, accurately and with understanding (Association of School and College Leaders, 2019; Jerrim and Shure, 2016; Sizmur et al., 2019). Despite this evidence, there is very little longitudinal research showing the trajectory of reading through adolescence, and how language skills continue to influence reading into secondary education, particularly among low SES groups. This chapter reviews the research evidence examining language and reading in adolescence.

Section 2.1 defines the period of adolescence. Section 2.2 discusses the Bloom and Lahey (1978) model of language which is used as a model to discuss the language development in adolescents. Section 2.3 examines reading in adolescence followed by an exploration of academic outcomes for adolescents with language difficulties.

2.1 Adolescence

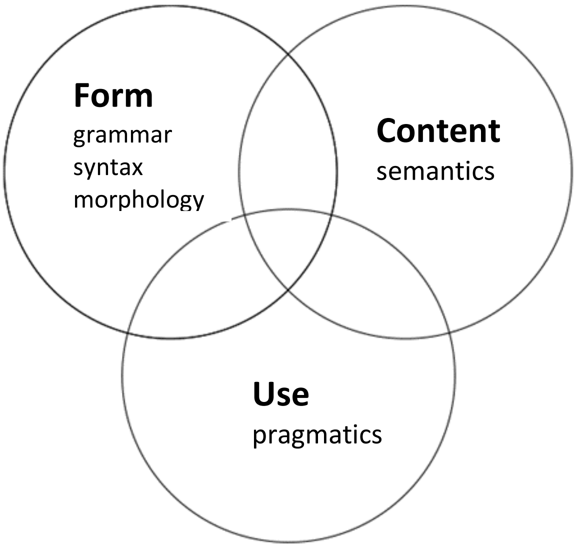
Adolescence refers to the period of human development between childhood and adulthood and corresponds approximately to the ages between 10 and 24 years of age (World Health Organisation, 1986). There are three developmental stages within adolescence: early adolescence (10 - 13 years of age); middle adolescence (14 - 17 years of age) and late adolescence (18 - 21 years of age) (Allen and Waterman, 2019). Early adolescence coincides with a key transition in education: the shift from primary to secondary education, when students are aged 11 - 12 years (Year Seven in the UK and Grade Six in the USA). The start of middle adolescence marks the shift from the end of KS3 to the beginning of the academic period linked to national examinations at the age of 16 and 18 years.

As young people grow into adults, they experience significant changes in their language, cognitive, social and emotional development (Nippold, 2014). Burnett et al., (2011) in their review of adolescent social cognitive behaviour, highlight the importance of peer relationships and peer approval. This means that social communication becomes important as adolescents use language to help form their identities and relationships with others (Spencer et al., 2013).

2.2 Language development in adolescence

Language is used to communicate with others: it can be spoken, written or signed (expressive language) and is used to support understanding (receptive language) (Hopkins et al., 2018). Bloom and Lahey (1978) split language into three overlapping components: form, content and use (See Figure 2.1). The form of language refers to how words are put together to make sentences (grammar). The content of language is about the meaning of language and includes vocabulary and world knowledge and the use of language relates to how individuals adapt their language to communicate with different listeners for different purposes.

Figure 2.1. Model of language (Bloom and Lahey, 1978, p22)



The model illustrates that all three dimensions are required and intersect in the middle of the diagram for effective communication. For example, knowing the meaning of a word means it can be understood and used differently in different contexts: for example, the word ‘ice’ can be used as a noun or a verb: ‘the water froze into ice’ or ‘he iced the cake’. It can be used in a simile, ‘he was as cold as ice’; or a metaphor, ‘his heart was ice’ or slang, ‘the gang iced him,’ or ‘basketball coaches being iced out of top jobs’. Bloom and Lahey (1978, p23) suggest that children ‘learn language as they use language’, indicating that language develops as children move through stages in their life, meeting and mixing with different people. The following sections examine how adolescents derive meaning from grammar, form syntactic structures into sentences and use language to communicate.

2.2.1 Form

According to Bloom and Lahey (1978), form refers to the grammatical aspects of language, including morphology and syntax. In both primary and secondary classrooms, expository discourse has been shown to contain greater syntactic complexity than conversational discourse (Nippold, Hesketh, Duthie and Mansfield, 2005). If language is learnt through using language (Frith, 1986), then learning to use these complex syntactic sentence structures may be through expository discourse within the classroom.

2.2.1.1 Morphology

Managing the more challenging language of the secondary classroom, includes understanding and reading morphologically complex academic words, which may not have been encountered before. Morphological processing allows the reader to recognise and work out the meaning of unknown complex words (Goodwin, Petscher and Tock, 2020). Therefore, reading texts containing unknown morphologically complex words, requires an ability to break apart the morphemic units such as the prefixes, suffixes or root words and understand their meaning. For example, *respiration* is built from the root of 'spire' meaning to breathe; 're-' meaning again and '-ation' meaning the act of, allowing the reader to work out the meaning to be the action of breathing. In comparison, *inspiration* still contains the root word, 'spire' but the addition of the suffix 'in-' alters the meaning to the drawing in of breath or being filled with creativity depending on the context of the text (DFE, 2016).

Dawson, Rastle and Ricketts (2018) investigated the morphological effects in visual word recognition, comparing performance on a lexical decision task for 30 postgraduate and undergraduate students (mean age of 20 years, SD, one and half), 36 older adolescents (aged 16- 17 years), 37 younger adolescents (aged 12- 13 years) and 50 children (aged seven to nine years). Participants' morphological knowledge and reading response time were assessed with an online test reading involving 60 nonwords and 60 real words. Half of the nonwords were morphologically correct, created by pairing the stem of a real word with a recognised suffix (e.g., earist); the remaining nonwords words were created by using the same stem with a nonmorphological ending (e.g. *earilt*). Participants were asked if each word was a word they knew. The study reported that all age groups were more likely to accept a morphological nonword as a word they knew, but the effect was greater in older adolescents and adults. Older adolescents and adults were also slower to reject the morphological nonwords compared to the control words indicating that they spent more time thinking about the accuracy of the stem-suffix combination. These findings suggest that older adolescents and adults were using orthographic-morphological knowledge to access unknown words. However, an alternative explanation as to the lack of evidence in response times for younger adolescents and children rejecting nonwords based on morphological structure, is that they may have been quicker to press ‘no’ to the question: ‘is this a real word you know?’ (Dawson, et al., 2018, p648). However, the study demonstrates a longitudinal change in the processing of morphologically structured letter strings. Older adolescents were more likely to accept a nonword comprising of a real stem and suffix thereby thinking the word to be real, than younger adolescents. Becoming aware of differences in morphological structure is important as adolescents encounter new, complex words which are not always explicitly taught.

A study by Goodwin, Petscher & Tock (2020) aimed to explore how morphological knowledge supports reading comprehension for students with poor reading vocabulary. One thousand, one hundred and forty participants took part in a computer-adaptive gaming application assessing morphology, vocabulary and syntax: 447 fifth graders (average age = 11 years), 257 sixth graders (average age = 12 years), 198 seventh graders (average age = 12 years) and 237 eighth graders (average age = 13 years). The gaming app assessed skills on morphological awareness, use of syntactic morphological knowledge, use of semantic morphological knowledge and use of phonological/orthographic morphological knowledge. Reading vocabulary was measured through a reading vocabulary assessment, with participants reading an underlined word within a phrase and selecting a similar word from a multichoice format. The authors reported that the semantic information in morphemes was more problematic than the orthographic and phonological information in supporting reading comprehension, for readers with limited reading vocabulary. Although measures of oral vocabulary as opposed to reading vocabulary may have shown different results, the results show the variation in reading comprehension, highlighted by the Simple View of Reading (1986). Those participants with limited reading vocabulary showed lower levels of applying word meanings to their reading, resulting in poorer performance in reading comprehension.

These research findings suggest readers draw on morpho-orthographic knowledge to read print and morpho-semantic knowledge to understand print. If written language is the driver for learning new vocabulary based on the Expanded View of Reading (2019), then failure to read new words may be due to an inability to develop links between morphological, semantic and orthographic knowledge (LARRC and Logan, 2017; Ricketts et al., 2008).

2.2.1.2 Syntax

Students learn from reading academic texts. These texts tend to use more complex syntactical structures and technical vocabulary in their attempt to explain abstract ideas (Ward-Lonergan, 2015). Readers need to understand the different meanings within each separate clause and integrate these meanings. Failure to understand these more complex syntactical sentence structures will limit reading comprehension A study by Brimo, Apel and Fountain (2017) examined the effects of syntactic knowledge and awareness on adolescents' reading comprehension in Grades Nine and 10. The cross-sectional study assessed 179 participants, aged on average 15 years 7 months (one year, three months), on measures of reading comprehension, syntactic awareness, syntactic knowledge, vocabulary knowledge, word-level reading and short-term memory. According to the study authors, syntactic knowledge refers to the ability to understand different grammatical structures within a sentence whereas syntactic awareness refers to the ability to reflect and manipulate grammatical structures. Path analysis showed that knowledge of vocabulary and syntactic knowledge directly contributed to reading comprehension, and syntactic awareness made an indirect effect through syntactic knowledge. Although, vocabulary knowledge may have affected performance on the syntactic knowledge assessment, it appears that the more knowledge a reader has about syntax, the better they are at manipulating it, enabling them to show a better understanding of the text.

Within both narrative and expository discourse, the timing of hypothetical, conditional events are expressed through past tense counter-factual (PTCF) sentences. Using the Trabusso and Suh example (1993) (Section 1.13), if Betty *had not* gone to the department store, she *would not* have realised everything was too expensive. PTCF sentences provide a different perspective on how things might have turned out, in this case based on Betty's decisions. Nippold, Nehis-Lowe & Lee (2020) examined the extent to which 80 young adolescents, aged 11 – 14 years, produced and understood PTCF sentences. Their performance was compared to young adults aged 19 – 29 years of age, with the aim of exploring if growth occurred between a widely separated age group. Half the participants completed a paper and pen task (production) and the other half completed a multiple-choice version (comprehension).

Results showed that overall young adolescents did less well on both the production and comprehension of PTCF sentences, and that for both groups production was more difficult than comprehension. However, some adolescents scored as well as the young adults indicating they were acquiring proficiency in what appeared to be a late-developing aspect of grammar. As the young adults were attending university, they were probably not representative of all young adults. The findings may have been different if the adolescents had been matched against young adults with different educational trajectories but they show how grammar continues to develop through adolescence and into adulthood.

2.2.2 Content

Vocabulary expresses the meaning of words, essential in effective communication (Schmitt et al., 2015). Snow's (2021) Language House schema (See section 1.5) illustrates that the quality and quantity of words that young children are exposed to depends on home language and literacy environments. Once children learn to read, reading becomes the main way of learning new vocabulary (Feng and Webb, 2020). A longitudinal study by Duff, Tomblin and Catts (2015) investigated if differences in word reading were related to vocabulary growth. A composite score for word reading abilities at the age of 10 years (non-word and sight words) was compared to earlier composite oral vocabulary measures at kindergarten, to control for the word-learning aspect prior to formal reading, and to the composite vocabulary measures at ages 10, 13 and 15 years. Four hundred and eighty-five children participated in the study. Results showed that the rate of vocabulary growth between the ages of 10 to 15 years was associated with word reading at 10 years. The better word readers showed higher rates of vocabulary growth compared to the average and weaker readers. However, all participants showed growth in their oral vocabulary measure, indicating that average or weaker word reading was not affecting oral vocabulary growth, merely the rate of oral vocabulary growth. These findings reflect the importance of word reading to learning new vocabulary, and the importance in supporting poorer word readers.

The Component Model of Reading (Scarborough, 2001, Valentino et al., 2007) suggests that vocabulary can be seen as part of the reciprocal relationship between different language skills related to reading comprehension. Lervag, Hulme and Melby-Lervag (2018) followed 198 children over five years to investigate the importance of four factors, vocabulary, grammatical skills, verbal working memory and inference skills in predicting listening comprehension and reading comprehension. Participants joined the study at the average age of seven years, six months and were assessed on six occasions with measures of word reading, reading comprehension, listening comprehension and the four language measures. Listening comprehension predicted both early growth (from the ages of seven years, six months to eight years, six months) and later growth (eight years, six months to twelve years, six months) of reading comprehension. Word reading predicted early growth in reading comprehension. None of the four individual measures of vocabulary, grammatical skills, verbal working memory and inference skills significantly predicted reading comprehension. However, when formed into a general language factor, the four factors explained 95% of the variance in listening comprehension thus supporting the view that the Simple View of Reading is still relevant in adolescence. On the other hand, it could also be argued that the findings support the component model in that specific component skills formed a better representation of listening comprehension.

Van Steensel et al., (2016) examined the relationships between the specific components of word decoding, vocabulary knowledge, meta-cognitive knowledge and reading comprehension in low achieving adolescents. The cross-sectional study assessed 328 adolescents ranging in age from 13 to 15 years. All were identified as poor readers based on a national academic aptitude test and teacher assessment. Participants were assessed on measures of reading comprehension, word decoding, print based vocabulary knowledge and meta-cognitive knowledge around reading and writing strategies. Findings from the study showed that for both younger and older adolescents, vocabulary knowledge and meta-cognition were important factors in understanding an extended piece of text. Due to the cross-sectional design of the study, any associations between growth in meta-cognitive knowledge and growth in reading comprehension cannot be concluded. However, the study shows that poor vocabulary knowledge, and poor knowledge and use of effective reading strategies leads to reading comprehension difficulties.

Adolescents with language difficulties have been shown to have limited vocabulary knowledge (McGregor et al., 2013; Rice and Hoffman, 2015). In a longitudinal study comparing the breadth and depth of vocabulary, McGregor et al., (2013) reported on the vocabulary knowledge of children with a language impairment compared to their typically developing peers. Based on kindergarten language diagnoses, 502 children were classified as either language impaired (n=177) or typically developing (n=325). An oral vocabulary test assessed how many words they knew (breadth) and how well they knew them (depth) at four time points: age seven, nine, 13 and 15 years of age. Children with language impairment knew fewer words at all grades than their peers and found it harder to define the meanings of words, and this deficit persisted into adolescence. The findings related to performance on a single task relying on expressive language to explain word meanings. This may have disadvantaged the language impaired group more than the control group. Additionally, the lack of verbs and abstract nouns in the list of definitions may be a reason why the gap between the two groups did not widen as children grew older. If vocabulary adds to reading comprehension, and reading adds to vocabulary knowledge, then adolescents with language difficulties will require additional support in the classroom.

2.2.3 Use of language

Pragmatic proficiency refers to the appropriate use of language to engage with others (Matthews et al., 2018). According to Wilson and Bishop (2022), pragmatics encompasses a set of skills, and well-developed pragmatic processing and language comprehension overlap to achieve successful communication. Pragmatic processing includes the ability to take part in effective social communication (Norbury, 2014), and to recount cohesive narratives and organised expository discourse (Nippold and Scott, 2015). These three skills are discussed in the following sections.

2.2.3.1 Social communication

Becoming aware of another person's perspective is important in using language successfully to communicate with others, and helpful in developing friendships, and engaging in class discussions (St Clair et al., 2011). Adolescents rely on effective communication skills to form friendships and help develop their identity (Hill et al., 2021). Peer friendships become more important in adolescence and individuals use language to manage these peer group friendships (Eckert, 2005). Adolescents are expected to be in formal education until the age of 16 years in the UK. Whether they are in school or have been excluded, like or dislike school, society dictates that they should be there. Therefore, school is an important setting for adolescent language (Eckert, 2005).

Spencer et al., (2013) reported that adolescents from middle class areas associated language with educational success, whereas adolescents from working class areas appeared to see language as part of their group identity. The study compared the language of 21 adolescents living in working class areas to 21 adolescents living in more affluent areas. Following semi-structured interviews with 42 English participants aged between 14;6 and 15;7 years, the data was coded into themes to allow comparison between individuals and groups based on their SES background. The findings showed that both groups had good language use but differences arose in how language was viewed. It would have been interesting to know the selection process, as more articulate students across both groups may have been more likely to respond to recruitment, thereby resulting in sample bias. Although the study demonstrated that social deprivation did not affect the working class participants' use of language to communicate, it did show that within a semi-structured interview the middle class perspective aligns with the language of the school. This makes it easier for those students to feel part of a school community, as opposed to the working class adolescents' use of language to differentiate social boundaries.

Adolescents who have problems with social communication and the use of language tend to show social, emotional and behavioural difficulties. A longitudinal study by St Clair et al., (2011) followed 234 children with a history of specific language impairment from the ages of seven to 16 years of age, assessing them at four time points. All the participants attended language units at seven years of age. By 16 years of age, 51.5% of the sample were in mainstream secondary education with classroom support, 16.5% were in mainstream with no support and the remainder were in language units or special schools. Receptive and expressive language was measured at seven years of age, along with a measure of single word reading. Pragmatic abilities were measured through teacher assessment of the pragmatic scale of the Children's Communication Checklist (Bishop, 1998). The study reported that difficulties in behaviour (hyperactivity and conduct) and emotional conduct reduced over time but social difficulties increased. Lower levels of reading accuracy and expressive language at the age of seven years, were associated with more behavioural difficulties but not social or emotional difficulties. Social difficulties such as difficulties with peer relationships, were related to pragmatic skills.

Adolescents who have difficulties in the social use of language may need on-going support as the complexity of social communication increases throughout school and beyond (Norbury, 2014). Ogulcan et al., (2022) examined the association between pragmatic language impairment, social cognition and emotion regulation skills in a cross-sectional study comparing 70 adolescents with Attention Deficit and Hyperactivity Disorder (ADHD) to 64 typically developing adolescents. The average age of the participants was 14 years. Pragmatic language skills were assessed using the Children's Communication Checklist (Bishop et al., 2001). The study found that those children with ADHD had difficulties with pragmatic language, social cognition and emotional regulation compared to the typically developing group. A longitudinal approach may have shown the development of pragmatic abilities, but the findings demonstrate that adolescents with ADHD have associated pragmatic difficulties which may impact on their formation of social relationships.

Pragmatic difficulties endure into adulthood. A retrospective longitudinal study by Whitehouse et al., (2009) examined language and literacy outcomes of 48 adults, who had been identified with developmental language disorder in childhood and had attended specialised language schools. The participants were split into four groups based on their childhood need: specific language impairment (now known as developmental language disorder, Bishop, 2007), pragmatic language impairment, autism spectrum disorder (ASD) and typically developing. The results showed those with specific language impairment also showed late emerging pragmatic deficits, either due to the demands of more complex social interactions or language difficulties that made social interactions difficult. Both the pragmatic difficulty group and ASD group showed lasting difficulties with language use. The literacy skills of the pragmatic difficulty and ASD groups were comparable to the typically developing group, although this could be down to recruitment bias. The authors indicated that more literate adults might be happier taking part in a follow-up study than less literate adults. Despite any bias, the longitudinal nature of the study shows the evidence that children who find it difficult to use language appropriately face long term difficulties.

2.2.3.2 Narrative Discourse

Central to effective communication, social interaction and reading achievement is the ability to narrate a story whilst showing awareness of the listener or reader (Ekert, 2005; Lervag et al., 2018). Narrative is 'a telling which selects and orders events in time and speculates on life and human behaviour' (Whitehead, 2002, p33.) In order to tell a good story, adolescents need to draw on age-appropriate syntax, semantics and pragmatics (Nippold, 2007). Therefore, a good narrative is the product of the interaction of form, content and use and is related to reading achievement.

The ability to narrate or listen to a spoken account may be represented through the Construction-Integration model (Kintsch, 1988) (See section 1.3.3.1). Application of this model shows that firstly, spoken language forms the microstructure (ideas which are represented through word meanings and arranged into grammatical structures). This microstructure is organised into a macrostructure reflecting the genre of the discourse, for example narrative or expository. Both structures are then integrated into the textbase. According to the model, deep understanding of the textbase develops when the listener or reader actively engages with the process of integrating information from the text with relevant prior knowledge.

A recent cross-sectional study by Hill et al., (2021) aimed to profile the variability and development of narrative-based (personal recount and fictional narrative) and fact-based (expository and persuasive) discourse in 160 mainstream adolescents, aged 12 – 15 years. Each participant recorded a sample of their recounts (n=3), expository (n=3), persuasive (n=3) and narrative (n=3). Their recorded transcripts were assessed on micro-features (fluency, lexical diversity, syntactic complexity and cohesion) and macro-features (sentence coherence, relevance and efficiency and use of genre components, such as setting and time for narratives or elaborations for expository). Participants' expressive and receptive language skills were also assessed using a Core Language Score (CELF4. Semel et al., 2003). Descriptive statistics showed individual differences in productivity, fluency and syntactic complexity, and similar use of genre components. Although the authors acknowledge the potential confounding effect of prior knowledge in the participants' spoken narratives, the participants showed considerable differences in the quality and quantity of content across genres, showing personal strengths and weaknesses. Findings from the study showed that participants with higher levels of oral ability produced well-organised spoken sentences which were longer, more fluent, and lexically diverse. Participants with poorer language skills found recount and expository genres more difficult than persuasive or narrative genres, regardless of age or gender. The authors reported that this was due to difficulties in generating coherent and relevant links between sentences, and including genre specific components.

Narrative ability has been shown to differ in adolescents with language impairment. Wetherall, Botting and Conti-Ramsden (2007) carried out a cross-sectional study assessing two different genres of oral narrative: storytelling and conversation on four measures of language (productivity, syntactic complexity, syntactic errors and performance). Ninety-nine typically developing adolescents from two mainstream secondary schools, and 19 adolescents with DLD were assessed on two tasks: a story-telling task and a conversational task. Transcripts were examined on measures of productivity, syntactic complexity and syntactic errors. Both groups produced narratives of similar length and lexical diversity. As the study was comparing language abilities by using different narrative genres, story structure was not measured. The SLI group made more errors overall, with a higher percentage of errors associated with tense (time of events) and agreement (cohesion) in both the story telling and spontaneous narrative. The findings point to the difficulties adolescents with SLI may have with story-telling, a genre favoured by schools, but that these adolescents managed more effectively with personal narratives, a genre more associated with conversation.

The importance of narrative skills at the age of five years in predicting reading comprehension in adolescents was highlighted in a nine-year prospective study by Babayigit et al., (2021). The study followed 716 typically developing children from the age of five to 14 years. Participants were tested at the age of five years on two language measures: verbal comprehension and narrative skills, along with measures of phonological abilities, verbal memory and cognitive skills. At the age of ten years, participants were assessed on measures of word reading and reading comprehension and at 14 years, on a national standardised test of reading achievement. The reading achievement tests focused on comprehension skills. Findings showed that both narrative and receptive skills at five years, made unique direct contributions to reading comprehension at 10 years of age and indirect contributions to reading achievement at 14 years. Although the study included fewer families from lower SES which may have affected the findings, it shows that early oral language skills form the foundation of reading comprehension in adolescence.

Similar findings were reported by Suggate et al., (2018) in their longitudinal study, tracking 58 children from 19 months to 16 years of age, who also found that children's early oral narrative skills assessed at forty months, predicted reading comprehension at 16 years. The quality of the oral narrative, rather than the recall of the story, was associated with later reading comprehension, showing that both telling a narrative and reading comprehension draw on higher order semantic processing. By adolescence, robust research indicates that narrative ability is a measure of linguistic and communicative competence.

2.2.3.3 Expository discourse

Whereas constructing a narrative involves selecting, sequencing and evaluating events in time (Whitehead, 2002), expository discourse is defined as a 'monologue that conveys factual, academic or technical information' (Ward-Lonergan and Duthie, 2016, p52). Textbooks and classroom lectures, particularly in the secondary school context, use expository language which then becomes the 'language of the classroom' (Ward-Lonergan, 2015, p155) and research points to expository text as more complex than narratives (Nippold, 2017). This is due to the inclusion of technical words (Nippold, 2007) and morphologically more complex words (Goodwin et al., 2020) used to convey subject specific information. Furthermore, in order to express relationships and ideas, expository discourse uses more complex syntactic structures (Lundine and McCauley, 2016).

Nippold et al., (2005) explored the syntactic development in conversational versus expository discourse. One hundred and twenty participants, aged from seven to 49 years took part in the cross-sectional study. All the children were typically developing and all the adults had completed high school education. A conversational and expository discourse was recorded for each participant and assessed on syntactic complexity. The findings showed syntax developed into adolescence and adulthood, and that expository discourse involved greater syntactic complexity than conversational. Although there were individual differences within the sample, the evidence shows that later syntactic development reflected a process of learning to *use* grammatical structures more effectively, as opposed to simply learning new structures. The authors point to the fact that expository discourse involves using grammatical structures not always relevant to conversational discourse, to communicate complex ideas in a clear way.

However, for children moving from primary education to secondary with existing weak language skills, hidden language difficulties (Myers and Botting, 2008) or late-emerging difficulties (Catts et al., 2012; Leach, Scarborough and Rescorla, 2003), understanding and expressing this academic language is particularly challenging.

Welie, Schoonen and Kuiken (2018) explored whether understanding how expository texts are structured predicted adolescents' reading comprehension of these texts. Three hundred and thirty-seven students, aged between 13 – 15 years took part in a cross-sectional study, and were assessed on measures of expository text comprehension, vocabulary knowledge (general vocabulary knowledge and knowledge of connectives), metacognitive knowledge, sentence reading fluency and text structure inference skill. The study reported high levels of attrition during testing, with large numbers of students being excluded due to poor behaviour (n=92) or incomplete test scores (n=38). We have considered previous studies that have linked emotional and behavioural issues to language difficulties (See section 2.2.3.1), so the fact so many participants were excluded may have skewed the results. Welie et al. found that text structure inference was strongly correlated with expository text comprehension but alone did not predict eighth graders' expository text comprehension. When metacognitive knowledge and knowledge of connectives were controlled, text structure inference skill did predict expository text comprehension. Therefore, readers with low levels of metacognition and poor knowledge of connectives may have had poorer knowledge of the different text structures preventing them from inferring text structure during expository text reading.

The study highlights the relevance of the Construction-Integration model (1988). Connectives and metacognition are important in helping to build a coherent understanding of the text, when there is not enough background knowledge. This is an important strategy when listening to, or reading texts containing new information needing to be understood. Connectives are words that link ideas embedded within phrases or sentences across a conversation or text, for example 'but' indicating two opposite ideas; 'because' indicating a reason; 'or' shows a choice; 'so' a result and 'if' a condition (DFE, 2016). Most conjunctions are used to join a series of ideas or subordinate clauses to the main clause or idea of a sentence, and are an important foundation to understanding texts in secondary school.

Difficulties with expository discourse have been reported in adolescents exhibiting emotional and behavioural difficulties. These behaviours negatively affect relationships with peers and teachers in the classroom. Hopkins, Clegg and Stackhouse (2018) compared the receptive and expressive language, and expository discourse abilities of 52 Young Offenders (YO) (aged

13 to 18 years) to 25 non-offenders from mainstream secondary schools (aged 13 to 14 years). The YO group had missed an average of two years and eight months of compulsory education meaning they matched the Year Nine group in terms of overall schooling. Participants were assessed on language measures (expository discourse, Understanding Spoken Paragraphs and Recalling Sentences subtests, CELF4, Semel et al., (1995); syntactic complexity and expressive vocabulary) and matched on measures of non-verbal IQ, social disadvantage and educational attendance to the non-offender control group. The study reported that those participants who scored poorly in each language measure were one to five times more likely to have shown offending behaviour. The YO group found it difficult to communicate and process information, and based on the processing demands of two language subtests (understanding spoken paragraphs and recalling sentences), may also have had difficulties associated with working memory. Although a small group difference in non-verbal IQ may have affected the difference in language performance between the groups, the study suggests that when adolescents have difficulties in using or understanding complex language to convey ideas, they are less likely to manage emotional and behavioural difficulties. This in turn affects social and academic success.

2.3 Reading in adolescence

As children enter secondary education, they are faced with the complex, academic language of the curriculum (Nippold, 2017; Ward-Lonergan, 2010). This expository discourse is aimed at conveying unfamiliar or new information to the listener or reader, using low-frequency, complex or technical words (Lundine and McCauley, 2016). Often this academic language is delivered through a lecture-style format by teachers, requiring the students to both listen and read the information on a power-point (Schuth, Kohne and Weinert, 2017).

Students must typically try to understand new and difficult vocabulary and abstract concepts across many subjects in a single day (Ehren, 2015). In the first three years of UK secondary schooling, students attend a multitude of classes: English, Mathematics, Physics, Chemistry, Biology, History, Geography, Modern Foreign Language, Religious Education, Art and Design, Computer Science, Music and Physical Education (DFE, 2016). Students need to learn to think abstractly and express informational language within each of these subjects (Ravid, Dromi and Kotler, 2015). Understanding the macro-structure of narrative and expository use of language is central to reading comprehension: description, sequence or process, cause/effect, compare/contrast or problem/solution. Students need to draw on their use of language to understand classroom discourse: for example, in Art and Design, different styles of painting may be compared and contrasted, or in Geography, when reading an explanation on the causes and effects of flooding.

Difficulties with vocabulary, syntax and word reading have been shown to be associated with poor reading comprehension (Nippold, 2017). As part of a larger cohort study, Nippold (2017) investigated the reading comprehension of adolescents at the age of 14 years, who had been identified at the age of six years as having typical language development specific or non-specific language difficulties. Based on composite scores for lexical, syntactic, word reading and reading comprehension abilities, the study reported that children identified with early language or non-specific language difficulties still showed difficulties with language in adolescence. Reading comprehension at the age of 14, was associated with proficiency in lexical and syntactical development and word reading abilities. Thus, individual differences in reading comprehension are shown to be dependent on the two components illustrated by the Simple View of Reading (1986): language comprehension and word recognition.

Skilled readers develop rapid, automatic word recognition processes (Ehri, 2007). Conversely, low skills in word reading are associated with struggling readers. Oslund et al., (2018) compared struggling (n=305) and adequate (n=491) adolescent readers on measures of word reading and vocabulary. The cross-sectional study reported that struggling readers were relying on word reading skills to understand the text, whereas vocabulary knowledge helped the adequate readers in reading the sight words. Eight hundred and fifty-nine students took part, across Sixth Grade (n=320), Seventh Grade (n=266) and Eighth Grade (n=273), with an average age of 14.17 years. Mediation analyses showed that the direct effects of vocabulary and sight word reading on reading comprehension for the entire group were significant. Vocabulary was the stronger predictor of reading comprehension in the adequate reader group. However, the study used a measure of vocabulary that required the content to be read, and therefore introduced a confounding variable. If a measure of oral vocabulary had been used, the results may have differed. Sight word reading was the stronger predictor of reading comprehension for struggling readers, pointing to the central role of word reading in the reading process and thence to reading comprehension. Those students with adequate reading comprehension showed a stronger reciprocal relationship between word-reading skills and word knowledge (vocabulary). Therefore, good readers profit from the 'bi-directional' relationship between language and reading (Myers & Botting, 2008, p97, Nation, 2019; National Institute of Child Health and Human Development, 2005) whereby the more an individual reads, the more language they understand, which in turn enables them to read more.

Elleman and Oslund (2019) argue that learning new words is dependent on reading as written text uses vocabulary and grammar not always used in conversation (Whitehead, 2011; Storch & Whitehurst, 2002). Knowing orthographic and semantic parts to words, helps the reader to understand their meaning and contributes to reading comprehension. Reed, Petscher and Foorman (2016) examined the contributions of vocabulary and spelling to the reading comprehension of 2,813 students in Sixth Grade to Tenth Grade (average age 11 to 15 years). Their cross-sectional study assessed vocabulary knowledge through an online sentence completion task: participants read a variety of sentences each with a missing word, and selected the best fit from a selection of three morphologically similar words. Spelling knowledge was assessed by a dictation task. Findings from the study demonstrated that vocabulary predicted reading comprehension across all the grades. As this was again a print-based vocabulary task, different measures of vocabulary may have altered the relationship. However, mediation analysis showed that the direct effect of reading vocabulary on reading comprehension decreased across the grades whereas the direct effect of spelling increased suggesting that improving orthographic knowledge and word knowledge helps with reading more complex text associated with higher grades, compared to younger students in grades Six and Seven. Unlike the traditional view of the Simple View of Reading, with language comprehension and word recognition making separate contributions to reading comprehension, the authors suggest that increased lexical knowledge, supports word meaning and reading comprehension as students move through secondary education. It is important to note that this is a cross-sectional study and therefore causality can not be determined.

To summarise the evidence so far presented, as students move through the secondary education and the demands of the curriculum increase, reading becomes an important mechanism for learning new information. As adolescents read harder material, improvements in reading comprehension drives growth in both constituents of reading:

language comprehension and word recognition. Hoover and Tunmer's cognitive framework illustrating reciprocal Matthew effects (2019) shows by reading more complex text, readers develop language use through more diverse text genres; form through the understanding of more complex syntactic structures and content by developing their vocabulary. Word recognition improves through morphological – orthographic mapping allowing fluency to develop. As reading helps adolescents to learn, better readers develop their knowledge allowing them to understand harder material.

In contrast, adolescents with weaker language skills may start to read less as they find the reading process too difficult. According to the Expanded View of Reading (2019), these weaker readers miss out on the language and knowledge opportunities that reading experience offers. Students who find it hard to process information quickly through formal teacher talk in the classroom or from print will be at a disadvantage in assimilating new curriculum content and applying it in examination situations or routine assessments used in schools in the UK, like for example, the Cognitive Ability Tests (CAT, 2003) used for grouping students into ability sets for teaching.

2.3.1. Reading and academic outcomes

One third of 16-year-olds cannot read or write English at a standard-pass-level, after 12 years in compulsory education (Association of School and College Leaders, 2019). These students will fail to progress into further education impacting on career choices. Dockrell, Lindsay and Palikara (2011) in their study exploring the academic outcomes of students with SLI, found literacy measures and non-verbal ability to be important indicators of progression. Sixty-two adolescents identified with SLI at the average age of eight years and three months, were assessed on measures of receptive and expressive language, literacy, non-verbal language and written language. Academic attainment was obtained from Key Stage Three (KS3) national assessments, sat when students were 14 years of age and GCSE outcomes when students were 16 years of age. At the age of 16 years, most participants performed significantly below average on measures of language and literacy. Based on the overall number of GCSE's sat by the cohort, 25% were at A* to C level, 60% were at D to G level and 15% failed. Eight students achieved 5 GCSE's passes at A* - C level pass (12.5%) indicating a poor performance relative to the national average of 63.4% of pupils in England, 2011. Literacy skills at the age of 14 years, along with non-verbal ability were significant predictors of attainment at GCSE, reflecting that good levels of reading and writing skills are essential for completing written examination questions that are part of educational outcomes. Both writing and reading processes require a level of language to translate students' ideas into written text (Abbott et al., 2010) and the study reported significant correlations between oral language measures of listening comprehension and receptive grammar, and the average KS3 assessments and literacy measures (Dockrell et al., 2011). The study did not measure factors such as motivation, which could be important as this age. However, it shows that overall performance for this group of students was poor although there were individual differences with successes for some.

Non-verbal IQ, early and concurrent literacy and language skills were also found to be important predictors of academic attainment in an earlier study by Conti-Ramsden et al., (2009). One hundred and twenty adolescents with SLI were compared to 121 typically developing (TD) adolescents on measures of oral language, literacy (single word reading and reading comprehension), IQ performance and academic attainment at the age of 16 years of age. All participants were classified on their language status: 46% of the SLI group were classified as meeting the criteria for SLI, with the remainder showing resolved or impaired abilities and 21% of the TD group presenting with low expressive or receptive language. GCSE outcomes revealed that 67% of the TD group achieved five or more passes at A* to C, and 16% of the SLI group, compared to the national average of 53.7% reported by the DFE in 2005. Adolescents with SLI were entered for fewer GCSE examinations compared with their TD peers. The authors highlight the fact that teachers tend to enter students into an examination only if they think the student will succeed. Being excluded for sitting examinations at GCSE level was associated with expressive vocabulary, reading comprehension and exclusion at KS2 SATs, which children take when aged 11 years at the end of primary education.

After excluding the students who did not attempt any GCSEs, hierarchical regression undertaken on the whole group showed that performance at GCSE level in English language, Mathematics and Science was predicted by literacy, rather than oral language skills. When the educational attainment of adolescents with SLI was examined, the predictors showed that non-verbal abilities, literacy; language and earlier attainment in KS2 SAT's were associated with performance at GCSE level. The results indicate that although the SLI group did less well on academic outcomes, some students achieved as well as their TD peers. In addition, the large amount of unexplained variance in both groups indicates that other unknown factors were affecting the model. Importantly, the authors report a hierarchy of predictors for educational attainment: non-verbal IQ, followed by literacy skills, followed by language skills implying a developmental influence of language skills on later literacy skills.

Overall, research suggests that a good level of reading comprehension does not automatically predict the level of knowledge and understanding required to pass examinations. Language and learning problems are associated with poor academic performance but these factors do not exist in isolation. Snow's (2021) Language House places language as central to the reading process, but also gives prominence to the emotional and contextual environments in which oral language and print reading develop. Participation in the formal, abstract learning within the secondary classroom not only requires cognitive and linguistic proficiency but pragmatic language use. Matthews et al., (2018) reports that participating effectively in social interactions with peers and teachers supports adolescents' well-being and conversely, poor pragmatic proficiency is associated with emotional and behavioural difficulties. Snow (2021, p230) places social-emotional and well-being as the structural beam in the 'Language House', noting that competent readers and users of oral language are 'more protected' against mental health difficulties and involvement with the youth justice system.

It is hard to find evidence that mainstream teachers are fully aware of the language difficulties of struggling adolescent readers. Many teachers rely on traditional lecture-style teaching methods, using complex language to present abstract concepts. For struggling readers, understanding and keeping up with this flow of information may be challenging, (Kennedy & Ihle, 2012).

2.4 Summary

Chapter Two aimed to review the research evidence examining language and reading in adolescence. The evidence shows that the bidirectional relationship between oral language and written language development continues throughout adolescence. As adolescents read more complex text to learn new knowledge, their understanding of text genres, syntactic structures and vocabulary also develops. This in turn deepens their understanding, allowing them to read more challenging material.

Adolescents use language to narrate events, and explain knowledge. Language helps adolescents to form and support social relationships and to show different perspectives. Evidence shows that when adolescents have difficulties with social communication or in using or understanding complex language to convey ideas, they are less likely to manage personal conflicts which in turn affects social and academic success. Furthermore, the formal, abstract language of the secondary classroom uses complex syntactical structures and morphologically complex academic words, which may not have been encountered before.

By reading more difficult texts, adolescents further develop their language skills, word recognition and learn new knowledge. However, those adolescents with poorer use of language, grammatical abilities or vocabulary knowledge find themselves in classrooms with reading material that is too hard. Language difficulties are associated with poor academic outcomes. As Tunmer and Hoover (2019) note, poor readers tend to read less, less successfully and more slowly. Based on the Cognitive Foundations Framework (Tunmer and Hoover, 2019) and the Expanded View (Nation, 2019), poor readers then miss out on the language growth that successful reading experience provides.

The central purpose of the current thesis is to undertake a longitudinal study of adolescents at the start of secondary mainstream education in order to examine the relationship between oral language ability, non-verbal ability, socio-economic status, and academic attainment with reading comprehension. The next chapter aims to report on a systematic review undertaken of the research evidence available examining the relationship between oral language and reading comprehension in typically developing students in mainstream secondary school.

Chapter Three

The relationship between oral language ability and reading comprehension in mainstream secondary school-age students aged 11 – 14 years: A systematic review

3.0 Overview

The first chapter of this thesis described reading comprehension, conceptual models of reading comprehension and the underlying skills necessary for successful reading development. Chapter Two explored the research evidence examining language and reading in adolescence, and the associated reading difficulties faced by adolescents. Research has found that oral language and reading comprehension continue to develop in adolescence (Nippold, 2017), and that both skills are reliant on the other for their development (Adolf et al., 2010; Lervag et al., 2017; Nation, 2019). Successful oral language underpins reading development, and successful reading comprehension drives oral language development throughout adolescence and adulthood (Snow, 2021).

In order to support this bidirectional relationship, it is important to understand the relationship between oral language skills and reading comprehension. The first three years of secondary education (11- 14 years of age) coincide with early adolescence: a time of physical, social and emotional change for many young people (Burnett et al., 2011; Nippold, 2014), yet there appear to be relatively few studies exploring the relationship between oral language and reading comprehension across this educational phase.

This chapter presents a systematic review of the literature examining the relationship between oral language abilities and reading comprehension in secondary aged students, between 11 – 14 years of age, attending mainstream education.

3.1 The background and rationale for the systematic review

There is limited research investigating oral language and reading development in young adolescents, within mainstream education. Most studies focus on early childhood or struggling readers with previously identified speech and language difficulties.

As reading in secondary education is how most students learn (Nippold and Scott, 2015), being a good reader is therefore crucial to individual success, and to the school's overall academic performance. Studies show that children who begin primary school with proficient language abilities are more likely to achieve adequate reading comprehension skills and later academic success than children who struggle with poor language skills (Cain and Oakhill, 2011; Catts et al., 1999; Conti-Ramsden et al. 2009; Dockrell et al., 2011; Lervag et al., 2017); Nation et al., 2010; Snowling et al., 2001; Storch & Whitehurst 2002; Ricketts, 2014).

Students in secondary education are taught new ideas and concepts on a daily basis. Teachers convey this new knowledge through novel vocabulary using complex language which is spoken, read or written (Ward-Lonergan, 2015). Linguistic comprehension is therefore essential in understanding what the teacher/ author intends. In order for reading comprehension to work, the Simple View of Reading points to the two evolving skills of word recognition and linguistic comprehension as essential to understanding what the writer intends (Gough and Tunmer, 1986; Hoover and Gough 1990). Generally, as children become proficient at decoding words; the contribution of linguistic comprehension increases (Oakhill and Cain, 2012) and studies show that understanding vocabulary contributes to accurate and fluent word reading (Adolf, 2019).

When students enter secondary education, they are assumed to be proficient readers. Based on the Simple View of Reading, linguistic comprehension explains more variation in their reading comprehension than their word recognition skills (Nation, 2019). However, by the end of compulsory education aged 16 years, we have seen that approximately one third of the population will fail to reach the expected standard in English and Maths (ASCL, 2019). Research has shown that good performance in reading comprehension is associated with good academic outcomes at age 16 years (Conti-Ramsden, Durkin, Simkin & Knox, 2009; Ricketts, Sperring & Nation, 2014). Hence understanding reading development during this phase is critical to teachers and other professionals working in the education context; yet, there has been relatively little attention paid to the longitudinal relationship between oral language development and reading comprehension in early adolescence.

The aim of this review is to examine how oral language skills contribute to reading comprehension in adolescents between the ages of 11 - 14 years within a mainstream secondary setting. As oral language skills and reading comprehension skills share a similar foundation, such as vocabulary and grammar, understanding the contribution of these shared skills may provide teachers with an appreciation of the importance of these structural language skills in the classroom.

Previous systematic reviews on adolescent readers have focused on interventions in reading (Paul & Clarke, 2016; Rodge, Hagen, Melby-Lervag & Lervag, 2019; Scammacca, Roberts, Vaughn & Stuebing, 2015; Wexler, Vaughn, Edmonds, & Reutebuch, 2008); decoding (Landi & Ryherd, 2017) or vocabulary instruction (Wright & Cervetti, 2017).

None of these reviews focused on exploring the relationship between oral language ability and reading comprehension in adolescents within mainstream education. The current review builds on and extends previous research by addressing the following specific question: how do oral language skills in adolescents, aged 11-14 years within a mainstream secondary setting, contribute to reading comprehension?

3.2 Aim

The aim was to review research that explored an association between oral language ability and reading comprehension in mainstream adolescents aged 11- 14 years, within a secondary education setting in order to better understand their relationship. The constituent parts of oral language have been previously outlined in Chapter One.

3.3 Methods

The review was registered with PROSPERO: registration number CRD42017056529, on the 28th February, 2017.

3.3.1 Inclusion criteria

3.3.1.1 Participants

The review considered studies that included students of secondary age, between 11- 14 years, who were taught reading using the English alphabet. It included studies of heritage/ minority students speaking a first language but learning to read in English and students learning to read English as a second language. All students had to be in mainstream secondary education. Studies of students with dyslexia, developmental language disorder, Speech

Language and Communication Needs and genetic conditions were included if participants were within the target age range and attended mainstream school. When the same sample of participants was included in more than one article, the findings were amalgamated into one outcome for the study characteristics.

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3.3.2 Studies

The review considered all designs where studies explored the relationship between reading comprehension and oral language skills undertaken in mainstream secondary schools, including studies learning to read English as a second language. Due to the time factor built into longitudinal studies, published literature from 1986 onwards was included to reflect the theoretical framework of the Simple View of Reading (Gough and Tunmer, 1986). Studies were either published in academic journals or available as grey literature. The studies had to report the results of a measure of reading comprehension or reading achievement and a measure of oral language skill and to focus on associations of oral language skills with reading comprehension or achievement.

3.3.3 Exclusion criteria

The review excluded all studies of secondary aged children attending non-mainstream education and taught reading using non-English language texts. Studies not written in English were excluded, and if the mean age was not representative of the target age range 11- 14 years.

3.3.4 Assessment of Bias

Studies were assessed on their methodical quality and the extent to which each study addressed the possibility of bias in its design, conduct and analysis according to the critical appraisal checklist from the Joanna Briggs Institute (JBI) (Moola et al., JBI, 2020). The JBI critical appraisal checklist was chosen because of its detailed criteria for appraising a level of quality across different study designs: cross-sectional, longitudinal, quasi-experimental and cohort studies. The quality of included studies was recorded according to the study design.

3.3.5 Search Strategy

The search strategy included terms relevant to oral language and reading comprehension (see Table 3.1). The following databases were searched in November 2020: PsycINFO; Communication Source; Academic Search Complete; Teacher Reference Centre; Ovid Online; Cochrane Central Register of Randomised Control Trials; BASE and Open Grey data bases. The Open Gray databases contain semi or unpublished information, such as research reports, conference papers, theses or government reports. The databases were searched again in August 2022.

Table 3.1. Subject terms and key words used in searches

Population	Issue	Comparison
Controlled Vocabulary (subject term search)		
Adolescents	“Oral language”	“Reading comprehension”
students teenager youth “young people” adolescen*	language listening	“poor comprehen*”

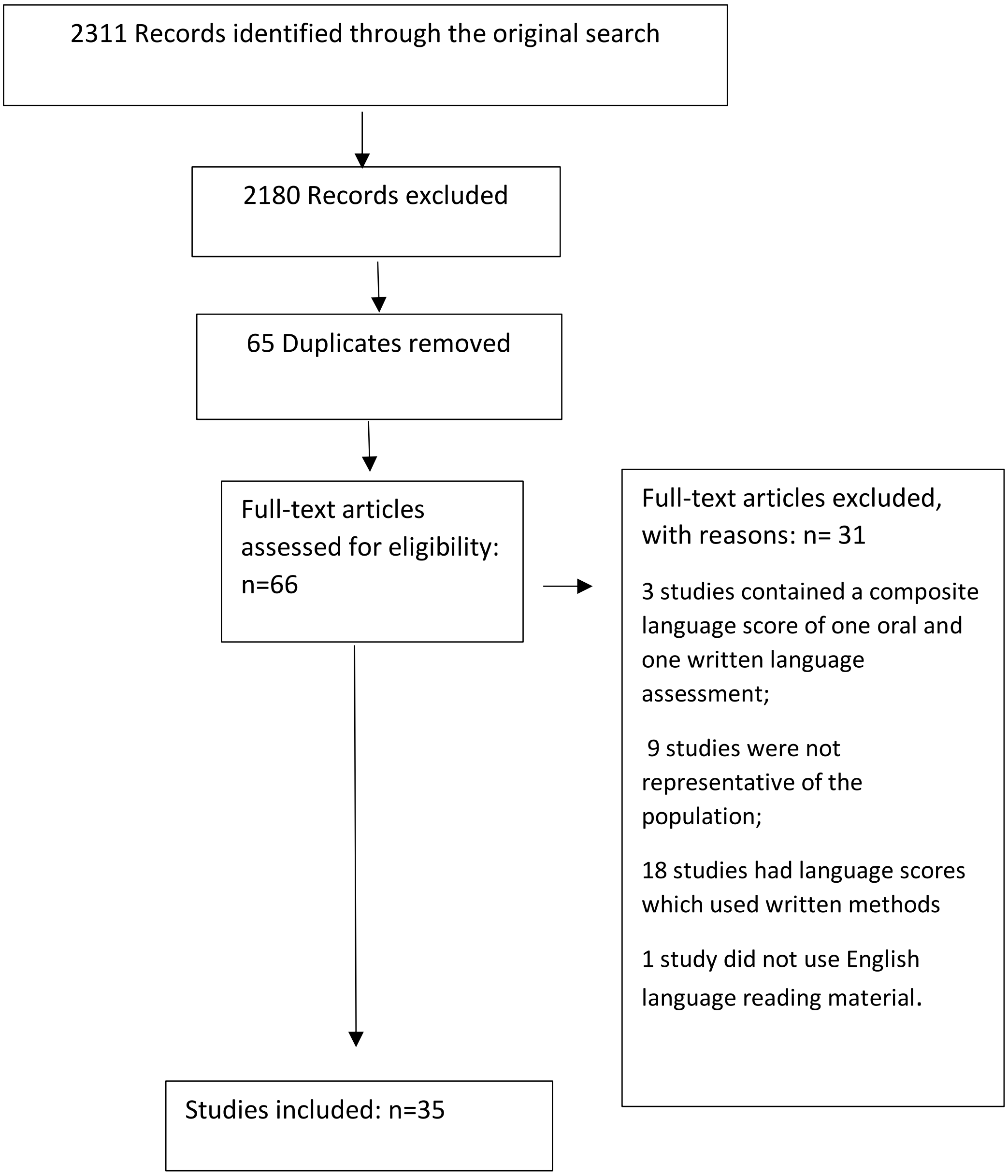
3.3.6 Interrater reliability

During the search process, titles and abstracts of identified studies were assessed against the review question and inclusion and exclusion criteria. One hundred percent dual screening of titles and abstracts were carried out by a second qualified Speech and Language Therapist, who had recently had a systematic review published. Discrepancies between first and second reviewers on abstract screening were resolved once full texts were examined, resulting in 100% agreement. Thirteen of the included studies (n=35) were appraised by the second reviewer on the quality and the possibility of bias using the appropriate study design JBI critical checklist with 100% agreement.

3.4 Study Selection

The titles and abstracts of 2,311 articles were reviewed and 2,180 were excluded. Reasons for exclusion were as follows: studies that reviewed research on reading comprehension that were not empirical in nature (n=109); studies of students younger than 11 years, or older than 14 years of age or of students not in mainstream education (n=965); studies of reading languages other than English (n=224); studies not written in English (n=8); studies with no measure of oral language (n=776); and studies with no measure of reading comprehension (n=98). A further sixty-five articles were excluded as duplicates. Sixty-six studies were screened for full-text eligibility. Of these, thirty-one were excluded after reading the full text for the following reasons: three studies contained a composite language score of one oral and one written language assessment; nine studies were not representative of the population (for example, the study reported a mean age of 11 years but the age of students ranged from 6 – 18 years); 18 studies had language scores based on written measures and one study did not use English language reading material. This left 35 articles for inclusion in the systematic review. See Figure 3.1 for a flow chart of the review process.

Figure 3.1. A flow chart of the review process



3.5. Study Selection: results

The search strategy resulted in the inclusion of 35 studies. Table 3.2 presents an overview of these studies with information on the research design; number of participants; age or grade of participants; setting; type of reader; measures of oral language skills; reading comprehension measures; main results of the study and critical appraisal. Studies varied in the amount of detail describing the age of participants: either reporting stages in education (grades), ages or average age. In addition to reporting the oral language test(s) used in each study, the measures were categorised into subtests of linguistic comprehension, based on Rodge et al., (2019) linguistic comprehension outcomes: receptive vocabulary, expressive vocabulary, composite vocabulary, grammar, narrative and listening comprehension and a language composite. In contrast, reading comprehension was categorised by test in order to show *how* reading comprehension was measured (See key to all acronyms in Tables 3.7 and 3.8). Cutting and Scarborough (2009) report that different reading comprehension tests may measure different cognitive processes thus influencing study results. The majority of studies (24) used a cross-sectional design. Six studies used a longitudinal design and five studies were classified as an intervention. The studies are listed in alphabetical order within design type.

3.5.1. Critical appraisal of studies

Table 3.2 also presents the methodological quality and the extent to which each study addressed the possibility of bias in its design, conduct and analysis according to the JBI checklist (Moola et al., 2020). Detail about the quality of included studies was recorded according to study design. For each study, the indicators of quality were recorded as yes, no, unclear or not applicable. No overall grade was given to a study and no studies were excluded on the basis of the critical appraisal. The criteria against which the judgements were made are presented in Appendix 3A and the risk of bias table for every study in Appendix 3B. A traffic light system was used to show the level of bias: high bias in red; low bias in green, unclear in amber.

Table 3.2. Studies exploring the relationship of oral language skills with reading comprehension

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
Cross-sectional studies								
Brasseur-Hock, Hock, Kieffer and Biancarosa, 2011	n= 319	Mean age 14.9 years/ 9th Grade	USA: 3 urban high schools in 2 Midwest cities	Struggling reader ** same data set as Hock et al 2009*	**Receptive vocabulary** (PPVT-111, 1997) **Expressive vocabulary** (WLPB-R, 1991) **Listening comprehension** (WLPB-R, 1991)	1.KRA, 2005 2.WLPB-R, 1991 3.GORT-4, 2001	*RQ: to identify the component reading skills of adolescent struggling readers.* Results: 5 unique subgroups of adolescent struggling readers with distinct profiles of reading skills: Dysfluent Readers; Weak Language Comprehenders; Weak Reading Comprehenders; Readers with Severe Global Weaknesses and Readers with Moderate Global Weaknesses. Although the 5 groups could be ranked in terms of weaknesses in the measures, their skill profiles differed. This indicated that while the groups each presented a unique profile, they also shared strengths and weaknesses.	A B C D E F G H
Carlisle, 1989	n= 60	12:6/ 7th Grade	USA	Good and poor reading comprehenders	**Listening comprehension** (PILAR listening subtest, 1989)	1.GHRT, 1978 2.PILAR, 1989	*RQ: to determine whether previously identified poor comprehenders would be identified by their performances on PILAR*. Results: Listening comprehension scores based on performances on Profiles in	A B C D E F

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
							Listening and Reading discriminated good from poor comprehenders. Poor comprehenders were significantly weaker than the good comprehenders but the difference was more pronounced in reading than in listening.	G H
Clemens, Hsiao, Lee, Martinez-Lincoln, Moore, Toste and Simmons, 2020	n= 180	Grade 6 to 8	USA: two schools: rural and suburban in the southwest , USA	Struggling readers	**Listening comprehension** (Listening Comprehension subtest, GRADE, 2001)	1.GMRT, 2000 2. GRADE, 2001 3.GORT, 2012 4. TOSREC,2010	*RQ: to investigate the differential importance of reading comprehension and language skills on a set of standardised tests of reading comprehension among struggling adolescent readers.* <u>Results:</u> component skills differentially contributed to test performance across the six reading comprehension measures; specific test characteristics may dictate which component skill is most influential.	A B C D E F G H
Davis, Huang and Yi, 2016	n= 83	Mean age 12yrs/ Grades 5-7	USA: 3 schools in a large city in the Southwest, USA	Range of readers from different language backgrounds	*Language composite*: **Receptive vocabulary** (PPVT-4) **morphological awareness** (research designed,	A researcher-designed assessment patterned after sentence verification (SV) and inference verification (IV) tests based on	*RQ: to examine the relative contributions of strategy expertise, English-language proficiency, content knowledge and epistemic beliefs to students' reading comprehension of science texts.* <u>Results</u>: English-language proficiency and prior content knowledge were independent predictors of expository comprehension in this sample. English-	A B C D E F G H

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
					Kieffer and Lesaux, 2008). **Productive syntax** (Sentence Assembly, CELF4) **Receptive syntax** (researcher designed grammaticality judgement task, Huang, 2014)	two science texts.	language proficiency was the strongest predictor, explaining twice as much variance in comprehension as content knowledge. Strategy knowledge and epistemic beliefs did not show a relationship in this sample.	
Foorman, Koon, Petscher, Mitchell and Truckenmiller, 2015	n= 840	Grade 6-8	USA: 18 schools in two large urban school districts in the southeast	Typically developing	**Syntax:** (Recalling Sentences, CELF4; Grammaticality Judgement, CASL) **Receptive Vocabulary**	1.GMRT, 2000 2.FCAT, 2013	*RQ: to examine dimensions of oral language and word reading and their influence on reading comprehension* <u>Results</u>: The general oral language factor, measured by both syntax and vocabulary significantly predicted reading comprehension in all grades. The specific vocabulary factor significantly predicted reading comprehension in 7^{th} grade.	A B C D E F G H

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
					(PPVT-4; vocabulary subtest, SARA, Morphological awareness, SARA)		The findings indicate that vocabulary's primary role in predicting reading comprehension is as part of a general oral language factor and not as a unique predictor that explains individual differences in reading comprehension.	
Foorman, Petscher and Herrera, 2018	n= 1078	grade 6-9	USA: 2 large urban districts in Florida	Typically developing	*Language composite*: **Receptive vocabulary** (PPVT-4; SARA vocabulary; SARA Morphological Awareness) **Receptive syntax** (Sentence Structure, CELF4) **Expressive syntax** (Recalling	1. GMRT, 2000 2. FCAT, 2013	*RQ: to examine the unique and common effects of decoding and linguistic comprehension factors that explain variance in reading comprehension.* Results: Above grade 3, most of the variance in reading comprehension was explained by unique variance of the language factor.	A B C D E F G H

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
					Sentences, CELF4, Grammaticality Judgement, CASL)			
Foorman and Petscher, 2018	n= 299	Grade 7	USA: 18 schools in two large urban districts in Florida.	Typically developing ** Subset of Foorman et al, data 2018*	Receptive vocabulary (PPVT-4)	GMAT, 2000	*RQ: to investigate the contributions of unique and common variance of language and decoding to predict reading comprehension.* Results: Based on the SVR model, the study partitioned the variance in reading comprehension into what is due uniquely to decoding and language, and what is shared in common. Language was represented by a single observable measure of receptive vocabulary. The individual variance model showed that the proportion of variance in reading comprehension due to decoding was 25% and the proportion of variance in reading comprehension due to receptive language was 46%. Decoding uniquely explained 7% of the variance in reading; language explained 28%. The common variance of decoding and language in	A B C D E F G H

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
							explaining variance in reading was 18%. The finding indicated that language accounts for a higher proportion of variance in reading in grade seven.	
Hock, Brasseur, Deshler, Catts, Marquis, Mark and Stribling, 2009	n= 345	14:9 years/ Grade 9	USA: 2 suburban junior high school, 2 urban middle schools, and 3 urban high schools in two mid-west cities	Adolescent struggling reader	**Vocabulary composite: Receptive oral vocabulary** (PPVT-111): **Reading vocabulary** (WLPB-R); **Listening comprehension** (WLPB-R)	1. WLPB, 1991 2. GORT, 2001	*RQ: to identify the component reading skill profile of adolescent struggling readers*. Results: 61% of the struggling adolescent readers scored low on all component reading skills and a further 12% scored low on all reading components but not on Word Level (word attack and word identification). The findings highlight difficulties experienced by poor readers in the areas of word-level skills, vocabulary and fluency.	**A B C D E F G H**
Klecan-Aker and Caraway, 1997	n= 34	11;6 years/ 6th Grade	USA: African-American suburban public school in southwest, USA	Typically developing	**Expressive narrative** (Expressive Connection)	1. ITBS,1986	*RQ: to examine the relationship of storytelling skills to achievement in reading comprehension*. Results: an expressive narrative measure was significantly correlated to reading comprehension. Students with better oral narratives, performed better on reading tests.	**A B C D E F G H**

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
Larsen and Nippold, 2007	n= 50	12;2/ 6th Grade	USA: a public school in middle-income setting in western Oregon, USA	Typically developing	**Receptive vocabulary** (PPVT-111); **morphological awareness** (study specific)	1.OSA, 2005	*RQ: to examine the association between students' morphological analytical skills and their literate language abilities, including word knowledge and reading comprehension.* Results: Better performance on the morphological analysis task was associated with stronger word knowledge and reading comprehension skills in children.	A B C D E F G H
Lesaux, and Keiffer, 2010	n= 262	12;0 years/ 6th Grade	USA: 6 schools with students from low-incomes. Each school had a range of pupils, 44% to 100% on free or reduced lunch	Struggling readers	**Receptive vocabulary** (PPVT); **Semantic association** (SCPT)	GMRT, 2000	*RQ: to explore the nature of reading comprehension difficulties among early adolescent language minority learners and native English speakers.* Results: Comparison of language minority and native English students showed underdeveloped vocabulary was evident across the two populations. Three unique skill profiles were identified: slow word callers (above average pseudo-word reading, below average vocabulary and fluency); automatic word callers (above average pseudo-word reading, below average vocabulary and fluency in the average range); and globally impaired readers (average on pseudo-word reading	A B C D E F G H

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
							accuracy but below on vocabulary and fluency). Each of the three profiles demonstrated low vocabulary and semantic working memory skills, while two of the three profiles (slow word callers and automatic word callers) demonstrated comprehension difficulties in the face of generally well-developed (i.e., accurate and fluent) decoding skills. The findings suggest that the two populations shared the same difficulties.	
Lesaux, and Harris, 2017	n= 41	12;11 years	USA: 8 public schools in a small, industrial city. Home to many low-income families of Latino origin.	Below average Latino readers **subsample of Lesaux & Keiffer 2010*	**Expressive vocabulary** (WLPB-R)	GMRT, 2002	*RQ: to examine the reading skills and processes of early adolescent Latino English learners demonstrating below-average reading comprehension.* Results: Adolescents demonstrated a skill profile characterised by adequate word-reading skills and below-average vocabulary knowledge. Reading comprehension was inaccurate with a number of misunderstandings related to the text.	**A** **B** **C** **D** **E** **F** **G** **H**
Li and Kirby, 2014	n= 246	13;5 years/	China: 4 English immersion	Chinese English	**Expressive vocabulary** (PPVT);	1.GMRT, 1992	*RQ: to explore the characteristics of reading comprehension difficulties among*	**A** **B** **C**

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
		8^{th} Grade	classes in Grade 8 from a middle school in Xi'an	immersion students	**listening comprehension** (Woodcock LC test)	2.Researcher designed inference tests	*Chinese students learning English as a second language.* Results: Poor vocabulary skills accounted for the reading comprehension difficulties in poor comprehenders in Grade 8 Chinese ESL students reading English texts, whereas higher level skills (inference strategy, listening comprehension, summary of main ideas) explained the advanced reading comprehension of good comprehenders. The lack of differences between the groups on matched measures of reading comprehension in Chinese suggests that L1 reading proficiency did not influence L2 reading skills.	**D** **E** **F** **G** **H**
Lipka and Seigel, 2012	n= 674	12;75 years	Canada: 30 different schools within one school district, province of British Columbia	English-as-a-Second-Language (ESL) reader **sample of Marinova-Todd, et al, 2013 study*	**Expressive vocabulary** (working memory for words test, Siegel and Ryan, 1989a); **Syntactic awareness** (Oral Cloze Task, Siegal	1.SDRT, 1994 2. Researcher designed experimental reading comprehension task, Planet Filk and Greb (Lipka &Siegal, 2012).	*RQ: to investigate the cognitive and linguistic factors that influence reading comprehension in ESL speakers.* Results: When monolingual and ESL groups were compared, there were no significant differences on any of the reading comprehension tests. The good comprehenders group performed significantly better than the poor comprehenders group on all the oral language measures.	**A** **B** **C** **D** **E** **F** **G** **H**

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
					and Ryan, 1989a)			
Logan and Keiffer, 2017	n= 107	12;6 years/ 7th Grade	USA: 3 New York City public schools:85 % of the students qualified for free-or-reduced lunch	American Spanish-English bilingual speakers	**Receptive vocabulary** Study specific Polysemous Word Test**,** Logan and Kieffer, (2017); PPVT	GMRT, 2002	*RQ: to explore the relationship between polysemous word knowledge and reading comprehension among Spanish-English bilinguals*. Results: Both knowledge of academic polysemous words, and vocabulary breadth made significant unique contribution to reading comprehension.	**A B C D E F G H**
Marinova-Todd, Siegel and Mazabel, 2013	n= 1126; 888 had English as 1st language and 244 had English as 2nd language	11;8 years/ 6th Grade	Canada: 30 schools in one urban district, culturally and socioeconomically diverse	Proficient decoders	**Syntactic awareness** (Oral Cloze task, Siegal and Ryan, 1988)	1.SDRT, 1996 2.Experimental measure of reading comprehension requiring no background knowledge (Siegal & Ryan, 2013)	*RQ: to examine how groups of English-speaking and students learning English as a second language compare on morphological awareness (MA) and reading comprehension, and to investigate the role of morphological structure on the association of MA and literacy skills in English.* Results: The English monolingual group had better syntactic scores compared to other English Language Learners (ELL) suggesting that syntactic awareness is still developing	**A B C D E F G H**

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
							in other ELL groups. Morphological awareness contributed significantly to reading comprehension over the contribution of syntactic awareness. Morphological structure of the first language influenced morphological awareness in the second language.	
Miller, Davis, Gilbert, Cho, Toste, Street and Cutting, 2014	n= 94	11;97 years	USA	Typically developing and struggling readers	**Inferencing** (Making Inferences, TLC) **Expressive vocabulary** (Test of Work Knowledge, Expressive vocabulary, TLC) **Morphological knowledge** (Morphological Relatedness Test, Mahoney,	Experimental Expository Reading Comprehension Task (Miller et al., 2014)	*RQ: to examine the degree to which word recognition, inferencing, vocabulary, morphological awareness and executive functioning linked to five manipulated expository science passages (baseline, cohesion-manipulated, decoding-manipulated, syntax-manipulated and vocabulary manipulated) and student characteristics influenced students' reading comprehension.* Results: Students with better word reading, morphology, vocabulary, and executive functioning had higher probabilities of correct responses on the reading comprehension questions, including inferential questions.	**A** **B** **C** **D** **E** **F** **G** **H**

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
					Singson & Mann, 2000)			
Myers and Botting, 2008	n= 36	11;8 years/ 6th Grade	UK, England: 1 inner-city mainstream secondary school, 59% of the sample in receipt of free school meals	Typically developing	**Receptive vocabulary** single-word, (BPVS); Reception of Grammar, (TROG-2,) **Narrative language** (ERRNI)	WORD, 1993	*RQ: to describe the language and literacy skills of 11-year-old students attending an inner-city mainstream school*. Results: Students who had difficulties with reading also had lower spoken language skills. The difficulties seen in language related to grammatical aspects of language. Readers with only reading comprehension difficulties and readers with additional decoding difficulties showed similar performance on the spoken language measures, despite the fact that the group with additional decoding difficulties had greater difficulties with reading comprehension.	A B C D E F G H
Nellenbach, 2012	n= 60	11;45 years/ 6th Grade 12;54 years	USA: a public, rural middle school central Piedmont	Typically developing	**General language:** Concepts and directions, Recalling Sentences	WRMT-R, 1998	*RQ: to determine the unique and combined contribution to components of oral language, problem solving and reading attitudes to silent reading comprehension*. Results: The results for the advanced oral language measures indicate that students who performed better on measures	A B C D E F G

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
		/7th Grade, 13;70 years/ 8th Grade	area of North Carolina.		and Sentence Assembly (CELF-4). **Advanced language** composite: Ambiguous Sentences and Listening Comprehension (TLC-2).		assessing their ability to decipher ambiguous lexicon and generate inferences showed stronger reading comprehension skills. Multiple regression analyses found that Listening Comprehension; Making Inferences, Lexical Ambiguity and Recalling Sentences were the strongest contributors to the variance in silent reading comprehension.	H
Ouellette and Beers, 2010	n= 56	11;95 years/ 6th Grade	Canada:3 English schools in Eastern Canada	Typically developing	**Listening comprehension:** Understanding Spoken Paragraphs (CELF4, 2003) **Receptive vocabulary** (PPVT-4, 2006), **Expressive vocabulary**	WRMT-R, 1998	*RQ: to examine the nature of the relations between word reading, listening comprehension, oral vocabulary and reading comprehension.* Results: Oral vocabulary was found to predict reading comprehension in the grade six students. Listening comprehension explained greater variance in reading comprehension than decoding.	A B C D E F G H

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
					(Test of Word Knowledge, Wiig & Secord, 1992)			
Ouellette and Shaw, 2014	n= 96	11.94 years/ 6th Grade	Canada: 2 English speaking schools in Eastern Canada. Diverse range within socio-economic status	Typically developing	**Receptive vocabulary** (PPVT-4, 2006) **Expressive vocabulary** (Test of Word Knowledge, Wiig & Secord, 1992)	WRMT–R, 1998	*RQ: to explore relations amongst measures of oral vocabulary and reading comprehension* <u>Results:</u> Receptive vocabulary explained 22.4% of significant unique variance in reading comprehension. Results support contention that having a larger oral vocabulary supports reading comprehension directly.	A B C D E F G H
Penning and Raphael, 1991	n= 60	11;9 years/ 6th Grade	USA,	Normally achieving readers (NA) & poor comprehenders (PC)	**Composite language**: (PICAC, Porch, 1971) **Grammar:** (Story Reformatio	Two researcher designed tests involving free and probed recall and answer (Penning and Raphael, 1991)	*RQ: to examine differences between normally achieving and poor comprehenders on measures of language ability and describe how these characteristics influence text comprehension.*	A B C D E F G H

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
				(as defined by the authors)	n Test, Chappell, 1980)		<u>Results:</u> Significant differences were found in language abilities between NA and PC groups. Differences related to performance on free and probed comprehension. The PC students scored more poorly on vocabulary and syntax and were limited in their ability to use complex sentence structures to answer questions. Normally achieving readers demonstrated greater syntactic ability in free and probed recall responses to researcher questions.	
Skebo, Lewis, Freebairn, Tag, Ciesla and Stein, 2013	n= 196	11;34 years/ 6th Grade	USA middle schools: recruited through longitudinal family study of the genetics of Speech Sound Disorders	3 groups of readers: Typically developing (TL); speech sound disorders (SSD); SSD + language impaired (LI)	**Language composite**: (receptive and expressive language skills, CELF3) **Vocabulary composite:** (PPVT-III, EOWPVT-R,) Performance Intelligence Quotient (PIQ: WISC-111)	WIAT, 1992	*RQ: to examine the impact of SSD on literacy acquisition and secondly, the predictors of literacy in older students.* <u>Results:</u> For typical language (TD) readers, vocabulary skills and PIQ predicted reading comprehension. The SSD-only group had significantly better overall language and reading comprehension compared to the SSD+LI group.	**A B C D E F G H**

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
Srivastava and Gray, 2012	n= 39	14 years/ 8th Grade	USA Charter School, Pheonix Arizona. Charter schools are autonomous, public schools, exempt from state or local regulations	Typical language reader (TLR) and language-learning disabled reader (LLD)	**Core Language Score:** (Concepts and Following Directions, Recalling Sentences, Formulated Sentences and Word Classes, CELF4)	Four reading passages adopted from the eighth-grade English assessment reading passages used to assess reading achievement in three states: Texas, Washington, and Florida.	*RQ: to compare reading comprehension of computer-based and paper-based texts in adolescents with and without language-learning disabilities.* Results: The LLD group scored significantly lower than the TLD group on the reading comprehension measure. Students with higher vocabulary and semantic knowledge demonstrated significantly better reading comprehension.	A B C D E F G H
Key for cross sectional critical appraisal: A, clearly defined criteria for inclusion; B, detailed description of participants and setting; C, valid and reliable measures; D, standard criteria for measurement; E, confounding factors identified; F, stated strategies to deal with confounding factors; G, valid and reliable measurement of outcomes; H, appropriate statistical analysis Green =Yes, Amber = Unclear, Red = not applicable								
Study	**No in sample**	**Age or grade**	**Setting**	**Type of reader**	**Oral language outcomes**	**Reading comprehension measures**	**Findings**	**Critical Appraisal**
Intervention studies								
Barth, Vaughn, Capin, Cho, Stillman-Spisak,	n= 134: Treatment= 83 Comparison = 51	Grade 6, 7 & 8	USA: 3 public schools in three different	Struggling readers	**Listening comprehension:** (WJ-III)	1.GMRT, 2000 2. WJ-III, 2001 3. Bridge-IT, 2004	*RQ: to examine the effectiveness of a text-processing reading comprehension intervention emphasising listening comprehension and expressive language.*	A B C D E

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
Martinez and Kincaid, 2016			school districts in low socio-economic, rural mid-west.				Results: All participants received usual teaching in classes. Students in intervention group received supplementary text-processing reading comprehension strategies for 40 mins four times per week for eight weeks. Across the schools, the number of intervention sessions varied significantly. There were no transfer effects to standardised measures of listening comprehension (LC) or reading comprehension (RC) showing that that a subgroup of middle grade struggling readers were minimally responsive to an intensive intervention.	**F G H I**
Denton, Wexler, Vaughn and Bryan, 2008	n= 38: Treatment = 20, Comparison = 18	Grade 6, 7 & 8	USA: One middle school in an urban school district. 93% of students economic disadvantage	Struggling readers: 60% identified as Spanish-speaking English Language Learners	**Receptive vocabulary** (PPVT 111)	WJ-III, 2001	*RQ: to investigate the effectiveness of a multicomponent reading intervention.* Results: Students were randomly assigned to reading intervention or typical instruction. Attendance for the treatment group indicated an average of 43 daily sessions, with an average of 29 hours of instruction. All the students displayed nearly universally low receptive oral language skills, whether their native language was English or Spanish. Despite intervention, treatment students did not demonstrate significantly higher outcomes	**A B C D E F G H I**

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
							on any reading measure than students who received the school's typical teaching.	
Klingner and Vaughn, 1996	n= 26: Tutoring group = 13 Cooperative learning group = 13	13;8 years/ 7th & 8th Grade	USA: 1 (89%) Hispanic urban middle school	Spanish speaking Language Minority students with learning difficulties	**Language composite:** (Woodcock Language Proficiency Battery, Woodcock and Johnson, 1989 and Language Assessment Scales – English and Spanish versions (De Avila and Duncan, 1990).	1. GMRT, 2000 2. Passage Comprehension Tests (Palincsar & Brown,1984)	*RQ: to investigate the efficacy of two related interventions on reading comprehension: (a) reciprocal teaching in combination with cross-age tutoring and (b) reciprocal teaching in combination with cooperative grouping.* <u>Results</u>: All 26 students participated in reciprocal teaching of reading comprehension strategies for 15 days and then were randomly assigned for 12 days to either reciprocal teaching with cooperative grouping or reciprocal teaching with cross-age tutoring. The overall difference in growth between groups was not statistically significant on any of the RC tests. Students' potential to improve was related to initial reading ability and oral language proficiency.	A B C D E F G H I
Roberts, Fletcher, Stuebing, Barth and	n= 327: Treatment = 214	Grade 6	USA: Six middle schools serving	Struggling readers	**Listening comprehension** (GRADE)	1.GRADE, 2001 2. WJ-III; 2001 3. TAKS, 2004	*RQ: to evaluate whether a yearlong reading programme moderated the interrelationship among elements of the SVR (listening comprehension, word*	A B C D

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
Vaughn, 2013	Comparison= 113		urban, suburban and rural sites		**Receptive verbal knowledge** (K-BIT 2, Kaufman and Kaufman, 2004)		*reading and reading comprehension). Intervention group focused on word level and comprehension skills and strategies for expository text.* Results: Students in the intervention group participated in a comprehensive reading intervention for 50min daily for 160 sessions across the school year. The control group received business as usual schooling. Post-test descriptive data showed mean reading comprehension (RC) scores for business-as -usual remained stable but decreased for treatment group. Significant attrition: T=170 & C= 47 (p ≥ .05) was reported. Instead of looking at group mean differences in reading comprehension post-test, the study suggested that change should be hypothesised in terms of predicting underlying skills. Results show a diminished direct effect of verbal knowledge for students in the treated group.	**E** **F** **G** **H** **I**
Wright, Mitchel, O'Donoghue,	n= 28 Single group study:	12-14 years	Mid-West Ireland: All Girls secondary school with	Struggling readers	**Receptive and expressive language**	1. YARC, 2010 2. Additional Researcher Assessment for generalisation	*RQ: to examine if a four week classroom intervention would be effective in improving reading comprehension.*	**A** **B** **C** **D** **E**

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
Cowhey and Kearney, 2015	n =10 & n= 18		economic disadvantage, poor examination results and retention rates		**composite:** CELF4	to Irish curriculum	Results: Reading comprehension intervention delivered to two groups of students over eight sessions, each one hour long, twice weekly for four weeks. Pre-test data showed 65.5% of sample had undiagnosed language impairment. The short-term intervention transferred to immediate gains in standardised RC test. Study reported drop in gains after 14 months concluding children with language impairments require support throughout academic career so sustainability of 4-week intervention model questioned.	F G H I

Key for intervention studies critical appraisal: A - Clear 'cause' and 'effect'; B- Similar participants included in comparisons; C- No reported extra/other interventions happening; D- Control group; E - Comparison of results before and after the intervention; F- Follow up complete and if not, differences between groups described and analysed; G - Outcomes of participants included in comparisons measured in the same way; H - Reliability of the measurement; I - Appropriate statistical analysis used. Green = Yes; Red = No; Amber= unclear; Yellow = not applicable

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes	Reading comprehension measures	Research question and findings	Study
Longitudinal studies								
Catts, Adolf and Weismer, 2006	n=182 Poor comprehenders =57	8th grade, with retrospective perfor	USA: recruited from the Connecticut Longitudinal Study	Three groups: poor comprehenders (PC) poor	Study one: **Receptive vocabulary** (PPVT–R) **Grammar**	1. WRMT, 1987 2. GORT, 1992 3. QRI–2, 1995	*RQ: to examine concurrently and retrospectively the language abilities of children with specific reading comprehension deficits and compare to typical readers and children with specific decoding deficits.*	A B C D E F

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
	Poor decoders =27 Typical readers = 98	mance in kindergarten 2nd & 4th grade	(Tomblin, J., Records, N., Buckwalter, P., Zhang, X., Smith, E., and O'Brien, M., 1997)	decoders (PD) & typical readers (TR)	(Concepts and Directions CELF3) **Discourse** (QRI–2 and experimental measure based on Crais and Chapman, 1987; Kertoy and Goetz, 1995) Study two: **Composite language score** (Concepts and Directions, listening to Paragraphs, CELF3; PPVT-R; Discourse (Culatta,		Study one results: In 8th grade, poor comprehenders (PC) who were identified on the basis of reading achievement in eighth grade, showed deficits in language but normal abilities in phonological processing. The PC subgroup performed significantly worse than the PD and TR subgroups in measures of receptive language and discourse. The PC readers scored significantly worse than typical readers and poor decoders on inference questions. Study two results: Retrospectively, the 8th grade PC subgroup performed significantly worse than TR and PD subgroups when in kindergarten, 2nd and 4th grades on the oral language comprehension composite score. They also scored significantly lower in reading comprehension than TR in 2nd and 4th grades.	G H I J K

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
					Page, and Ellis, 1983)			
Foorman, Wu, Quinn, and Petscher, 2020	n=321 Grade 5-6 n=299 Grade 7-8 n=137 Grade 9-10	Average age 10.67, 12.73 14.56 years	USA: 3 middle schools and one high school in two school districts in Florida	Typically developing	**Language composite:** syntax (Recalling sentences, CELF4, GJT, CASL, and receptive vocabulary (PPVT-4)	1.GMRT-4, 2000 2.FCAT, 2013	*RQ: to investigate the predictive patterns of unique and common variance in the SVR model over two years in grade cohorts 5 to 6, 7 to 8 and 8 to 9.* <u>Results</u>: Findings pointed to the increasing importance of oral language over decoding to predict reading comprehension. By grade 9, the unique effect of decoding was nil and the unique effect of language comprehension was large (70%) leading the authors to conclude that language comprehension and reading comprehension are one dimension with language comprehension nearly perfectly predicting reading comprehension.	**A B C D E F G H I J K**
Mancilla-Martinez, Kieffer, Biancarosa, Christodoulou and Snow, 2011	n=55, 5th grade n=48 6th grade n=43 7th grade	5-7th grade	USA: urban K-8 public school serving a 91% Latino, low-income population.	Spanish speaking English minority readers	**Listening comprehension** (GRADE, Williams, 2002)	GRADE, 2002	*RQ: to investigate the English reading comprehension growth of language minority learners.* <u>Results</u>: Students improved in reading comprehension across the two years but demonstrated a slowing of growth during the middle school years. Listening comprehension (LC) and word reading	**A B C D E F G H I**

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
							(WR) were significant in determining if students were good or poor readers in 5th grade but WR had a larger effect on performance ranking. Neither listening comprehension nor word reading was found to be a statistically significant predictor of true initial rate of growth or true rate of acceleration in reading. Rates of growth showed that students with initially low reading performance remained on a low and slowing trajectory.	J K
Nippold, 2017	n=426 Typical language development= 247 Specific language impairment = 102 Non-specific	14 years/ Grade 8	USA: urban, suburban, and rural public-school districts representing the population of monolingual English-speakers	Three language groups: 1.typical language development (TLD) 2.specific language impairment (SLI) & 3. non-specific language development (NLI)	**Lexical composite**: receptive (PPVT-R) expressive vocabulary (CREVT) **Syntactic composite**: (Concepts and Directions, Recalling Sentences, (CELF3)	1. WRMT-R, 1998 2. GORT-3, 1992	*RQ: to explore reading comprehension deficits in adolescents in relation to their word reading skills and lexical and syntactic development.* In a longitudinal study over 10 years, each student was assessed at ages 6, 8, 10, 14 and 16 years. At age 6yrs, each student was identified as having TLD, SLI or NLI. Results: By Grade 8, the TLD group outperformed the SLI and NLI groups, and the SLI group outperformed the NLI group on the language composites, word reading and reading comprehension. Both the SLI and NLI groups showed deficits in lexical and syntactic development, word reading, and reading comprehension. Although the	A B C D E F G H I J K

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
	language impairment = 77						findings pointed to individual differences, in general children identified as having SLI or NLI continued to show language and reading deficits as 14 year old adolescents.	
Ricketts, Lervag, Dawson, Taylor and Hulme, 2020	n=210	12 to 14 yrs	UK, England: 3 socially mixed mainstream schools.	Typically developing	**Receptive vocabulary** (BPVS-3) **Expressive vocabulary** (WASI-11)	YARC, 2010	*RQ: to investigate how oral vocabulary, word reading and reading comprehension develop and interact within adolescence.* Results: Reading and vocabulary were assessed when students were 12, 13 and 14 years of age over a 2-year period. Raw scores indicated a large variation in vocabulary knowledge and reading comprehension (RC). Growth modelling showed significant growth and narrowing of performance gaps over time. RC and oral language initial status were predictive of their subsequent progress with rank order of students stable across the 3 time points. Reading comprehension and oral vocabulary knowledge were best conceptualized as reflecting a single higher order language construct.	**A B C D E F G H I J K**
Shaywitz, Fletcher, Holahan,	n= 95 PPR = 21	14.41 years/ Grade 9	USA: recruited from the	Persistently poor	*Composite of word finding:*	1. W-J, 1977 2. GORT-3, 2012	*RQ: to examine the outcomes of reading and language in adolescents identified as dyslexic in early years.*	**A B C**

Study	No in sample	Age or grade	Setting	Type of reader	Oral language outcomes and measures	Reading comprehension measures	Research question and findings	Critical appraisal
Sneider, Marchione, Stuebing, Francis and Shaywitz, 1999	AVR=35 SR = 39		Connecticut Longitudinal Study (Shaywitz, S., Shaywitz, B., Fletcher, K. and Escobar, M. 1990)	readers (PRR) Average readers (AVR) Superior readers (SR)	**Receptive vocabulary** (PPVT-R and Boston Naming Test, 1983) **Listening comprehension** (Story Comprehension Test, Diagnostic Achievement Battery: 1991)		The Grade 9 sample were selected from the Connecticut longitudinal study: the persistently poor reader (PPR) group showed persistent reading disability from kindergarten and a comparison group of non-disabled readers subdivided into average and superior readers. Results: Grade 9 results showed the PPR group had the lowest scores in both language and reading comprehension measures. The best predictor of reading comprehension was the receptive vocabulary composite. All 3 groups showed similar patterns of growth over time. There was no evidence that students in the PPR group caught up with their peers in reading.	D E F G H I J K

*Key for longitudinal critical appraisal studies: **A** Similar groups recruited from same population; **B** Exposure measured similarly; **C** Description of the method of measurement of exposure; **D** Confounding factors identified**; E** Strategies to deal with confounding factors**; F** Participants free from outcomes at the start of the study**; G** Outcomes measured in valid and reliable way**; H** Follow up time reported and long enough to enable outcomes**; I** Follow up complete**; J** Strategies to address incomplete follow up; **K** Appropriate statistical analysis used Green = Yes; Red = No; Amber= unclear; Yellow = not applicable*

3.5.1.1 Critical Appraisal - Cross-sectional studies

Table 3.3 presents a summary of the risk of bias from the twenty-four cross-sectional studies. The majority of studies (n=23.96%) gave clear inclusion criteria or included a brief statement of inclusion; described or mentioned the participants (n= 24, 100%); provided a clear or brief description of the methods of measurement (n=24, 100%); clearly defined the participating students (n=24, 100%); used validated tests in a reliable way (n=23, 96%) and appropriate statistical analysis (n=24, 100%). One fifth of studies (n=5, 21%) identified confounding factors such as maternal education or reading at home and over half (n=14, 58%) used some form of regression analysis to account for confounding factors, such as stratifying the participating students by academic year groups. This low percentage is to be expected, given that it is hard to identify and measure potential confounders for studies of reading comprehension where behavioural, attitudinal or lifestyle factors may impact on the results (Moola, et al., 2020).

Table 3.3 Summary assessment of cross-sectional critical appraisal judgements for each outcome by number and percentage

Appraisal	A Criteria For inclusion	B Description of participants and setting	C Method of measurement	D Objective standard criteria used in measurement	E Confounding factors	F Strategies to deal with confounding factors	G Outcomes measured in a valid & reliable way	H Appropriate statistical analysis
Yes	n=14 (58%)	n=16 (67%)	n=20 (83%)	n=24 (100%)	n=5 (21%)	n=14 (58%)	n=23 (96%)	n=24 (100%)
No	n=1 (4%)	n= 0	n=0	n=0	n=18 (75%)	n=9 (38%)	n=0	n=0
Unclear	n=9 (38%)	n= 8 (33%)	n=4 (17%)	n=0	n=0	n=0	n=1 (4%)	n=0
Not applicable	n=0	n=0	n=0	n=0	n=1 (4%)	n=1 (4%)	n=0	n=0

3.5.1.2 Critical Appraisal - Intervention studies

Five studies were classified as an intervention. The quasi- experimental checklist was chosen as the critical appraisal tool as it fits the one group pre-post-test design and the non-equivalent control group design. For each study, the features were appraised as yes, no, unclear or not applicable according to the criteria listed in Table 3.4. All the studies (n=5, 100%) demonstrated that: the intervention was delivered before the effect; that the participating students between intervention and control groups were similar; no other reported interventions were taking place during the time period; attrition was described with impact analysis and appropriate statistical analysis was used. Three studies used a control group and 2 studies used a single group pre-test post-test design. Five studies compared the student performance before and after the intervention using pre-and post-test tests. All five studies clearly reported that measures were performed in a reliable way.

Table 3.4. Summary assessment of intervention critical appraisal judgements for each outcome by number and percentage

Appraisal	A Clear cause and effect	B Similar participants included in comparisons	C No reported extra/other interventions happening	D Control group	E Comparison of results before and after the intervention	F Follow up complete and if not, differences between groups described and analysed	G Outcomes of participants included in comparisons measured in the same way	H Reliability of the measurement	I Appropriate statistical analysis
Yes	n=5 (100%)	n=5 (100%)	n=5 (100%)	n=3 (60%)	n=5 (100%)	n=5 (100%)	n=5 (100%)	n=5 (100%)	n=5 (100%)
No	0	0	0	0	0	0	0	0	0
Unclear	0	0	0	0	0	0	0	0	0

Appraisal	A Clear cause and effect	B Similar participants included in comparisons	C No reported extra/other interventions happening	D Control group	E Comparison of results before and after the intervention	F Follow up complete and if not, differences between groups described and analysed	G Outcomes of participants included in comparisons measured in the same way	H Reliability of the measurement	I Appropriate statistical analysis
Not applicable	0	0	0	n=2 (40%)	0	0	0	0	0

3.5.1.3 Longitudinal studies critical appraisal

Six studies used a longitudinal design. For each study, the features were appraised as yes, no, unclear or not applicable according to the criteria listed in Table 3.5. All the studies (n=6, 100%) recruited mainstream pupils; described how the assessments were measured; measured the outcomes using standardised tests; reported the length of time for outcome to occur; reported attrition and gave a clear and justifiable reason why participants dropped out. Follow-up on five studies was complete; one study adjusted the data and one study mentioned attrition. Five studies identified confounding factors and six studies described strategies to deal with confounding effects, such as regression methods. All six studies recruited suitable participants.

Table 3.5. Summary assessment of longitudinal critical appraisal judgements for each outcome by number and percentage

Appraisal	**A** Similar groups recruited from same population	**B** Exposure measured similarly	**C** Description of the method of measurement of exposure	**D** Confounding factors identified	**E** Strategies to deal with confounding factors	**F** Participants appropriate to study Inclusion or exclusion explained	**G** Outcomes measured in valid and reliable way	**H** Follow up time reported and long enough to enable outcomes	**I** Follow up complete	**J** Strategies to address incomplete follow up	**k** Appropriate statistical analysis used
Yes	n=6 (100%)	n=6 (100%)	n=5 (83%)	n=4 (67%)	n=5 (83%)	n=6 (100%)	n=6 (100%)	n=6 (100%)	n=6 (100%)	n=1 (17%)	n=6 (100%)
No	0	0	0	n=2 (33%)	n=1 (17%)	0	0	0	0	0	0
Unclear	0	0	n=1 (17%)	0	0	0	0	0	0	0	0
Not applicable	0	0	0	0	0	0	0	0	0	n=5 (83%)	0

3.6 Results: Study characteristics

In this descriptive section, data from the sample of participants across studies was compared in relation to: school setting, age of participants and type of reader identified. When the same sample of participants was included in more than one article, the findings were amalgamated into one outcome for this section. This included the following studies: Hock et al., (2009) and Brasseur-Hock et al., (2011); Lesaux and Harris (2017) and Lesaux and Keiffer (2010); Lipka et al., (2012) and Marinova-Todd et al., (2013) and four of the studies by Foorman et al., (2015, 2018, 2018 and 2020). This resulted in 30 unique studies. The oral language skills measured the reading comprehension assessment/s and study design were compared over the 35 studies as all the studies, including those with the same participants, used different measures and so contributed information that was independent and unique.

3.6.1 School setting

The majority of unique studies (22) were set in the USA; three were set in Canada; three in England; one in Ireland and one in China. All the studies used students from mainstream schools; eight reported participants from low socio-economic populations (25%) and one from a charter school (3%). A charter school is an independently run public school given greater flexibility than American state public schools and greater accountability for performance based on its 'charter' or mission statement.

3.6.2 Age and school grade of participants

Unique studies either stated the age or year group (UK)/grade (USA) of participating students. Of the 19 unique cross-sectional studies, nearly half (n=9, 47%) involved participants in their first year of secondary education spanning the age range 11 to 12 years. One study included participants from their final year of primary education with a mean age of 11;8 years. Two studies researched students in 7th Grade (12 to 13 years); two studies researched students in 8th Grade (13 to 14 years) and one study researched students in 9th Grade (14 to 15 years). The remaining four studies included participants across Grades Five to Nine (Grade 5 = 10 to 11 years; Grade Six = 11 to 12 years; Grade Seven = 12 to 13 years; Grade Eight = 13 to 14 years; Grade Nine = 14 to 15 years). Overall, the median age for the cross-sectional studies was 12;10 years with an interquartile range of 1.9 years. One unique intervention study targeted students in grade 6 (11 to 12 years), with a mean age of 11;6 years. The remaining four unique intervention studies included students across academic Grades Six to Eight (11 to 14 years) or UK year group 7 to 8 (11 to 13 years). The median age for intervention studies was 12;6 with an interquartile range of two years. Of the six unique longitudinal studies: three studies investigated students within the ages of 11 to 14 years and three studies identified students in Grades Eight or Nine, with an overall mean age of 14 years. Overall, the median age of students included in the 30 unique studies was 12;6 years with an interquartile range of two years.

3.6.3 Type of reader

Table 3.6 presents the classification of readers based on the study description of participants. Readers were classified into four broad categories: mainstream readers, struggling readers, participants reading English as a second language and language minority readers, who spoke Spanish at home but learnt to read in English. Most unique studies (n=16; 53%) included mainstream readers, described as pupils attending mainstream classrooms. Eight studies researched struggling readers, or poor comprehenders based on standardised reading assessments, with four of these studies examining the effects of an intervention on reading. The remaining six studies looked at participants who spoke a different language than English at home based on a state or school survey, but who were learning to read English in the mainstream classroom.

Table 3.6. Type of reader included in the unique studies

Types of reader	Study definition based on description of the participants	Number		
		Intervention	Longitudinal	Cross-sectional
Mainstream	• Attending mainstream classrooms: with typical language development or specific or non-specific language impairment based on specific criteria • Attending mainstream; typical achievers based on teacher assessment	0	4	12
Struggling readers (includes term poor comprehenders)	• Reading comprehension scores fell below 'basic' on State Reading assessment • Oral reading fluency rate of 80 words per minute • SENCO identification based on teacher opinion	2 1 1	1	3
Reading English as 2nd language	• Spanish spoken as native language, based on State language survey or home language survey • Middle school in China	1		3 1
Language minority readers	• Spanish speaking Language Minority readers (LM) based on school records		1	1

3.6.4 Oral language skills

The oral language outcomes fell into six broad categories based on the classification used by Rodge et al., (2019): receptive vocabulary, expressive vocabular, grammar, narrative skills, listening comprehension and language composite. In some studies (n=13) a language composite score comprised of more than one oral language outcome was used. If the measure of language skills used written methods, the corresponding language outcome was not included in oral language outcomes, or the study was excluded. Most of the 35 studies measured more than one oral outcome; each oral outcome was classified separately according to the classification used by Rodge et al., (2019). Table 3.7 presents the types of oral language outcomes that were included in the study, names of the tests and test descriptions used in the studies.

Table 3.7. Categories of oral language outcomes, test descriptions, corresponding tests and number of studies using the measures (based on the classification used by Rodge et al., 2019)

Oral language outcomes	Corresponding tests used in the studies	Test description	Number of studies using the measure (Proportion/%)	Total
Receptive vocabulary	Dunn & Dunn (1997) The Peabody Picture Vocabulary Test – Third Edition (PPVT-111)	Tests that require responses such as pointing to pictures	20/28 studies (72%)	28/35 studies used a measure of receptive vocabulary
	Dunn and Dunn (2009) The British Picture Vocabulary Test (BPVS – 3)		2/28 studies (7%)	
	Kaplan et al., (1983) The Boston Naming Test		1/28 study (3.5%)	
	Kaufman & Kaufman (2004) The Verbal Knowledge subtest (K-Bit-2)		1/28 study (3.5%)	
	Logan and Kieffer (2017) Researcher designed		1/28 study (3.5%)	
	SARA vocabulary (Study Aid and Reading Assistant, SARA, Educational Testing Service, 2009)		2/28 studies (7%)	

Oral language outcomes	Corresponding tests used in the studies	Test description	Number of studies using the measure (Proportion/%)	Total
	Semel et al., (2003) Word classes (CELF44)		1/28 study (3.5%)	
Expressive vocabulary	Gardner (1990) Expressive One Word Picture Vocabulary Test, Revised (EOWPVT-R)	Tests that require responses to name or explain the meaning of words and pictures	1/12 study (8.3%)	12/35 studies used a measure of expressive vocabulary
	Seigel and Ryan (1989a) Researcher designed		1/12 study (8.3%)	
	Seigel and Ryan (1989a) Working Memory for Words Test		1/12 study (8.3%)	
	Swanson (1996) Semantic Association subtest		1/12 study (8.3%)	
	Wallace and Hammill (1994) Comprehension Receptive and Expressive Vocabulary Test (CREVT) Expressive subtest		1/12 study (8.3%)	
	Weschler (2011) Vocabulary subtest of the Weschler Abbreviated Scale of Intelligence (WASI-11)		1/12 study (8.3%)	
	Wiig and Secord (1989) Test of Word Knowledge, Expressive Vocabulary subtest)		3/12 studies (25%)	
	Woodcock (1991) Expressive vocabulary subtest (WLPB-R)		2/12 studies (16%	
	Woodcock (1991) Synonym and Antonym Reading Vocabulary subtest (WLPB-R)		1/12 study (8.3%)	
Receptive syntax	Bishop (2003) The Test for Reception of Grammar, (TROG-2)	Tests that require responses to	1/14 study (7%)	14/35 studies used a

Oral language outcomes	Corresponding tests used in the studies	Test description	Number of studies using the measure (Proportion/%)	Total
	Carrow – Woolfolk (2008) Comprehensive Assessment of Spoken Language (CASL) Grammaticality Judgement subtest (GIT)	spoken grammatical knowledge (e.g. morphological awareness and grammatical understanding of sentences)	3/14 studies (21%)	measure of receptive syntax
	Educational Testing Service (2009) Morphological Awareness, (Study Aid and Reading Assistant, SARA)		2/14 studies (14%)	
	Huang (2014) Researcher designed		1/14 study (7%)	
	Larsen and Nippold (2007) Researcher designed		1/14 study (7%)	
	Semel et al., (2003) CELF-4, Sentence Structure		1/14 study (7%)	
	Semel, Wiig & Secord (1995) CELF-3, Concepts & Directions subtest		5/14 studies (36%)	
Expressive syntax	Chappell (1980) The Story Reformulation Test	Tests of spoken grammatical knowledge (e.g. morphological awareness and grammatical understanding of sentences)	1/12 study (8.3%)	12/35 studies used a measure of expressive syntax
	Kieffer and Lesaux (2008) Researcher designed derivational morphology		1/12 study (8.3%)	
	Mahoney, Singson and Mann (2000) Morphological Relatedness Test		1/12 study (8.3%)	
	Semel et al., (2003) CELF-4, Recalling Sentences subtest		4/12 studies (33%)	
	Semel et al., (2003) CELF-4, Formulated sentences subtest		1/12 study (8.3%)	
	Semel et al., (2003) CELF-4, Sentence Assembly subtest		2/12 studies (16.6%)	
	Seigel and Ryan (1989a) Oral Cloze Task		2/12 studies (16.6%)	

Oral language outcomes	Corresponding tests used in the studies	Test description	Number of studies using the measure (Proportion/%)	Total
Narrative	Bishop (2004) Expression, Reception and Recall of Narrative Instrument (ERRNI)	Tests defined as narrative tests where the student tells/ retells a story and is asked to respond to questions afterwards	1/3 study (33%)	3/35 studies used a measure of narrative
	Culcatta, Page and Ellis (1983) Experimental Discourse		1/3 study (33%)	
	Klecan-Aker & Brueggeman (1991) Expressive Connection		1/3 study (33%)	
Listening comprehension	Bowers et al., (2009) Test of Listening Comprehension Test-2	Tests defined as listening comprehension tests where the student listens to a story and is asked to respond to questions afterwards	1/16 study (6%)	16/35 studies used a measure of listening comprehension
	Carlisle (1989) PILAR listening subtest		1/16 study (6%)	
	Leslie and Caldwell (1995) Listening Comprehension score (QRI-2)		1/16 study (6%)	
	Newcomer (1991) Story Comprehension subtest		1/16 study (6%))	
	Semel, Wiig and Secord (2003) CELF-4, Understanding Spoken Paragraphs subtest		2/16 studies (13%)	
	Weismer (2006) Experimental measure of Listening Comprehension		1/16 study (6%)	
	Williams (2001) GRADE, listening comprehension subtest		3/16 studies (19%)	
	Wiig and Secord (1989) Test of Language Competence-Expanded Edition-Level 2, Listening Comprehension: Making Inferences subtest		1/16 study (6%)	

Oral language outcomes	Corresponding tests used in the studies	Test description	Number of studies using the measure (Proportion/%)	Total
	Wiig and Secord (1989) Test of Language Competence-Expanded Edition-Level 2, `Listening Comprehension; Ambiguous Sentences subtests		1/16 study (6%)	
	Woodcock (1991) Woodcock-Language Proficiency Battery – Revised (WLPB-R) Listening comprehension subtest		3/16 studies (19%)	
	Woodcock, McGrew and Mather (2001) Woodcock-Johnson 111 Tests of Achievement (WJ-111) Oral Comprehension subtest		1/16 study (6%)	
Language Battery	De Avila and Duncan (1990) Language Assessment Scales	A selection of subtests which are added together to give an overall picture of language ability	1/7 study (14%)	7/35 studies used a language battery
	Porch Index of Communicative Ability in Children (PORCH, 1971)		1/7 study (14%)	
	Semel, Wiig and Secord (2003) CELF4-4		4/7 studies (58%)	
	Woodcock (1981) Woodcock Language Proficiency Battery		1/7 study (14%)	

Across the 35 studies, receptive vocabulary was measured in 28 studies; expressive vocabulary was measured in 12 studies; receptive grammar was measured in 14 studies; expressive grammar was measured in 12 studies; narrative was measured in three studies; listening comprehension was measured in 16 studies and a language battery was used in seven studies. The Peabody Picture Vocabulary Test was the most commonly used measure of receptive vocabulary. There were considerable variations in the ways in which studies defined and measured oral language skills. Oral language skills were measured in some studies by a single measure of receptive or expressive vocabulary or listening comprehension and in others, by a language composite score including vocabulary, syntax and listening comprehension.

3.6.5 Reading comprehension

All 35 studies measured reading comprehension with a test requiring students to read a set number of passages and respond to questions. Passages varied by genre, length and number. Question type varied from the literal to the inferential and were read by the student or asked after the student read the passage. Responses to questions varied from single words to multiple choice sentences. Tests were timed or untimed. Eighteen tests of reading comprehension were identified as standardised assessments of reading comprehension, with the Gates-MacGinitie Reading Test -4th edition (GMRT; MacGinitie, 2000) being used in 22% of the studies. Further details can be found in Table 3. 8.

Table 3.8. Summary of Reading Comprehension Tests

Reading Comprehension Measure	Characteristics	Number of studies using the measure (proportion %)
American State District Accountability Tests: 1.The Florida Comprehensive Assessment 2.0 Reading (FCAT 2.0; Florida Department of Education 2.The Kansas Reading Assessment (Kansas DOE, 2005); 3.The Reading and Literature Section of the OSA, Standardised Achievement Test, Oregon 2005) 4.The ITBS, Hieronymus, Hoover and Lindquist, 1986, IOWA.; TAKS reading accountability, Texas	Group administered by class teachers. Timings not mentioned. Fiction and non-fiction passages Questions are 3-6 written multiple choice after each passage Questions are literal and inferential and focus on vocabulary, reading application, literary analysis (fiction and nonfiction), and informational text/research process. Answers are written	n=6, 11%
Bridge-IT (Barnes, Faulkner, Wilkinson and Dennis, 2004)	Untimed, group administered, online 32 narrative passages of 5 sentences in length Questions are written following each passage Questions focus on judging whether the next sentence is consistent/inconsistent with the previous sentences.	n=1, 2%

Reading Comprehension Measure	Characteristics	Number of studies using the measure (proportion %)
	Answers require pressing online green (yes) or red (no) buttons	
The Gates-MacGinitie Reading Test -4th edition (GMRT; MacGinitie, 2000).	Timed (35 min), group administered 11 expository and narrative passages ranging in length from 3 to 15 sentences. Questions are literal and inferential. Questions are written Multiple choice response	n=12, 22%
The Gray Oral Reading Test, comprehension subtest (GORT; Wiederholt and Bryant, 2012)	Untimed, individually administered Narrative and expository passages, ranging in length from 6-12 sentences. Questions are open-ended, multiple-choice Questions are asked orally by the examiner Answers are oral	n=6, 11%
The Group Reading Assessment Diagnostic Evaluation (GRADE; Wilder and Williams, 2001)	Untimed, group administered. Silent reading. Sentence comprehension (19 sentences) Narrative and Expository passages 6 passages ranging from 8 – 30 sentences in length Five multiple-choice questions per passage Questions are written Multiple choice response	n=3, 5%
Passage Comprehension Tests (Palincsar and Brown, 1984)	Untimed, group administered Expository passages, ranging from 400 to 475 words in length Ten passages read orally in turn by adult teacher and students Oral questions on questioning, summarising, discussing and predicting Oral output	n=1, 2%
The Performance in Listening and Reading (PILAR; Carlisle, 1989)	Untimed, individually administered Two expository texts, 12 sentences in length Sentences are checked for meaning Sentences are asked orally by the examiner	n=1, 2%

Reading Comprehension Measure	Characteristics	Number of studies using the measure (proportion %)
	Answers are circled yes/no	
The Qualitative Reading Inventory, 2nd edition (QRI-2; Leslie and Caldwell, 1995)	Untimed, group administered Narrative and expository texts, approximately 350 words in length Questions are inferential and non-inferential Eight written questions after each passage Written responses	n=1, 2%
Researcher designed assessments	Individually administered. Timed and untimed. Research designed questions Questions are read or listened to Answers are oral or multiple choice	n=7, 12%
The Stanford Diagnostic Reading Test - 4th edition (SDRT; Karlsen and Gardner, 1996)	Timed, group administered test. Short passages from a booklet Questions are multiple-choice about each passage. Answers are written	n=2, 3%
The Test of Silent Reading Efficiency and Comprehension (TOSREC; Wagner, Torgesen, Rashotte and Pearson, 2010)	Timed (3 minutes) either group or individual administered Series of individual sentences read by student Questions on whether each sentence is factually true. Answers are written	n=1, 2%
The Weschler Individual Achievement Test, reading comprehension subtest (WIAT, Weschler 1992)	Untimed, individually administered task. Expository and narrative passages read silently One literal and one inferential question. Questions are asked orally by the examiner Answers are oral	n=1, 2%
The Wechsler Objective Reading Dimensions (WORD: Rust, Golomok and Trickey, 1993)	Untimed, individually administered. Sentence or passage of text Questions are asked orally by the examiner	n=1, 2%
The Woodcock Language Proficiency Battery -revised (WLPB-R; Woodcock 1991)	Timed (6 minutes), individually administered reading cluster score of 4 tests: word attack, letter-word	n=2, 3%

Reading Comprehension Measure	Characteristics	Number of studies using the measure (proportion %)
	identification, reading vocabulary and a cloze passage comprehension. Passages approximately 40 words in length, read silently Questions based on cloze-procedure Answered through fill -in-the -blank	
The Woodcock Reading Mastery Tests, passage comprehension subtest (WRMT-R, Woodcock, 1998)	Untimed, individually administered. Narrative and expository passages, approximately 30 words in length, read silently Questions based on cloze procedure, Answered through fill -in-the -blank	n=6, 11%
The Woodcock-Johnson III Tests of Achievement, Passage Comprehension subtest (WJ-III; Woodcock, McGrew, and Mather, 2001)	Untimed, individually administered. Silent reading of Sentence cloze-based test. Participant retrieves a specific word needed in the blank to make the sentence complete. Vocabulary level increases throughout the section.	n=3, 5%
The York Assessment of Reading for Comprehension, Passage Reading Secondary (YARC: Snowling, Stothard, Clarke, Bowyer-Crane, Harrington, Truelove and Hulme 2010)	Untimed individually administered. Three passages: one fiction and two non-fiction, read silently. 13 open-ended questions on literal and inferential understanding Questions are asked orally by the examiner Answers are oral	n=2, 3%

Keenan et al., (2008) points to reading comprehension as a complex, cognitive construct but states that most researchers rarely give information on the choice of assessments. The systematic review identified 51% of studies (n=18) that reported reasons for their choice of reading comprehension measure; 40% (n=14) simply described the assessment and 9% (n=4) only mentioned the name of the reading assessment. Of the 18 studies which gave reasons for their choice of reading comprehension: six used researcher-designed assessments

(Carlisle, 1989; Klingner and Vaughn, 1996; Lipka and Siegel, 2012; Marinova-Todd et al., 2013; Miller et al., 2014; Penning and Raphael, 1991); four used a composite of complementary reading measures (Barth et al., 2016; Brasseur-Hock et al., 2011; Catts et al., 2006; Srivastava and Gray, 2012) e.g., State Reading Assessment to assess narrative and expository text; cloze assessment to assess vocabulary, and responses to oral questions read by an examiner; and eight gave reasons such as to assess academic language, or inferences in the reading assessment (Clemens et al., 2020; Davis et al., 2016; Foorman et al., 2018; Lesaux and Harris, 2017; Lesaux and Kieffer, 2010; Mancilla-Martinez et al., 2011; Ricketts et al., 2020; Nellenbach, 2010). This shows that half the studies in the systematic review had identified reading comprehension measures which could assess strengths and weaknesses in underlying language skills as opposed to testing areas of 'reading'.

3.6.6 Study design

As mentioned above, the 35 studies comprised 24 cross-sectional studies, five interventions and six longitudinal studies. The cross-sectional studies investigated either differences between groups of participants (e.g., poor readers compared with typically developing readers, reading comprehension outcomes across ages or grades, or across Spanish speaking language minority readers and native English speakers) or compared relationships or differences on measures such as, oral narrative, syntax, listening comprehension and measures of reading comprehension in a sample of participants. All the intervention studies evaluated the outcomes of a reading comprehension programme aimed at improving the reading comprehension of struggling readers. The longitudinal studies investigated the developmental growth of reading comprehension and language over a period of time.

3.7 Main Discussion

The aim of the systematic review was to investigate how oral language skills in adolescents, aged 11-14 years within mainstream school settings, contribute to reading comprehension. Thirty-five articles, including 30 unique studies, were included and there were considerable differences in how language and reading comprehension was measured. This narrative synthesis examines the characteristics of the adolescent student: their age, type of reader, school setting and how their language outcomes contribute to reading comprehension.

3.7.1. The influence of age

The first year of secondary education (Y7 or 6th grade) is a time when reading becomes a focus for learning, and comprehension skills become critical for school success (Ouellette and Shaw, 2014). By this age, proficient readers have automated their decoding skills, and reading comprehension becomes more reliant on language comprehension in line with the Simple View of Reading. The median age of participants across the 30 unique studies was 12;6 years with an interquartile range of 2 years (UK Y7 or Y8; USA Grade Six or Grade Seven).

In typically developing students, 6th grade (11-12 years) students' reading comprehension was found to be more reliant on oral vocabulary than on decoding skills (Ouellette & Beers, 2009). Similarly, Foorman et al., (2020) in their sample of typically developing students, reported that by Grade Seven, the effect of language comprehension on Grade Eight reading comprehension was greater than decoding. By Grade Nine, language comprehension predicted Grade Ten reading comprehension. Although the role of decoding had not disappeared by Grade Seven, the results seemed to show that by Grade Nine (14 years) language comprehension almost perfectly predicted Grade Ten reading comprehension.

Students aged 11- 14 years are at an important developmental period, when education places a high and critical expectation for reading to learn. For typically developing adolescent readers, studies such as Foorman et al., (2020) and Ricketts et al., (2020), point to the increasing importance of oral language over decoding to predict reading comprehension. This suggests that as students are required to read ever increasing complex text throughout secondary education, so the language skills of typical adolescent readers are also required to develop, in order to read to learn.

Although increasing chronological age predicted an increasing relationship between oral language and reading comprehension in typically developing students, 14 unique studies indicated that this was not the case for adolescents classified as struggling readers (n=8), reading English as a second language (n=4) and language minority readers (n=2). Struggling readers followed different patterns of development based on their difficulties with either word recognition or vocabulary or combinations of factors (Denton et al., 2008, Nippold, 2017).

3.7.2 The influence of adolescent reader type

Across the studies, adolescent readers fell into four broad categories: typically developing readers, struggling readers, reading English as a second language (EAL) and language minority (LM) readers. Struggling readers were defined by scores on standardised reading comprehension tests and language surveys defined students who classified themselves as either EAL or LM readers.

Mainstream readers, or typically developing adolescents who demonstrated higher oral vocabulary scores and semantic knowledge showed better reading comprehension overall (Nellenbach, 2010; Srivastava and Gray, 2012; Ouellette and Shaw 2014). Larsen and Nippold (2007) investigated typically developing 6th grade students' performance on a morphological assessment and its association with reading comprehension. Their findings suggested that the importance of metalinguistic competence – the ability to analyse linguistic units and reflect on their meanings – is associated with stronger word knowledge and better reading comprehension skills.

Struggling readers were shown to have a wide variation in strengths and weaknesses (Hock et al., 2009; Brasseur-Hock et al., 2011). For example, very poor readers were shown to have below average performance in receptive vocabulary and listening comprehension; whereas some struggling readers showed a weakness in listening comprehension but average word-reading or oral vocabulary skills. Longitudinal studies by Shaywitz et al., (1999); Catts et al., (2006) and Cain and Oakhill (2011) indicated that adolescents with poor reading comprehension showed low receptive language scores in retrospective measures and slower rates of vocabulary growth compared with their peers with good reading comprehension. Reading comprehension growth on the other hand, remained constant between struggling and good readers indicating that those students who had difficulties understanding text never caught up with their peers (Shaywitz et al., 1999; Cain and Oakhill 2011, Ricketts et al., 2020). The studies indicate a history of poor language development in adolescents who struggle to become fluent readers in secondary education.

Adolescent readers learning to read English-as-an-additional-language (EAL) who showed a wide breadth of oral vocabulary did better on reading comprehension measures than those with narrower vocabulary (Logan and Keiffer, 2017). Syntactic awareness was found to be more important than EAL status on reading comprehension (Lipka and Siegal, 2011; Marinova-Todd et al., 2013). The studies showed that poor readers did not perform as well on measures of syntactic awareness and reading comprehension as good readers, regardless of whether they were classified as EAL or mono-lingual English readers (L1). All four studies involving EAL adolescent readers indicated that an understanding of the structure of the language was important for reading comprehension in both EAL and L1 groups (Li and Kirby, 2014). This was similar to the findings of studies involving Language Minority readers.

Language Minority (LM) students tended to represent a specific population of EAL readers: adolescents from Spanish speaking, low-income homes, taught to read in English-speaking American classrooms. When comparing the reading comprehension difficulties of LM readers to their native English-speaking peers, it was found that struggling readers contained an even spread of both LM readers and native speakers, with both groups scoring low on receptive vocabulary (Denton et al., 2008; Lesaux and Keiffer, 2010). The influence of expressive vocabulary was seen in a study of struggling Latino readers by Lesaux and Harris (2017).

Although all the students were seemingly engaged in the reading comprehension process, results showed that their understanding of the text was inaccurate due in part to poor vocabulary knowledge. These three cross-sectional studies indicate that reading comprehension difficulties are due in part to low vocabulary scores. Stability in reading comprehension outcomes was seen in a longitudinal study involving LM students, with poor readers remaining poor readers as they moved through school (Mancilla-Martinez, 2011). Rates of reading growth did not vary across students' ability levels, so students with initially low reading measures at 5th grade remained poor readers into 7th grade.

The studies appear to show that regardless of the age of participants, or their language status as EAL or LM, their level of receptive or expressive vocabulary, syntactic awareness or listening comprehension appeared to play a significant role in determining whether adolescent readers were classified as typically developing or struggling readers.

3.7.3 The influence of setting

Studies which described the setting as 'mainstream' also tended to describe participants as typically developing, good or poor readers (Foorman et al., 2015; Klecan -Aker and Caraway, 1997; Larsen and Nippold, 2007; Nellenbach, 2012; Oullette and Beers, 2010; Penning and Raphael, 1991; Ricketts et al., 2020). Alternatively, studies which highlighted social deprivation in the school setting, described participants as struggling readers (Barth et al., 2016; Denton et al., 2008; Klingner and Vaughn, 1996; Lesaux and Keiffer, 2010; Lesaux and Harris, 2017; Logan and Keiffer, 2017; Mancilla-Martinez et al., 2011; Wright et al., 2015.

3.7.4 The Influence of Oral Language

3.7.4.1 The relationship between receptive oral vocabulary and reading comprehension

Studies indicate that understanding oral vocabulary supported adolescent reading comprehension and conversely that poor receptive vocabulary was associated with low reading comprehension scores (Myers and Botting, 2008; Ouellette and Beers, 2009; Lesaux and Keiffer 2010; Srivasta and Gray, 2012; Ouellette and Shaw, 2014; Logan and Keiffer, 2017). Longitudinal studies showed that students with difficulties in reading comprehension showed slower rates of receptive vocabulary than their peers with good reading comprehension (Catts et al., 2006; Cain & Oakhill, 2011). Although reading comprehension demonstrated growth over time, findings showed that that poor readers remain poor readers relative to their peers. An intervention study (Denton et al., 2008) examining the effect of a reading comprehension intervention in struggling readers found that neither the treatment nor typical school instruction improved reading comprehension performance due to low receptive oral vocabularies in both groups.

3.7.4.2 The relationship between expressive oral vocabulary and reading comprehension

Adolescents with better scores in expressive vocabulary had higher probabilities of correct responses to an experimental reading comprehension task (Miller et al., 2014). Even though adolescents with well-below average expressive vocabulary knowledge actively tried to use comprehension processes to read a text, results showed that their understanding of the text was inaccurate due in part to poor vocabulary knowledge (Lesaux and Harris, 2017). The studies showed that if adolescents' expressive vocabulary was low, understanding of the passage was also low; as was the students' ability to show understanding through a reading comprehension assessment (Lesaux and Harris, 2017; Miller et al., 2014; Srivastava and Gray, 2012).

3.7.4.3 The relationship between oral grammatical understanding and reading comprehension

Studies by Lipka and Siegel (2012) and Larsen and Nippold (2007), found that adolescents with lower scores in syntactic awareness were also poor comprehenders indicating that understanding the structure of the language was important for reading comprehension. Marinova-Todd et al., (2013) demonstrated that syntactic and morphological awareness offered a meaning-related strategy to reading and understanding complex words, which was helpful in reading more academic text. Larsen and Nippold (2007) showed that adolescents with better performance on the morphological task, demonstrated stronger word knowledge and reading comprehension indicating that students' ability to analyse the structure of words could be a key word learning strategy driving language development in school environments.

3.7.4.4 The relationship between narrative and reading comprehension

Two studies which used a narrative measure showed that adolescents with more sophisticated narratives, demonstrated better reading comprehension outcomes (Klecan-Aker and Caraway, 1997; Myers and Botting, 2008). As the ability to tell a story draws on multiple language and cognitive abilities, such as understanding of story structure, oral vocabulary, semantic and grammatical skills (Babayigit et al., 2021), it appears that the knowledge and use of narrative skills supports the understanding and recall of information during reading, such as the role and intention of characters.

3.7.4.5 The relationship between listening comprehension and reading comprehension

Listening comprehension measures tended to discriminate good from poor comprehenders in some of the studies (Carlisle, 1989; Catt et al 2006; Brasseur-Hock, 2011; Clemens et al 2020). Poor listening comprehension performance was evident in students who struggled with semantic operations and the ability to infer implications, yet showed average word reading fluency (Brasseur-Hock et al., 2010; Hock, 2011). Two longitudinal studies reported that poor comprehenders showed poor performance across time on the listening comprehension measure used (Catts et al., 2006; Mancilla-Martinez et al., 2011). These studies appear to converge on the finding that adolescents with difficulties in listening comprehension also have difficulties in reading comprehension and these difficulties remain consistent over time.

Listening comprehension measures were used in two intervention studies (Barth et al., 2016) and Roberts et al., (2013). The aim of both interventions was to improve reading comprehension through developing listening comprehension and word reading abilities. However, listening comprehension did not improve after treatment in either study. Results suggested that struggling readers, who may already have language difficulties in vocabulary and background knowledge, did not improve on standardised measures of reading comprehension, possibly due to poor reading comprehension strategies (Barth et al., 2016).

Clemens et al., (2020) examined the influence of listening comprehension ability on four standardised reading comprehension tests: GMRT, GRADE, GORT and TOSREC. The authors reported that the contribution of listening comprehension to reading comprehension was the best predictor of GORT-5 Comprehension (average unique contribution of .04) in which students read passages aloud and responded orally to questions asked by the examiner. The average unique contribution of listening comprehension to reading comprehension test performance ranged from .0623 for TOSREC; .0165 for GMRT reading comprehension and .0128 for GRADE reading comprehension. The study points to the evidence of different reading tests measuring relatively different skills and draws attention to the fact that low scores on a reading comprehension assessment may not mean poor comprehension performance of the text, but rather poor word reading skills and/or poor vocabulary knowledge.

Low outcomes in measures of listening comprehension were shown to identify adolescent readers with a 'poor comprehender' profile (Brasseur-Hock et al., 2011; Clemens et al., 2020). Listening comprehension relies on the ability to listen and understand spoken language, which is in turn dependent on oral vocabulary, grammar and working memory and is measured through asking questions. Based on the Simple View of Reading, as students become proficient word readers and less reliant on decoding skills, their linguistic comprehension becomes more important and should show greater contribution to understanding written text. In the current review, although weaknesses in listening comprehension could be seen in struggling adolescent readers (Myers and Botting, 2008;

Brasseur-Hock et al., 2011; Mancilla-Martinez et al., 2011; Barth et al., 2016), longitudinal studies did not show an increase in the strength of simple correlations between listening comprehension and reading comprehension (Ouellette and Beers, 2010; Mancilla-Martinez et al., 2011), although the association was stable. A low performance in listening comprehension was associated with a low and slowing reading trajectory throughout early adolescence (Mancilla-Martinez et al., 2011).

3.7.4.6 The relationship between composite language measures and reading comprehension

Three longitudinal studies explored the relationship of an oral vocabulary composite with reading comprehension (Shaywitz et al., 1999: Nippold, 2017; Ricketts, 2020). All three studies used a single measure of receptive vocabulary and a single measure of expressive vocabulary to form a composite lexical score, capturing the breadth and depth of oral vocabulary. The findings of all three studies indicated that a composite oral vocabulary measure predicted reading comprehension. In general, adolescents with poor oral vocabulary showed weaker reading performances, although individual differences were apparent as some readers appeared to draw on other skills, such as listening comprehension, grammatical understanding or inferencing in order to perform well in reading comprehension.

Seven studies used a language composite score: four reported an overall language score from a standardised language assessment (CELF4; PICAC and Woodcock Language Proficiency Battery); three studies used a composite score of expressive and receptive syntax, receptive vocabulary and one included an additional measure of listening comprehension to examine the differences in reading comprehension. Findings consistently showed that language composite scores predicted reading comprehension across grades (Foorman et al., 2020) and differentiated between good and poor readers (Penning et al, 1991; Nellenbach, 2010, Skebo et al, 2013; Davis et al., 2016).

3.7.4.7 Summary of the influence of oral language

As students enter secondary education, those with low language abilities but average word reading may not be noticed (Myers & Botting, 2008). However, if they struggle to understand the increasingly complex oral language of secondary education then it appears they will have problems understanding written language (Nippold, 2017). The studies all point to the conclusion that if oral language skills are inadequately low, then students will develop insufficient reading comprehension skills for the secondary classroom. Studies show that oral language skills contribute towards variance in reading comprehension: having a larger vocabulary helps in understanding written text; better performance on a morphological task was associated with stronger word knowledge and reading comprehension, showing the importance of analysing word structure (Larsen and Nippold, 2007).

Interventions typically focused on improving the reading comprehension of struggling readers but overall, the studies pointed to limited success. Three of the five intervention studies showed no improvements in students' reading comprehension, with two studies showing an improvement on a measure of oral vocabulary post-test (Barth et al., 2016; Denton et al., 2008). Struggling readers, who may already have language difficulties did not improve on standardised measures of reading comprehension (Klinger & Vaughn, 1996). Two studies reported an improvement in reading comprehension (Barth et al., 2016; Wright et al., 2015) with one study reporting improvement in a researcher designed vocabulary measure. Some students were described as 'minimal responders' to previous interventions (Denton et al., 2008). Although this resistance to improvement could be associated with issues around poor comprehension strategies, (motivation or attention have not been taken into account in this review), it should be considered that students' language difficulties did not allow them to sufficiently access either the intervention, the text to be read or the reading strategies to enable them to read with understanding.

3.8 Limitations of the review

There are a number of limitations to this review. First, only studies in English were included, possibly excluding some relevant research in other languages. Secondly, only articles including language skills with oral outcomes were considered, excluding language outcomes that relied on written outcomes such as reading vocabulary or pen and paper grammar tests.

Due to the many methodological differences between the studies, and the language and reading comprehension measurements used, it was felt inappropriate to carry out a meta-analysis. Meta-analysis combines data from multiple studies to explore variability in effect sizes across studies (Field and Gillett, 2010). A future meta-analysis of reading comprehension is an important next step, and would involve relevant moderator variables such reliable language and reading comprehension measures, number of assessment points and similar samples of students (age, language, home background) (Pfost et al., 2014).

3.9 Conclusions and future research

In conclusion, the systematic review shows that oral language skills in adolescent students between the ages of 11-14 years, in mainstream school settings, are crucial to supporting their reading comprehension, however outcomes are defined or measured. The relationship found in the studies between reading comprehension and access to a large vocabulary, being able to understand and use complicated sentence structures to express ideas combined with adequate listening comprehension supports the view that linguistic understanding underpins reading comprehension in the groups studied. Listening comprehension differentiates those adolescents with a 'poor comprehender' profile. Oral language skills have been shown to be developmental and necessary to support the reading-to-learn requirements of the secondary classroom. By 14 years of age, some studies showed that oral language skills of typically developing students predicted reading comprehension.

Difficulties with reading comprehension, meant some students were given access to interventions. Due in part to their language difficulties, some students still struggled to respond to intervention. Unfortunately, it also appeared that the developmental trajectory for both language development and reading comprehension was difficult to shift: poor readers remained poor readers and good readers remained good readers.

This systematic review contributes to the current body of research by identifying the relatively small number of longitudinal studies, and the finding that most studies are based in the US. More longitudinal research into developmental trends within secondary education is therefore needed to support the teaching of reading in the United Kingdom. The review also highlights the relatively few studies measuring spoken language skills through oral responses in mainstream adolescents. The high number of papers excluded from the systematic review is due to the finding that many studies measured spoken language through written methods. Measuring verbal language skills (listening comprehension or oral expression) through written methods (reading or writing) means that the assessment task may influence the measured oral language performance confounding the results. In examining the outcomes of this review, more emphasis on assessment using oral language methods to measure spoken language performance is required in longitudinal research. Furthermore, the review identifies the wide variety of assessments tasks used to measure both oral language and reading comprehension showing the difficulty in measuring language and reading performances. These findings suggest that teachers need to be aware of the need to interpret a wide range of reading comprehension outcomes, whilst understanding that assessments tasks vary in their level of difficulty and place different demands on the language system. As the purpose of reading in secondary education is primarily to learn new information, future longitudinal research could determine how oral language performance affects reading comprehension for students living in England from low SES backgrounds.

Chapter Four

Methods

4.0 Overview

This chapter describes the methodology of the study. The introduction summarises the content of previous chapters, which provide the rationale for the study. Section 4.2 states the aims, research questions, and predictions, and section 4.3 gives an overview of the study design. An outline of ethical approval and the process of consent is covered in Section 4.4. Section 4.5 describes the recruitment, and Section 4.6 gives details of the school and student participants. Section 4.7 describes the measures used, the rationale for each assessment, the assessment timeline and gives information on validity and reliability. Finally, Section 4.8 introduces the approach taken to the data analysis.

4.1 Introduction and summary of rationale

It has been shown that that oral language underpins reading comprehension (Stothard & Hulme, 1992; Nation et al., 2004; Catts et al., 2008), and there is a strong association between adolescent language development and academic success which in turn affects young people's economic success and social mobility in later life (Snowling et al., 2001; Conti-Ramsden et al., 2009; Dockrell et al., 2011; Ricketts 2014).

A systematic review of the literature (Chapter Three) found oral language skills in adolescent students to be crucial in supporting their reading comprehension. Further, the review revealed that oral language continued to develop and students with low oral language struggled to understand the increasing complex language of the secondary classroom, including written language (Nippold, 2017). Moreover, interventions designed to improve the reading comprehension of struggling readers have to date shown limited success (Klinger & Vaughn, 1996; Penning et al., 1991; Wright et al., 2015). These findings show that more research is needed to understand the association between oral language and reading comprehension over time, during adolescence.

4.2 Aims

The aim of the study was to explore the relationships between oral language ability, non-verbal ability, socio-economic status and academic attainment with reading comprehension in secondary school students across Years Seven, Eight and Nine, from a mainstream secondary school, in an area of high social deprivation and to explore the influence of oral language on reading comprehension.

4.2.1 Research Questions

Through the use of various statistical methods, the study aimed to answer the following research questions of data collected from secondary students, aged 11 to 14 years, in a mainstream school.

RQ1. To what extent is there variability in the language and literacy performances of students across three cohorts (C7, C8 and C9) and over time?

RQ2. Is student gender, special educational needs or deprivation related to performance in language and literacy over time?

RQ3. What are the relationships between verbal and nonverbal skills, single-word reading, social deprivation and reading comprehension?

RQ4. a) Does listening comprehension significantly predict reading comprehension in secondary school students? b) What are the final predictors of academic outcomes at General Certificate of Standard Education (GCSE) level?

RQ5. To what extent do a) oral language skills, b) non-verbal ability and c) socio-economic status explain the relationships between academic attainment and reading comprehension?

4.2.2 Predictions

Based on the framework of the Simple View of Reading (Gough & Tunmer, 1986) and the literature described in the preceding chapters, the following predictions were proposed:

1. There will be significant variability in the language and literacy performances of students across the three cohorts, but student performances will remain stable over time. Studies have pointed to the heterogeneity in strengths and weaknesses of adolescent readers (Brasseur-Hock et al., 2011; Nippold, 2017) and to the stability of individual rank order in word reading, oral vocabulary and reading comprehension (Ricketts et al., 2020).
2. Individual students' successive measures of language and literacy will change over time, indicating growth over time. Differences between student characteristics related to gender, SEN and social deprivation will explain differences in language and literacy growth over time. Based on previous research, females will perform better than males (Babayigit et al.,2021); students identified with SEN (Foorman et al., 2017) or living in areas of high deprivation (Spencer et al., 2012) will perform significantly less well on tests.
3. Of verbal and non-verbal skills, single-word reading and social deprivation, verbal skills generally will make the largest contribution to reading comprehension as verbal skills and reading comprehension rely on the same cognitive skills (Hulme and Snowling, 2011; Muter et al., 2004).
4. Performance on listening comprehension measures will predict reading comprehension; and reading comprehension measures will predict academic outcomes by the end of Key Stage 4, based on the GCSE performance in English, Mathematics and Science. Research shows the increasing importance of linguistic comprehension in predicting reading comprehension in older children (Foorman et a., 2020; Ricketts et al., 2020)
5. (a) Oral language skills will significantly explain the differences in academic attainment and reading comprehension; (b) Non-verbal skills will affect both

reading comprehension and academic attainment and (c) Socio-economic status will make a difference to reading comprehension and therefore to academic attainment. Longitudinal studies point to developmental language and demographic factors affecting reading comprehension (Law et al.2009; Reynolds and Turek, 2012) and academic attainment (Conti-Ramsden et al., 2009).

4.3 Overview of the study design

The study was a mixed design study comprising cross-sectional, retrospective, and prospective data across Key Stage 3 (KS3). This stage of education covers the first three years of secondary schooling in maintained schools in England and Wales, comprising of Year Seven, Eight and Nine, when students are aged between 11 and 14 years. See Table 4.1 for study design.

Table 4.1 Design of the study

Two-year longitudinal study comparing performance across three cohorts (Y7, Y8 and Y9) and across three school years				
Testing point	**Key Stage 3**			**Study design**
	Year Seven	**Year Eight**	**Year Nine**	
	C9 - 2			**retrospective**
	C8 - 1	C9 -1		
1st testing point	**Cohort Y7**	**Cohort Y8**	**Cohort Y9**	**cross sectional**
2nd testing point		C7+1	C8 + 1	**prospective**

Key: C9 = cohort in Year Nine at the start of the study; C8 = cohort in Year Eight at the start of the study; C7 = cohort in Year Seven at the start of the study.

Four-hundred and forty-three students participated from one mainstream secondary school in the UK. Reading ability was assessed by exploring both single-word reading and reading comprehension; together with cognitive ability; and oral language skills, specifically, recall of sentences and listening to spoken paragraphs. The data was collected from three sources:

Statutory Assessment Tasks (SATs) at the end of primary education (Year Six); data routinely collected in the secondary school, including academic outcomes for a single cohort in the General Certificate of Secondary Education (GCSE) for English, Mathematics and Science (Year Eleven) and standardised language and literacy tests used specifically for the study.

Secondary schools operate on a three-term school year, each term divided into half terms. Autumn term runs from early September to mid-December, with half term falling in late October. Spring term runs from early January to Easter, with half term falling in mid-February. Summer term runs from April to late July, with half term falling in late May.

The first testing point occurred during the first half of the Spring term. At this first testing point, data on child gender, age, socio-economic status, special educational needs and the Year 6 Statutory Assessment Tests were collected alongside routine school data on reading, cognitive ability and academic attainment for the participants who were in year groups seven, eight and nine at that time. Academic attainment data based on raw scores for English, Mathematics and Science, was collected twice over each academic year: the end of the autumn term and the end of summer term.

The three cohorts of students are henceforth referred to as the C7 cohort, the C8 cohort and the C9 cohort. Additional assessments of participants' word reading efficiency, ability to remember and recall spoken sentences and understanding of spoken paragraphs were administered. The data provided a cross sectional comparison for the three **cohorts** (C7, C8 and C9) across the three school **Years** (Year Seven, Eight and Nine).

A second testing point, one year later, collected the same routine school data, including academic data at the end of the autumn and summer term, and the same additional assessments for the C7 cohort of students as they moved into Year Eight (C7 +1); and for the C8 cohort of students as they moved into Year Nine (C8 + 1). This longitudinal data measured any change in the assessments for students between testing point 1 and testing point 2.

Additionally, retrospective school data was collected at testing point one for the participants in both C8 and C9 cohorts. Routine school data was collected for a retrospective period of one year for the C8 cohort of students from their Year Seven assessments (C8 – 1). Routine school data was collected for a retrospective period of one year for the C9 cohort of students from their Year Eight assessments (C9 – 1) and two years for their Year Seven assessments (C9 – 2). This retrospective data allowed further examination of any change in the actual scores (age-adjusted). See Table 4.1 for study design.

4.3.1 Rationale for using a longitudinal cohort design

The cross sectional and retrospective design at the first data point provided data on the oral language and literacy abilities of the three cohorts of students when in Years Seven, Eight and Nine, and enabled an investigation of the relationships between oral language, word reading, social economic status and non-verbal ability with reading comprehension and academic performance at one time point. The inclusion of Year Six data enabled investigation into the longitudinal nature of reading comprehension between primary and secondary education.

The longitudinal design used data at the second collection point (the following year) to provide data exploring growth and stability of performance and relationships between variables across time. It also allowed an investigation of predictive relationships retrospectively from Year Six and then at time 1 and time 2 to explore measures that best predict reading comprehension. Furthermore, it provided the opportunity to investigate predictive relationships from the C9 cohort to explore measures that best predict academic attainment, as assessed by GCSE performance in English, Mathematics and Science at Year Eleven.

4.4 Ethical considerations

Approval was given for recruitment of the sample based on a parental opt-out strategy that followed usual school policy. An alternate policy of opt-in consent to the research, may have led to sample bias, due to the low levels of literacy and social cohesion in the community the school serves.

4.4.1. Ethical approval

Full ethical approval for the study was obtained by the City, University of London School of Health Sciences Ethics Committee (Reference Number: LCS/PR/PhD/16-17/01). See Appendix 4A for the indemnity letter pertaining to ethical approval. Approval was given for amendments to the use of routine school data to include the Statutory Assessment Data and the GCSE data (ETH1920-0377, Appendix 4B).

4.4.2 Process of consent

Signed informed consent was firstly obtained from the head teacher. The school welfare team were asked to identify any parents not deemed able to understand the opt-out process of consent. These parents were to be phoned personally by the researcher for the process to be explained more fully. No parent was deemed unable to understand the opt-out strategy and therefore all parents of Key Stage Three (KS3) students were sent leaflets explaining the study and containing the opt-out consent form, with a return slip for those not wishing to take part. This process is accepted school practice. Forty- two parents opted out of the study, and two of those parents opted out from their child's data being used for future research (see Table 4.2 for consent of participants).

Verbal information introducing the study was given to students during year group assemblies by their Head of Year. Information leaflets explaining the study were handed out by class tutors to all students over the same week. The researcher was part of the senior leadership team and known to both students and staff. In order to avoid any pressures that might have made it difficult for students to refuse to take part in the study, the researcher was absent from all assemblies and tutor discussions.

Additional assent was sought at the first face to face contact between student and researcher, where the content of the information and consent forms was explained verbally. No student refused to take part in the study.

See Appendix 4C for the information leaflets and consent forms for head teachers, parents, and students.

Table 4.2 Number of parents who opted out of their child's participation by school year

Cohort	Parents who opted out	Parents who opted out of future studies	Number of students who refused to give assent	Final student sample	Final sample as a percentage of cohort
Year 7	11	1	0	159	94%
Year 8	1	1	0	158	99%
Year 9	30	0	0	126	81%
Total	42	2	0	443	91%

4.5 Recruitment

All the students for the study were recruited from a secondary school in the North East of England. Five local primary schools feed into the secondary school, which consists of 850 students plus 120 in the 6^{th} Form, and is made up primarily of White British students.

4.5.1 Student participant inclusion criteria

To be eligible for the study, the following inclusion criteria were used:

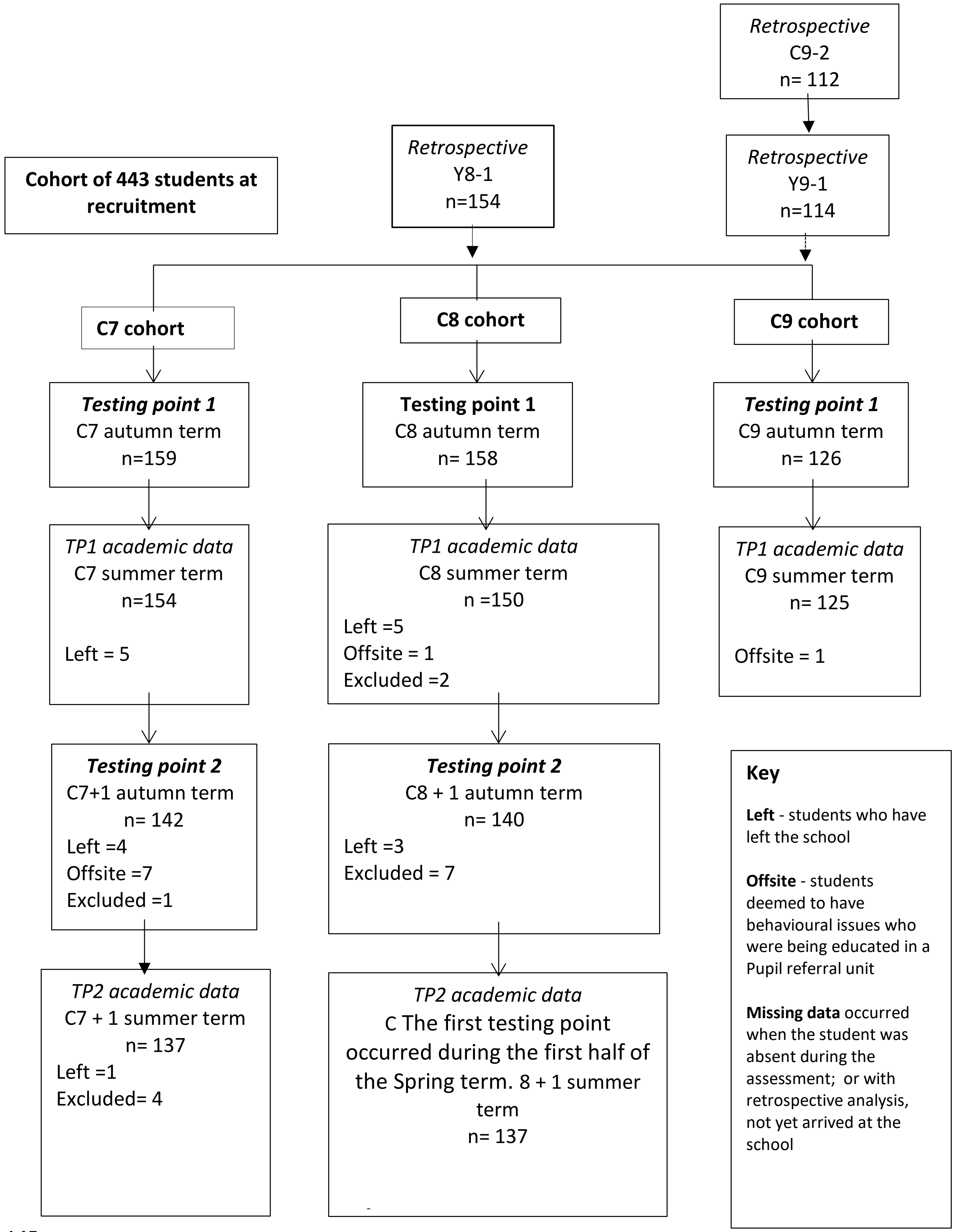
- Attend the mainstream secondary school included in the study
- Be in Year Seven, Year Eight or Year Nine for the academic year 2016 – 2017
- Either have English as a first language, or if English is an additional language, have lived in the UK for at least 2 years in order to have gained a level of competency in reading.

If students were deemed to be vulnerable, had no capacity to assent or had any impairments that prevented them from accessing the test materials, they were excluded from the study. Vulnerable students were identified by school and social workers as struggling with mental or physical health issues, or students in difficult circumstances following for example, a sexual assault or family suicide. These students require differing forms of support. The secondary pastoral team and secondary Special Educational Needs Co-ordinator gave advice on the exclusion of students. One student was excluded as all reading material required translation into Braille.

4.5.2 Sample size

A total of 443 students assented to take part in the study. All students spoke English as their first language, and none had been in the UK for less than 2 years. By the end of testing point two, 44 students representing 10% of the sample, had left the school or were being educated off site. Students who joined the school after the first testing point were not invited to take part in the study. (See Figure 4.1 for flow of participants).

Figure 4.1 Flow of participants through the study



4.6 Characteristics of the student sample

The characteristics of the student sample are presented in Table 4.3.

4.6.1 Gender

Of the 443 participants, 236 were males and 207 were females, representing 53% and 47% of the sample respectively. Comparing the proportion of males observed in the sample to the expected number in English secondary schools aged 11 - 15 years, a chi-square goodness-of-fit test indicates 10 more males in the school sample. However, there is no significant difference in the proportion of males identified in the current sample (53.3%) as compared to the value of 51.4% obtained from the DFE Education Census (2017) for students aged 11 to 15 years attending English Secondary Schools (National Tables: SFR28/2017), x^2 (1, n=443) = 0.9, p =.34).

4.6.2 Socio-economic factors

The school measured socio-economic factors using three factors: the income deprivation affecting children index (IDACI) based on postcodes, which measures the proportion of children under the age of 16 years that live in low-income households in the UK; eligibility for free school meals (FSM) and pupil premium (PP). Pupil premium funding is allocated to schools by the Department for Education based on their number of disadvantaged pupils; students are defined as 'disadvantaged' by the Department for Education (2015) if they are or have been eligible for means-tested free school meals.

One drawback of using FSM or PP as an indicator of deprivation was that parents needed to apply for the means-tested benefit and not every parent did. IDACI scores, on the other hand, take into account any means-tested benefits and could be considered to be more representative of children living in areas of deprivation. IDACI scores were therefore used in this study as the measure of socio-economic status. The scores range from less than 0.20 to 0.6 or above: the higher the score, the higher the probability of income deprivation. For example, an IDACI score of 0.5 indicates a 50% likelihood the student is from an income-deprived home (Education & Skills Funding Agency, July 2018). Of the students with an IDACI score, 26% (n=109) showed very little deprivation, 33% (n=136) showed moderate levels of deprivation and 41% (n=172) showed high or significant deprivation The average IDACI score for the sample was 0.39 (SD .21), with a minimum of .02 and maximum of .67. The school catchment area fell within the ten percent most deprived areas in England based on the 2010 census (Great Britain, Department of Communities and Local Government, 2011).

4.6.3 Special Educational Needs

Schools identify students with a special educational need (SEN) based on factors affecting their educational performances. The SEN profile shows 25% of the KS3 cohort identified as having a special educational need. This percentage was over double the national average of 10.5% for secondary academies, identified by the Department of Education in their annual report on SEN in England in 2017 (Department for Education (DFE) SEN 2017). Within the identified SEN cohort, 22.8% of the students were supported in the classroom by a teaching assistant which is double the 11.6% identified by the Department for Education, statistical report for Special Educational Needs (DFE SEN 2017). The positive z scores, shown in table 4.4 reflect the high proportion of SEN students.

Students with more complex educational needs receive support through an Education, Health and Care (EHC) plan which is funded by the local authority. Nine students had an EHC plan and one student had a statement identifying SEN reflecting an overall percentage of 2.2%, above the overall percentage of 1.6% for secondary academies in England, (DFE, Special Educational Needs in England, 2017).

There were two 'looked after' students within the KS3 cohort. 'Looked after children' or LAC, refers to children in foster care. (See Table 4.3 for overall characteristics of the KS3 sample at testing point 1).

Table 4.3 Characteristics of KS3 sample, testing point 1

KS3 sample at testing point 1			
Gender	Sample	National average	Comparison to national population
	53.3% male (n=236) 46.7% female (n=207)	50.7% (2017) 49.3% (2017)	Chi-Square: 38.45 df: 1 Asymp Sig: p < 0.001
Deprivation measure as measured by IDACI Index	54.2% participants live in areas where deprivation ranges from 41% of families living in relative deprivation to 67%. Mean value .39 (SD .21) min 02; max .67		
Special Educational Needs	*Sample*	*National Average*	*Z score as proportion*
	25% of the overall sample (n= 111)	10.5% for secondary academies	Z= 9.96 p < 0.001
	22.8% of the sample required support in the classroom (n=101)	11.6% support in the classroom	Z=7.36 p < 0.001
	2.2% of the sample had an EHCP or Statement (n = 10)	1.6% EHCP or Statement (*Based on Special Educational Needs in England: 2017. DfE statistical report)*	Z=1.006 p = 0.314
Looked After Children	0.5% (n=2)	0.62% *(Based on DfE Children looked after in England Report, 2017)*	No test due to low numbers

Key: KS3 – Key Stage Three; IDACI – Index Deprivation Affecting Children Index; EHCP – Education, Health and Care Plan; DFE – Department of Education

4.7 Measures

The measures selected for the study were chosen to provide information on oral language skills, cognitive ability, academic attainment and reading comprehension, including single-word reading and reading comprehension. Table 4.4 presents all the measures, with their scoring ranges, mean and SD.

Table 4.4. Summary of measures used in the study

Measure	Standardised scoring ranges	Mean	SD
School data			
Y6 Reading SAT	80 - 120	100	3
CAT4	70 - 130	100	15
NGRT	60 - 140	100	15
Routine TA assessments of English, Mathematics and Science	Raw scores 0 -20	5= expected KS2 SATs performance 7 = expected end of Y7 performance 9 = expected end of Y8 performance 11 = expected end of Y9 performance	1
GCSE in English, Maths and Science	Bands 1-9	16 = Band 5	
Additional standardised measures			
TOWRE2	55- 141	100	15
CELF4-RS	0-19	10	3
CELF4-USP	0-19	10	3

Key: TA – Teacher Assessment; SAT – Statutory Assessment Test; CAT – Cognitive Abilities Test; NGRT – New Group Reading Test; GCSE – General Certificate of Secondary Education; TOWRE2 – Test of Word Reading Efficiency; RS CELF4 – Recalling Sentences subtest, Clinical Evaluation of Language Fundamentals- Fourth Edition; USP CELF4 – Understanding Spoken Paragraphs, Clinical Evaluation of Language Fundamentals – Fourth Edition

The existing school data consisted of the Year 6 Reading Statutory Assessment Test (SATs); the Cognitive Abilities Test, Fourth Edition (CAT-4, Lohman and Smith, 2012); reading comprehension measured using the New Group Reading Test, (NGRT, Burge et al., 2014); routine teacher-based assessments of English, Mathematics and Science for Year Seven, Eight and Nine students; and Year Eleven GCSE performance in English, Mathematics and Science.

The additional standardised measures administered to students included the Sight Word Efficiency subtest from the Test of Word Reading Efficiency, second edition, (TOWRE2, Torgesen et al., 2012) and two oral language subtests from the Clinical Evaluation of Language Fundamentals, Fourth edition –UK test (CELF4-UK, Semel et al., 2006), 'Recalling

Sentences'(RS) and 'Understanding Spoken Paragraphs' (USP). The rationale for the choice of each of the additional tests is given below.

4.7.1 Routine School Measures

4.7.1.1 Statutory Assessments Tasks

The Statutory Assessment Tasks (SATs) are taken by most Year Six students at the end of primary education. In 2016, the national assessment procedures for the English reading paper were changed from level descriptors to a scaled score to reflect changes in the new primary curriculum (DFE, 2013). A student's scaled score is based on their raw score. A scaled score of 100 represents the expected standard set by the government on the test; a score of 80 is the lowest scale score that can be awarded and 120 is the highest. C7 was the first cohort to be awarded a scaled score of a 100: a scaled score between 99 to 102 shows the student has met the expected standard in the test.

Before 2016, the expected level for an average pupil to achieve by the end of primary schooling was a level 4 in reading. In this study, retrospective levels for the Year 6 Statutory Assessment Tasks taken before 2016 for the C8 and C9 cohorts were converted to the comparative scaled score of the new interim system using the test conversion table (Appendix 4D). Due to changes to the content of the curriculum being assessed, a national curriculum level of 4b prior to 2016 best compares to the average scaled score of 100.

4.7.1.2 School Attainment Measures

Teacher assessments in English, Mathematics and Science were based on test performances within a classroom environment. School attainment measures have been included in the study to show the relationship between oral language skills, word reading and reading comprehension and academic attainment. In this study, data from the teacher assessments at the end of the autumn term and summer term were used. (See Table 4.5 for the timeline of academic assessment points within the two -year study).

Table 4.5 Timeline of academic assessment points within the two-year study

School year	School term	Student sample across Key Stage Three			Academic subjects
		Year Seven	Year Eight	Year Nine	
2014 – 15 *Retrospective*	autumn 2014	C9-2			English, Maths, Science
	summer 2015	C9-2			English, Maths, Science
2015 – 16 *Retrospective*	autumn 2015	C8-1	C9-1		English, Maths, Science
	summer 2016	C8-1	C9-1		English, Maths, Science
2016 – 17 ***1st testing point***	autumn 2016	**Cohort C7**	**Cohort C8**	**Cohort C9**	English, Maths, Science
	summer 2017	C7	C8	C9	English, Maths, Science
2017 – 18 ***2nd testing point***	autumn 2017		C7+1	C8+1	English, Maths, Science
	summer 2018		C7+1	C8+1	English, Maths, Science

The aim of routine school data collection is to track the progress of a student from end of primary, through key stage three (KS3) to achieving a pass at GCSE grade. (See Table 4.6 showing the expected progress of a pupil from end of primary to achieving a pass at GCSE grades).

Table 4.6 Expected progress through KS3 (based on DFE secondary accountability measures: DFE 2019)

Before 2015	**From 2016**	**Expected progress to reach a grade 5 'strong pass' at GCSE**						
National Curriculum level descriptor	Expected standard on KS2 SATs	**Year Seven expected progress**		**Year Eight expected progress**		**Year Nine expected progress**		**Year Eleven GCSE prediction**
		End of Autumn term	End of Summer term	End of Autumn term	End of Summer term	End of Autumn term	End of Summer term	
4b	99 – 102	1+	2-	2+	3-	3	3+	5
Converted to Teacher assessed (TA) raw scores		6	7	8	9	10	11	16

Key: KS2 – Key Stage Two, SATs - Statutory Assessment Tests, GCSE – General Certificate of Secondary Education

4.7.1.3 Cognitive Abilities

The CAT4 has four sub-tests which assess different aspects of a student's reasoning ability in key areas that support academic attainment. These include 1) verbal reasoning, which measures the ability to think with words; 2) numerical reasoning measuring thinking with numbers; 3) non-verbal reasoning measuring thinking with shapes and 4) spatial reasoning which measures thinking about the patterns or relationships between visual concepts. Standardised scores for each subtest, and an overall score, allow a comparable measure within or across a year group. Scores on these tests can indicate a student's reasoning ability and hence impact on their ability to learn new material in a wide range of school subjects (Lohman and Smith, 2012).

The CAT4 is a timed test administered online to classes of students. The researcher oversaw the administration of this test across year groups in this study, including giving the administrative instructions and ensuring that the students worked individually under test conditions. The test formed part of the school's regular assessment cycle. Students from Year Seven and Year Nine were tested once a year, providing information on the entry and exit to KS3. Senior leadership decided that students in Year Eight were not tested due to cost, both of the tests and the time taken to test all students. The mean is 100, indicating average performance, with a standard deviation of 15. The test was scored and conversion to standard scores was carried out online by the test provider (www.gl-assessment.co.uk/cat4).

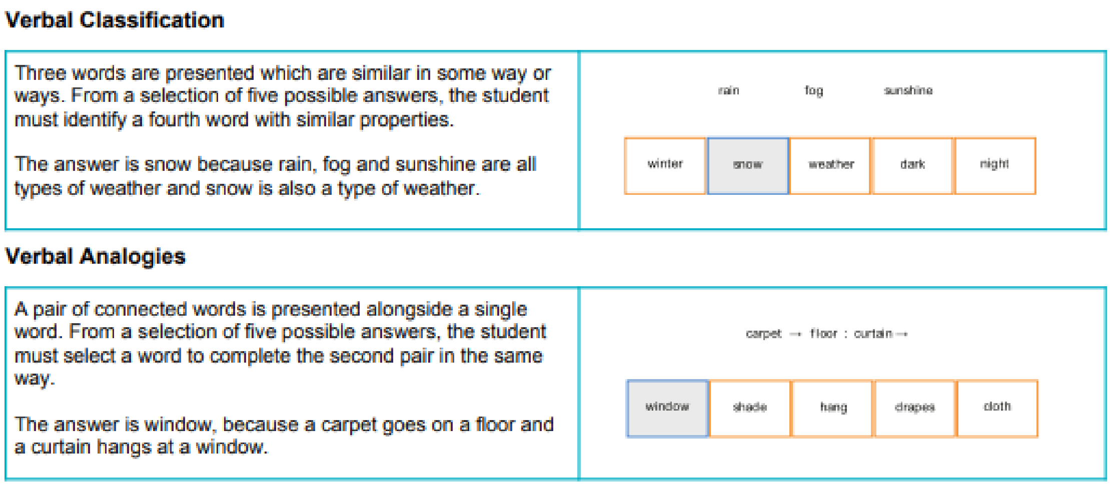
4.7.1.3.1 Verbal Reasoning Subtest

The verbal reasoning standard score of the CAT4 can be used as an indicator of a student's potential performance in the English Language GCSE. The correlation between these scores is 0.7 and offers evidence of the link between verbal reasoning ability and attainment in English (Smith, Fernandes & Strand, 2003). The verbal reasoning subsection of the CAT4 consists of two tests: verbal classification and verbal analogies. Although test administrators deem this to be a test of verbal ability, both tests are in written form. As students need to read the questions, it therefore also tests reading ability.

The verbal classification subtest measures the ability to make connections between words. Three words are presented in written form, which are similar in some way and the student must select a fourth word with similar properties from a choice of five possible answers. For example, rain, fog and sunshine are three given words and the student must select a fourth from winter, snow, weather, dark, night which shares properties with the words given from the first selection. The answer is 'snow' because rain, fog and sunshine, like snow, are all types of weather.

The verbal analogies subtest measures the ability to understand relationships between words. A pair of connected words is presented alongside a single word. From a selection of five possible answers, the student must select a word to complete the second pair in a similar way. For example, the pair,' carpet and floor' are given, with the single word- 'curtain' and the student is given a choice of 'window', 'shade', 'hang', 'drapes' and 'cloth' and is required to choose one word from this selection which mirrors the relationship of the first pair given. The answer is ‘window’ because a carpet goes on a floor and a curtain hangs at a window. (See Figure 4.2 for an example).

Figure 4.2 Example of Verbal Reasoning, CAT4 (2017, p5)



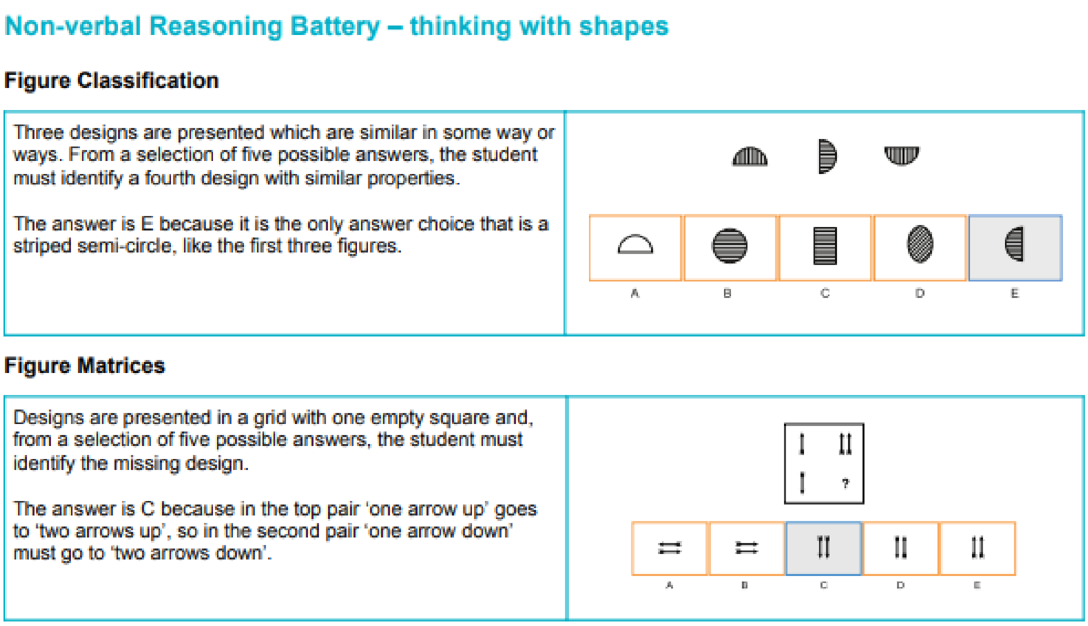
4.7.1.3.2 Non-Verbal Reasoning Subtest

The non-verbal reasoning standard score can be used as an indication of a student's ability to understand and assimilate information independent of language skills (Smith et al., 2003). The non-verbal subtest measures reasoning ability including identifying similarities and relationships, and using shapes and designs rather than words or numbers. Where performance on this test scores higher than on the verbal sections, it may either suggest potential that is not fully expressed in performance on school-related tasks or the presence of a language difficulty (Lohman and Smith, 2012). The authors claim that scores on this test may be useful in assessing the reasoning ability of students with poor English language skills, students with speech and language difficulties, or disaffected students who may have failed to achieve in academic work. The test consists of two sections: figure classification and figure matrices.

The figure classification subtest requires students to identify similarities based on the common characteristics of three given figures and choose the correct option from the five presented, which shares the same characteristics. For example, the three figures given could be three shaded semi-circles differently orientated and students must identify a fourth from a clear semi-circle, a shaded circle, a shaded rectangle, a shaded oval and a shaded semi-circle. The answer is the shaded semi-circle because it is the only choice that is the same as the first three figures.

The figure matrices subtest requires students to identify the relationship of the figures in the design or grid and from the five options presented, select the figure that shares the same relationship. For example, they may be presented with a sequence of arrows pointing in two directions and be asked to identify the direction of the missing arrow. (See Figure 4.3 for an example).

Figure 4.3 Example of Non-verbal Reasoning, CAT4 (2017, p6)



4.7.1.4 Reading comprehension

The New Group Reading Test (NGRT, Burge, Ager, Lynn, Styles, Cook and Rabiasz, 2014) assesses a range of reading comprehension skills and monitors reading progress up to the age of 16 years. It comprised of two sections: sentence completion and passage comprehension. The sentence completion section assesses a student's understanding of written vocabulary through reading an incomplete sentence and choosing the correct word from a choice of five words. Passage completion measures their ability to comprehend fiction and non-fiction passages using a range of skills such as inference, deduction and retrieval (Burge et al., 2014). The standard age score ranges from 60 to 140 with an average standard score of 100, and a standard deviation of 15. This standard score can be used as a benchmark against a national sample and allows objective progress to be tracked.

Students from Years Seven, Eight and Nine take the NGRT every year as part of the school's regular assessment cycle to provide information on students' reading comprehension abilities. The test is administered online to groups of students. The researcher oversaw the test organisation, giving the instructions and ensuring that the students worked individually under test conditions. The test was not timed and students were given as long as they needed for completion, normally between 30 to 50 minutes. The test was scored and conversion to standard scores was carried out online by the test provider (www.gl-assessment.co.uk/ngrt).

4.7.2 Additional standardised measures

4.7.2.1. Word reading

The Sight Word Efficiency subtest of the TOWRE2 (Torgesen, Wagner and Rashotte, 2012) was administered. This test assesses the number of sight vocabulary words that can be read fluently and automatically within 45 seconds. Although standardised in America, the list of words reflects the word lists within the new National Curriculum Framework (DFE, 2013). This subtest was chosen as it is quick to administer giving information on the fluency and accuracy of print-based word reading.

The subtest was individually administered by either the researcher or a member of staff trained by the researcher. The test was scored by the researcher and converted to scaled scores. The scaled scores range from 51 to 141; a standardised score of 100 is the average performance with a standard deviation of 15.

4.7.2.2 Recall and retrieval of spoken language

The Recalling Sentences subtest (RS) of the CELF4 (Semel, Wiig and Secord, 2006) was administered. This subtest measures the ability to remember and repeat sentence structures of varying length and syntactic complexity. Students tend to repeat the sentences based on their own language system and memory capacity (Semel et al., 2006); consequently, low scores can point to disordered language development. The ability to remember spoken sentences of increasing complexity for discussion or note-taking or understanding new subject knowledge is essential in the secondary classroom (Nippold & Scott, 2015). During testing, the students were asked to repeat sentences verbatim after listening to them being read out by the researcher. The administration and scoring followed manual guidelines.

4.7.2.3 Understanding spoken paragraphs

The Understanding Spoken Paragraph subtest (USP) of the CELF4, measuring the ability to listen to and understand oral narratives was administered (Semel et al., 2006). The test comprises of three paragraphs and five questions for each paragraph. All three paragraphs are administered and the questions assess if the student has understood the main idea of the paragraph, can remember details, the sequence of events and has the ability to make inferences and predictions. Listening to spoken material and applying thinking skills in order to learn and create new knowledge within the classroom is critical to academic attainment (Nippold and Scott, 2015). The simple view of reading highlights listening comprehension as a critical skill in reading comprehension (Gough and Tunmer, 1986) and this subtest was included as a measure of this skill. During testing, the students answered questions about orally read paragraphs. A trial paragraph was read out at a conversational speed followed by five questions. This was followed by three test paragraphs with five questions each. The administration and scoring followed manual guidelines. Both CELF4 subtests were scored by the researcher and converted to a scale with a mean of 10 and a standard deviation of 3.

4.8 Procedure

4.8.1 Routine school assessments

Teacher assessments of English, Mathematics and Science were taken under examination conditions in classrooms, marked by teachers and moderated internally within faculties at the end of every school half term (as per regular procedures).

The CAT4 (Lohman and Smith, 2014) and NGRT (Burge et al., 2014) were also part of the routine school assessment cycle; both are online assessments and took place in an information technology classroom in the first half of the spring term. The students were tested in groups, under exam conditions. The researcher routinely organised and supervised the online assessments.

4.8.2 Additional standardised measures

The TOWRE2 (Torgesen et al., 2012) and CELF4, (Semel et al., 2006) are individually administered tests. Students were withdrawn from an English lesson for testing purposes, and once assent was given, testing took place in one of two sound-proofed offices within the English Faculty. Testing point one started in January 2017 and was completed by the end of March 2017 during the spring term. Testing point two started in January 2018 and was completed by the end of March 2018, again during the spring term. Testing was either undertaken by the researcher or a member of staff trained by the researcher. In addition, a speech and language therapy student from Newcastle University trained by the researcher helped on one day during time one testing and tested 12 students. All testers followed the standard test administration directions.

All three measures were completed at the first meeting after assent was given and took from 20 minutes to 30 minutes depending on the interaction with the student. The three tests were completed within the same session and were administered in the same sequence. Students completed the word reading first, followed by the Recalling Sentences subtest, and then the Understanding Spoken Paragraphs subtest.

Testing point one started with students from the C7 group; students from the C8 group were tested during the same period if they had a class on the researcher's day of testing. Most C7 students were tested by February half term, 2017. The remaining C8 students and all of the students from the C9 group were tested in the second half term of the spring term, 2017. Students were withdrawn from the class in alphabetic order except in instances of non-attendance or behaviour.

Testing two followed the same format with assessments starting with students from the C8 group and finishing with the C9 group. Students were again withdrawn alphabetically unless attendance or behaviour dictated otherwise. Again, all three tests were completed within the same session and were presented in the same order.

4.8.3. Scoring of the assessments

4.8.3.1 Routine school assessments

Teacher assessments of English, Mathematics and Science were carried out and marked by class teachers. The assessments were based on the national curriculum for England taught in all local-authority-maintained schools. In 2017, the GCSE qualifications in English and Mathematics employed a new grading scale using numbers rather than letters to identify levels of performance. The qualifications reflect an 8-point scale, where 1 is equivalent to a Grade G up to 8, which is equivalent to a Grade A* in England (Office of Qualifications and Examination Regulations (Ofqual) 2018). To reflect the shift at national level, teachers at the mainstream secondary school chosen for the study, assessed all pupils from Year Seven to Year Eleven on the numerical point scale from September 2016. The retrospective pre-2017 data for C8 and C9 at the first testing point was converted to the new scaled grades (Appendix 4D).

School data was stored in the secure School Information Management System (SIMS) which holds legal registration of students, recording of achievements and documentation of public examinations.

4.8.3.2 Additional standardised language and literacy assessments

The TOWRE2 and the subtests Understanding Spoken Paragraphs and Recalling Sentences from the CELF4-UK are individually administered tests. The researcher scored the tests following the manual guidelines.

4.9. Validity of the assessments

4.9.1 Routine school assessments

The Key Stage Two (KS2) Statutory Assessment Tests are national tests designed by the Standards and Testing agency (STA) for the DFE in England. The test development and standard setting is regulated by the Office of Qualifications and Examinations Regulation in England. Secondary teacher assessments of English, Mathematics and Science are based on the requirements of the National Curriculum in England: framework for Key Stages One to Four (2013, DFE) The CAT4 and NGRT are standardised tests and the authors report that Cronbach's alpha was above 0.85, demonstrating good reliability which provides evidence of validity (Austin, 2014, p114)

4.9.2 Additional language and literacy assessments

Validity of the TOWRE2 (Torgesen et al., 2012) sight word efficiency subtest, as a measure of a student's ability to recognise familiar words accurately and fluently, is reported by the authors to be robust. Criterion-prediction validity measures the correlation of word reading efficiency from the TOWRE2 with other tests known to measure the same word reading skills. The average correlation coefficients of .95 demonstrates strong evidence of criterion prediction validity.

Construct-identification validity relates to how the test is constructed and performs. The relationship of word reading with reading comprehension and fluency based on Fisher's average of coefficients across samples shows an average concurrent correlation of .78. This indicates that the sight word efficiency subtest of the TOWRE2 is strongly related to concurrent measures of reading comprehension.

The CELF4 subtests have extensive evidence of validity as presented in the CELF4, Examiner's Manual (Semel et al., 2006). Standard error of measurement and confidence intervals based on critical values at 68%, 90%, and 95% are provided. Critical values for .15 and .05 levels of significance are given by age group.

4.10 Reliability of the assessments

4.10.1 Routine school assessments

All routine school assessments are taken under examination conditions in classrooms, marked by teachers and moderated internally within faculties as per regular procedures. Training and support is given to all teachers to ensure reliability of the assessments.

4.10.2 Additional language and literacy assessments

Test reliability on the TOWRE2 was based on 'alternate forms: delayed administration,' (Torgesen et al, 2012, p58) which reported on both content and time sampling. The average alternate-forms delayed-administration coefficient is 0.87 for Sight Word Efficiency providing evidence of the TOWRE2's strong reliability**.**

The researcher scored all three standardised language and literacy tests following clear guidelines for scoring from the manual, and before the start of testing practised scoring with a trained NHS speech and language therapist. Reliability of scoring was ensured through double-marking of 10% of the three language tests, at both time points, by a NHS speech and language therapist not connected with the study. Forty-five students' test scores were double-marked at the first testing point and 32 students' tests the following year, with the first four surnames selected from each of the 18 tutor classes. There was strong agreement between the two scorers, suggesting that the scoring was reliable. At the first testing point, no disagreements were seen on 45 sets of the TOWRE2, single word reading or on the 675 answers of the CELF4 USP subtest. Four scoring errors and two disagreements relating to dialect were evident on the 1440 sentences of the CELF4 RS leading to a Kappa Measurement Agreement of 1.0 with a significance of $p < .001$. At the second testing point, there were no errors or disagreements on the scoring of the TOWRE2, single word reading or CELF4 USP subtest; with one scoring error on CELF4 RS subtest. All disagreements were resolved following discussion between the researcher and the NHS speech and language therapist.

4.11 Assessment time line

The Reading Statutory Assessment Tasks (SATs) are sat at the end of Year 6 and the student scores formed part of the retrospective data collection.

The first testing point contained the routinely collected academic data from Years Seven, Eight and Nine split over two time points: the end of the autumn and summer terms. The Cognitive Assessments Tests (CAT4, Lohman and Smith, 2014) and New Group Reading Tests (NGRT, Burge et al., 2014) were carried out once at the beginning of the spring term. Table 4.6 sets out the timeline for the academic assessments. Additional language and literacy data collected by the researcher provided information on listening skills and oral comprehension. These assessments were also carried out over the spring term.

A second data testing point one year later collected the routine data comprising of teacher assessment for English, Mathematics and Science, cognitive assessments and the Group Reading Test for two Year groups (C7+1 and C8+1) and provided the longitudinal data to explore growth and stability of performance and predictive relationships between variables. Data from the test of Word Reading Accuracy (TOWRE2), USP and RS subtests (CELF4-UK) was collected again in the spring term.

English, Mathematics and Science GCSE attainment was collected for the C9 cohort when they were in Year Eleven. Due to the impact of the Coronavirus pandemic (COVID-19) on school testing, GCSE results were not collected for the C8 and C7 cohorts.

4.12 Statistical analysis

All statistical analyses were performed using the statistical package IBM SPSS for Windows (version 25) and jamovi v3.3.2.0. (jamovi project, 2021).

4.12.1 Data screening

A process of data cleaning was carried out after all the data had been entered and before any data analysis was performed. The range of scores for each continuous variable was examined to check that they fell within the possible ranges for each subtest. Missing data was identified using the code '999' and was used on occasions when a student was absent for the assessments, or with the case of retrospective data if the student had not yet arrived at the school. The code '777' was used for students who left during the 2-year longitudinal study. The code '666' was used for those students who had no data due to the fact they had been excluded for a period of time and the code '555' was used for students who were being educated offsite. Any potential errors in the data were corrected where necessary during the cleaning process.

4.12.2 Organisation of data

Student data was organised into two formats within SPSS: wide and long. In the wide format, each participant's repeated assessment measures were in a single row, with each measure in a separate column. This allowed analysis of the data at the student level and was used in descriptive analysis and in research questions 1,3,4, and 5. **Cohort data** used data from the three cohorts (C7, C8 and C9) and was used to describe and analyse the longitudinal performances over 2 timepoints for research question 1. **Year group data** used retrospective and prospective data from the three cohorts to show attainment when students were in their first, second and third year of secondary education. This allowed the tracking of the three cohorts through three years in education.

In the long format, data was viewed as hierarchical with the measures nested within the individual students within classes. Each participant had six rows of data, with each row representing a single assessment time point. The six rows contained the six academic assessment points: the end and beginning of the three Years Seven, Eight and Nine. A two-level multilevel regression model was used to examine any differences in development between groups of participating students over the first three years of secondary education.

4.12.3 Data analysis

Descriptive analysis of the data is presented in Chapter Five. The approach to data analysis for each research question is outlined below and detailed in relevant sections of Chapter Six.

Research question one (RQ1) looked for any differences in the three cohorts at the time of recruitment; how they performed on measures of language, reading and teacher assessed (TA) English, and if there were any differences in the two cohorts the following year (C7+1; C8+1). Group differences were analysed using one-way-between groups ANOVAs. In RQ2, multilevel modelling was used as set out by Heck et al., (2014). For RQ3, standard multiple regression was used to assess which measure made the strongest contribution to reading comprehension. Hierarchical multiple regression was used in RQ4 to investigate the predictors of reading comprehension and academic outcomes in secondary aged adolescents. Finally, mediation analysis was performed for RQ5 to assess the extent to which language skills (CAT- verbal, CELF4 recalling sentences, CELF4 understanding spoken paragraphs), single word reading (TOWRE2), socio-economic status (IDACI) and cognitive abilities (CAT-overall, and CAT – non-verbal subtest) influence reading comprehension.

Effect sizes are described using *partial eta squared* or *Cohen's d*. Partial eta squared values indicating the proportion of variance of the dependent variable explained by the independent variable, range from 0.01 (small) to 0.06 (medium) to 0.14 (large) effect size. Cohen's d presenting the difference between groups in terms of standard deviation units ranges from 0.2 (small) to 0.5 (medium) to 0.8 (large) effect size (Pallant, 2016). The p-value set for each analysis is 0.01 to reduce any false-positive findings due to the number of calculations in the study.

4.13 Summary

This chapter has described the methodology for the study. The aim of the study was firstly to understand the influence of oral language on reading comprehension, and secondly to understand the relationships between oral language, reading comprehension and academic attainment in early adolescence. In order to answer these questions, adolescents' language and literacy performances over time are explored; student differences, based on gender, SEN and deprivation that may explain performance are analysed; predictors of reading comprehension and academic outcomes are examined and finally the extent to which the measures explain the relationship between oral language, reading comprehension and academic attainment in early adolescence are reported.

Four hundred and forty-three students formed the sample. At the time of recruitment, the students were known as the C7, C8 and C9 cohorts. The data was collected at two time points over two years. GCSE results were collected for one cohort (C9) two years after time point two. Retrospective routine school data was collected for both the C8 cohort and C9 cohort. This allowed the three cohorts to be tracked longitudinally through school years seven, eight and nine, known collectively as Key Stage Three (KS3).

Routine data collected by the school comprised the end of primary education, SATs in Reading and in secondary education: teacher assessments in English, Maths and Science; the CAT-4, (Lohman and Smith, 2012); the NGRT, (Burge et al., 2014) and GCSE results. Additional language and literacy data collected by the researcher (for the purpose of the study) was obtained through the TOWRE2, (Torgesen et al., 2012) alongside the RS and USP subtests, (CELF4-UK, Semel et al., 2006). Appendix 4.E shows the measures used in the study.

The results are reported in Chapters Five and Six.

Chapter Five

Results from descriptive statistics

5.0 Overview

This chapter describes the student sample used in the study; how they performed academically over time and their word reading and oral language ability measured over two academic school years. The study employed a mixed study design examining cross sectional, longitudinal and retrospective data across Key Stage 3 (KS3). Four-hundred and forty-three students, aged 11 – 14 years, from one mainstream secondary school in the North East of the UK, participated in the study. The term '**cohort**' describes the group of participants and the term '**year'** indicates their stage of education.

At the point of recruitment, the participants were in three cohorts, Year Seven (C7), Year Eight (C8) and Year Nine (C9) spanning the first three academic years of secondary education. Routine school data of reading comprehension, cognitive ability and academic attainment (English, Mathematics and Science) was collected for the three cohorts (C7, C8 and C9), alongside assessments of their word reading ability and oral language skills.

Following the year of recruitment, routine school assessments, the word reading and language assessments were carried out for the C7 cohort who had moved into Year Eight, (C7+1) and for the C8 cohort who had moved into Year Nine, (C8+1). Retrospective school data for the C8 and C9 cohorts, when they were in previous year groups, was also collected (C8-1, n=154; C9 -1, n=114; C9-2 n=112). This data was analysed to compare whether each cohort met age-related expectations.

Section 5.1 describes the characteristics of the overall sample (KS3) and for the three cohorts at the year of recruitment. Age, gender, special educational needs (SEN) status and socio-economic indicators are reported. The language and literacy attainment is described for male and female students, students with SEN and students living in different socio-economic areas.

Section 5.2 presents the academic performance of the cohorts over time, including their end of primary school attainment in reading. Section 5.3 includes, the results of the routine school measures from the Cognitive Ability Tests (CAT4, Lohman and Smith, 2012) and the New Group Reading Tests (NGRT, Burge et al., 2014). The results from the single-word reading test (TOWRE2, Torgesen et al., 2012) and oral language measures (CELF4, Semel et al., 2006, Recalling Sentences (RS) and Understanding Spoken Paragraphs (USP) subtests) are presented in sections 5.4 and 5.5 respectively. Results are summarised in section 5.6.

5.1 Description of the Mainstream Secondary-age Students in the Sample

5.1.1 Sample characteristics

Four hundred and forty-three students comprise the sample, with ages ranging from 11 years and three months to 14 years and five months at the start of the study. At the year of recruitment, a cohort of 159 students were in Year Seven, and are referred to as the C7 cohort; 158 were in Year Eight, referred to as the C8 cohort and 126 were in Year Nine, referred to as the C9 cohort.

5.1.2 Age at recruitment

Table 5.1 shows the average age of students at recruitment, and the year after for the C7 cohort who had moved into Year Eight, (C7+1, n=142) and for the C8 cohort who had moved into Year Nine, (Y8+1, n=140). The average age at recruitment was 11 years and nine months (SD 3.95 months) at C7; 12 years and nine months (SD 3.58 months) at C8 and 14 years (SD 3.65 months) at C9. Retrospective school data indicated that the average age for students in corresponding years, was similar.

Table 5.1. Average age of students at the academic year of recruitment and one year later

Year *Year of recruitment*	Cohort number, Average Age (Standard Deviation) and Number of Pupils		
	Year Seven	**Year Eight**	**Year Nine**
2016 – 17 *Year of Recruitment*	C7,11;9yr (SD 3.77) n=159	C8, 12;89yr (SD 3.58) n= 158	C9, 14;0yr (SD 3.65) n=126
2017 – 18 *1 year later*		C7+1 cohort, 12;85yr (SD 3.54) n= 142	C8+1 cohort 13;93yr (SD 3.53) n= 140

Key: SD – Standard Deviation; C= Cohort

5.1.3 Gender

Table 5.2 presents the gender distribution of the overall sample and for each cohort. In the overall sample, there were 236 males (53%) and 207 females (47%). Chi-square test for goodness of fit indicates that the proportion of males in the overall sample and across cohorts, was not statistically significantly different from the proportion (51%) recorded in the DFE Education Census for students aged 11- 15 years attending English Secondary Schools (DFE, 2017).

Table 5.2 Proportion of males and females in the sample compared to English secondary schools, 2017

Students	Gender			
	Actual number of males & females in the sample (%)	**Expected number based on English secondary schools (%)**	**Chi-Square value**	**P value**
Overall sample	M= 236 (53%) F = 207 (47%) Total = 443	M= 226 (51%) F= 217 (49%)	.916	.339
C7 cohort	M = 82 (52%) F = 77 (48%) Total = 159	M=81 (51%) F =78 (49%)	.021	.885

Students	Gender			
	Actual number of males & females in the sample (%)	**Expected number based on English secondary schools (%)**	**Chi-Square value**	**P value**
C8 cohort	M = 86 (54%) F = 72 (46%) Total = 158	M= 81 (51%) F=77 (49%)	.744	.388
C9 cohort	M = 68 (54%) F = 58 (46%) Total = 126	M= 64 (51%) F=62 (49%)	.444	.505

Key: C – cohort, M- male, F - female

Descriptive statistics using data from the time of recruitment showed there was no difference in the language and literacy levels between males and females. Table 5.3 presents language and literacy data from the overall sample indicating that both male and female students appeared to perform in a similar manner. Inferential statistics are reported in Chapter Six.

Table 5.3. Comparison of language and literacy attainment by gender

Measures	Gender	
	Male students	**Female students**
Reading Comprehension (NGRT) SS=100: SD =15	95.15 (SD 16.78)	97.56 (SD 15.19)
Single-Word Reading (TOWRE2) SS=100: SD =15	95.47 (SD 14.93)	95.51 (SD 13.16)
English Attainment Raw score based on teacher assessment *	6.28 (SD 2.80)	6.93 (SD 2.69)
CAT4-overall (Y7 & Y9) SS=100: SD =15	90.98 (SD 12.04)	90.45 (SD 10.89)
CAT4- verbal (Y7 & Y9) SS=100: SD =15	91.20 (SD 13.06)	90.89 (SD 13.33)
CAT4-non-verbal (Y7 & Y9) SS=100: SD =15	89.58 (SD 14.21)	89.64 (SD 12.70)
Recalling Sentences (CELF4-RS) SS=10: SD =3	7.80 (SD 2.73)	8.14 (SD 3.17)
Understanding Spoken Paragraphs (CELF4-USP) SS=10: SD =3	6.28 (SD 3.56)	5.78 (SD 3.40)

Key: SS = Standard Score; SD = Standard Deviation; NGRT = New Group Reading Test; CAT4 = Cognitive Abilities Test; Y7 = Year 7 cohort; Y9 = Y9 cohort

*School predictor performance scores in English Attainment range from 0-20 (a raw score of 5 = the KS2 scaled score of 100 – 103; a raw score of 13 = GCSE Band 4; a raw score of 16 = GCSE Band 5)

5.1.4 Special Educational Needs (SEN)

Schools identify students with a special educational need (SEN) based on factors affecting their educational performances. One in four students from the overall sample had a special educational need (SEN) as identified by the school (n=111). Ninety-one percent (n=101) of those, required support in the classroom with 9% (n=10) having an Educational Health Care Plan (EHCP) The overall percentage of students identified as SEN (25%) was significantly higher than the national average of 10.7% for state funded secondary schools, as reported by the Department for Education, (DFE, 2017). Table 5.4 presents a chi-square goodness-of-fit test showing a significant difference in the proportion of SEN students identified in the current sample (25%) as compared with the national average of 10.7% (DFE, 2017), x^2(df =1, n= 443) = 95.557, p<0.001. Sixty-four more students are recorded as having SEN than expected nationally, based on the DFE 'Special educational needs in England: January 2017', for students attending English Secondary Schools (DFE, 2017: SFR 37/2017).

Table 5.4 Proportion of SEN and Non-SEN students in the sample compared to English secondary schools, 2017

Students	Actual number of SEN & Non-SEN in the sample (%)	Expected number based on English secondary schools (%)	Chi-Square (df=1)	P value
Overall sample	SEN= 111 (25%) Non-SEN= 332 (47%) Total = 443	SEN = 47 (10.61%) Non-SEN= 396 (89.4%)	95.56	<0.001

Key: SEN – Special Educational Needs

Schools use school data to support the identification of students with SEN. Table 5.5 presents the school data for those students identified as having SEN compared to the students within the sample without SEN. As a group, students with SEN performed below the expected standard in reading comprehension and English attainment. Performance in the overall CAT4 and the CAT4 non-verbal subtest was also below average but it must be remembered that these tests are read online and so depend on a level of reading comprehension to access the test format. It therefore appears that students who struggled with reading were also identified as students with SEN via an assessment relying on reading.

Table 5.5. Performance on School Data between students with and without SEN

School measures	Students with an identified special educational need, n=101 Mean (SD)		Students without an identified educational need, n=332 Mean (SD)
Reading comprehension (NGRT) SS = 100; SD =15	Classroom support	84.87 (SD 15.64)	101.04 (SD 14.33)
	EHCP	80.10 (SD 14.53)	
English Attainment Raw score based on teacher assessment*	Classroom support	3.90 (SD1.60)	5.21 (SD 1.62)
	EHCP	3.40 (SD 1.58)	
CAT4-overall (C7, C8-1, C9) SS = 100; SD =15	Classroom support	84.74 (SD 10.54)	93.84 (SD 10.84)
	EHCP	80.00 (SD 6.43)	
CAT4-verbal (C7, C8-1, C9) SS = 100; SD =15	Classroom support	85.33 (SD 13.36)	94.10 (SD 12.29)
	EHCP	80.70 (SD 7.41)	
CAT4-non-verbal (C7, C8-1, C9) SS = 100; SD =15	Classroom support	84.14 (SD 12.27)	93.26 (13.33)
	EHCP	81.10 (SD 8.80)	

Key: SS = Standard Score; SD = Standard Deviation; NGRT = New Group Reading Test; CAT4 = Cognitive Abilities Test; CAT4- verbal = verbal reasoning subtest; CAT4 non-verbal – subtest; EHCP = Educational Health Care Plan

*School predictor performance scores in English Attainment range from 0-20 (a raw score of 5 = the KS2 scaled score of 100 – 103; a raw score of 13 = GCSE Band 4; a raw score of 16 = GCSE Band 5)

Table 5.6 compares the students identified by the school as having SEN to those students without SEN on the additional language and literacy measures used in the study. It can be seen that SEN students requiring classroom support (but not those with an EHCP) and their non-SEN peers achieved age-related expectations for single-word reading, with both groups falling into the confidence values of 15 SD from the mean. Although the SEN group were performing at low-average, this shows that as a group they could read single words out of context at an age appropriate level. However, in contrast to this, the SEN students struggled with reading comprehension, performing significantly below age level (table 5.5). As a group, SEN students performed below their expected age range for both RS and USP subtests showing evidence of language difficulties, not identified by routine school assessments.

Table 5.6. Comparison of single-word reading (TOWRE2) and language (CELF4) scores for students with and without special educational needs (SEN)

Measures	**Students identified with a special educational need Mean (SD) n=101**		**Students without an educational need Mean (SD) n=332**
TOWRE2 SS=100; SD = 15	Classroom support	86.72(SD 13.90)	98.52 (SD 12.86)
	EHCP	83.60 (SD 14.37)	
CELF4-RS SS=10; SD = 3	Classroom support	6.28 (SD 2.93)	8.58 (SD 2.65)
	EHCP	4.50 (SD 3.60)	
CELF4-USP SS = 10; SD = 3	Classroom support	5.54 (SD 3.49)	6.20 (SD 3.44)
	EHCP	5.90 (SD 4.93)	

Key; SS = Standard Score; SD = Standard Deviation; TOWRE2 = Test of Word Reading Efficiency; CELF4-RS =Clinical Evaluation of Language Fundamentals, Recalling Sentences; CELF4-USP = Clinical Evaluation of Language Fundamentals, Understanding Spoken Paragraphs

Table 5.7 presents SEN by gender. SEN was more prevalent in males than females, a finding that has been reported nationally in the Department for Education's statistical release of Special Educational Needs in England 2017 (DFE 2017). A chi-square test for independence (with Yates' Continuity Correction) indicated a significant association between gender and SEN in this sample, x^2 (1, n= 443) = 8.63, p = .003, *phi* = -.145. This shows that males are more likely to be identified with SEN than females.

Table 5.7. Observed Frequencies, Percentages, Values and Chi-square test for independence for SEN and gender

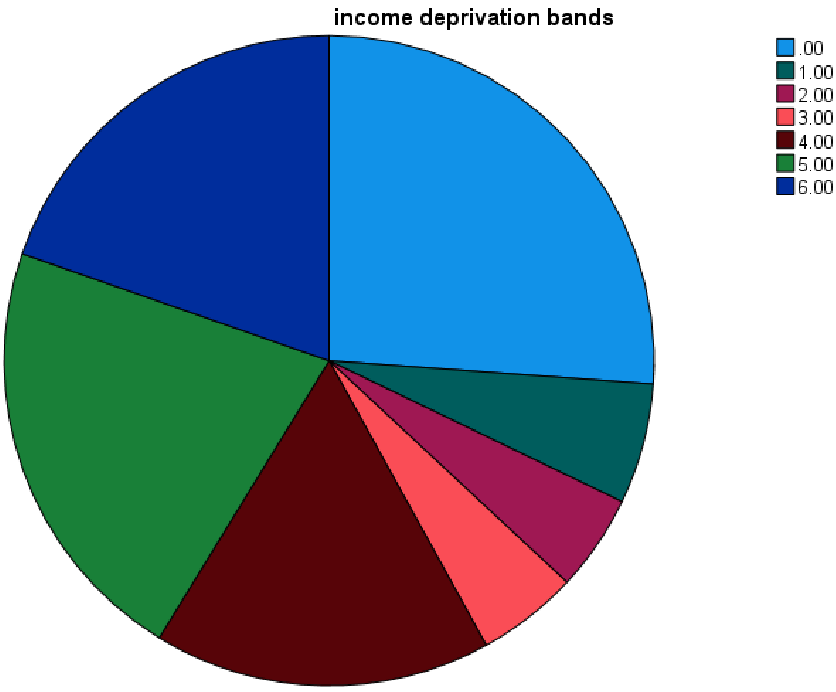
Gender	Number and % of students with SEN	Chi-Square value	Test for Independence
Male (National % of males with SEN = 14.6%)	n=73 (30.9%)	8.628	0.003
Female (National % of females with SEN = 8.1%)	n= 38 (18.4%)		
Total of students with SEN in the sample (National % = 10.7%)	n= 111 (25.1%)		

Key: SEN = Special educational needs

5.1.5 Socio-economic indicators

Figure 5.1 shows the proportions of the participants' IDACI scores based on the associated IDACI bands. IDACI scores were used in this study as the measure of socio-economic status. The data showed that the proportion of students living in income-deprived households varied across the sample. Twenty-six students (6%) had no IDACI postcode as they were living in new houses still to be allocated an IDACI score. Of the students with an IDACI score, 25% (n=109) showed very little deprivation, 31% (n=136) showed moderate levels of deprivation and 38% (n=172) showed high or significant deprivation. The mix of postcode data reflects the different neighbourhoods of the 5 feeder primary schools.

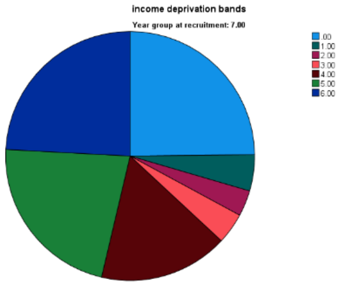
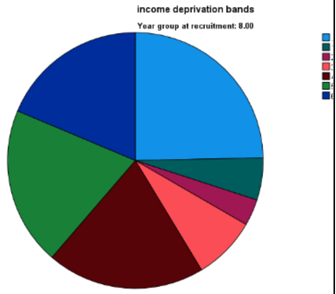
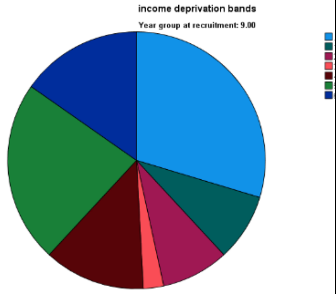
Figure 5.1. Proportion of IDACI band values (overall number and percentage) across the sample indicating levels of deprivation



Key: IDACI - Income Deprivation Affecting Children Index; Band 0 = very little deprivation (n=109, 25%); Band 1 =10% deprivation (n=25, 6%); Band 2 = 20% deprivation (n=20, 4%); Band 3 = 30% deprivation (n=21, 5%); Band 4 = 40% deprivation (n=70, 16%) and significant deprivation, Band 5 (n=90, 20%) and Band 6 (n=82, 18%).

Figure 5.2 compares the proportion of IDACI band values (overall number and percentage) across the cohorts indicating similar levels of deprivation.

Figure 5.2 Proportion of IDACI band values (overall number and percentage) across the cohorts indicating levels of deprivation

<table>
<tr><th>Y7</th><th>Y8</th><th>Y9</th></tr>
<tr>
<td>
</td>
<td>
</td>
<td>
</td>
</tr>
<tr>
<td>Band 0: n= 37, 23%
Band 1: n=7, 4%
Band 2: n=5, 3%
Band 3: n=6, 4%
Band 4: n= 25, 16%
Band 5: n=33, 21%
Band 6: n=36, 23%

No IDACI band: n=10, 6%</td>
<td>Band 0: n= 37 23%
Band 1: n=8, 5%
Band 2: n=5, 3%
Band 3: n=12, 8%
Band 4: n=30, 19%
Band 5: n=30, 19%
Band 6: n=28, 18%

No IDACI band: n=8, 5%</td>
<td>Band 0: n= 35 28%
Band 1: n=10, 8%
Band 2: n=10, 8%
Band 3: n=3, 2%
Band 4: n=15, 12%
Band 5: n=27, 22%
Band 6: n=18, 14%

No IDACI band: n=8, 6%</td>
</tr>
</table>

Key: IDACI - Income Deprivation Affecting Children Index; Band 0 - very little deprivation; Band 1 - 10% deprivation Band 2 -20% deprivation Band 3 - 30% deprivation (n=21, 5%); Band 4 -40% deprivation; significant deprivation, Band 5 and Band 6.

5.1.6 Proportion of students leaving the study

Table 5.8 presents the demographic summary of students who left the study. Overall, 10% of students (n=44) left the sample (refer to the flow chart Figure 4.1). Of those who left, 28 (64%) were male and 22 (50%) had SEN. Twenty-one (48%) lived in significant deprivation (band 5, n=4 and band 6, n= 17).

Just over half of the students who left (n=23), moved to another school. The remaining 21 students left due to exclusion for behaviour or to be educated in a pupil referral unit (PRU). A chi-square test for independence (with Yates's Continuity Correction) indicated no significant association between gender and reasons for moving school, x^2 (1, 44) = 1.797, p = 0.180, *phi* = -0.249; SEN with leaving school, x^2(1, 44) =1.458, p =.0.227, *phi* = .131 or levels of deprivation, with leaving school, x^2(5,38) = 5.259, p= 0.385, *phi* = 0.372.

Table 5.8. Demographic summary of students who left the school during the study

Student sample	**Reason for leaving the school**				
	Number who were excluded/educated off-site (% of the students who left)	**Number who moved to another school (% of the students who left)**	**Chi-Square value**	**Significance**	**Effect size *phi***
Number who left	21(48%)	23 (52%)			
Gender	16 males 5 females	12 males 11 females	1.797	0.180	0.249
Identified with SEN	13	9	1.458	0.227	0.131
IDACI	Bands 0-2 = 4 Bands 3-4= 3 Bands 5-6= 12 Missing = 2	Bands 0-2 = 6 Bands 3-4 = 4 Bands 5-6 = 9 Missing = 4	5.259	0.385	0.372

Key: SEN = Special Educational Needs; IDACI = Income Deprivation Affecting Children Index with bands 5-6 representing the most significant deprivation.

5.1.7 Summary of the student characteristics in the study sample

Four hundred and forty-three students took part in the study. The average age of students in Y7 was 11 years and 9 months; 12 years and 9 months at Y8 and 14 years at Y9. Fifty-three percent of the overall sample were male (n=236); a proportion not statistically different from the national proportion of 51% (DFE, Education Census 2017).

The overall percentage of students identified as SEN (25%) was significantly higher than the national average of 10.7% for state funded secondary schools (DFE, 2017). Ninety-one percent (n=101) of those identified with SEN, require support in the classroom with 9% (n=10) having an EHCP. SEN was significantly more prevalent in males than females in this sample, indicating that males are more likely to be assessed with SEN than females.

Socio-economic background based on IDACI bands showed that the proportion of students living in income-deprived households varied across the sample. Twenty-six students (6%) had no IDACI postcode as they were living in new houses still to be allocated an IDACI score. Of the students with an IDACI score, 25% (n=109) showed very little deprivation, 31% (n=136) showed moderate levels of deprivation and 38% (n=172) showed high or significant deprivation.

By the end of the two-year data collection, 10% of the sample had left. Just over half of the students who left (n=23), moved to another school. The remaining 21 students left due to exclusion for behaviour or to be educated in a pupil referral unit.

5.2 Academic achievement of the three cohorts: C7, C8 and C9

Section 5.2 describes the academic achievement of the three cohorts as they moved through their respective academic years. Section 5.2.1 describes the end of primary assessment for students in the sample (retrospective data). Section 5.2.2 describes the academic data for the 3 cohorts (C7, C8 and C9) at the point of recruitment (cross sectional data) and for two cohorts as they move into the next academic year (C7+1; C8+1) (prospective data).

5.2.1 End of primary attainment for reading

Table 5.9 shows end of primary attainment for reading for cohorts C7, C8 and C9. Primary education is completed by Year Six and is assessed by the KS2 SATs. The C7 cohort were assessed on the 2016 SATs which were the first to assess the 'new, more rigorous' national curriculum introduced in 2014, (DFE, 2016, p.23). The 2016 KS2 SATs were designed to reflect the Department for Education's drive for 'higher national standards' (DFE 2013, p1). The C8 and C9 cohorts were assessed on the 2015 and 2014 KS2 SATs respectively, which reflected the 2000 National Curriculum (Department for Education and Skills, 1999) using the previous national curriculum levels of attainment**.**

The reading achievement for cohorts C8 and C9 was in line with national expectations, with attainment at a level 4b. In comparison, fewer students in the C7 cohort achieved the new national score of 100 (equivalent to a 4b; DFE, 2016) in 2016 indicating it was a weaker cohort or were assessed with the more rigorous assessment.

Table 5.9. End of primary attainment for reading for cohorts C7, C8 and C9 at time of recruitment

Cohort	Year of sitting the Year Six SAT	End of primary reading attainment measured by Reading Statutory Assessment Test (SAT)		
		National standard	Study Sample	Difference
C7	**2016**	66% achieved a scaled score of 100+, national expected standard	51.3% achieved a scaled score of 100+	-14.7% below national
C8	**2015**	80% achieved 4b+, national expected standard	78.4% achieved 4b+	-1.6% below national
C9	**2014**	78% achieved 4b+, national expected standard	79% achieved 4b+	+1.4% above national

Key: C7 = C7 cohort; C8 = C8 cohort; C9 = C9 cohort

5.2.2 Teacher assessed academic data

Academic scores for English, Maths and Science, were based on teacher assessment (TA) at the end of the autumn and summer school terms. Table 5.10 presents the mean scores for the academic data (end of autumn and summer terms) for the three cohorts at the year of recruitment, and for two cohorts when they progressed into the next academic year, the following year (C7+1, C8+1).

These TA raw scores are used by the school to track students' progress from the end of Year Six, when the KS2 SATs in Reading and Mathematics are taken, at the end of compulsory education. The progress of students, along with their attainment at GCSE, are the main measures of secondary schools' performance. 'Progress 8' was introduced by the Government in 2016 (DFE 2016) and compares students' KS4, GCSE results to those of other students nationally with similar prior attainment at KS2. Hence, students leaving primary education with a scaled score of 100 (or 4b) would be expected to achieve a TA score of 7 by the end of Year Seven; 9 by the end of Year Eight and 11 by the end of Year Nine to be on track for average progress towards gaining a GCSE Band 5 pass. This progress is monitored by all mainstream secondary schools in England. (See Appendix 5A).

In the current study, as students moved through their year group and key stage, academic performance based on TA raw scores towards GCSE outcomes increased suggesting that students demonstrated an increasing understanding of the taught curriculum. Longitudinal achievement of the cohorts showed English and Mathematics teacher assessments to be consistent with the retrospective data across year groups. (See Appendix 5B).

Table 5.10. Longitudinal teacher assessed mean academic performance from the autumn to summer term for the year of recruitment, and the following year

Two-year longitudinal study comparing performance across three cohorts (Y7, Y8 and Y9) and three academic school years							
School year	Key Stage 3						Study design
	Year Seven		Year Eight		Year Nine		
Cohort	Cohort C7		Cohort C8		Cohort C9		
First testing point	Autumn TA score (SD) number of students	Summer TA score (SD) number of students	Autumn TA score (SD) number of students	Summer TA score (SD) number of students	Autumn TA score (SD) number of students	Summer TA score (SD) number of students	cross sectional
English	4.33 (1.91) n=159	5.52 (2.34) n= 150	7.06 (2.17) n=152	8.50 (2.65) n= 147	8.62 (2.37) n= 125	10.34 (3.15) n= 125	
Mathematics	5.11 (1.47) n= 159	6.46 (2.05) n= 142	7.33 (2.42) n= 152	8.51 (2.81) n= 146	9.37 (3.26) n= 126	10.34 (3.51) n= 125	
Science	4.87 (1.21) n= 159	6.08 (1.87) n= 143	6.81 (2.15) n= 152	9.87 (2.79) n= 145	7.78 (3.08) n= 124	9.49 (4.00) n= 123	
2nd testing point			**C7+1**		**C8+1**		longitudinal
			Autumn TA score (SD) number of students	Summer TA score (SD) number of students	Autumn TA score (SD) number of students	Summer TA score (SD) number of students	
English			6.22 (2.41) n =143	7.59 (2.37) n= 138	8.62 (2.46) n= 139	9.67 (2.92) n= 140	
Mathematics			6.89 (2.48) n= 144	8.11 (2.80) n=138	9.0 (2.94) n= 139	10.02 (3.50) n= 138	
Science			7.74 (3.88) n=143	8.29 (3.95) n= 139	10.84 (2.86) n= 140	12.34 (2.95) n= 136	

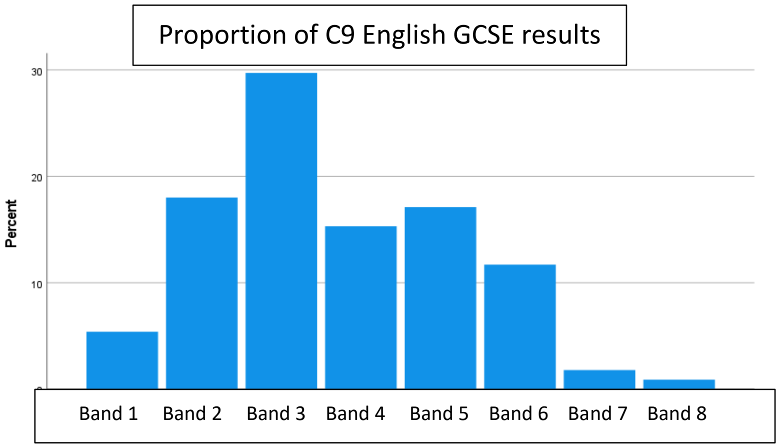
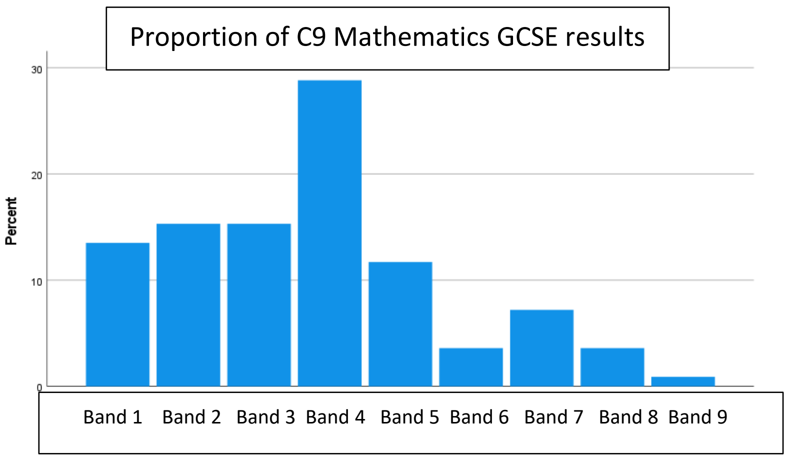
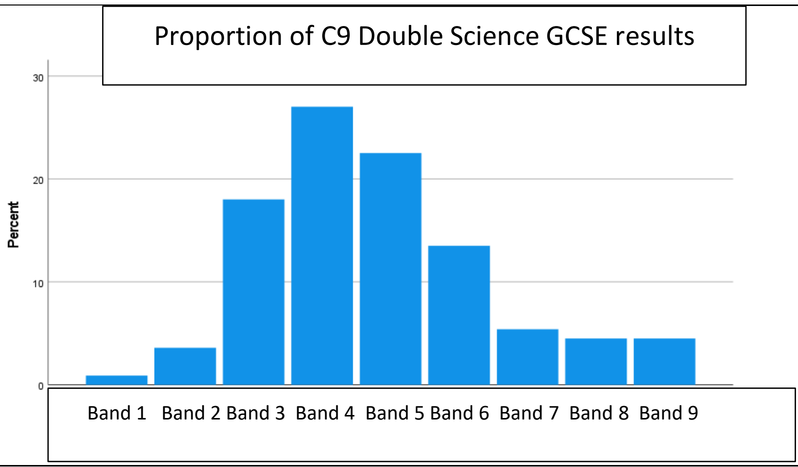
Key: TA = SD = Standard deviation: *School predictor performance scores in English Attainment range from 0-20 (a raw score of 5 = the KS2 scaled score of 100 – 103; a raw score of 7 expected by end of Y7; a raw score of 9 by the end of Y8; a raw score of 11 by the end of Y9: 13 = GCSE Band 4; 16 = GCSE Band 5)

5.2.3 Academic outcomes for the C9 cohort at Year Eleven, end of compulsory education, England

The General Certificate of Secondary Education (GCSE) is an academic qualification sat by students in Year Eleven, aged on average 16 years of age, marking the end of compulsory education in England. One hundred and eleven students from the C9 cohort sat the academic external examinations in 2019, two years after the data collection concluded. Fifteen students left from the original sample of 126. The results reflect the changes to the GCSE qualifications. In 2019, changes to the GCSE grading system replaced A* to G grades with bands nine to one (Ofqual, 2018). Band nine is equivalent to an A* and band one to G. Band five is described as 'strong pass' and Band four as a 'standard pass' (DFE, 2019).

Results showed the C9 cohort achieved outcomes below the National and County average performances in both English and Mathematics. At English GCSE, 46.8% achieved Band Four as opposed to the national average of 70.5% and the county average of 67.9%. At Mathematics GCSE, 55.85% achieved a Band Four opposed to the national average of 71.5% and the county average of 71.9% (See Figure 5.3).

Figure 5.3 Distribution of the General Certificate of Secondary Education (GCSE) results for the 9C cohort

<table>
<tr><th rowspan="2">C9 General Certificate of Secondary Education outcomes</th><th colspan="3">% Comparison (2019*)</th></tr>
<tr><th>Pass</th><th>National level %</th><th>County level %</th></tr>
<tr><td rowspan="4">
</td><td>Band 9</td><td>2.8</td><td>2.7</td></tr>
<tr><td>Band 7</td><td>17.4</td><td>15.5</td></tr>
<tr><td>Band 5</td><td>53.4</td><td>49.7</td></tr>
<tr><td>Band 4</td><td>70.5</td><td>67.9%</td></tr>
<tr><td rowspan="4">
</td><td>Band 9</td><td>3.7</td><td>3.3</td></tr>
<tr><td>Band 7</td><td>20.4</td><td>18.6</td></tr>
<tr><td>Band 5</td><td>50.1</td><td>50.1</td></tr>
<tr><td>Band 4</td><td>71.5</td><td>71.9</td></tr>
<tr><td rowspan="4">
</td><td>Band 9</td><td>0.9</td><td rowspan="4">County results not published</td></tr>
<tr><td>Band 7</td><td>4.4</td></tr>
<tr><td>Band 5</td><td>17.7</td></tr>
<tr><td>Band 4</td><td>4.4</td></tr>
</table>

*Reference: *national comparison figures and county comparison figures downloaded: [Map of GCSE (9 to 1) grade outcomes by county in England (ofqual.gov.uk)]*
*** Reference: [GCSE results 2019: How many people passed double science (schoolsweek.co.uk)]*

5.3 Routine standardised school measures of cognitive ability and reading comprehension

The school annually assesses all students entering secondary (Year Seven) and leaving Key Stage Three (KS3) by Year Nine, on their cognitive ability through the CAT4. Reading comprehension is assessed annually for students in Year Seven, Eight and Nine through the NGRT. Sections 5.3.1 and 5.3.2. describes the cognitive ability and reading comprehension of the 443 students in the sample.

5.3.1 Cognitive ability

5.3.1.1 Students' cognitive ability measured at the beginning and end of KS3

Table 5.11 presents the standardised scores of CAT4 overall, CAT-4 verbal subtest and CAT4 non-verbal subtests collected at time point 1 for participating students in Years Seven and Nine as dictated by the school testing calendar. The following year, those students who moved into Year Nine (C8+1) were tested. The standardised CAT4 scores indicated an overall performance that was low-average.

Table 5.11 Descriptive statistics for routine cognitive ability measures (mean: SD) at the year of recruitment, and the following year

Cognitive ability measures		
Time point 1		
Measures	**Year seven**	**Year Nine**
	Cohort C7 (n=157)	**Cohort C9 (n=123)**
CAT4 overall (Mean =100; SD=15)	90.89 (SD 11.68)	90.51 (SD 11.30)
CAT4 verbal (Mean =100; SD=15)	91.80 (SD 13.62)	90.10 (SD 12.54)
CAT4 non-verbal (Mean =100; SD=15)	89.38 (SD 13.69)	89.90 (SD 13.29)
The following year (time point 2)		**Cohort Y8+1 (n=137)**
CAT4 overall (Mean =100; SD=15)		92.70 (11.71)
CAT4 verbal (Mean =100; SD=15)		90.87 (16.00)
CAT4 non-verbal (Mean =100; SD=15)		93.74 (12.97)

Key: CAT4 = Cognitive Abilities Test; SD = Standard Deviation

The data was analysed to compare whether each cohort met age-related expectations. The C7 cohort performance compared to Year Seven (the first year of secondary education for C7, C8-1 and C9-2 cohorts) and the C9 cohort performance was compared to Year Nine (the third year of secondary education for C8+1 and C9 cohorts). The comparison shows the mean cognitive ability of the cohorts was consistent with the mean cognitive ability in school year groups. Unfortunately, there was a technical issue with the C9 cohort when sitting the CAT4 assessments in their first year of secondary and the data from those assessments was not saved. However, the data indicates that each cohort achieved age-related expectations.

5.3.2 Reading comprehension

5.3.2.1 Longitudinal reading comprehension ability assessed at time point 1 and 2

Cohorts C7, C8 and C9 were routinely assessed for reading comprehension at time point 1. The following year at time point 2, the C7+1 and the C8+1 cohort were routinely assessed in

Year Eight and Nine. Table 5.12 presents the results from the NGRT tests and shows that each cohort achieved age-related expectations.

Table 5.12. Descriptive statistics for performance on the New Group reading Test (NGRT) (mean: SD) at the year of recruitment, and the following year

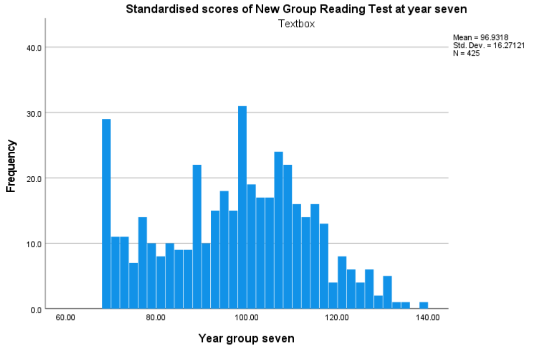
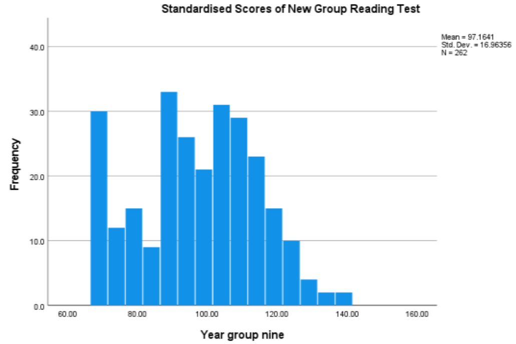
NGRT (SS = 100; SD = 15)		
Year Seven	**Year Eight**	**Year Nine**
Cohort C7	**Cohort C8**	**Cohort C9**
95.90 (SD 16.62) n=159	96.77 (SD15.75) n=155	96.09 (SD 15.93) n= 122
The following year (time point 2)		
	Cohort C7+1	**Cohort C8+1**
	98.00 (17.49) n=142	98.09 (17.81) n= 140

Key: NGRT = New Group Reading Test; SD = Standard deviation

5.3.2.2. KS3 Reading comprehension ability

Figure 5.4 presents the retrospective standardised scores of the NGRT measures for the year group performance for each of the 443 students. The standardised NGRT scores indicates the overall performance is average. The data from the cohorts is similar to the retrospective, cross-sectional year group performance and indicates that each cohort achieved age-related expectations.

Figure 5.4 Retrospective standardised reading comprehension (NGRT) across Years Seven, Eight and Nine

<table>
<tr><th colspan="3">Retrospective, cross-sectional standardised scores of New Group Reading Test at years seven, eight and nine (SS = 100: SD = 15)</th></tr>
<tr><th colspan="3">Year
(Cohorts)</th></tr>
<tr><th>Year Seven
(C7, C8-1, C9-2) n=425</th><th>Year Eight
(C7+1, C8, C9-1) n=413</th><th>Year Nine
(C8+1, C9) n=262</th></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
<tr><td>Mean = 96.93 (SD = 16.27)</td><td>Mean = 97.22 (SD = 16.10)</td><td>Mean = 97.16 (SD = 16.96)</td></tr>
</table>

Key: C7 = cohort 7; C8 = cohort eight, C9 = cohort 9; SD = Standard deviation

5.4 Word reading

All participants in the study were assessed on their single word reading abilities using the TOWRE2 (Torgesen et al., 2012).

5.4.1 Longitudinal measures of single word reading, assessed at time point 1 and 2

Cohorts C7, C8 and C9 were assessed for word reading accuracy at time point 1. The following year at time point 2, the C7+1 and the C8+1 cohort were also assessed with the same measure. Table 5.13 presents the results from the TOWRE2 for each group. Performance on the TOWRE2 showed that for each cohort, the students were performing age appropriately for single word reading.

Table 5.13. Longitudinal performance of single word reading, Test of Word Reading Efficiency (TOWRE2) at time point 1 and 2

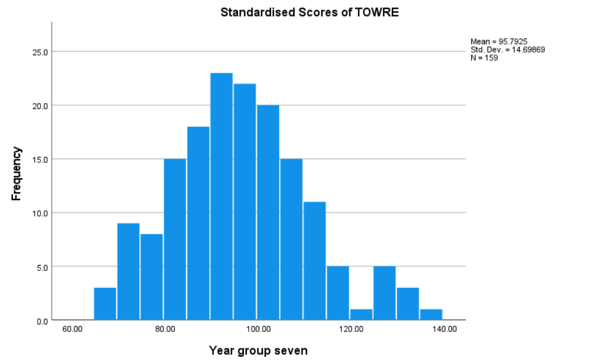
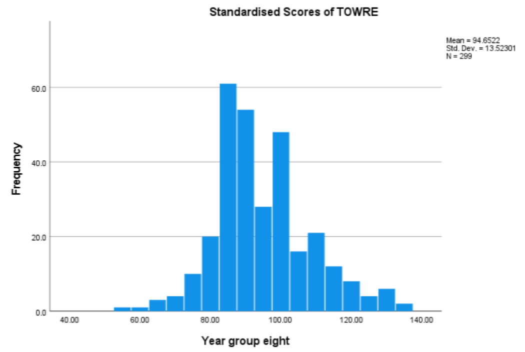
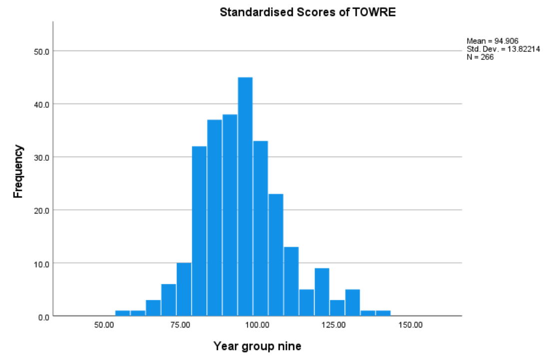
TOWRE2 (SS = 100; SD = 15)		
Year Seven	**Year Eight**	**Year Nine**
Time Point 1		
Cohort C7 (n=159)	Cohort C8 (n=158)	Cohort C9 (n=126)
95.79 (SD 14.70)	95.25 (13.72)	95.41 (13.98)
The following year (time point 2)		
	Cohort C7+1 (n=141)	Cohort C8+1 (n=140)
	93.98 (SD 13.32)	94.45 (SD 13.71)

Key: SS = Standard score; SD = Standard deviation;

5.4.2 KS3 Single word reading

Figure 5.5 presents the retrospective cross sectional standardised scores of the TOWRE2 measures for the year group performance for each of the 443 students. The standardised TOWRE2 scores indicates the overall performance is average. The data from the cohorts is similar to the cross-sectional year group performance and indicates that each cohort achieved age-related expectations.

Figure 5.5. Retrospective cross-sectional standardised scores of single word reading (TOWRE2) in Years Seven, Eight and Nine

<table>
<tr><th colspan="3">Cross-sectional standardised scores of TOWRE2 at Years Seven, Eight and Nine (SS = 100: SD = 15)</th></tr>
<tr><th colspan="3">Year group
(cohort)</th></tr>
<tr><th>Year Seven
(C7) n=159</th><th>Year Eight
(C7+1, C8) n=299</th><th>Year Nine
(C8+1, C9) n=266</th></tr>
<tr>
<td>
</td>
<td>
</td>
<td>
</td>
</tr>
<tr><td>Mean = 95.79 (SD 14.70)</td><td>Mean = 94.65 (SD 13.52)</td><td>Mean = 94.90 (SD 13.82)</td></tr>
</table>

Key: C7 = Y7 cohort; C8 = Y8 cohort; C9 = Y9 cohort; SD = Standard deviation; TOWRE2 = Test of Word Reading Efficiency

5.5 Oral language assessments

5.5.1. Longitudinal oral language abilities, assessed at time point 1 and 2

Cohorts C7, C8 and C9's oral language skills were assessed using CELF4 Recalling Sentences and Understanding Spoken Paragraphs subtests at time point 1. The following year at time point 2, the C7+1 and the C8+1 cohort were also assessed with the same two assessments. Table 5.14 presents longitudinal findings from these tests. Performance on Recalling Sentences was at the lower end of the age-appropriate range for all cohorts, however performance on the measure of Understanding Spoken Paragraphs was below age-appropriate levels across cohorts.

The students' Understanding Spoken Paragraphs standardised scores ranged from a minimum of one mark (14% of the sample, n= 63) to full marks (15/15) (0.7% of the sample, n=3) with variance of 12.19 indicating a wide spread of scores. The low performance in understanding a spoken narrative was shown in each of the three cohorts suggesting that most students experienced difficulties with listening comprehension across KS3.

Table 5.14. Descriptive statistics for Recalling Sentences and Understanding Spoken Paragraphs subtests from the CELF4 (Mean (SD) at time of recruitment, and the following year

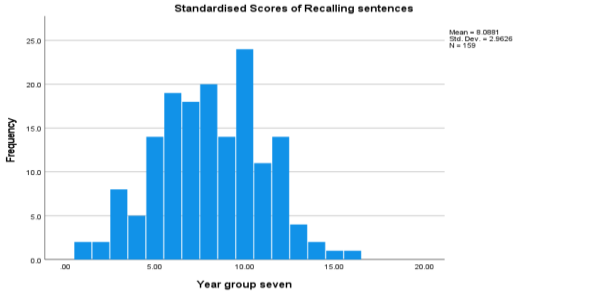
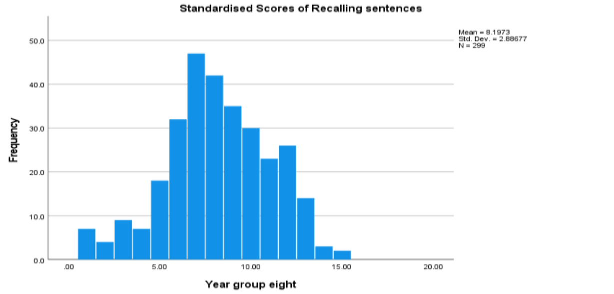
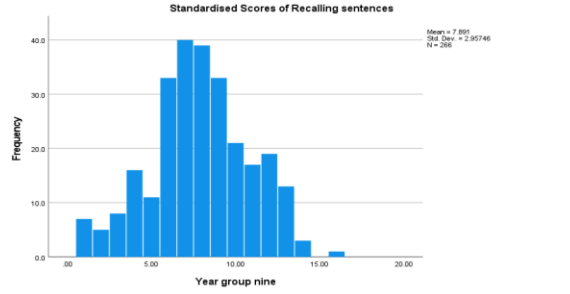
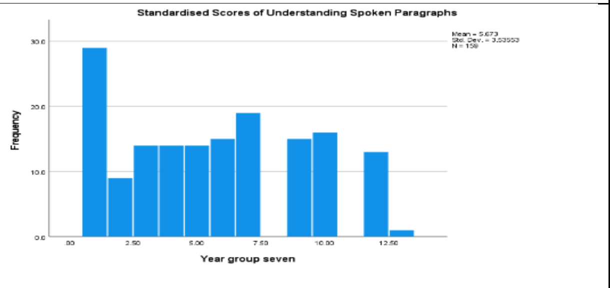
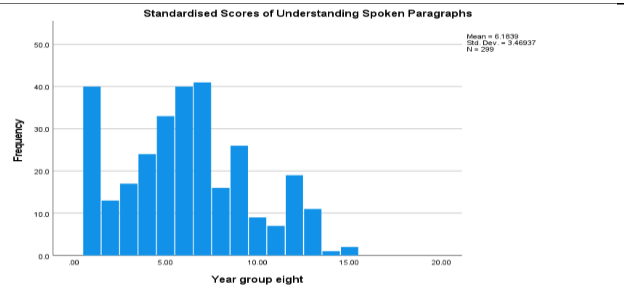
Recalling Sentences and Understanding Spoken Paragraphs subtests from the CELF4 (SS = 10; SD = 3)			
Time point 1			
Measures	**Year Seven**	**Year Eight**	**Year Nine**
	Cohort C7 n=159	**Cohort C8** n=158	**Cohort C9** n= 126
CELF4 Recalling Sentences	8.09 (SD 2.96)	8.04 (3.05) n=159	7.70 (2.78) n=126
CELF4 Understanding Spoken Paragraphs	5.67 (SD 3.53) n=159	6.25 (3.64) n=158	6.26 (3.22) n=126
Time point 2		**Cohort C7+1** n= 141	**Cohort C8+1** n= 140
CELF4 Recalling sentences		8.38 (SD 2.69)	8.06 (SD 3.11)
CELF4 Understanding spoken paragraphs		6.11 (SD 3.27)	6.58 (SD 3.51)

Key: CELF4 = Clinical Evaluation of Language Fundamentals, 4th edition, SS = Standard Score, SD = Standard deviation

5.5.2 KS3 retrospective cross-sectional oral language assessments

Figure 5.6 presents the retrospective, cross-sectional standardised oral language scores measured with the two subscales of the CELF4 (Recalling Sentences subtest and Understanding Spoken Paragraphs) for the year group performance across KS3. Performance on the CELF4 Recalling Sentences subtest indicated overall performance was average. However, on the CELF4 Understanding Spoken Paragraphs subtest, performance was below average.

Figure 5.6. Descriptive standardised scores of CELF4 Recalling Sentences (RS) and Understanding Spoken Paragraphs (USP) in Year Seven, Eight and Nine

<table>
<tr><th colspan="3">Cross-sectional standardised scores of Recalling Sentences (RS) at Year Seven, Eight and Nine (SS = 10: SD = 3)</th></tr>
<tr><td>Year Seven (C7)</td><td>Year Eight (C7+1, C8)</td><td>Year Nine (C8+1, C9)</td></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
<tr><td>Mean 8.09 (SD 2.96)</td><td>Mean 8.20 (SD 2.89)</td><td>Mean 7.89 (SD 2.96)</td></tr>
<tr><th colspan="3">Cross-sectional standardised scores of Understanding Spoken Paragraphs (USP) at Year Seven, Eight and Nine (SS = 10: SD = 3)</th></tr>
<tr><td>Year Seven (C7)</td><td>Year Eight (C7+1, C8)</td><td>Year Nine (C8+1, C9)</td></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
<tr><td>Mean 5.67 (SD 3.53)</td><td>Mean 6.18 (SD 3.47)</td><td>Mean 6.43 (SD 3.37)</td></tr>
</table>

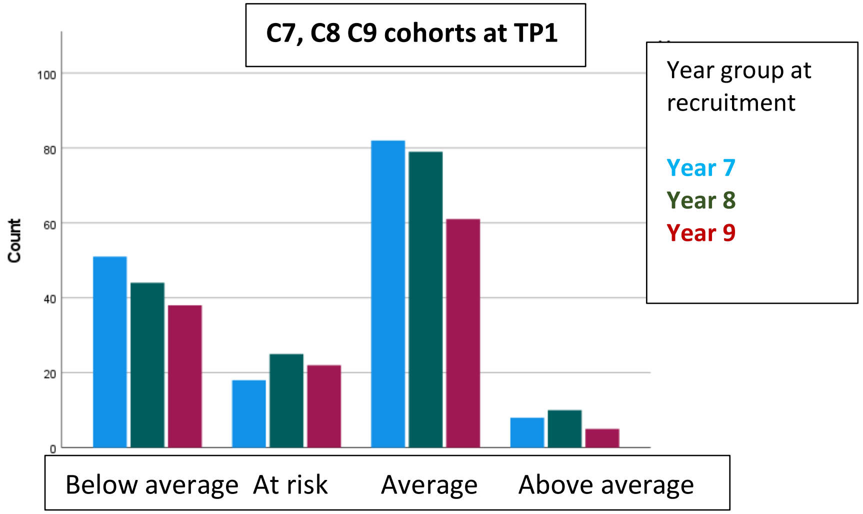
Key: SS =Standard Score; SD =Standard deviation, C7 = Y7 cohort; C8 = Y8 cohort; C9 = Y9

5.5.3 Frequencies of students' scores on the CELF4 Recalling Sentences subtest

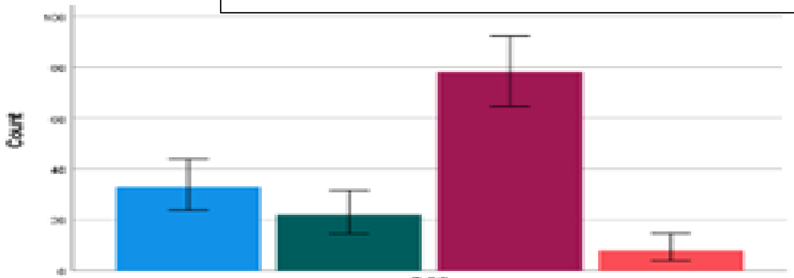
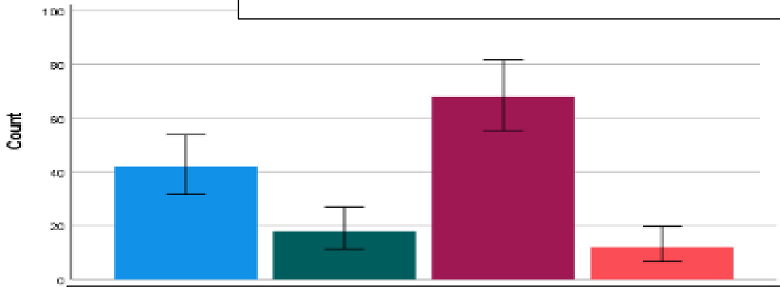
In order to examine the distribution of students' standardised scores on CELF4 Recalling Sentences subtest over the two-year sample, student scores were split into below, at-risk, average and above in the overall sample, and by cohort, at time points one and two. (See Figure 5.7). The 'at-risk' category is included in this section of the descriptive statistics to show the proportion of students likely to be struggling in the classroom. Using the CELF4 guidelines to compare student's performance to the typical performance, a scaled score of 6 is classified as low to very low; 7 as borderline or at-risk; 8-12 as average and 13 or above, as above average. The data shows that 30% of the overall sample are classified in the below average ability, 15% as at-risk, 50% as average and 5% showing above average ability. The proportions are similar for the two cohorts tested the following year with the same test.

Figure 5.7. Distribution of students with below average, at-risk, average and above average mean, CELF4 Recalling Sentences

CELF4: Recalling Sentences (SS=10; SD =3) at time point one



Performance Time point 1	**Below average** Scaled score 6 and below	**At risk** Scaled score of 7	**Average** Scaled score between 8-12	**Above average** Scaled score 13 and above
Overall	30% n=133	15% n= 65	50% n=222	5% n=23
C7	32% n=51	11% n= 18	52% n=82	5% n=8
C8	28% n=44	16% n= 25	50% n=79	6% n=10
C9	30% n=38	18% n= 22	48% n=61	4% n=5

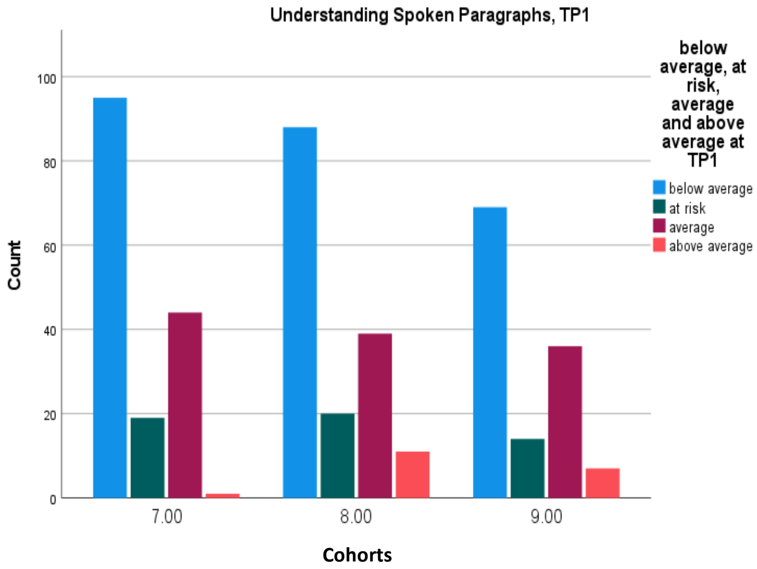
CELF4: Recalling Sentences (SS=10; SD =3) at time point two	Below average Scaled score 6 and below	At risk Scaled score of 7	Average Scaled score between 8-12	Above average Scaled score 13 and above
Recalling sentences, C7+1  Below average At risk Average Above average	23% n=33	16% n= 22	55% n=78	6% n=8
Recalling sentences, C8 +1  Below average At risk Average Above average	30% n=42	13% n= 18	49% n=68	8% n=112

5.5.4 Distribution of students standardised scores on CELF4 Understanding Spoken Paragraphs

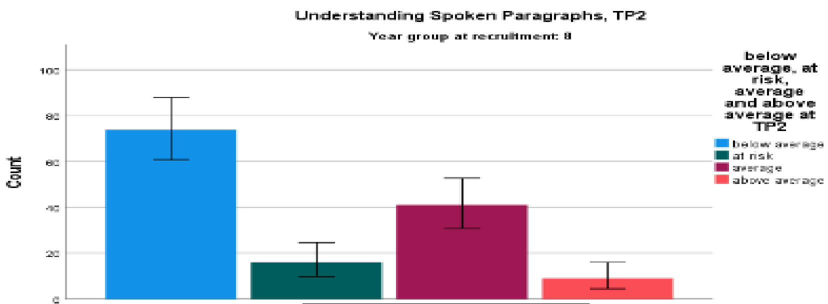
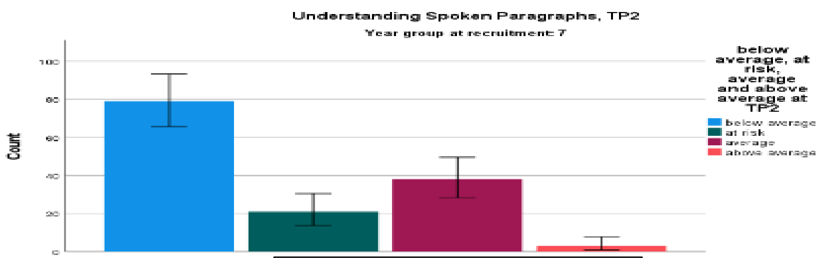
In order to examine the distribution of students' mean scores on the Understanding Spoken Paragraphs subtest over the two time points, student scores were again split into 'below average', 'at risk', 'average' and 'above average' in the overall sample and by cohort (see Figure 5.8). The data shows that 57% of the overall sample are classified in the below average ability, 12% as at-risk, 27% as average and 4% showing above average ability. The proportions were similar for the two cohorts tested the following year with the same test.

Figure 5.8. Distribution of students with below average, at-risk, average and above average mean, CELF4 Understanding Spoken Paragraphs

CELF4 Understanding Spoken Paragraphs at time point 1 (SS=10; SD =3)



Performance Time point 1	**Below average** Scaled score 6 and below	**At risk** Scaled score of 7	**Average** Scaled score between 8-12	**Above average** Scaled score 13 and above
Overall	57% n=252	12% n=53	27% n=119	4% n=19
C7	59% n=95	12% n=19	28% n=44	1% n=1
C8	55% n=88	13% n=20	25% n=39	7% n=11
C9	54% n=69	11% n=14	29% n=36	6% n=7

CELF4 Understanding Spoken Paragraphs: (SS=10; SD =3) at time point two	Below average Scaled score 6 and below	At risk Scaled score of 7	Average Scaled score between 8-12	Above average Scaled score 13 and above
 C7 + 1	56% n=79	15% n=21	27% n=30	2% n=3
 C8 + 1	53% n=74	11% n=16	30% n=41	6% n=9

5.6 Summary of the characteristics of the sample and student performance

This chapter aimed to describe the student sample, their performance on school tests and their oral language assessments. Four hundred and forty-three students participated in the study, with ages ranging from 11 years and three months to 14 years and five months. By the end of the two-year data collection period, 10% of the sample had left. They had either moved school, or had been excluded, or were being educated off-site.

There was no statistical difference between the proportion of males (53%) and females (47%) in the overall sample. There was a significant difference in the proportion of SEN students identified in the current sample (25%) as compared with the national value of 10.7% (DFE, 2017). It appears that more than expected students in the sample were having difficulties accessing the curriculum. Those students identified as having SEN also showed below average reading comprehension, low-average single word reading attainment and below average language abilities.

Socio-economic background based on postcode (IDACI) data showed that 25% of the sample (n=109) lived in homes with little or relatively little deprivation and 38% (n=172) lived in high to significant deprivation.

End of primary school, reading achievement (KS2 SATs) for cohorts C8 and C9 was in line with national expectations. In comparison, fewer students in the C7 cohort achieved the new national score of 100 (equivalent to a 4b, DFE, 2016) in 2016 indicating it was a weaker cohort. or reflected different test standards. School performance showed that as students moved through the school year groups, academic performance based on teacher assessments towards GCSE outcomes increased suggesting that students demonstrated an increasing understanding of the taught curriculum. Academic outcomes at the age of 16 years for the C9 cohort demonstrated below average attainment in English and Mathematics. Retrospective year group performance showed that each cohort (C7, C8 and C9) achieved age-related expectations. In other words, the performance of C7 cohort was similar to that of C8-1 and C9-2 when in Year Seven. Cognitive measures (CAT-4) indicated an overall performance that was low-average across all cohorts. Reading comprehension (NGRT) showed that each cohort achieved age-related expectations. Performance on the TOWRE2 showed that for each cohort, the students were performing at low average for single word reading. Performance on Recalling Sentences was at the lower end of the age-appropriate range for all cohorts, however performance on the measure of Understanding Spoken Paragraphs, measuring listening comprehension was below age-appropriate levels across all cohorts. The low performance in understanding a spoken narrative was shown in each of the three cohorts suggesting that most students experienced difficulties with listening comprehension across KS3.

Chapter Six

Results from Statistical Analysis

6.0 Overview

The previous chapter described the student sample. This chapter analyses the data from the student sample to explore the relationships between oral language ability, non-verbal ability, socio-economic status and academic ability with reading comprehension in order to address the research questions posed in Chapter Four.

In section 6.1, univariate repeated measures analyses are used to address RQ1, which explores the variability in the language and literacy performances of students cross-sectionally across the three cohorts, and longitudinally over the two years of the study. Section 6.2 addresses RQ2 and investigates whether gender, special educational needs or levels of deprivation are related to language and literacy performance, and TA English attainment over time using multivariate data analysis. Section 6.3 addresses RQ3, examining the relationships between verbal and non-verbal skills, word reading, social deprivation and reading comprehension. Section 6.4 reports on the analyses used to address RQ4(a), which concerns whether measures of listening comprehension significantly predict reading comprehension in the sample. Section 6.5 reports on analyses exploring predictors of academic outcomes at GCSE which are the focus of RQ4(b). Section 6.6 explores RQ5, the extent to which oral language skills, socio-economic status and cognitive abilities mediate student growth in reading comprehension and academic achievement in secondary students.

6.1 RQ1: To what extent is there variability in the language and reading performances of students across the three cohorts (C7, C8 and C9) and over the two years of the study?

The first aim of the study is to look for any differences across the three cohorts at the time of recruitment; how they perform on measures of language and reading, and if there are any differences between the two cohorts the following year (C7+1; C8+1). Previous research described in Chapter Two suggested there would be significant variability in the language and literacy performances of students within each cohort due to differences in individual student performance (Brasseur-Hock et al., 2011; Nippold, 2017) but that student performance across the three cohorts would be stable (Ricketts et al, 2020). Descriptive data, in the previous chapter, points to the similarity of the three cohorts (C7, C8 and C9) as measured by cross-sectional school year data which indicates that each cohort achieved age-related expectations on all measures, with the exception of understanding spoken paragraphs which was below-average.

6.1.1 Cross-sectional differences in language and reading performances across the three cohorts: C7, C8 and C9 in the autumn term, first testing point.

One-way-between-groups ANOVAs were conducted to explore whether students in cohorts C7, C8 and C9 differed in their language (CAT-verbal; CELF4-RS; CELF4-USP) and reading (TOWRE2; NGRT) at the point of recruitment. There were no statistically significant differences across the three cohorts, at the $p<0.01$ level on the standardised language measures (CAT-verbal $F_{(2, 425)} = 2.12$, $p = 0.12$; CELF4-RS $F_{(2, 440)} = 0.70$, $p = 0.50$; CELF-USP $F_{(2,440)} = 1.41$, $p=0.24$) and reading (TOWRE2 $F_{(2,440)} = 0.06$, $p=0.2$; NGRT $F_{(2,422)} = 1.55$, $p=0.21$) measures. This indicates that the cohorts are comparable on these measures.

6.1.2 Longitudinal changes in language and reading performances as the C7 cohort moved into Year Eight (C7+1)

Table 6.1 presents the change in scores for the C7 cohort in language and reading between the year of recruitment and the following year. Paired samples t-tests were conducted to examine if there were significant changes in student performance in the standardised language (CELF4-RS and USP subtests), TOWRE2 single word reading and NGRT-reading comprehension measures from the first time of testing for the C7 cohort (year of recruitment) to the second time of testing (C7+1). No comparison was made for the CAT-verbal, as students are not routinely tested in Year Eight.

There were no statistically significant changes in the standardised language scores or the standardised reading comprehension measures from time 1 to time 2, indicating that student performance on these measures was stable and that students were staying within their ability range relative to the norm. However, in contrast, there was a statistically significant decrease in TOWRE2-single word measures from time 1 (M=97.08, SD =14.17) to time 2 (M= 93.98, SD =13.31), t (141) 5.13, p<0.001 (two-tailed), suggesting that students were finding it harder to read single words out of context over time.

Table 6.1. Change in scores for the C7 cohort in reading and language performances between year of recruitment and the following year

Measure	C7 cohort		Number of students[n]	C7+1 cohort		t	df	p
	M	SD		M	SD			
CELF4-RS SS = 10; SD=7	8.33	2.79	141	8.38	2.68	-0.33	140	0.74
CELF4-USP SS = 10; SD=7	5.76	3.53	141	6.11	3.27	-1.20	140	0.23
TOWRE2 SS = 100; SD=15	97.08	14.17	141	93.98	13.31	5.13	140	**<.001*** **
NGRT SS = 100; SD=15	97.79	15.92	142	98.00	17.49	-0.24	141	0.81

Key; SS = Standard Score; SD = Standard Deviation; CELF4-RS – Clinical Evaluation of Language Fundamentals, Recalling Sentences; CELF4-USP – Clinical Evaluation of Language Fundamentals, understanding spoken paragraphs; TOWRE2 = Test of Word Reading Efficiency; NGRT- New Group Reading Test
p<.001 (2- tailed)
[n] *Refer to flow diagram of students through the study, Figure 4.1*

6.1.3 Longitudinal changes in language and reading performances as the C8 cohort moved into Year Nine (C8+1)

Table 6.2 presents the change in scores for the C8 cohort in language and reading between the year of recruitment and the following year. Paired samples t-tests were conducted to examine if there were significant changes in student performance in the standardised language scores (CELF4-RS and USP subtests), TOWRE2 single word reading and NGRT-reading comprehension measures between the first data collection point (C8) and second data point (C8+1).

Similar to the C7 cohort, the results indicate that student performance in language measures (CELF4-RS and USP) and reading comprehension remain stable (NGRT) and that students stayed within their ability range relative to the norm. However, there was a trend towards a decrease in TOWRE2 single word reading from time 1 (M=96.05, SD =13.87) to time 2 (M= 94.45, SD =13.71), t (139) 2.36, p =.019 (two-tailed) suggesting that students were finding it harder to read single words out of context over time.

Table 6.2. Change in scores for the C8 cohort in reading and language performances between year of recruitment and the following year

Measure	C8 cohort		Number of students [n]	C8+1 cohort		t	df	p
	M	SD		M	SD			
CELF4-RS SS = 10; SD=7	8.16	3.03	140	8.06	3.11	0.66	139	.512
CELF4-USP SS = 10; SD=7	6.30	3.70	140	6.59	5.51	-1.01	139	.316
TOWRE2 SS = 100; SD=15	96.05	13.87	140	94.45	13.71	2.36	139	**.019***
NGRT SS = 100; SD=15	97.64	15.97	138	98.17	17.92	-6.27	137	.534

Key; SS = Standard Score; SD = Standard Deviation; CELF4-RS – Clinical Evaluation of Language Fundamentals, Recalling Sentences; CELF4-USP – Clinical Evaluation of Language Fundamentals, understanding spoken paragraphs; TOWRE2 = Test of Word Reading Efficiency; NGRT- New Group Reading Test

**p<.05*

[n] *Refer to flow diagram of students through the study, Figure 4.1*

6.1.4 Summary of RQ1

RQ1 sought to determine whether there were significant differences in the language and reading performances across the three cohorts (C7, C8 and C9). There were no differences in standardised language, single-word reading and reading comprehension performances across the cohorts at the first testing point, suggesting that students in each cohort were staying within their ability range relative to the norm. As the C7 and C8 cohort moved into the next year of education, their performance in standardised language and reading comprehension scores remained stable. However, measures in single-word reading decreased significantly for both cohorts, suggesting that students were finding it harder to read single words over time. These analyses allow the datasets from the three different cohorts (C7, C8, C9) to be joined into Year Seven (C7, 8-1, Y9C-2); Year Eight (C7+1, C8) and Year Nine (C8+1, C9) to reflect their position in their school journey without introducing bias.

6.2. RQ2. Are gender, special educational needs or deprivation related to different performances in language and literacy over time?

The stability of students' reading comprehension performance across the cohorts (C7, C8 and C9), retrospectively (C8-1, C9-2) and prospectively (C7+1; C8+1) was established using average achievement levels. In order to examine if student profiles based on special education needs (SEN), gender or socio-economic status explained any differences in language (CELF4-RS; CELF4-USP), word-reading (TOWRE2) and reading comprehension (NGRT), multi-level modelling (MLM) was used.

The advantage of using MLM is the way in which it considers the school hierarchical data. As the sample is drawn from a single secondary school, it could be argued, the students are more similar to each other than to students in a different school, and students in any particular class are likely to be more similar than those between two different classes. In order to reduce any bias, hierarchical data nests the assessments within individual students, who are assigned to different classes and teachers. For example, not all students recall sentences to the same level. The recalled sentences are nested within each student, and their recall depends on the student. The probability of the sentence being recalled depends on what other sentence structures are available, and the recall of one sentence may have an effect for any other sentences recalled. Therefore, the student acts as a 'context' within which language is recalled (Field, 2009, p727). A second advantage is the way in which MLM deals with missing data: this is important in schools with transient populations or with high absenteeism, when not every student will be in school to sit the assessments. Traditional methods of listwise deletion or pairwise deletion may lead to biased parameter estimation (Heck et al., 2014). For MLM with its vertically arranged data, information on the outcome will only be affected for the occasion the data is missing, and all available data on outcomes will be utilised in the analysis.

By including the effect of time (refer to figure 6.1, Level 1), it was possible to describe any changes in language and literacy among individual students over academic years. The rate of change in the language and literacy measures that each individual student experienced over the time of the study is defined as their growth rate (Field, 2009).

It was predicted that SEN and low socio-economic status would adversely affect individuals' growth rate in language and literacy over the 3 academic years of Key Stage 3 (Foorman et al., 2017; Spencer et al., 2012) and female students would perform significantly better on the language and literacy tests (Babayigit et al.,2021).

6.2.1 Measurement of the students' growth rates

Data analysis followed guidelines developed by Heck et al (2014) for dealing with longitudinal data using MLM in SPSS. Firstly, data was restructured into a higher-level arrangement (level 2 at student level; level 3 at the class level {as opposed to cohort level}) that recognised the hierarchical structure of the data. This resulted in each participant having six rows of assessments, each row indicating a time point (See Figure 6.1). The six time points (Level 1) represent the two routine school assessments sat by students at the end of the autumn term and end of the summer term over the three years of seven, eight and nine (KS3). Nested within each individual's time points, were the three routine reading comprehension assessments sat in Years Seven, Eight and Nine; the two CAT assessments sat in Years Seven and Nine and the researcher administered measures of single-word reading, recalling sentences and understanding spoken paragraphs assessed twice in the study. Each of these was taken as an individual outcome. Therefore, variation in students' growth rates in language and literacy (Level 2) might be explained by student characteristics, based on groupings of gender, SEN status and socio-economic background.

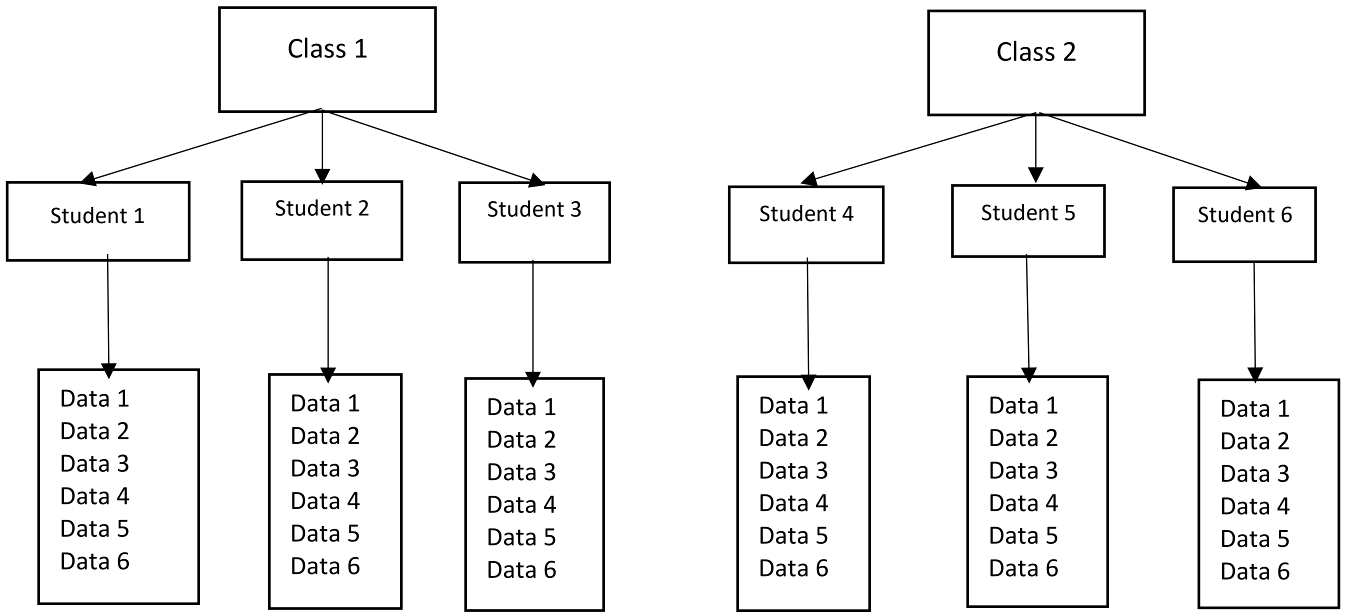
As effects of repeated measures (i.e., time) were used in the MLM, a covariance structure was required to specify the model parameters. The covariance structure describes the way that repeated measurements on participants are potentially correlated (Heck et al 2014). A mixed model approach was chosen for the study as it provided flexibility in identifying a Level 1 covariance structure. An auto-regressive structure was assumed as the data was measured over time. The first-order autoregressive structure (AR1) takes into account the correlation between repeated measures and assumes that whilst scores between two adjacent time points are likely to be correlated, this correlation decreases as scores become further apart over time (Field, 2009).

Figure 6.1. The hierarchical data structure used to model the data for RQ2

Level 3: English, Maths and Science class

Level 2: Student gender, SEN and IDACI

Level 1:
Data 1: Year Seven, Autumn
CATS, NGRT, TA (En, Ma, Sci), TOWRE2, CELF4 RS & USP
Data 2: Year Seven, Summer
TA (En, Ma, Sci)
Data 3: Year Eight, Autumn
NGRT, TA (En, Ma, Sci), TOWRE2, CELF4 RS & USP
Data 4: Year Eight,Summer
TA (En, Maths, Sci)
Data 5: Year Nine, Autumn
CAT4, NGRT, TA (En, Ma, Sci), TOWRE2, CELF4 RS & USP
Data 6: Year Nine, Summer
TA (En, Maths, Sci)



Key: SEN – Special Educational Need; IDACI- Income Deprivation Affecting Children Index; TA – Teacher assessment; En – English; Ma – Mathematics; Sci – Science; CELF4-RS – Clinical Evaluation of Language Fundamentals, Recalling Sentences; CELF4-USP – Clinical Evaluation of Language Fundamentals, Understanding Spoken Paragraphs; TOWRE2 = Test of Word Reading Efficiency; NGRT- New Group Reading Test

6.2.1.1. Effect size and power

According to Heck et al (2014), multilevel models require an effective sample size at each level. Lorah (2018) points to differing recommendations of sufficient sample size, ranging from a minimum of 30 groups, with at least 30 members in each group to 10 groups, modelling with random rather than fixed effects. The size of the study sample at Level one (55 variables) nested into Level two (443 students) and Level 3 (19 classes) fell within the recommended sample size. In the two-level model of measures nested within students, the intra-class correlation (ICC) was used to inform the proportion of variance in the outcome that was attributable to the students (Field, 2009; Heck et al., 2014). The higher the ICC, the more homogeneous the measures at Level 1, with a range from completely correlated (ICC=1) to no correlation (ICC=0) (Heck et al., 2014). In other words, if the differences in the individual students' nested data are small, then the difference between students is large, with a high ICC showing a diverse group of students. In contrast, a low ICC shows little difference between students.

6.2.2. The effect of gender, SEN and socio-economic status on students' language, reading and English achievement over time

The following section analyses each of the language measures (CAT4-verbal, CELF4-RS and CELF4-USP) and reading measures (TOWRE2 and NGRT) separately, with student characteristics being included in each analysis as covariates/ predictors. The aim is to examine students' average achievement in language and reading over time and to assess whether gender, SEN or IDACI are related to different achievement patterns.

6.2.2.1. Verbal Reasoning (CAT4-verbal)

The descriptive statistics showed that verbal reasoning performance, based on standardised scores, was stable across Years Seven and Nine. The overall average achievement for CAT4-verbal ability was 91.62, SD 13.82 (M = 100, SD = 15).

Using MLM to look at the effect of CAT4-verbal over time, the linear trend was trending towards, but did not reach significance, F (1, 561.93) = 3.96, p<.047). The average students' achievement around their own growth trajectory was 93.10 (Level 1). Across students (Level 2), the variance was 3.39 (Wald Z = 4.75, $p<.001$) suggesting a significant variation in cognitive verbal ability. The proportion of variance in cognitive verbal ability between individual students in the sample was 2.60% meaning that 97.4% of the variance related to differences within individual adolescents.

Table 6.3 presents the students' grand-mean achievement adjusted for the profile, differences in average achievement related to student profiles, the average growth rate and the differences in growth rates between students. Each analysis was run separately for gender, SEN and IDACI. Special educational needs and IDACI (socio-economic background) (Level 2) were significantly related to differences in average CAT4-verbal performance: SEN (β = - 6.649, $p<.001$) and IDACI (β = 3.096, $p = .002$). This suggests that students with SEN had a significantly lower performance on the CAT4-verbal measures, and levels of deprivation were related to CAT-verbal performance. Gender (β = 1.148, $p = .514$) was not significant.

There were significant differences in individual growth rates for students identified with SEN (β = - .636, $p=.008$). This suggests that the average CAT4-verbal scores for students with SEN decreased from the time they were in Year Seven to Year Nine, with growth varying across the students, (Wald Z = 2.297, $p=.022$). There were no significant differences in individual student growth rates for IDACI (β= .516, $p=.224$) or gender (β =-.509, $p =.092$). One variable that may explain this variability in CAT4-verbal growth between individual students is the interaction of time with deprivation, significant at $p < .001$ (β = -3.130, $p <.001$) indicating that SEN students with higher levels of deprivation demonstrated less growth over time, compared to SEN students with average levels of deprivation. The linear interaction of time with deprivation is significant ($p < .001$) indicating students at higher levels of deprivation demonstrate less growth over time than their more affluent peers.

Table 6.3. Estimates of Fixed Effects for differences in student growth rates in CAT4- verbal

Profile	β	Std. Error	df	t	Sig (p)	95% Confidence Interval	
						Lower	Upper
Gender							
*Mean adjusted for gender	92.60	1.208	531.995	76.606	<**.001***	90.223	94.972
Gender related to achievement	1.148	1.757	531.735	.654	.514	-2.303	4.601
Average growth rate	-.509	.300	269.359	-1.693	.092	-1.100	.083
Time*gender	-.218	.435	265.568	-.502	.616	-1.076	.639
Special Educational Needs							
*Mean adjusted for SEN	94.938	.886	294.663	107.190	<**.001***	93.195	96.681
SEN related to achievement	-6.649	1.481	293.359	-4.490	<**.001***	-9.564	-3.735
Average growth rate	-.636	.2385	262.428	-2.666	**.008**	-1.105	-.166
Time*SEN	.183	.382	296.955	.479	.632	-.568	.934
Deprivation							
*Mean adjusted for IDACI	92.28	.929	360.967	99.272	<**.001***	90.45	94.11
IDACI related to achievement	3.096	.984	285.381	3.146	**.002***	1.159	5.033
Average growth rate	.516	.423	280.083	1.219	.224	-.317	1.348
Time*IDACI	-3.130	.959	259.756	-3.265	<**.001***	-5.017	-1.243

**Note this shows that the mean is different from zero as expected and has no intrinsic value for interpretation*

6.2.2.2 Recalling sentences (CELF4- RS)

The descriptive statistics showed that performance based on standardised scores was stable across the academic years of seven and eight and fell slightly in the academic year nine (See section 5.5.1). The overall average achievement for recalling sentences (CELF4 - RS) was 8.06, SD 2.93 (Standardised population mean of 10, SD = 3).

MLM was carried out to examine whether a change took place in students' performance on recalling sentences over time and if there were differences in development between groups of students. The linear trend was not significant, F (1, 646.99) = .306, p=.580. The average students' (Level 1) improvement on their own measures (i.e., growth trajectory) was 8.122. At the student level (Level 2) the variance was 0.296 (Wald Z = 9.55, p<.001) suggesting that growth in recalling sentences varied significantly across the student sample. The proportion of variance in recalling sentences between individual students in the sample was 9.04 indicating that 90.96% of variance related to differences within individual adolescents.

Table 6.4 presents the students' grand-mean achievement adjusted for the different student groups, differences in average achievement related to the student groups, the average growth rate and the differences in growth rates between students. SEN was significantly related to differences in average performance of recalling sentences (β = -1.978, p<.001). Gender (β=.716, p=.091) and IDACI (β = -.487, p=.446) were not significant.

There were no significant differences in student growth rates related to recalling sentences for any profile nor was the linear interaction of time significant suggesting that growth rates across and between individuals was stable.

Table 6.4. Estimates of Fixed Effects for differences in student growth rates CELF4- RS

Profile	β	Std. Error	df	t	Sig (p)	95% Confidence Interval	
						Lower	Upper
Gender							
*Mean adjusted for gender	7.699	.292	351.097	26.325	**<.001*** **	7.123	8.274
Gender related to achievement	.716	.422	361.470	1.694	.091	-.115	1.546
Average growth rate	.0399	.066	422.623	.606	.545	-.089	.169
Time*gender	-.126	.095	417.655	-1.328	.185	-.312	.060
Special Educational Needs							
*Mean adjusted for	8.559	.221	381.604	38.698	**<.001*** **	8.123	8.993

Profile	β	Std. Error	df	t	Sig (p)	95% Confidence Interval	
						Lower	Upper
SEN							
SEN related to achievement	-1.978	.390	555.125	-5.079	<**.001*****	-2.743	-1.213
Average growth rate	-.025	.051	434.780	-.498	.619	-.126	.075
Time*SEN	.066	.092	546.803	.718	.473	-.114	.246
Deprivation							
*Mean adjusted for IDACI	8.248	.313	1131.863	26.350	<**.001*****	7.634	8.862
IDACI related to achievement	-.487	.638	998.941	-.763	.446	-1.741	.766
Average growth rate	-.037	.088	1107.951	-.423	.673	-.211	.136
Time*IDACI	.048	.198	1108.459	.241	.809	-.341	.436

**Note this shows that the mean is different from zero as expected and has no intrinsic value for interpretation*

6.2.2.3 Understanding Spoken Paragraphs (CELF4- USP)

The descriptive statistics showed that performance based on standardised scores was stable across the three academic years (section 5.5.1). The overall average achievement for Understanding Spoken Paragraphs (CELF4 - USP) was 6.16, SD 3.46 (standardised score of 10, standard deviation = 3).

MLM was carried out to examine whether a change took place in students' measures of listening comprehension (CELF4-USP) over time and if there were differences in development between groups of students. The linear trend was not significant at $p<.01$, $F(1, 692.10) = 4.99$, $p=.026$). The average students' (Level 1) improvement on their own measures (i.e., growth trajectory) was 5.55. At the student level (Level 2) the variance was 0.215 (Wald Z = 5.939, $p<.001$) suggesting that growth in listening comprehension varied significantly across the student sample. The proportion of variance in listening comprehension between individual students in the sample was 2.8% suggesting that 97.2% of the variance related to differences within individual adolescents.

Table 6.5 presents the students' grand-mean achievement adjusted for the profile, differences in average achievement related to student profiles, the average growth rate and the differences in growth rates between students. There were no differences in development between males and females (β=-.351, p=.558), students with special educational needs (β=.571, p=.308) or socio-economic status (IDACI) (β= 1.838, p=.087). However, there were significant differences in individual student growth rates related to understanding spoken paragraphs for SEN (β= .262, p =.002) and IDACI (β= .451, p =.003) suggesting that having a special educational need made a difference to listening comprehension performance. The negative gradient for deprivation indicates that high levels of deprivation were associated with lower performance in listening comprehension.

The linear interaction of time showed a trend towards significance for students with SEN (β= -.322, p =.021), suggesting that students with SEN demonstrate less growth in listening comprehension over time compared with their peers without SEN.

Table 6.5. Estimates of Fixed Effects for differences in student growth rates CELF4- USP

Profile	β	Std. Error	df	t	Sig	95% Confidence Interval	
						Lower	Upper
Gender							
*Mean adjusted for gender	5.734	.415	719.005	13.800	<**.001***	4.917	6.549
Gender related to achievement	-.351	.599	719.002	-.586	.558	-1.528	.825
Average growth rate	.177	.106	627.968	1.668	.096	-.031	.385
Time*gender	-.010	.153	620.971	-.068	.946	-.310	.289
Special Educational Needs							
*Mean adjusted for SEN	5.425	.325	719.347	16.663	<**.001***	4.785	6.064
SEN related to achievement	.571	.557	718.782	1.025	.306	-.523	1.66
Average growth rate	.262	.084	613.344	3.133	**.002**	.097	.427

Profile	β	Std. Error	df	t	Sig	95% Confidence Interval	
						Lower	Upper
Time*SEN	-.322	.139	700.870	-2.321	**.021***	-.593	-.049
Deprivation							
***Mean adjusted for IDACI**	4.681	.508	996.356	9.217	**<.001*****	3.684	5.677
IDACI related to achievement	1.838	1.073	1068.632	1.712	.087	-.268	3.944
Average growth rate	.451	.152	969.775	2.965	**.003****	.153	.750
Time*IDACI	-.635	.342	975.401	-1.858	.063	-1.305	.036

**Note this shows that the mean is different from zero as expected and has no intrinsic value for interpretation*

6.2.2.4 Single word reading (TOWRE2)

The descriptive statistics showed that performance based on standardised scores was stable across the three academic years (See chapter 5, section 5.4). The overall average achievement for single word (TOWRE2) was 94.99, SD 13.88 (Standardised score of 100, SD = 15).

MLM was carried out to examine whether a change took place in student's measures of single word reading (TOWRE2) over time and if there were differences in progression between groups of students. The linear trend was not significant at $p<.01$ for single word reading over time, $F(1,643.99) = 4.36$, $p=.037$). The average students' (Level 1) improvement on their own measures (i.e., growth trajectory) was 96.65. At the student level (Level 2) the variance was 6.92 (Wald $Z = 9.62$, $p<.001$) suggesting a significant variation in single word reading achievement across students. The proportion of variance in single word reading ability between individual students in the sample was 9.56%.

Table 6.6 presents the students' grand-mean achievement adjusted for the profile, differences in average achievement related to student profiles, the average growth rate and the differences in growth rates between students. Special educational needs were significantly related to differences in average performance of single word reading (TOWRE2) (β = -8.590, p<.001). Gender (β=2.031, p=.294) and IDACI (β =3.337, p=.284) were not significant.

There was a trend towards a significance difference in student growth rates related to single word reading for gender (β= -.576, p =.048) and significant differences for students with SEN (β=-.846, p<.001) suggesting that scores for reading single-words decreased over time for males and students with special educational needs. There were no significant differences in student growth rates for socio-economic deprivation, IDACI (β= -.422, p=.362). The linear interaction of time was not significant for any profile suggesting that growth rates between individuals was stable.

Table 6.6. Estimates of Fixed Effects for differences in student growth rates on TOWRE2

Profile	β	Std. Error	df	t	Sig (p)	95% Confidence Interval	
						Lower	Upper
Gender							
*Mean adjusted for gender	96.811	1.339	710.113	72.288	<**.001***	94.182	99.440
Gender related to achievement	2.031	1.934	712.359	1.050	.294	-1.767	5.829
Average growth rate	-.576	.289	398.422	-1.987	**.048***	-1.145	-.006
Time*gender	-.614	.415	392.678	-1.478	.140	-1.430	.203
Special Educational Needs							
*Mean adjusted for SEN	99.987	1.029	713.808	97.135	<**.001***	97.966	102.008
SEN related to achievement	-8.590	1.802	715.855	-4.768	<**.001***	-12.128	-5.053
Average growth rate	-.846	.226	403.069	-3.747	<**.001***	-1.289	-.402
Time*SEN	.187	.408	537.541	.458	.647	-.615	.989
Deprivation							
*Mean adjusted for IDACI	96.479	1.611	521.621	59.869	<**.001***	93.314	99.645
IDACI related to achievement	3.337	3.108	397.859	1.074	.284	-2.772	9.448

Profile	β	Std. Error	df	t	Sig (p)	95% Confidence Interval	
						Lower	Upper
Average growth rate	-.422	.462	395.693	-.912	.362	-1.331	.487
Time*IDACI	-1.153	1.032	395.010	-1.116	.265	-3.183	.878

**Note this shows that the mean is different from zero as expected and has no intrinsic value for*

6.2.2.5 Reading comprehension (NGRT)

The descriptive statistics showed that reading comprehension performance based on standardised scores was stable across the three academic years (See chapter 5, section 5.3.2) The overall average achievement for reading comprehension (NGRT) was 97.10 (Standardised score of 100, SD = 15).

Table 6.7 presents the students' grand-mean achievement adjusted for the profile, differences in average achievement related to student profiles, the average growth rate and the differences in growth rates between students. SEN (β = -10.905, p<.001) and IDACI (β = -.586, p=.037) were associated with average reading achievement showing that students identified as having SEN were poorer readers and higher levels of deprivation were associated with lower reading achievement. No groups showed increased growth over time. However, IDACI showed a linear interaction with time (β = .178, p = .011) suggesting some students with higher levels of deprivation demonstrated a trend towards more growth in reading comprehension compared to students at the grand-mean for IDACI.

Table 6.7. Estimates of Fixed Effects for differences in student growth rates in reading comprehension (NGRT)

Profile	β	Std. Error	df	t	Sig (p)	95% Confidence Interval	
						Lower	Upper
Gender							
*Mean adjusted for gender	95.812	1.18	723.667	80.914	**<.001***	93.487	98.137
Gender related to achievement	-.199	.234	757.319	-.852	.395	-.659	.260

Profile	β	Std. Error	df	t	Sig (p)	95% Confidence Interval	
						Lower	Upper
Average growth rate	2.529	1.740	728.795	1.453	.147	-.888	5.945
Time*gender	.226	.344	756.239	.659	.510	-.449	.903
Special Educational Needs							
*Mean adjusted for SEN	100.149	.905	772.989	110.709	<**.001*** **	98.374	101.925
SEN related to achievement	-10.905	1.393	763.696	-7.823	<**.001*** **	-13.64	-8.168
Average growth rate	-.026	.192	769.549	-.137	.891	-.402	.349
Time*SEN	-.186	.297	806.194	-.626	.531	-.769	.397
Deprivation							
*Mean adjusted for IDACI	97.335	.903	681.716	107.798	<**.001*** **	95.562	99.108
IDACI related to achievement	-.586	.280	723.993	-2.092	**.037***	-1.137	-.036
Average growth rate	-.212	.177	728.389	-1.191	.234	-.561	.137
Time*IDACI	.178	.069	632.133	2.548	**.011***	.041	.315

**Note this shows that the mean is different from zero as expected and has no intrinsic value for interpretation*

6.2.2.6 English academic performance

The descriptive statistics showed that English academic performance based on teacher assessment (raw scores) increased over the three academic years. The overall average achievement for English achievement was 7.21, SD 2.84 (equivalent to Grade 2 at GCSE).

The final MLM was carried out to examine the effect on literacy (English academic performance) at six time points nested within the individual students. The linear trend was significant, F (1, 769.69) = 850.37, p<.001) indicating that students made progress in English over time. The average students' (Level 1) improvement on their own measures (i.e. growth trajectory) was 4.24. At the student level (Level 2), the variance was .248 (Wald Z = 13.458, p<.001) suggesting a significant variation in English performance across students. The proportion of variance in English academic performance between individual students in the sample was 17.15%.

Table 6.8 presents the students' grand-mean achievement adjusted for the profile, differences in average achievement related to student profiles, the average growth rate and the differences in growth rates between students. Gender (β=-.644, p= <.001) and SEN (β= -.945, p <.001) were significantly related to differences in average English performance whereas IDACI (β=-.276, p=.355) was not.

There were significant differences in student growth rates related to academic English performance for gender (β= .799, p <.001), SEN (β= .916, p <.001) and IDACI (β=-.955, p <.001). The linear interaction of time was showing a trend to significance for gender (β= .112, p =.036), and IDACI (β=-.276, p =.015), and significance for SEN (β= -.219, p <.001) This suggested that girls showed a higher growth rate than boys; students with SEN have lower growth than their non-SEN peers and students with high levels of deprivation show a lower growth rate in English academic performance compared to their peers.

Table 6.8 Estimates of Fixed Effects for differences in student growth rates for teacher assessed English performance

Profile	β	Std. Error	df	t	Sig (p)	95% Confidence Interval	
						Lower	Upper
Gender							
*Mean adjusted for gender	3.93	.079	2079.705	49.218	<**.001*** **	3.775	4.089
Gender related to achievement	.644	.128	1983.025	5.018	<**.001*** **	.392	.895
Average growth rate	.799	.037	856.001	21.633	<**.001*** **	.726	.871
Time*gender	.112	.053	849.488	2.096	**.036***	.007	.217
Special Educational Needs							

Profile	β	Std. Error	df	t	Sig (p)	95% Confidence Interval	
						Lower	Upper
*Mean adjusted for SEN	4.498	.065	2095.927	68.639	<**.001***	4.370	4.627
SEN related to achievement	-.945	.130267	1359.304	-7.259	<**.001***	-1.201	-.690
Average growth rate	.916	.029	903.214	31.191	<**.001***	.858	.973
Time*SEN	-.219	.044596	1009.554	-4.924	<**.001***	-.307	-.132
Deprivation							
*Mean adjusted for IDACI	4.348	.122	2001.506	35.745	<**.001***	4.109	4.586
IDACI related to achievement	-.242	.278	2017.228	-.870	.385	-.788	.304
Average growth rate	.955	.052	1006.460	18.352	<**.001***	.853	1.057
Time*IDACI	-.276	.113	1215.497	-2.446	**.015***	-.497	-.054

**Note this shows that the mean is different from zero as expected and has no intrinsic value for interpretation*

6.2.2.7 Summary of RQ2

RQ2 sought to determine if differences in gender, special educational needs or socio-economic status were related to any changes in attainment of language and literacy, including English attainment over time. Average attainment, average change over time and the effect of time were examined using MLM and summarised in Table 6.9

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Table 6.9 Summary of the significant effects across the language, literacy and English attainment measures for the sample

Student background	Effect	CAT4-verbal	CELF4-RS	CELF4-USP	TOWRE2	(NGRT)	English
Gender	Average achievement	.514	.091	.558	.294	.395	**<.001*** **
	Average change over time	.092	.545	.096	**.048***	.147	**<.001*** **
	Time interaction	.616	.185	.946	.140	.510	**.036***
Special Educational needs	Average achievement	**<.001*** **	**<.001*** **	.306	**<.001*** **	**<.001*** **	**<.001*** **
	Average change over time	**.008****	.619	**.002****	**<.001*** **	.891	**<.001*** **
	Time interaction	.632	.473	**.021***	.647	.531	**<.001*** **
Deprivation (IDACI)	Average achievement	**.002*** **	.446	.087	.284	**.037***	.385
	Average change over time	.224	.673	**.003****	.362	.234	**<.001*** **
	Time interaction	**<.001*** **	.809	.063	.265	**.011***	**.015***

Student gender was significantly related to differences in average English attainment (p<.001) with girls doing better than boys, but not reading comprehension NGRT, single-word reading (TOWRE2) or language (CAT4-verbal, CELF4-recalling sentences, understanding spoken paragraphs). Differences in student growth rates were trending towards significance for TOWRE2 single word reading (p=.048) suggesting that scores for reading single words decreased over time for boys. The variability in English academic growth rates between students was trending towards significance at p=.036, (β = .112) suggesting that girls were showing a faster rate of improvement in English than boys.

Students identified as having SEN have been shown in the descriptive data chapter (Chapter Five) to be poor readers with low language levels. Multilevel modelling showed significant differences related to average performance in language and literacy, with SEN students doing less well than their peers; the exception being listening comprehension (CELF4- understanding spoken paragraphs). Growth rates indicated that students with SEN showed a trend towards a decreasing performance in verbal reasoning (CAT4-verbal, $p=.008$) but significant decreasing performance in single word reading (TOWRE2) and English attainment ($p<.001$). Surprisingly, listening comprehension (CELF4- understanding spoken paragraphs) showed a higher average growth rate ($p=.002$). Closer examination of the data showed some SEN students performed at the highest levels of the test. However, there were no differences in growth rates for CELF4 recalling sentences ($p=.619$) or reading comprehension (NGRT) ($p=.891$) indicating that students already identified as having below-average reading comprehension, neither improved nor fell in performance but continued to remain as poor readers. The effect of time showed that the students with SEN demonstrated less growth over time compared to their peers in English attainment $p<.001$ ($\beta = -.219$).

Those students who lived in higher deprivation did less well in average CAT4-verbal performance ($p<.002$) and NGRT reading comprehension ($p=.037$) but not language measures (CELF4- recalling sentences ($p=.446$); CELF4- understanding spoken paragraphs ($p=.087$) or single-word reading (TOWRE2) ($p = .284$) or English performance ($p=.385$). Student growth rates showed differences for CELF4- understanding spoken paragraphs ($p=.003$) and English performance ($p<.001$). However, the linear interaction of time was significant for performance in CAT4- verbal $p<.001$ ($\beta = -3.130$) and trended towards significance for English $p=.015$ ($\beta = -.276$) suggesting that students at the higher levels of deprivation demonstrated less growth over time in these measures. Students at higher levels of deprivation also showed a trend towards demonstrating slightly more growth over time in reading comprehension compared to other students ($p=.011$).

6.3 RQ3. What are the relationships between language skills, single- word reading, deprivation and reading comprehension?

Student performance in reading comprehension has been shown to be stable between cohorts and across school years. One exception that was evident concerns students living in areas of disadvantage who showed greater improvement in reading comprehension over time than students living in moderate disadvantage, despite continuing to show average attainment that was within age-related expectation. In order to explore the variation in reading comprehension, standard multiple regression was performed; separate regressions were performed for Year Seven, Eight and Nine.

In a standard multiple regression model, all the independent variables (n=7) are entered simultaneously. According to Tabachnick and Fidell (2014) the required sample size for seven predictors is 50 + (8)(7) = 106 cases to test multiple regression and 104 +7 = 111 cases to test individual predictors. In this study, there are 147 students in Year Seven; 273 students in Year Eight and 255 students in Year Nine and therefore the ratio of cases to IVs is substantial.

Preliminary analyses were performed to ensure no violation of the assumptions for normality, linearity, homoscedasticity and independence of residuals. There was linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values. There was independence of residuals, as assessed by the Durbin-Watson statistic. Visual inspection of the plots of studentized residuals versus unstandardized predicted values showed heteroscedasticity. According to Tabachnick et al., (2014) the linear relationship between variables is captured by the analysis but there is more predictability if the heteroscedasticity is accounted for. Following the recommendations of Tabachnick et al., (2014), SPSS GRAPH was run to check the bivariate plots: both NGRT with CAT4-V and NGRT with TOWRE2 show a pileup of scores at the low values of NGRT. Heteroscedasticity is evident in the greater variability in NGRT scores for low rather than high values of CAT4-V and TOWRE2 (Appendix 6A). There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1. There were no studentized deleted residuals greater than ±3 standard deviations, no leverage values greater than 0.2, nor values for Cook's distance above 1 (Appendix 6B).

Pearson correlations (r) were used to explore the strength and direction of relationships between variables compared within Years Seven, Eight and Nine. In Year Seven, the relationship was assessed across all variables within the C7 cohort (n=147) measures. In Year Eight, the relationship was assessed across all measures within C7+1 (n=130) and C8 cohort (n=143). In Year Nine, the relationship was assessed between measures within C8+1 (136) and C9 cohort (n= 119). The contribution of each measure to reading comprehension was compared using standardised coefficients (β). The R square (R^2) and adjusted R square values indicated the proportion of variance in reading comprehension explained by each measure and the shared variance of correlated measures. The semi-partial correlations were analysed to show the strength of the relationships in the model (sr) and when squared (sr^2), indicated the unique contribution of each measure to reading comprehension (Pallant, 2016).

6.3.1 The relationship between reading comprehension and language, non-verbal skills, social deprivation, single-word reading at Year Seven

Table 6.10 displays the correlations between the measures (r). There are strong, positive correlations between reading comprehension (as measured by NGRT) and verbal reasoning (CAT4-verbal) $r = 0.704$, $p < .001$. and CELF4-RS ($r = 0.638$, $p < .001$); between NGRT and non-verbal skills (CAT4-NV), $r = 0.548$, $p < .001$, and between NGRT and TOWRE2, $r = 0.603$, $p < .001$, reading comprehension is associated with high levels of language, cognitive skills and single-word reading efficiency.

Table 6.10 Correlations, significance and the strength of the relationship between reading comprehension (NGRT) and language (CAT4-verbal, CELF4-RS, CELF4-USP), non-verbal skills, IDACI and single-word reading (TOWRE2) in Year Seven

Measure	NGRT	CAT verbal	CELF4 RS	CELF4 USP	CAT NV	IDACI	TOWRE2
NGRT	1.000						
CAT4-V	.704***						
CELF4-RS	.638***	.561***					
CELF4-USP	.372***	.437***	.341***				
CAT4- NV	.548***	.714***	.426***	.325***			
IDACI	-.162*	-.205	-.179*	.010	-.099		
TOWRE2	.603***	.454***	.513***	.121	.292*	-.148*	

Key: NGRT – New Group Reading Test; CAT4-V – Cognitive Assessment Test- verbal subtest; CELF-4 RS - Recalling Sentences; CELF-4 USP – Understanding Spoken Paragraphs; CAT4-NV – Cognitive Assessment Test non-verbal ability: IDACI – Income Deprivation Affecting Children Index; TOWRE2 – Test of Word Reading Efficiency

*$p < .05$, ** $p < .01$, *** $p < .001$

Small relationship, r=.10 to .29	Medium, r = .30 to .49	Large, r= .50 to 1.0

In the multiple regression, there was independence of residuals, as assessed by a Durbin-Watson statistic of 1.552. Language (as measured by the CAT4-verbal, CELF4-RS and CELF4-USP) and non-verbal skills, single-word reading and socio-economic status explain 62.9% of the variance in reading comprehension. R^2 for the overall model is 0.644 with an adjusted R^2 of 0.629, a large effect size according to Cohen (1988). The model significantly predicts reading comprehension in Year Seven, $F_{(6,140)} = 42.21$, $p<.001$.

Table 6.11 presents the comparison of the contribution of each independent variable (β); their significance; the 95% confidence intervals for β; the semi partial correlation coefficients; the contribution of each independent variable to the total (sr^2) with the C7 cohort (n = 147) and the proportion of the unique contribution to reading comprehension (NGRT). Of the variables, verbal reasoning skills (CAT4-verbal) makes the largest statistically significant unique contribution (β = .338) followed by single-word reading (β = .294) and recalling sentences (β=.230). Although the unique contribution of the measures to reading comprehension is small: oral language (CAT4-verbal, 4%; CELF4 – RS, 3%) and single-word reading (TOWRE2, 5.8%), they are statistically significant.

Table 6.11 Standard Multiple Regression of language (CAT4-verbal, CELF4-RS, CELF4-USP), non-verbal skills, IDACI and single-word reading (TOWRE2) with Year Seven reading comprehension scores (NGRT)

Measure	Standardised coefficients β	t	p	95.0% Confidence Interval for β		Semi-partial correlation coefficients	Unique variance Sr^2	Proportion of unique contribution of variance in NGRT %
				lower	Upper			
CAT4-V	0.338	3.967	$<.001$	.206	.615	.200	0.040	4
CELF4-RS	0.230	3.457	$<.001$	.557	2.045	.174	0.30	3
CELF4-USP	0.079	1.362	.175	-1.168	.915	.069	0.005	0.5
CAT4-NV	0.098	1.355	.177	-.055	.294	.068	0.005	0.5
IDACI	0.001	0.014	.989	-7.905	8.016	.001	0.000	0
TOWRE2	0.294	4.798	$<.001$	.193	.464	.241	0.058	5.80

Key: NGRT – New Group Reading Test; CAT4-V – Cognitive Assessment Test- verbal subtest; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs; CAT4-NV – Cognitive Assessment Test non-verbal ability; IDACI – Income Deprivation Affecting Children Index; TOWRE2 – Test of Word Reading Efficiency

6.3.2. The relationship between reading comprehension and language, social deprivation, single-word reading at Year Eight

Table 6.12 displays the correlations between the measures (r). There are strong, positive correlations between reading comprehension (as measured by NGRT) and language (CELF4-RS, $r = 0.557$, $p < .001$; CELF4-USP, $r = 0.438$, $p < .001$), and between NGRT and word reading (TOWRE2, $r = 0.521$, $p < .001$). There is a strong, negative correlation between NGRT and deprivation (IDACI, $r = -0.180$, $p < .001$). High levels of reading comprehension are associated with high levels of oral language and single-word reading efficiency and lower levels of deprivation.

Table 6.12 Correlations, significance and the strength of the relationship between reading comprehension (NGRT), language (CELF4-RS, CELF4-USP), IDACI and single-word reading (TOWRE2) at Year Eight

Measure	NGRT	CELF4- RS	CELF4- USP	IDACI	TOWRE2
NGRT	1000				
CELF4-RS	.557***				
CELF4-USP	.438***	.392***			
IDACI	-.180***	-.137*	.002		
TOWRE2	.521***	.418***	.277***	-.056	

Key: NGRT – New Group Reading Test; CELF4-RS - Recalling Sentences; CELF-4 USP – Understanding Spoken Paragraphs; IDACI – Income Deprivation Affecting Children Index; TOWRE2 – Test of Word Reading Efficiency

*p< .05,** p< .01,*** $p < .001$

Small relationship, r=.10 to .29	Medium, r = .30 to .49	Large, r= .50 to 1.0

Oral language (as measured by the CELF4-RS and CELF4-USP), single-word reading and socio-economic status explain 45.4% of the variance in reading comprehension. Cognitive Assessment tests are not sat in Year Eight. R^2 for the overall model is 0.465 with an adjusted R^2 of 0.458, a medium effect size according to Cohen (1988). The model significantly predicts reading comprehension in Year Eight (C7+1, C8), $F_{(4,275)} = 59.843$, $p<.001$.

Table 6.13 presents the comparison of the contribution of each independent variable (β); their significance; the 95% confidence intervals for β; the semi partial correlation coefficients;

the contribution of each independent variable to the total (sr^2) with Year Eight (C7+1 and C8, n = 280) and the proportion of the unique contribution to reading comprehension (NGRT). Of the variables, oral language (CELF4-RS) makes the largest statistically significant unique contribution (β = .341) followed by singe-word reading (TOWRE2) (β = .319) and understanding spoken paragraphs (β=.215). The unique contribution of the measures to reading comprehension is small: oral language (CELF4 – RS, 8.53%; CELF4-USP – 3.8%) and single-word reading (TOWRE2, 8.24%).

Table 6.13 Standard Multiple Regression of oral language (CELF4-RS, CELF4-USP), IDACI and single-word reading (TOWRE2) with Year Eight reading comprehension scores (NGRT)

Measure	**β**	**t**	**p**	**95.0% Confidence Interval for β**		**Semi partial correlation coefficients**	**Unique variance sr^2**	**Proportion of unique contribution of variance in NGRT %**
				lower	Upper			
CELF4-RS	.316	6.096	**.000*** **	1.240	2.422	.269	0.072	7.24
CELF4-USP	.230	4.728	<**.001*** **	.643	1.561	.208	0.043	4.33
IDACI	-.128	-2.867	**.004** **	-17.799	-3.307	-.126	0.015	1.59
TOWRE2	.318	6.499	<**.001*** **	.273	.509	.287	0.082	8.24

Key: NGRT – New Group Reading Test; CELF4-4 RS - Recalling Sentences; CELF4-4 USP – Understanding Spoken Paragraphs; IDACI – Income Deprivation Affecting Children Index; TOWRE2-2 – Test of Word Reading Efficiency

6.3.3 The relationship between reading comprehension and language, non-verbal skills, social deprivation, single-word reading at Year Nine

Table 6.14 displays the correlations between the measures (r). By Year Nine, there are strong, positive relationships between reading comprehension (NGRT) and all the language measures (CAT4-verbal, r = 0.776, $p < .001$; CELF4-RS, r = 0.606, $p < .001$; CELF4-USP, r = 0.533, $p < .001$). Non-verbal skills (r = 0.541, $p < .001$) and single word reading (r = 0.561, $p < .001$) also make a strong positive contribution. High levels of reading comprehension are associated with high levels of oral language, cognitive skills and single-word reading efficiency. Deprivation (IDACI, r = -. 0.193, p <.001) shows a small, negative relationship, indicating that higher levels of deprivation are associated with lower levels of reading comprehension.

Table 6.14 Correlations, significance and the strength of the relationship between reading comprehension (NGRT) and language (CAT4-verbal, CELF4-RS, CELF4-USP), non-verbal skills, IDACI and single-word reading (TOWRE2) at Year Nine

Measure	NGRT	CAT verbal	CELF4 RS	CELF4 USP	CAT NV	IDACI	TOWRE2
NGRT	1000						
CAT4-V	.776***						
CELF4-RS	.606***	.546***					
CELF4-USP	.533***	.511***	.427***				
CAT- NV	.541***	.599***	.406***	.335***			
IDACI	-.193***	-.229***	-.144*	-.152**	-.180*		
TOWRE2	.561***	.525***	.475***	.276***	.422***	-.114*	

Key: NGRT – New Group Reading Test; CAT4-V – Cognitive Assessment Test- verbal subtest; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs; CAT4 NV – Cognitive Assessment Test non-verbal ability: IDACI – Income Deprivation Affecting Children Index; TOWRE2 – Test of Word Reading Efficiency

*p< .05,** p< .01,*** $p < .001$

Small relationship, r=.10 to .29	Medium, r = .30 to .49	Large, r= .50 to 1.0

Comparison of the contribution of each independent variable (β) and their statistically significant unique contribution and the contribution of each independent variable to the total (sr^2) at Year Nine (n = 245**).** The measures explained 68.3% of the variance in reading comprehension; R^2 for the overall model was 0.683 with an adjusted R^2 of 0.675, a large effect size according to Cohen (1988). The model significantly predicted reading comprehension in Year Nine, $F_{(6, 238)}$ = 85. 548, p<.001.

Table 6.15 presents the comparison of the contribution of each independent variable (β); their significance; the 95% confidence intervals for β; the semi partial correlation coefficients; the contribution of each independent variable to the total (sr^2) with Year Nine (C8+1, C9, n = 147) and the proportion of the unique contribution to reading comprehension (NGRT). Of the variables, language abilities (CAT4-verbal, β = .484; CELF4-RS, β = .180; CELF4-USP, β = .145) made the largest statistically significant unique contribution followed by single-word reading (β = .155). The unique contribution of verbal reasoning to reading comprehension is 10%, with CELF4-RS contributing only 2% and CELF4-USP, 1.5%.

Table 6.15 Standard Multiple Regression of language (CAT4-verbal, CELF4-RS, CELF4-USP), non-verbal skills, IDACI and single-word reading (TOWRE2) with Year Nine reading comprehension scores (NGRT)

Measure	**Standardised coefficients β**	**t**	**p**	**95.0% Confidence Interval for *β***		**Semipartial correlation coefficients**	**Unique variance sr^2**	**Proportion of unique contribution of variance in NGRT %**
				lower	Upper			
CAT4-V	.484	8.756	<**.001*****	.472	.746	.319	0.102	10.18
CELF4-RS	.180	3.879	<**.001*****	.508	1.558	.142	0.020	2.0
CELF4-USP	.145	3.344	<**.001*****	.300	1.161	.122	0.015	1.5
CAT4-NV	.064	1.386	.167	-.034	.197	.051	0.002	0.2
ICACI	.000	-.007	.994	-6.166	6.122	.000	0.000	0.0
TOWRE2	.155	3.452	**.001*****	.082	.300	.126	0.016	1.59

Key: NGRT – New Group Reading Test; CAT4-V – Cognitive Assessment Test- verbal subtest; CELF-4 RS - Recalling Sentences; CELF-4 USP – Understanding Spoken Paragraphs; CAT4 NV – Cognitive Assessment Test non-verbal ability; IDACI – Income Deprivation Affecting Children Index; TOWRE2 – Test of Word Reading Efficiency

6.3.4 Summary of RQ3

RQ3 sought to determine the nature of the relationships between verbal and non-verbal skills, single word reading, social deprivation and reading comprehension across the first three academic years of secondary education (KS3). Table 6.16 presents the predictors, direction of effect, significance and proportion of unique variance for each variable for the start and end of KS3. (Year 8 had a different set of measures and so is not used in the comparison).

Table 6.16 Comparison of standard multiple regression of language (CAT4-verbal, CELF4-RS, CELF4-USP), non-verbal skills, IDACI and single-word reading (TOWRE2) with reading comprehension scores (NGRT), Year Seven and Year Nine

Key Stage Three (KS3)						
Measure	**Year Seven**			**Year Nine**		
	Standardised coefficient β	**p**	**Proportion of unique contribution of variance in NGRT %**	**Standardised coefficient β**	**p**	**Proportion of unique contribution of variance in NGRT %**
CAT4-V	0.338	$<.001$	4	.484	$<.001$	10.18
CELF4-RS	0.230	$<.001$	3	.180	$<.001$	2.0
CELF4-USP	0.079	.175	0.5	.145	$<.001$	1.5
CAT4- NV	0.098	.177	0.5	.064	.167	0.2
IDACI	0.001	.989	0%	-.000	.994	0.02
TOWRE2	0.294	$<.001$	5.80	.155	$<.001$	1.59

Key: NGRT – New Group Reading Test; CAT-V – Cognitive Assessment Test- verbal subtest; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs; CAT4 NV – Cognitive Assessment Test non-verbal ability; IDACI – Income Deprivation Affecting Children Index; TOWRE2 – Test of Word Reading Efficiency

At the start of secondary education (Year Seven), the adjusted R^2 value of .629 indicates that 62.9% of the variance explained for reading comprehension is predicted by the measures. By Year Nine, the adjusted R^2 value of .675 indicates that variance in reading comprehension increased by 4.6% indicating the measures used in this study were explaining more of the variance.

In Year Seven, verbal reasoning (CAT4-verbal), Recalling Sentences and single-word reading uniquely explained variance in reading comprehension: four percent, three percent and almost six percent respectively. In Year Nine, verbal reasoning continued to uniquely explain reading comprehension accounting for 10.18% of the variance, followed by Recalling Sentences (2%) and Understanding Spoken Paragraphs (1.5%). Word reading still continued to make a unique contribution to reading comprehension but the proportion dropped to 1.59% to the explanation of reading comprehension in Year Nine.

6.4 RQ4 (a) Does performance on measures of listening comprehension significantly predict reading comprehension in secondary school students?

Research shows that multiple skills underpin text comprehension, including vocabulary, grammar, verbal working memory, inference and comprehension monitoring (Kim, 2015, Lervag et al., 2018). What perhaps, is less well understood from an educational perspective, is the variation in adolescent reading comprehension that can be explained by language skills, and if this is developmental. Results from RQ3 shows that the variance in reading comprehension from Year Seven to Year Nine increased by 4.6%, suggesting an increasing relative contribution of language measures. As listening comprehension is a skill associated with understanding oral vocabulary and syntactic structures, and therefore similar to reading comprehension (Babayiit and Shapiro, 2020), it seems likely it will significantly predict reading comprehension in this sample of secondary school students.

Hierarchal multiple regression was used to determine if listening comprehension scores (CELF4-USP) predicted levels of reading comprehension as measured by NGRT in Year Seven, Eight and Nine beyond that of individual factors, non-verbal abilities, accuracy of single-word reading and language abilities (CELF4-RS and CAT4-verbal). Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. There was linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values. There was independence of residuals, as assessed by the Durbin-Watson statistic (Year Seven, 1.571; Year Eight, 1.603; Year Nine, 1.926). There was homoscedasticity, as assessed by visual inspection of a plot of studentized residuals versus unstandardised predicted values. There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1. There were no studentized deleted residuals greater than ±3 standard deviations, no leverage values greater than 0.2, nor values for Cook's distance above 1. The assumption of normality was met, as assessed by Q-Q Plot. Missing values were excluded listwise (Year Seven, n= 15; Year Eight, n= 16; Year Nine, n= 18) (Appendix 6.2).

Table 6.17 presents the hierarchy used to enter the measures into the regression sequence. In order to identify the effects of listening comprehension, the following blocks were entered. Block one formed the individual participant factors previously discussed of gender, SEN and deprivation; non-verbal scores (CAT4 NV) was entered into block two; literacy measures (single -word reading, TOWRE2) were entered in block 3; language measures (CAT4-verbal and CELF4-RS) were entered into block 4 and listening comprehension (CELF4-USP) was entered into block 5.

Table 6.17. The entry of blocks in the hierarchical multiple regression

Measures					Outcome
BLOCK 1	**BLOCK 2**	**BLOCK 3**	**BLOCK 4**	**BLOCK 5**	
Individual participant measures	Non-verbal measure	Literacy measure	Language measures	Listening comprehension measures	
GENDER	CAT4 - nonverbal	TOWRE2- single word reading	CAT4-verbal	CELF4 understanding spoken paragraphs	Reading comprehension (NGRT)
SEN			CELF4 recalling sentences		
IDACI					

Key: SEN – Special Educational Needs: IDACI - Income Deprivation Affecting Children Index

6.4.1 Does performance on measures of listening comprehension significantly predict reading comprehension in students in Year Seven?

Table 6.18 presents the unstandardised regression coefficients (B); the standardised regression coefficients (β); R^2, the adjusted R^2 after entry of the measures at each step and the adjusted R-squared change. The full model of individual factors (gender, SEN and deprivation, non-verbal skills (CAT4 NV), single-word reading (TOWRE2), language measures (CAT4-verbal and CELF4-RS) and listening comprehension (CELF4-USP) to predict reading comprehension (NGRT) was statistically significant, $R^2 = 0.650$, $F_{(8.138)} = 32.041$, $p < .001$, adjusted $R^2 = 0.630$ indicating that 63.0% of the variability in reading comprehension is predicted by all the measures.

The addition of CAT4-V to the prediction of reading comprehension (BLOCK 2) led to a statistically significant increase in R^2 of 0.245, $F_{(1,142)} = 55.881$, $p<.001$. The addition of TOWRE2 (model 3) led to a statistically significant increase in R^2 of 0.150, $F_{(1,141)} = 44.599$, $p<.001$. The addition of language measures (model 4) led to a statistically significant increase in R^2 of 0.117, $F_{(2,139)} = 22.836$, $p<.001$. However, the addition of listening comprehension (model 5) did not lead to a statistically significant increase in R^2 of 0.006, $F_{(1, 138)} = 2.380$, $p= .125$ indicating that listening comprehension is not a unique predictor of reading comprehension at the start of secondary education.

Table 6.18 Hierarchical Regression Analysis Predicting Reading Comprehension in students at Year Seven

Step and predictor measure	**B**	**SE B**	**β**	**p**	**R^2**	**Adjusted after entry R^2**	**R^2 change**
Block 1							
Gender	2.987	2.616	.091	.255	.132	.114	**.132*** **
SEN	-13.427	3.518	-.301	<**.001**			
IDACI	-9.967	6.066	-.129	.103			
After Block 1 (model 2)							
4Gender	.756	2.244	.023	.737	.377	.359	**.245*** **
SEN	-11.283	3.004	-.253	<**.001**			
IDACI	-7.028	5.172	-.091	.176			
CAT4-NV	.614	.082	.505	<**.001**			
After Block 2 (model 3)							
Gender	.426	1.963	.013	.829	.527	.510	**.150*** **
SEN	-4.567	2.814	-.102	.107			
IDACI	-3.745	4.551	-.049	.412			
CAT4-NV	.488	.074	.402	<**.001**			
TOWRE2	.489	.073	.438	<**.001**			
After Block 3 (model 4)							
Gender	1.070	1.718	.032	.535	.644	.626	**.117*** **
SEN	-2.800	2.499	-.063	.264			
IDACI	1.005	4.038	.013	.804			
CAT4-NV	.114	.089	.093	.204			
TOWRE2	.290	.071	.259	<**.001**			
CAT4-verbal	.457	.100	.376	<**.001**			
CELF4-RS	1.323	.378	.234	<**.001**			
After Block 4 (model 5)							
Gender	1.094	1.709	.033	.523	.650	.630	.006

Step and predictor measure	B	SE B	β	p	R^2	Adjusted after entry R^2	R^2 change
SEN	-3.305	2.508	-.074	.190			
IDACI	.259	4.047	.003	.949			
CAT4-NV	.114	.089	.094	.200			
TOWRE2	.301	.071	.270	<**.001**.			
CAT4-verbal	.413	.103	.339	<**.001**			
CELF4-RS	1.203	.384	.212	**.002**			
CELF4-USP	.426	.276	.090	.125			

Key: SEN – Special Educational Needs; IDACI – Income Deprivation Affecting Children Index; CAT4- NV – Cognitive Assessment Test non-verbal ability; TOWRE2 – Test of Word Reading Efficiency; CAT4-V – Cognitive Assessment Test- verbal subtest; CELF4-RS - Recalling Sentences; CELF4-USP - Understanding Spoken Paragraphs

6.4.2 Does performance on measures of listening comprehension significantly predict reading comprehension in students in Year Eight?

Table 6.19 presents the unstandardised regression coefficients (B); the standardised regression coefficients (β); R^2, the adjusted R^2 after entry of the measures at each step and the adjusted R-squared change. In Year Eight, no CAT4 assessments were undertaken. Consequently, the full model is as follows: step one, individual factors (gender, SEN and deprivation; step two, single-word reading (TOWRE2); step three, language measure (CELF4-RS) and step four, listening comprehension (CELF4-USP). The full Year Eight model predicting reading comprehension (NGRT) was statistically significant, $R^2 = 0.497$, $F_{(6, 273)} = 44.89$, $p < .001$, adjusted $R^2 = 0.486$ indicating that without the inclusion of cognitive skills, 48.60% of the variability in reading comprehension is predicted by the measures.

The addition of TOWRE2 (model 2) led to a statistically significant increase in R^2 of 0.188, $F_{(4,275)} = 36.56$, $p<.001$. The addition of CELF4-RS (model 3) led to a statistically significant increase in R^2 of 0.103, $F_{(5,274)} = 44.89$, $p<.001$. The addition of listening comprehension (model 4) led to a statistically significant increase in R^2 of 0.046, $F_{(6,273)} = 44.90$, $p< .001$, indicating that listening comprehension is a significant predictor of reading comprehension, when measures of cognitive skills are not included.

Table 6.19 Hierarchical Regression Analysis Predicting Reading Comprehension in students at Year Eight

Step and predictor measure	B	SE B	β	p	R^2	Adjusted after entry R^2	R^2 change
Block 1							
Gender	2.650	1.900	.079	.164	.160	.150	**.160*****
SEN	-13.762	2.382	-.330	<**.001**.			
IDACI	-11.764	4.565	-.143	.010			
After Block 1 (model 2)							
Gender	2.919	1.678	.088	.083	.347	.338	**.188*****
SEN	-8.348	2.189	-.200	<**.001**.			
IDACI	-10.987	4.031	-.134	.007			
TOWRE2	.555	.062	.452	<**.001**.			
After Block 2 (model 3)							
Gender	2.869	1.542	.086	.064	.450	.440	**.103*****
SEN	-5.624	2.048	-.135	.006**			
IDACI	-7.899	3.731	-.096	.035*			
TOWRE2	.394	.062	.321	<**.001**			
CELF4-RS	2.108	.294	.363	<**.001**			
After Block 3 (model 4)							
Gender	3.481	1.483	.104	.020*	.497	.486	**.046*****
SEN	-5.378	1.964	-.129	.007**			
IDACI	-9.609	3.593	-.117	.008**			
TOWRE2	.355	.060	.289	<**.001**			
CELF4-RS	1.629	.298	.281	<**.001**			
CELF4-USP	1.142	.228	.238	<**.001**			

Key: SEN – Special Educational Needs; ; IDACI – Income Deprivation Affecting Children Index; CAT4 NV – Cognitive Assessment Test non-verbal ability; TOWRE2 – Test of Word Reading Efficiency; CAT4-V – Cognitive Assessment Test- verbal subtest; CELF4-RS - Recalling Sentences; CELF4-USP - Understanding Spoken Paragraphs

6.4.3 Does performance on measures of listening comprehension significantly predict reading comprehension in students in Year Nine?

Table 6.20 presents the unstandardised regression coefficients (B); the standardised regression coefficients (β); R^2, the adjusted R^2 after entry of the measures at each step and the adjusted R-squared change. The full model of individual factors (gender, SEN and deprivation, non-verbal skills (CAT4 NV), single-word reading (TOWRE2), language measures (CAT4-verbal and CELF4-RS) and listening comprehension (CELF4-USP) to predict reading comprehension (NGRT) was statistically significant, $R^2 = 0.727$, $F_{(8.237)} = 78.74$, $p < .001$, adjusted $R^2 = 0.717$ indicating that 71.70% of the variability in reading comprehension is predicted by all the measures

The addition of CAT-V to the prediction of reading comprehension (model 2) led to a statistically significant increase in R^2 of 0.127, $F_{(4,241)} = 53.86$, $p<.001$. The addition of TOWRE2 (model 3) led to a statistically significant increase in R^2 of 0.070, $F_{(5.240)} = 56.85$, $p<.001$. The addition of language measures (model 4) led to a statistically significant increase in R^2 of 0.167, $F_{(7,238)} = 82.80$, $p<.001$. Finally, the addition of listening comprehension (model 5) led to a statistically significant increase in R^2 of 0.018, $F_{(8,237)} = 78.74$, $p< .001$ indicating that listening comprehension is a significant predictor of reading comprehension in Year Nine, when cognitive skills are included in the model again.

Table 6.20 Hierarchical Regression Analysis Predicting Reading Comprehension in students at Year Nine

Step and predictor measure	B	SE B	β	p	R^2	Adjusted after entry R^2	R^2 change
Block 1							
Gender	.516	1.792	.015	.774	.345	.337	**.345*****
SEN	-21.398	2.036	-.554	**<.001**			
IDACI	-12.984	4.332	-.157	**.003****			
After Block 2							
Gender	1.194	1.616	.035	.461	.472	.463	**.127*****
SEN	-16.568	1.939	-.429	**<.001**.			
IDACI	-8.074	3.952	-.098	.042*			
CAT4 – NV	.486	.064	.383	**<.001**			
After Block 3							
Gender	2.534	1.524	.074	.098	.542	.533	**.070*****
SEN	-13.084	1.898	-.339	**<.001**.			
IDACI	-7.486	3.688	-.090	.043*			
CAT4 - NV	.362	.063	.285	**<.001**.			
TOWRE2	.379	.063	.308	**<.001**.			
After Block 4							
Gender	2.237	1.221	.066	.068	.709	.700	**.167*****
SEN	-10.928	1.544	-.283	**<.001**.			
IDACI	-1.743	2.996	-.021	.561			
CAT4-NV	.085	.056	.067	.131			

Step and predictor measure	B	SE B	β	p	R^2	Adjusted after entry R^2	R^2 change
TOWRE2	.172	.054	.139	**.002****			
CAT-verbal	.513	.055	.443	<**.001**.			
CELF4-RS	.973	.253	.170	<**.001**.			
After Block 5							
Gender	2.570	1.189	.076	**.032***	.726	.717	**.018*****
SEN	-10.344	1.507	-.268	<**.001**.			
IDACI	-1.362	2.911	-.016	.640			
CAT4-NV	.076	.054	.060	.165			
TOWRE2	.180	.052	.146	<**.001**.			
CAT-verbal	.455	.056	.393	<**.001**.			
CELF4-RS	.773	.251	.135	**.002****			
CELF4-USP	.792	.202	.157	<**.001**.			

Key: SEN – Special Educational Needs; IDACI – Income Deprivation Affecting Children Index; CAT4 NV – Cognitive Assessment Test non-verbal ability; TOWRE2 – Test of Word Reading Efficiency; CAT4-V – Cognitive Assessment Test- verbal subtest; CELF4-RS - Recalling Sentences; CELF4-USP - Understanding Spoken Paragraphs

6.4.4. Summary of RQ4

RQ4 sought to determine if performance on measures of listening comprehension significantly predicted reading comprehension in secondary school students, beyond differences in gender, SEN and deprivation. The model as a whole was statistically significant and explained 62.90% variability in Year Seven; 48.70% in Year Eight (without inclusion of CAT4 measures) and 73.50% in Year Nine. Table 6.21 summarises the variation in reading comprehension explained by the addition of CELF4-USP (R^2) and whether this change was statistically significant (Sig. F Change).

Table 6.21 Summary of the variation in reading comprehension explained by listening comprehension (CELF4-USP) across the first three years of secondary education

Predictors	Final Model		
	Year Seven	Year Eight	Year Nine
	Sign F change, p = .126	**Sign F change, p <.001**	**Sign F change, p <.001**
Gender	.523	.020*	.032*
SEN	.190	.007**	**<.001**
IDACI	.949	.008**	.640
CAT4-NV	.200	*Not sat in Y8*	.165
TOWRE2	**<.001**	**<.001**	**<.001**
CAT4-verbal	**<.001**	*Not sat in Y8*	**<.001**
CELF4-RS	.002**	**<.001**	.002**
CELF4-USP	.125	**<.001**	**<.001**

Key: SEN – Special Educational Needs; IDACI – Income Deprivation Affecting Children Index; CAT4 NV – Cognitive Assessment Test non-verbal ability; TOWRE2 – Test of Word Reading Efficiency; CAT4-V – Cognitive Assessment Test- verbal subtest; CELF4-RS - Recalling Sentences; CELF4-USP - Understanding Spoken Paragraphs

In Year Seven, the addition of understanding spoken paragraphs to the model did not improve $R^{2.}$ This suggests that in Year Seven, reading comprehension is predicted by verbal reasoning (CAT4-V) and single word reading (TOWRE2) and that listening comprehension, as measured by CEL4 USP subtest does not make any additional unique contribution. In contrast, by Year Nine, listening comprehension does add statistically significantly to the model. This pattern of results suggests that language measures (understanding spoken paragraphs, verbal reasoning, recalling sentences) and single word reading predict reading comprehension at the end of KS3. Special Educational needs is also a significant predictor suggesting that those with SEN, perform significantly less well in reading comprehension than their peers.

6.5 RQ4 (b) What are the unique predictors of academic outcomes at General Certificate of Secondary Education (GCSE) level, in students' final year of compulsory year education?

Success in gaining a General Certificate of Secondary Education (GCSE) in English, Maths and Science is both a measure of students' academic ability and a route to gaining success in further education through college or university. Exploring the unique predictors of academic outcomes is important for school in understanding how to support students.

Final multiple regressions examined the unique predictors of academic outcomes at GCSE English, Maths and Science (Year Eleven). The C9 cohort sat the external examinations in 2019, two years after the data collection concluded. The students had retrospective data (excluding Y7 CAT4 scores) and one year of language assessments at time point 1. The measures entered into the regression were collected for the C9 cohort at time point 1. Missing data was excluded list wise.

6.5.1 Unique Predictors of outcomes at English GCSE for the Y9 cohort

One hundred and one students from the sample sat their English GCSE. Table 6.22 displays the correlations between the measures (r). By the end of compulsory education (KS4), there are strong, positive relationships between literacy (NGRT, $r = 0.719$, $p < .001$; TOWRE2, $r = 0.532$, $p < .001$) and verbal reasoning (CAT4-verbal, $r = 0.565$, $p < .001$; CELF4-RS, $r = 0.533$, $p < .001$) with high levels of literacy and language associated with high levels of attainment in the English GCSE.

The model significantly predicted GCSE English in Year Eleven (Y9), $F_{(10, 90} = 15.401$, $p<.001$, with the measures explaining 59.0% of the variance in the English GCSE; R^2 for the overall model was 0.631, with an adjusted R^2 of 0.590, a large effect size according to Cohen (1988).

Table 6.22 Correlations, significance and the strength of the relationship between the English General Certificate of Secondary Education (GCSE) and individual student factors, non-verbal, literacy and language measures

Measure	GCSE English	Gender	SEN	IDACI	KS2 SAT	CAT4 NV	CAT V	TOWRE2	NGRT	CELF4 RS	CELF4 USP
Gender	.155										
SEN	-.471***	-.037									
IDACI	-.271**	.086	.037								
KS2 SAT	.495***	.102	-.377***	-.164							
CAT4 NV	.429***	-.163	-.234**	-.198*	.296***						
CAT4 V	.565***	-.183*	-.332***	-.214*	.498***	.571***					
TOWRE2	.532***	-.160	-.336***	-.168*	.391***	.407***	.539***				
NGRT	.719***	-.026	-.625***	-.159	.593***	.542***	.767***	.548***			
CELF4-RS	.533***	.000	-.457***	-.134	.427***	.320***	.471***	.438***	.652***		
CELF4-USP	.223*	-.060	-.183*	-.137	.298***	.259**	.373***	.218*	.463***	.376*	

Key: SEN – Special Educational Needs; IDACI – Income Deprivation Affecting Children Index; KS2 SAT – Key Stage Two, Statutory Assessment Test, reading; CAT4 NV – Cognitive Assessment Test non-verbal ability; CAT4-V – Cognitive Assessment Test- verbal subtest; TOWRE2– Test of Word Reading Efficiency; NGRT – New Group Reading Test; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs
*p< .05,** p<.01,*** p<.001

Small relationship, r=.10 to .29	Medium, r = .30 to .49	Large, r= .50 to 1.0

Table 6.23 presents the comparison of the contribution of each independent variable (β); their significance; the 95% confidence intervals for β; the semi partial correlation coefficients (SP CC); the contribution of each independent variable to the total (sr^2) with year eleven (Y9 cohort, n = 101) and the proportion of the unique contribution to the English GCSE.

The size and direction of the relationships suggested that higher scores in English GCSE were among female students, students with low levels of deprivation, higher word reading skills and higher reading comprehension measures. Reading comprehension at year nine was the most important measure within this analysis, uniquely explaining five percent of the variance in GCSE English at Year Eleven.

Table 6.23 Standard Multiple Regression of individual student factors, non-verbal skills, literacy and language measures with Year Eleven, English GCSE scores

Measure	β	t	p	95.0% Confidence Interval for β		SP CC	Unique variance sr^2	Proportion of unique contribution of variance in English GCSE %
				lower	Upper			
Gender	.214	3.129	**.002****	.717	3.214	.200	.04	4
SEN	-.017	-.197	.844	-1.982	1.625	-.013	.000	.017
IDACI	-.160	-2.406	**.018***	-6.340	-.605	-.154	.024	2.37
KS2 SAT	.030	.362	.718	-.528	.763	.023	.000	.053
CAT4 NV	.050	.613	.541	-.037	.070	.039	.001	.152
CAT4 V	.024	.214	.831	-.071	.088	.014	.000	.019
TOWRE2	.192	2.361	**.020***	.010	.117	.151	.023	2.28
NGRT	.526	3.476	**<.001**	.065	.238	.223	.049	4.97
CELF4 RS	.090	1.036	.303	-.138	.438	.066	.004	.043
CELF4 USP	-.139	-1.871	.065	-.399	.012	-.120	.014	1.44

Key: SEN – Special Educational Needs; IDACI – Income Deprivation Affecting Children Index; KS2 SAT – Key Stage Two Statutory Tests, Reading; CAT4 NV – Cognitive Assessment Test non-verbal ability; CAT4-V – Cognitive Assessment Test- verbal subtest; TOWRE2 – Test of Word Reading Efficiency; NGRT – New Group Reading Test; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs
*p< .05,** p<.01,*** p<.001

6.5.2 Unique Predictors of outcomes at Maths GCSE for the C9 cohort

One hundred and one students from the sample sat their English GCSE. Table 6.24 displays the correlations between the measures (r). By the end of compulsory education (KS4), there are strong, positive relationships between literacy (KS2 SAT reading, $r = 0.527$, $p < .001$; NGRT, $r = 0.745$, $p < .001$; TOWRE2, $r = 0.502$, $p < .001$); verbal reasoning (CAT4-verbal, $r = 0.708$, $p < .001$) and non-verbal reasoning (CAT4 NV, $r = 0.640$, $p < .001$). Oral language measures show moderate, strong relationships (CELF4-RS, $r = 0.442$, $p < .001$, CELF4-USP, $r = 0.354$, $p < .001$) indicating that high levels of literacy and moderate levels of language are associated with high levels of attainment in the Mathematics GCSE.

Comparison of the contribution of each independent variable (β), their statistically significant unique contribution and the contribution of each independent variable to the total (sr^2) at Year Eleven ($n = 101$). The model significantly predicted GCSE Mathematics in year eleven (Y9), $F_{(10, 90} = 19.627$, $p<.001$, with the measures explaining 65.0% of the variance in the Mathematics GCSE; R^2 for the overall model was 0.686, with an adjusted R^2 of 0.651, a large effect size according to Cohen (1988).

Table 6.24 Correlations, significance and the strength of the relationship between the Mathematics General Certificate of Secondary Education (GCSE) and individual student factors, non-verbal, literacy and language measures

Measure	GCSE Mathematics	Gender	SEN	IDACI	KS2 SAT	CAT4 NV	CAT V	TOWRE2	NGRT	CELF4 RS	CELF4 USP
Gender	.028										
SEN	-.386***	-.037									
IDACI	-.226*	.086	.037								
KS2 SAT	.527***	.102	-.377***	-.164							
CAT4 NV	.640***	-.163	-.234**	-.198*	.296***						
CAT4 V	.708***	-.183*	-.332***	-.214*	.498***	.571***					
TOWRE2	.502***	-.160	-.336***	-.168*	.391***	.407***	.539***				
NGRT	.745***	-.026	-.625***	-.159	.593***	.542***	.767***	.548***			
CELF4 RS	.442***	.000	-.457***	-.134	.427***	.320***	.471***	.438***	.652***		
CELF4 USP	.354***	-.060	-.183*	-.137	.298***	.259**	.373***	.218*	.463***	.376***	

Key: SEN – Special Educational Needs; IDACI – Income Deprivation Affecting Children Index; KS2 SAT – Key Stage Two, Statutory Assessment Test, reading; CAT NV – Cognitive Assessment Test non-verbal ability; CAT4-V – Cognitive Assessment Test- verbal subtest; TOWRE2 – Test of Word Reading Efficiency; NGRT – New Group Reading Test; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs
*p< .05,** p<.01,*** p<.001

Small relationship, r=.10 to .29	Medium, r = .30 to .49	Large, r= .50 to 1.0

Table 6.25 presents the comparison of the contribution of each independent variable (β); their significance; the 95% confidence intervals for β; the semi partial correlation coefficients (SP CC); the contribution of each independent variable to the total (sr^2) with Year Eleven (C9 cohort, n = 101) and the proportion of the unique contribution to the Mathematics GCSE.

The size and direction of the relationships suggested that higher scores in GCSE Mathematics were among female students, and students with high levels of non-verbal and verbal reasoning skills and higher reading comprehension measures. Non-verbal cognitive skills at year nine was the most important measure, uniquely explaining five percent of the variance in GCSE Mathematics at Year Eleven.

Table 6.25 Standard Multiple Regression of individual student factors, non-verbal skills, literacy and language measures with Year Eleven, Mathematics GCSE scores

Measure	β	t	p	95.0% Confidence Interval for β		SP CC	Unique variance sr^2	Proportion of unique contribution of variance in Math GCSE %
				lower	Upper			
Gender	.133	2.104	**.038***	.081	2.825	.124	.015	1.53
SEN	.027	.334	.739	-1.649	2.315	.020	.004	.4
IDACI	-.054	-.887	.378	-4.558	1.745	-.052	.002	.27
KS2 SAT	.096	1.261	.211	-.259	1.160	.075	.005	.56
CAT4 NV	.291	3.887	<**.001**	.056	.173	.230	.052	5.29
CAT4 V	.217	2.069	.041*	.004	.179	.122	.014	1.49
TOWRE2	.072	.961	.339	-.030	.087	.057	.003	.325
NGRT	.377	2.703	**.008****	.034	.225	.160	.025	2.56
CELF4 RS	-.071	-.886	.378	-.458	.175	-.052	.002	.27
CELF4 USP	.010	.153	.879	-.208	.243	.009	.000	.008

Key: SEN – Special Educational Needs; IDACI – Income Deprivation Affecting Children Index; KS2 SAT – Key Stage Two Statutory Tests, Reading; CAT4 NV – Cognitive Assessment Test non-verbal ability; CAT4-V – Cognitive Assessment Test- verbal subtest; TOWRE2 – Test of Word Reading Efficiency; NGRT – New Group Reading Test; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs
*p< .05,** p<.01,*** p<.001

6.5.3 Unique Predictors of outcomes at Science GCSE for the C9 cohort

One hundred and one students from the sample sat their Science GCSE. Table 6.26 displays the correlations between the measures (r). By the end of compulsory education (KS4), there are strong, positive relationships between literacy (KS2 SAT reading, $r = 0.536$, $p < .001$; NGRT, $r = 0.696$, $p < .001$; TOWRE2, $r = 0.540$, $p < .001$); verbal reasoning (CAT-verbal, $r = 0.644$, $p < .001$) and non-verbal reasoning (CAT4 NV, $r = 0.575$, $p < .001$). Oral language measures show moderate, strong relationships (CELF4-RS, $r = 0.412$, $p < .001$, CELF4-USP, $r = 0.389$, $p < .001$) indicating that high levels of literacy and moderate levels of language are associated with high levels of attainment in the Science GCSE.

Comparison of the contribution of each independent variable (β), their statistically significant unique contribution and the contribution of each independent variable to the total (sr^2) at Year Eleven (n = 101**).** The model significantly predicted GCSE Science in Year Eleven (C9), $F_{(10, 90} = 14.576$, $p<.001$, with the measures explaining 57.6% of the variance in the Science GCSE; R^2 for the overall model was 0.618, with an adjusted R^2 of 0.576, a large effect size according to Cohen (1988).

Table 6.26 Correlations, significance and the strength of the relationship between the Science General Certificate of Secondary Education (GCSE) and individual student factors, non-verbal, literacy and language measures

Measure	GCSE Science	Gender	SEN	IDACI	KS2 SAT	CAT4 NV	CAT V	TOWRE2	NGRT	CELF4 RS	CELF4 USP
Gender	.041										
SEN	-.367***	-.037									
IDACI	-.176*	.086	.037								
KS2 SAT	.536***	.102	-.377***	-.164							
CAT4 NV	.575***	-.163	-.234**	-.198*	.296***						
CAT4 V	.644***	-.183*	-.332***	-.214*	.498***	.571***					
TOWRE2	.540***	-.160	-.336***	-.168*	.391***	.407***	.539***				
NGRT	.696***	-.026	-.625***	-.159	.593***	.542***	.767***	.548***			
CELF4-RS	.412***	.000	-.457***	-.134	.427***	.320***	.471***	.438***	.652***		
CELF4-USP	.389***	-.060	-.183*	-.137	.298***	.259**	.373***	.218*	.463***	.376***	

Key: SEN – Special Educational Needs; IDACI – Income Deprivation Affecting Children Index; KS2 SAT – Key Stage Two, Statutory Assessment Test, reading; CAT4 NV – Cognitive Assessment Test non-verbal ability; CAT4-V – Cognitive Assessment Test- verbal subtest; TOWRE2 – Test of Word Reading Efficiency; NGRT – New Group Reading Test; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs
*p< .05,** p<.01,*** p<.001

Small relationship, r=.10 to .29	Medium, r = .30 to .49	Large, r= .50 to 1.0

Table 6.27 presents the comparison of the contribution of each independent variable (β); their significance; the 95% confidence intervals for β; the semipartial correlation coefficients (SP CC); the contribution of each independent variable to the total (sr^2) with Year Eleven (Y9 cohort, n = 101) and the proportion of the unique contribution to the Science GCSE.

The size and direction of the relationships suggested that higher scores in GCSE Science were associated with higher levels of non-verbal skills and a trend with word reading skills. Non-verbal skills at year nine was the most important measure, uniquely explaining three and a half percent of the variance in GCSE Science at Year Eleven.

Table 6.27 Standard Multiple Regression of individual student factors, non-verbal skills, literacy and language measures with Year Eleven, Science GCSE scores

Measure	**β**	**t**	**p**	**95.0% Confidence Interval for β**		**SP CC**	**Unique variance sr^2**	**Proportion of unique contribution of variance in Science GCSE %**
				lower	Upper			
Gender	.137	1.973	.052	-.009	2.711	.129	.016	1.66
SEN	.023	.261	.795	-1.707	2.223	.017	.000	.030
IDACI	-.006	-.086	.931	-3.260	2.988	-.006	.000	.004
KS2 SAT	.148	1.770	.080	-.077	1.330	.115	.013	1.32
CAT4 NV	.243	2.944	**.004****	.028	.144	.192	.037	3.69
CAT4 V	.137	1.183	.240	-.035	.138	.077	.005	.592
TOWRE2	.196	2.370	.020*	.011	.128	.154	.024	2.37
NGRT	.305	1.982	.051	.000	.188	.129	.017	1.66
CELF4 RS	-.105	-1.194	.236	-.502	.125	-.078	.006	.61
CELF4 USP	.099	1.309	.194	-.076	.371	.085	.007	.722

Key: SEN – Special Educational Needs; IDACI – Income Deprivation Affecting Children Index; KS2 SAT – Key Stage Two Statutory Tests, Reading; CAT4 NV – Cognitive Assessment Test non-verbal ability; CAT4-V – Cognitive Assessment Test- verbal subtest; TOWRE2 – Test of Word Reading Efficiency; NGRT – New Group Reading Test; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs
*p< .05,** p<.01,*** p<.001

6.5.4 Summary of RQ4 (b)

Research question five sought to determine the unique predictors of academic outcomes at General Certificate of Secondary Education (GCSE) level for English, Mathematics and Science. Table 6.28 summarises the significance effect of the measures.

Table 6.28 Significance effect of the unique predictors of outcomes at English, Mathematics and Science GCSE level

Measures	General Certificate of Secondary Education		
	English	**Mathematics**	**Science**
Gender	**.002****	.038*	○
SEN	○	○	○
IDACI	.018*	○	○
KS2 SAT	○	○	○
CAT4 NV	○	**<.001*****	**.004****
CAT4 V	○	.041*	○
TOWRE2	.020*	○	.020*
NGRT	**<.001*****	**.008****	○
CELF4-RS	○	○	○
CELF4 USP	○	○	○

Key: SEN – Special Educational Needs; IDACI – Income Deprivation Affecting Children Index; KS2 SAT – Key Stage Two Statutory Tests, Reading; CAT4 NV – Cognitive Assessment Test non-verbal ability; CAT4-V – Cognitive Assessment Test- verbal subtest; TOWRE2 – Test of Word Reading Efficiency; NGRT – New Group Reading Test; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs

○ - non-significant effect

The model explained 59% of the variance for English GCSE, 65% for Mathematics GCSE and 58% for Science GCSE. Of all the variables, reading comprehension made the largest unique contribution across all analyses (English β =.719; Mathematics = .745; Science = .696). This appears to indicate that good levels of reading comprehension are necessary for academic attainment in English, Mathematics and Science.

The significant, unique predictor of outcome at English GCSE level was reading comprehension at $p < .001$, with single word reading trending towards significance at $p < .05$. Non-verbal reasoning was the significant, unique predictor at Mathematics GCSE level ($p < .001$) and at Science GCSE level ($p < .01$). Verbal reasoning was trending towards significance with Mathematics ($p < .05$) and single word reading with the English and Science GCSE ($p < .05$)

Student profiles showed girls achieved higher English, Mathematics and Science scores. Lower levels of deprivation were associated with higher English attainment.

6.6. RQ5: To what extent does deprivation, non-verbal ability, single word reading and language abilities explain the relationship between student academic attainment in English and reading comprehension?

Previous analysis explored the extent to which variation in reading comprehension can be explained by language, non-verbal skills, social deprivation, single-word reading and the unique contribution of each measure. The results point to the increasing relative contribution of language measures from Year Seven to Year Nine, with listening comprehension (USP) a significant predictor of reading comprehension by Year Nine. At Year Eleven, reading comprehension is the significant, unique predictor of outcome at English GCSE level, and made the largest unique contribution across English, Mathematics and Science indicating that good levels of reading comprehension are necessary for academic attainment in English, Mathematics and Science. In order to understand how deprivation, non-verbal ability, single word reading and language skills explain the relationship between academic attainment and reading comprehension, mediation analysis was performed. It was predicted that oral language skills, non-verbal skills, single-word reading and deprivation will explain the relationship between student attainment in reading comprehension and KS3 academic attainment in students. Although English attainment is the main focus of this section, findings for Mathematics and Science are also included.

To fully capture the nature of the interacting variables, two theoretical perspectives are used: specific effects and the global model. According to Agler and De Boeck (2017), specific effects using separate mediation models focus on isolated effects of interest, whilst the global model examines the larger set of effects. The advantage of the specific effects is that model constraints are avoided but there is a risk of 'overfitting' (Agler & De Boeck, 2017 p4); whereas the global model may give better replication but interpretation is based on the model used.

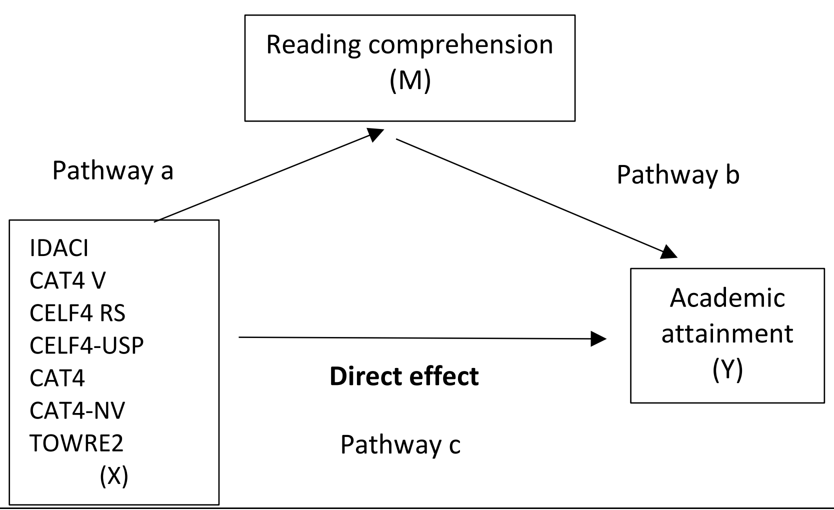
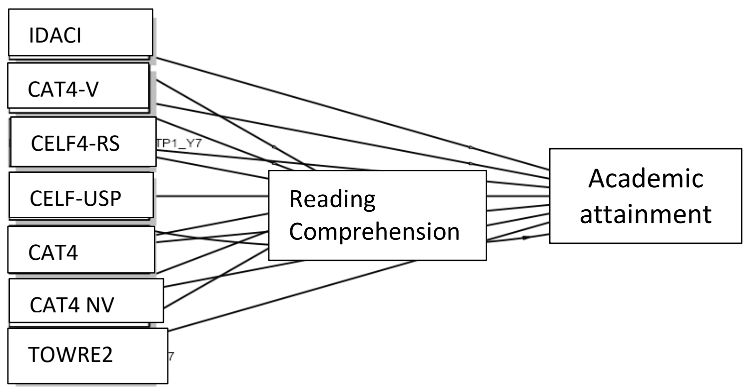
This section describes the results of both perspectives on mediation analysis performed to assess the extent to which deprivation (IDACI), non-verbal (CAT4 NV), single word reading

(TOWRE2), language skills (CAT4- verbal, CELF4 recalling sentences, CELF4 understanding spoken paragraphs) influence reading comprehension, which in turn influences student academic attainment.

The path analysis sample size requirements for 7 IVs: N> 50 + 8m (where m = number of independent variables) following Tabachnick et al (2014) are 106 cases. In academic year seven, 158 students were assessed for additional language measures; in academic year eight (Y7 +1, Y8) there were 317 students and in academic year nine (Y8+1, Y9) there were 284 students. Assessments from the summer term were used to show end of year achievement.

Mediation analysis was performed using Jamovi software (The Jamovi Project, 2021). Jamovi (Version 3.3.2.0) was used to assess the role of deprivation, cognitive ability including non-verbal, word reading and language ability on reading comprehension and academic attainment at the end of each academic year. Mediation analysis was run using both Jamovi software and SPSS Process, and both gave the same results. Jamovi software was chosen over SPSS Process due to the more efficient processing time; the software provided mediation estimates and pathway estimates. Figure 6.2 illustrates the sequence of simple mediation for specific effects (Tabachnick et al., 2014) and multivariate mediation for the global model (adapted from Aung et al., 2020).

Figure 6.2. Analytical framework for conducting specific effects and global model mediation analysis of deprivation, non-verbal, single word reading, language, reading comprehension, and academic attainment in English (adapted from Aung et al., 2020)

Total effect	**X** → **Y** **Total effect**	Unmediated model
Specific effects	 	Pair-wise mediation with individual variables
Global model	 	Multivariate mediation

Key: IDACI – Income Deprivation Affecting Children Index; CAT4 - Cognitive Assessment Test complete battery: CAT4 NV – Cognitive Assessment Test non-verbal ability; TOWRE2 – Test of Word Reading Efficiency; CAT4-V – Cognitive Assessment Test- verbal subtest; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs

The total effect is described as the impact of deprivation or oral language or cognitive or single-word reading measures (X) on academic achievement (Y) without the involvement of a mediator (M). Adding a potential mediator, partitions the relationship into a direct effect of the measures (X) on academic attainment (Y) and an indirect effect of the measures (X) on academic attainment (Y) transmitted through reading comprehension (M), (Baron and Kenny, 1986; Tabachnick and Fidell, 2014).

From the perspective of explaining the causal process, if the direct effect (c) is significant, it shows that there is an effect of (X) on (Y). Hayes (2009) points to the possibility of the moderator (in this study, reading comprehension) to be causally between (X) and (Y) even if they are not associated. If the indirect effect (pathway (a*b) is significant, then (X) has had an indirect effect on (Y) through (M). However, for example if oral language (X) exerts some influence via the mediator (indirect effect) and some influence directly on academic attainment (direct effect), then partial mediation has occurred (Agler and De Boeck, 2017).

6.6.1 An effect-perspective to mediation

By examining the tests of the effects of interest, any potentially interesting mechanisms by which deprivation, language, cognitive abilities and single word reading (X) exert some effect on academic attainment can be examined (Agler and De Boeck, 2017; Hayes, 2009). The following three sections examine the specific effects for Year Seven, Eight and Nine.

6.6.1.2 Mediation effects of deprivation, language, cognitive abilities and single word reading measures on reading comprehension and English attainment at the end of Year Seven

Table 6.29 shows the results of path estimates, the standard error (SE), the 95% confidence interval, the z score, the significance and the percentage of mediation between the variables influencing reading comprehension and academic attainment of students in academic year seven, summer term. Deprivation was showing a trend towards influencing English attainment directly ($\beta = 0.121$, $t = 1.97$, $p = 0.049$). The path from deprivation to reading comprehension was positive and statistically significant ($\beta = 0.367$, $t = 11.57$, $p < .001$) as was the path from reading comprehension to English attainment ($\beta = 0.793$, $t = 9.87$, $p < .001$). The partial mediation indicated that at the beginning of secondary education, students who lived in higher levels of deprivation were doing well as they were more likely to score better in both reading comprehension and English attainment than their peers living in less deprived homes.

The indirect effect of language measures (CAT4-V, RS and USP) on English attainment, mediated through reading comprehension was significant. The path from CAT4 verbal to reading comprehension was positive and statistically significant ($\beta = 0.1015$, $t=5.16$, $p<.001$) as was the path from reading comprehension to English attainment ($\beta = 0.8892$, $t= 12.24$, $p<.001$). This shows that students with higher levels of verbal understanding are more likely to score higher in reading comprehension, and those students with higher reading comprehension are more likely to be awarded better marks in English. The percentage mediation shows the proportion of the effect passing through the reading comprehension. The direct effects were not significant with CAT4 verbal showing 29% mediation on English attainment, and recalling sentences and understanding spoken paragraphs showing 47%.

Cognitive measures, through CAT4 overall and CAT4 non-verbal subtests show a similar positive relationship between English attainment, partially mediated by reading comprehension.

The indirect effect of TOWRE2 single-word reading on reading comprehension was positive and significant ($\beta = 0.0653$, $t=3.37$, $p <.001$) as was the path from reading comprehension to English attainment ($\beta = 0.8497$, $t= 11.92$, $p <.001$). This indicates that higher levels of reading single words accurately were more likely to show a significant contribution in the relationship between reading comprehension and English achievement.

Table 6.29 Pathway estimates for individual mediation models of reading comprehension and English attainment (TA), at the end of Year Seven

Individual pathway estimates of reading comprehension and summer term English attainment at the end of Year Seven								
Pathway	**Label**	**Estimate**	**SE**	**95% confidence Interval**		**z**	**p**	**% Mediation**
				lower	**upper**			
Analysis 1: Deprivation								
IDACI → RC	a	0.367	0.032	0.305	0.429	11.57	**< .001**	(a*b) =70.1%
RC → TA	b	0.793	0.080	0.635	0.950	9.87	**< .001**	c =29.9%
IDACI → TA	c	0.121	0.061	7.56e-4	0.240	1.97	.049*	c+ a*b 100%
Analysis 2: CAT-verbal								
CAT -V → RC	a	0.1015	0.0196	0.0630	0.1400	5.16	<**.001**	(a*b) =71.2%
RC → TA	b	0.8892	0.0726	0.7468	1.0315	12.24	<**.001**	c = 28.8%
CAT -V→ TA	c	-0.0362	0.0309	-0.097	0.0244	-1.17	.241	c+ a*b 100%
Analysis 3: Recalling Sentences,								
RS → RC	a	0.0594	0.0176	0.0248	0.0940	3.36	<**.001**	(a*b) =52.5%
RC → TA	b	0.8498	0.0713	0.7100	0.9895	11.92	<**.001**	c = 47.5%
RS → TA	c	0.0456	0.0268	-0.007	0.0982	1.70	0.089	c+ a*b 100%
Analysis 4: Understanding Spoken Paragraphs								
USP →RC	a	0.0592	0.0126	0.0345	0.0839	4.70	<**.001**	(a*b) =52.2%
RC → TA	b	0.8497	0.0818	0.6894	1.0101	10.39	<**.001**	c = 47.6%
USP → TA	c	0.0456	0.0222	0.002	0.0892	2.05	.040*	c+ a*b 100%
Analysis 5: Cognitive abilities								
CAT overall → RC	a	0.1012	0.0196	0.063	0.1397	5.15	<**.001**	(a*b) =71.1% c = 28.9% c+ a*b 100%
RC → TA	b	0.8893	0.0726	0.7470	1.0317	12.25	<**.001**	
CAT overall → TA	c	-0.0366	0.0309	-0.097	0.0240	-1.18	.237	
Analysis 6: CAT non-verbal								
CAT NV → RC	a	0.1010	0.0196	0.0626	0.1395	5.15	<**.001**	(a*b) =71.2%
RC → TA	b	0.8892	0.0726	0.7469	1.0315	12.25	<**.001**	c = 28.8%
CAT NV→ TA	c	-0.0363	0.0309	-0.097	0.0242	-1.18	.240	c+ a*b 100%
Analysis 7: Single-word reading								
TOWRE2 → RC	a	0.0653	0.0194	0.0274	0.103	3.37	<**.001**	(a*b) =52.6% c = 47.4%
RC → TA	b	0.8497	0.0713	0.7099	0.989	11.92	<**.001**	c+ a*b 100%
TOWRE2 → TA	c	0.0500	0.0294	-0.008	0.108	1.70	.089	

Key: Key: TA – teacher assessment; IDACI – Income Deprivation Affecting Children Index; CAT4 - Cognitive Assessment Test complete battery: CAT4 NV – Cognitive Assessment Test non-verbal ability; TOWRE2 – Test of Word Reading Efficiency; CAT4-V – Cognitive Assessment Test- verbal subtest; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs

6.6.1.2.1. Mediation effects on reading comprehension and Mathematics and Science at the end of Year Seven

Appendix 6C shows the results of path estimates, the standard error (SE), the 95% confidence interval, the z score, the significance and the percentage of mediation between the variables influencing reading comprehension and Maths and Science attainment of students at the end of Year Seven, including the percentage mediation of the indirect effect on the total effect. Table 6.31 presents a summary of the significance of the effects of the mediation analysis.

Table 6.30 Summary of the significance of the effects for Mathematics and Science Mediation analyses

Pathway	Label	Mathematics p	Science p
Analysis 1: Deprivation			
IDACI → RC	a	**< .001**	**< .001**
RC → TA	b	**< .001**	**< .001**
IDACI → TA	c	0.013**	0.012**
Analysis 2: CAT-verbal			
CAT -V → RC	a	**< .001**	**< .001**
RC → TA	b	**< .001**	**< .001**
CAT -V→ TA	c	0.142	0.172
Analysis 3: Recalling Sentences			
RS → RC	a	**< .001**	**< .001**
RC → TA	b	**< .001**	**< .001**
RS → TA	c	0.915	0.924
Analysis 4: Understanding Spoken Paragraphs			
USP →RC	a	**< .001**	**< .001**
RC → TA	b	**< .001**	**< .001**
USP → TA	c	0.924	0.914
Analysis 5: CAT overall			
CAT → RC	a	**< .001**	**< .001**
RC →TA	b	**< .001**	**< .001**
CAT →TA	c	0.141	0.169
Analysis 6: CAT non-verbal			
CAT NV → RC	a	**< .001**	**< .001**
RC →TA	b	**< .001**	**< .001**
CAT NV→TA	c	0.143	0.172
Analysis 7: Single-word reading			
TOWRE2 → RC	a	**< .001**	**< .001**
RC → TA	b	**< .001**	**< .001**
TOWRE2 → TA	c	0.884	0.953

Key: TA – Teacher Assessment; RC – reading comprehension; IDACI – Income Deprivation Affecting Children Index; CAT4 - Cognitive Assessment Test complete battery: CAT4 NV – Cognitive Assessment Test non-verbal ability; TOWRE2 – Test of Word Reading Efficiency; CAT4-V – Cognitive Assessment Test- verbal subtest; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs

Mediation analysis for Mathematics and Science TA shows a similar pattern of effects to English TA attainment. The indirect effects of deprivation, language, cognitive ability and single word reading are significant at $p < .001$. This indicates that students who display higher levels of oral language skills, cognitive ability and single word reading are more likely to show a better understanding of texts and more likely to perform better in Mathematics and Science attainment. Deprivation shows partial mediation, influencing directly on attainment and indirectly through reading comprehension.

6.6.1.3. Mediation effects of deprivation, language, and single word reading measures on reading comprehension and English attainment at the end of Year Eight

Table 6.31 shows the results of separate pathway analysis for the total effect, direct effect and indirect effect of the relationship between reading comprehension and summer term English attainment for students in Year Eight, including the percentage mediation of the indirect effect on the total effect. The direct path from deprivation to English attainment is negative but not significant ($p= 0.353$) showing that higher levels of deprivation are not likely to impact in English attainment. However, the indirect path is statistically significant ($p< .001$) showing that reading comprehension mediates the relationship between deprivation and English attainment. The path from deprivation to reading comprehension is statistically significant ($\beta = 0.2666$, $t =7.24$ $p<.001$) as is the path from reading comprehension to English attainment ($\beta = 0.697$, $t = 12.67$, $p<.001$).

There is an indirect effect of language measures, specifically recalling sentences (67.2% CI = (.0429, .0982)) and understanding spoken paragraphs (67.2% CI = (.0428, .0980) which are statistically significant and show a relationship between oral language and English attainment, mediated by reading comprehension.

The path from TOWRE2 single-word reading on reading comprehension was positive and significant ($\beta = 0.113$, $t= 5.23$, $p<.001$) as was the path from reading comprehension to English attainment (β = 0.662, t = 12.38 p<.001). This indicates that higher levels of reading single words accurately is more likely to show a positive effect in the relationship between reading comprehension and English achievement.

Table 6.31 Pathway estimates for individual mediation of reading comprehension and English attainment (TA), at the end of Year Eight

Individual pathway estimates of reading comprehension and summer term English attainment, at the end of Year Eight								
Pathway	**Label**	**Estimate**	**SE**	**95% confidence Interval**		**z**	**p**	**% Mediation**
				lower	**upper**			
Analysis 1: Deprivation								
IDACI → RC	a	0.266	0.0367	0.194	0.0367	7.246	**< .001**	(a*b) =82.3%
RC → TA	b	0.697	0.0550	0.589	0.0550	12.678	**< .001**	c =17.7%
IDACI→TA	c	-0.042	0.0449	-0.130	0.0449	-0.929	.353	c+ a*b 100%
Analysis 2: Recalling Sentences								
RS → RC	a	0.107	0.0196	0.0686	0.1452	5.47	<**.001**	(a*b) =67.2%
RC → TA	b	0.659	0.0536	0.5548	0.7650	12.31	<**.001**	c = 32.8%
RS → TA	c	0.034	0.0228	-0.010	0.0791	1.51	.131	c+ a*b 100%
Analysis 3: Understanding Spoken Paragraphs								
USP →RC	a	0.107	0.0195	0.0685	0.1450	5.47	<**.001**	(a*b) =67.2%
RC →TA	b	0.659	0.0536	0.5548	0.7650	12.31	<**.001**	c = 32.8%
USP → TA	c	0.034	0.0227	-0.010	0.0789	1.51	.131	c+ a*b 100%
Cognitive abilities: not sat in Year Eight								
Analysis 4: Single word reading								
TOWRE2 → RC	a	0.113	0.0215	0.0704	0.1549	5.23	<**.001**	(a*b) =68.1%
RC → TA	b	0.662	0.0535	0.5574	0.7670	12.38	<**.001**	c = 31.9%
TOWRE2 → TA	c	0.035	0.0250	-0.014	0.0839	1.40	.162	c+ a*b 100%

Key: TA – Teacher Assessment; RC – reading comprehension; IDACI – Income Deprivation Affecting Children Index; CAT4 - Cognitive Assessment Test complete battery: CAT4 NV – Cognitive Assessment Test non-verbal ability; TOWRE2 – Test of Word Reading Efficiency; CAT4-V – Cognitive Assessment Test- verbal subtest; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs

6.6.1.3.1. Mediation effects on reading comprehension and Maths and Science at the end of Year Eight

Appendix 6D shows the results of mediation analysis for the total effect, direct effect and indirect effect of the relationship between reading comprehension and Maths and Science attainment at the end of Year Eight, including the percentage mediation of the indirect effect on the total effect. Table 6.32 presents a summary of the significance of the effects for the individual mediation analysis. Mediation analysis shows a similar pattern of effects to English TA attainment. The indirect effects of deprivation, language, cognitive ability and single word reading are significant at $p < .001$. This indicates that students who display higher levels of oral language skills and single word reading are more likely to show a better understanding of texts and more likely to be awarded higher marks on Mathematics and Science attainment.

Table 6.32 Summary of the significance of the effects for Mathematics and Science Mediation analyses

Pathway	Label	Mathematics p	Science p
Analysis 1: Deprivation			
IDACI → RC	a	< .001	**< .001**
RC → TA	b	< .001	**< .001**
IDACI → TA	c	.317	.043*
Analysis 2: Recalling Sentences			
RS → RC	a	< .001	**< .001**
RC → TA	b	< .001	**< .001**
RS → TA	c	.217	.194
Analysis 3: Understanding Spoken Paragraphs			
USP →RC	a	**< .001**	**< .001**
RC → TA	b	**< .001**	**< .001**
USP → TA	c	.214	.190
Analysis 4: Single-word reading			
TOWRE2 → RC	a	**< .001**	< .001
RC → TA	b	**< .001**	< .001
TOWRE2 → TA	c	.259	.223

Key: TA – Teacher Assessment; RC – reading comprehension; IDACI – Income Deprivation Affecting Children Index; CAT4 - Cognitive Assessment Test complete battery: CAT4 NV – Cognitive Assessment Test non-verbal ability; TOWRE2 – Test of Word Reading Efficiency; CAT4-V – Cognitive Assessment Test- verbal subtest; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs

6.6.1.4 Mediation effects of deprivation, language, cognitive abilities and single word reading measures on reading comprehension and English attainment at the end of Year Nine

Table 6.33 shows the results of path estimates, the standard error (S.E), the 95% confidence interval, the z score, the significance and the percentage of mediation between the variables influencing reading comprehension and academic attainment of students in Year Nine, summer term. By Year Nine, deprivation no longer influenced either reading comprehension ($\beta = 0.1052$, $t = 1.20$, $p = 0.230$) or English attainment ($\beta = 0.031$, $t = 1.30$, $p = 0.192$) indicating that students who lived in areas of high deprivation were no longer performing better than their peers in either reading comprehension or English attainment.

Cognitive measures, through CAT4 overall ($\beta = 0.607$, $t=17.2$, $p < .001$) and CAT4 non-verbal ($\beta = 0.607$, $t=17.3$, $p < .001$) subtests showed a positive relationship between English attainment, partially mediated by reading comprehension. This indicates that students with better cognitive skills were more likely to understand texts and be awarded higher marks in English.

Verbal reasoning (CAT4-verbal) partially mediated the relationship between reading comprehension and English attainment, with meditation estimates showing a positive and significant effect ($\beta = 0.640$, $t = 18.6$, $p=<.001$). This indicated that those students who displayed a better understanding of language were more likely to score higher in reading comprehension and more likely to score higher in English attainment. The influence of recalling sentences and understanding spoken paragraphs on reading comprehension and English attainment showed no mediation: the indirect effects shown by mediation estimates (RS, $\beta = -0.0127$, $t = -0.362$, $p= 0.72$; USP, $\beta = 0.00926$, $t = -0.270$, $p= 0.79$) were not significant showing that reading comprehension was not mediating the relationship. Instead, the direct effects shown by mediation estimates were positive and statistically significant (RS, $\beta = 0.9977$, S.E = 0.035, $p < .001$; USP, $\beta = 0.99414$, S.E = 0.035, $p <.001$) indicating that students who displayed higher levels of recalling sentences and understanding spoken paragraphs were more likely to score higher in reading comprehension and English attainment. This indicates that by Year Nine, language skills were showing a positive relationship with literacy.

The accuracy of reading single-words showed a similar result. The indirect effects shown by mediation estimates were not significant (β = -0.00375, t= -0.0975, p =0.34) showing the relationship between accurate single-word reading and English attainment was no longer mediated by reading comprehension. The direct effect from reading single words to English attainment was positive and significant (β = 1.08470, t= 27.62, $p < .001$) indicating that students who read a greater number of single words correctly were more likely to be awarded higher marks for English, as well as perform better in reading comprehension

Table 6.33 Pathway estimates for individual mediation of reading comprehension and English attainment (TA), at the end of Year Nine

Pathway estimates for individual mediation of reading comprehension and English attainment (TA), at the end of Year Nine								
Pathway	**Label**	**Estimate**	**SE**	**95% confidence Interval**		**z**	**p**	**% Mediation**
				lower	upper			
Analysis 1: Deprivation								
IDACI → RC	a	0.1052	0.0876	-0.066	0.0876	1.20	.230	(a*b) =78.2%
RC → TA	b	1.0562	0.0129	1.0309	0.0129	81.92	**< .001**	c =21.8%
IDACI→TA	c	0.0310	0.0238	-0.015	0.0238	1.30	.192	c+ a*b 100%
Analysis 2: Cat-verbal								
CAT -V → RC	a	0.936	0.0153	0.906	0.966	61.2	**< .001**	(a*b) =62.1%
RC →TA	b	0.683	0.0349	0.615	0.752	19.6	**< .001**	c = 37.9%
CAT -V→ TA	c	0.391	0.0346	0.324	0.459	11.3	**< .001**	c+ a*b 100%
Analysis 3: Recalling sentences								
RS → RC	a	0.8947	0.0086	0.8778	0.9115	103.95	**< .001**	(a*b) =1.25%
RC → TA	b	-0.0141	0.0390	-0.090	0.0624	-0.362	.717	c 98.75%
RS → TA	c	0.9977	0.0356	0.0278	1.0676	27.97	**< .001**	c+ a*b 100%
Analysis 4: Understanding Spoken Paragraphs								
USP →RC	a	0.8940	0.0087	0.8770	0.9110	103.10	**< .001**	(a*b) =0.92%
RC →TA	b	-0.0104	0.0384	-0.086	0.0650	-0.27	.787	c = 99.1%
USP → TA	c	0.9941	0.0351	0.9254	1.0629	28.34	**< .001**	c+ a*b 100%
Analysis 5: CAT overall								
CAT → RC	a	0.943	0.0146	0.914	0.972	64.4	**< .001**	(a*b) =58.5%
RC →TA	b	0.644	0.0360	0.573	0.715	17.9	**< .001**	c = 41.5%
CAT →TA	c	0.431	0.0358	0.361	0.501	12.1	**< .001**	c+ a*b 100%
Analysis 6: CAT -non verbal								
CAT NV → RC	a	0.943	0.0147	0.914	0.972	64.2	**< .001**	(a*b) =58.4%
RC →TA	b	0.643	0.0359	0.573	0.714	17.9	**< .001**	c = 41.6%
CAT NV→TA	c	0.432	0.0356	0.362	0.502	12.1	**< .001**	c+ a*b 100%
Analysis 7: Single Word Reading								
TOWRE2 → RC	a	0.9817	0.0095	0.9631	1.000	103.43	**< .001**	(a*b) =0.40% c = 99.6%

Pathway estimates for individual mediation of reading comprehension and English attainment (TA), at the end of Year Nine								
Pathway	**Label**	**Estimate**	**SE**	**95% confidence Interval**		**z**	**p**	**% Mediation**
				lower	upper			
RC → TA	b	-0.0038	0.0392	-0.081	0.073	-0.097	.922	c+ a*b 100%
TOWRE2 → TA	c	1.0847	0.0393	1.008	1.162	27.62	**< .001**	

Key: TA – Teacher Assessment; RC – reading comprehension; IDACI – Income Deprivation Affecting Children Index; CAT4 - Cognitive Assessment Test complete battery: CAT4 NV – Cognitive Assessment Test non-verbal ability; TOWRE2 – Test of Word Reading Efficiency; CAT4-V – Cognitive Assessment Test- verbal subtest; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs

6.6.1.4.1. Mediation effects on reading comprehension and Maths and Science at the end of Year Nine

Appendix 6E shows the results of mediation analysis for the total effect, direct effect and indirect effect of the relationship between reading comprehension and Maths and Science attainment at the end of Year Nine, including the percentage mediation of the indirect effect on the total effect. Table 6.35 presents a summary of the significance of the effects for the individual mediation analysis. Mediation analysis shows a similar pattern of effects to English TA attainment. Deprivation shows no significant direct or indirect effects on mathematics or science attainment. Cognitive abilities show partial mediation with attainment indicating that students with better verbal and non-verbal abilities are more likely to perform better in reading comprehension which influences attainment.

Oral language and single word reading show significant direct effects at $p < .001$. This indicates that students who display better language skills and single word reading are more likely to be awarded higher marks on Maths and Science attainment.

Table 6.34 Summary of the significance of the effects for Mathematics and Science Mediation analyses at the end of Year Nine

Pathway	Label	Mathematics p	Science p
Analysis 1: Deprivation			
IDACI → RC	a	.230	.230
RC → TA	b	**< .001**	**< .001**
IDACI → TA	c	.158	.033*
Analysis 2: CAT-verbal			
CAT -V → RC	a	**< .001**	**< .001**
RC → TA	b	**< .001**	**< .001**
CAT -V→ TA	c	**< .001**	**< .001**
Analysis 3: Recalling Sentences			
RS → RC	a	**< .001**	**< .001**
RC → TA	b	.828	.664
RS → TA	c	**< .001**	**< .001**
Analysis 4: Understanding Spoken Paragraphs			
USP →RC	a	**< .001**	**< .001**
RC → TA	b	.907	.735
USP → TA	c	**< .001**	**< .001**
Analysis 5: CAT overall			
CAT → RC	a	**< .001**	**< .001**
RC →TA	b	**< .001**	**< .001**
CAT →TA	c	**< .001**	**< .001**
Analysis 6: CAT non-verbal			
CAT NV → RC	a	**< .001**	**< .001**
RC →TA	b	**< .001**	**< .001**
CAT NV→TA	c	**< .001**	**< .001**
Analysis 7: Single-word reading			
TOWRE2 → RC	a	**< .001**	**< .001**
RC → TA	b	.979	.874
TOWRE2 → TA	c	**< .001**	**< .001**

Key: TA – Teacher Assessment; RC – reading comprehension; IDACI – Income Deprivation Affecting Children Index; CAT4 - Cognitive Assessment Test complete battery: CAT4 NV – Cognitive Assessment Test non-verbal ability; TOWRE2 – Test of Word Reading Efficiency; CAT4-V – Cognitive Assessment Test- verbal subtest; CELF4-RS - Recalling Sentences; CELF4-USP – Understanding Spoken Paragraphs

6.6.2. Global perspective of mediation

An alternate perspective to the above specific effect approach is to look at the global model; the difference between 'the forest or the tree when investigating mediation,' (Agler & De Boeck, 2017, p5). According to Agler & De Boeck (2017), the global model is a conceptual one based on the variables of interest and looks at relationships, as opposed to effects. The following table summarises the relationships from the global model for English, Mathematics and Science for students in Year Seven, Eight and Nine. (The CAT4-overall measure is removed due to multicollinearity).

Table 6.35 shows that the indirect effect of deprivation on English, Mathematics and Science (TA) is statistically significant at $p < .001$. in Year Seven and Eight (the first two years of secondary education). The positive relationship between the predictors and academic achievement, partially mediated by reading comprehension suggests that deprivation is not a barrier to how well students perform at the start of secondary education based on teacher assessment. At the end of Year Eight, the indirect path from the TOWRE2 to reading comprehension is negative and significant indicating that students who show poorer word reading scores are less likely to gain higher scores in reading comprehension. By the end of KS3 (Year Nine), the indirect effect of deprivation is no longer significant, indicating that deprivation no longer influences attainment when the relationship is mediated by reading comprehension. At Year Nine, the total effect of understanding spoken paragraphs on English achievement is positive and significant ($p = .004$), and positive and significant ($p < .001$) on Mathematical achievement. This shows that those students with better levels of understanding spoken paragraphs are more likely to demonstrate better English and Mathematics achievement.

6.6.2.1 Teacher Assessments

From the school perspective, the total effect of deprivation on English, Mathematics and Science achievement (TA, raw score) significant ($p < .001$) showing that those students living in poor homes are doing as well as their peers. It is important to note that these results are potentially subjective based on teacher assessments. As a teacher working in the school, there are difficulties in assessing students' performance against the norm.

At the end of Year Eight, the total effect from word reading to academic teacher assessment is negative and significant ($p < .001$) showing that students who exhibit poor word reading skills are less likely to be awarded higher marks in English, Mathematics or Science. By the end of Year Nine, the total effect from USP subtest is positive and significant for English (p=.

005) and Mathematics ($p < .001$) indicating that students with good Understanding of Spoken Paragraphs are more likely to be awarded better marks in English and Mathematics (See Table 6.35)

Table 6.35 Summary of the Global Model for English, Mathematics and Science Mediation analyses at the end of Year Seven, Eight and Nine

Type	Effect	Year Seven			Year Eight			Year Nine		
		English	Maths	Science	English	Maths	Science	English	Maths	Science
		p	p	p	p	p	p	p	p	p
Indirect	IDACI ⇒ READING⇒ TA	**< .001**	**< .001**	**< .001**	**< .001**	**< .001**	**< .001**	.513	.562	.540
	CAT V ⇒ READING ⇒ TA	.171	.171	.171	*Not sat*	*Not sat*	*Not sat*	.972	.972	.972
	RS ⇒ READING ⇒ TA	.329	.330	.329	.205	.308	.307	.516	.565	.543
	USP ⇒ READING ⇒ TA	.220	.220	.220	.890	.912	.912	.791	.795	.793
	CAT NV ⇒ READING ⇒ TA	.197	.197	.197	*Not sat*	*Not sat*	*Not sat*	.815	.818	.816
	WORD_READING ⇒ READING ⇒ TA	.456	.456	.456	**< .001**	**< .001**	**< .001**	.658	.677	.668
Component	IDACI ⇒ READING	**< .001**	**< .001**	**< .001**	**< .001**	**< .001**	**< .001**	.087	.087	.087
	READING⇒ TA	**< .001**	**< .001**	**< .001**	**< .001**	**< .001**	**< .001**	.479	.538	.512
	CAT V ⇒ READING	.166	.166	.166	*Not sat*	*Not sat*	*Not sat*	.972	.972	.972
	RECALLING_SENTENCES ⇒ READING	.327	.327	.327	.202	.306	.306	.103	.103	.103
	USP ⇒ READING	.216	.216	.216	.890	.912	.912	.775	.775	.775
	CAT NV ⇒ READING	.193	.193	.193	*Not sat*	*Not sat*	*Not sat*	.804	.804	.804
	WORD READING ⇒ READING	.455	.455	.455	**< .001**	**< .001**	**< .001**	.571	.571	.571
Direct	IDACI ⇒ TA	**.034***	**.028***	**.025***	.484	.202	**.024***	**< .001**	**< .001**	**< .001**
	CAT V ⇒ TA	.597	.789	.707	*Not sat*	*Not sat*	*Not sat*	.724	.852	.833
	RECALLING_SENTENCES⇒ TA	.304	.161	.090	.810	.516	.343	.847	.604	.587
	USP⇒ TA	.293	.058	**.030***	.799	.274	.180	**.005**	**< .001**	.090
	CAT NV ⇒ TA	.559	.757	.677	Not sat	Not sat	Not sat	.916	.781	.135
	WORD_READING ⇒ TA	.768	.134	.187	**.003****	**.009****	**.035***	.333	.140	.759
Total	IDACI ⇒ TA	**< .001**	**< .001**	**< .001**	**.003****	**< .001**	**< .001**	**< .001**	**< .001**	**< .001**
	CAT V ⇒ TA	.162	.415	.360	*Not sat*	*Not sat*	*Not sat*	.725	.854	.834

	RECALLING_SENTENCES ⇒ TA	.487	.383	.257	.515	.877	.773	.804	.571	.621
	USP ⇒ TA	.559	.224	.144	.089	.340	.285	**0.004**	**< .001**	.089
	CAT NV ⇒ TA	.156	.413	.358	*Not sat*	*Not sat*	*Not sat*	.923	.787	.133
	WORD READING ⇒ TA	.444	.291	.374	**< .001**	**< .001**	**< .001**	.343	.145	.746

Note. Confidence intervals computed with method: Standard (Delta method). Betas are completely standardized effect sizes

Key: TA – Teacher Assessment; RC – reading comprehension; IDACI – Income Deprivation Affecting Children Index; CAT - Cognitive Assessment Test complete battery: CAT NV – Cognitive Assessment Test non-verbal ability; TOWRE2 – Test of Word Reading Efficiency; CAT-V – Cognitive Assessment Test-verbal subtest; CELF-4 RS - Recalling Sentences; CELF-4 USP – Understanding Spoken Paragraph

6.6.3 Summary of RQ5

RQ5 sought to determine the extent to which socio-economic status, overall cognitive abilities and oral language skills explained the relationship between academic attainment and reading comprehension in adolescent students. Separate, individual mediation analyses and multivariate mediation were both used in order to give a balance between an effects-perspective and a relationship -perspective.

6.6.3.1 Effects perspective

At the beginning of secondary education, reading comprehension significantly mediated the relationship between deprivation and English, Mathematical and Science TA ($p < .001$) indicating that students who lived in areas of high deprivation and could read well, were likely to be awarded higher marks in English, Mathematics and Science. Students with a better performance in reading single-words were more likely to score better in reading comprehension and in turn be awarded higher marks in English. Secondly, students with higher levels of verbal understanding were more likely to perform better in reading comprehension, and those students who displayed higher levels of understanding texts were more likely to be awarded higher marks in English, Maths and Science.

Across the first three years of secondary education, the relationship between cognitive abilities and attainment was partially mediated by reading comprehension. Those students with higher levels of cognitive skills were more likely to be awarded higher marks in English, Maths and Science attainment, through their higher understanding of written text.

By Year Nine, the influence of reading comprehension on academic attainment had changed. Verbal cognitive abilities continued to partially mediate the relationship between reading comprehension and attainment but the influence of recalling sentences and understanding spoken paragraphs showed no mediation. Instead, the direct effects shown by mediation estimates were positive and statistically significant indicating that students who displayed higher levels of recalling sentences and understanding spoken paragraphs were now more likely to show better attainment in English Maths and Science, as well as reading comprehension. Reading comprehension no longer mediated the relationship between deprivation and TA, indicating that deprivation was affecting reading comprehension scores. Those students who lived in areas of less deprivation were now doing slightly better than those in higher levels of deprivation, but not to a statistically significant degree (β - 4.00, s.e. =.001, p=.513). By this stage, students who read single words out of context were more likely to be awarded higher marks in English, Maths and Science attainment, as well as gain higher marks in reading comprehension.

6.6.3.1 Relationships perspective

The global model indicated that deprivation was not a barrier to how well this sample of students performed at the start of secondary education. Students who could read well, were more likely to perform well in TA. At the end of Year Eight, students who showed lower word reading scores were less likely to gain higher scores in reading comprehension. By the end of KS3 (Year Nine), students who lived in more affluent areas were more likely to score better in academic achievement, when the relationship was mediated by reading comprehension, although not to a statistically significant degree. At this stage in their educational journey, the direct effect of understanding spoken paragraphs on English and Mathematics achievement was significant. This shows that those students in the sample with higher levels of understanding spoken paragraphs with more likely to score higher in English and Mathematics achievement.

6.7. Overall summary

The aim of chapter six was to explore the relationship between oral language ability, non-verbal ability, socio-economic status and academic attainment with reading comprehension in mainstream secondary school-age students. The results demonstrated that word reading showed a decline over time, suggesting that students were finding it harder to read single words over time. Students with SEN performed significantly less well on all measures apart from performance on Understanding Spoken Paragraphs and showed a significant decreasing performance in single word reading (TOWRE2) and English attainment ($p<.001$). Those students living in areas of higher deprivation did less well in average CAT4-verbal achievement (p<.002) and NGRT reading comprehension (p =.037). The effect of time showed that students at the higher levels of deprivation demonstrated less growth over time in verbal reasoning (CAT4-verbal) and English attainment. Standard multiple regression suggested that higher levels of language ability, and single word reading were associated with better reading comprehension across Years Seven to Nine. By Year Nine, language measures had a large, positive relationship with reading comprehension with listening comprehension (CELF4-USP) adding unique variance.

Reading comprehension significantly predicted success at the English General Certificate of Secondary Education (GCSE) level indicating that good levels of reading comprehension are necessary to access and understand the academic content of the English examination papers. Non-verbal reasoning was the significant, unique predictor at Mathematics GCSE level (p< .001) and at Science GCSE level (p< .01). Student profiles showed female students achieving higher English, Mathematics and Science scores. Lower levels of deprivation were associated with higher English attainment.

In order to understand how deprivation, non-verbal, single word reading and language skills explained the relationship between academic attainment and reading comprehension, mediation analysis was performed for Years Seven, Eight and Nine. At the beginning of secondary education, students who lived in more deprived homes were doing well as they were more likely to score better in both reading comprehension and academic attainment (English, Mathematics and Science) than their peers living in less deprived homes. By Year Nine, reading comprehension no longer mediated the relationship between deprivation and TA, indicating that deprivation was affecting reading comprehension scores. Those students living in areas of less deprivation were now doing slightly better than those in higher levels of deprivation, but not to a statistically significant degree (β - -4.00, s.e. =.001, p=.513). Accurately reading single words out of context showed a direct effect on TA in English, Maths and Science with students more likely to be awarded higher marks, as well as gain higher marks in reading comprehension. The global model of mediation showed the direct effect of understanding spoken paragraphs on English achievement was positive and trending towards significance (p = .005), and positive and significant (p < .001) on Mathematical achievement.

This shows that by Year Nine, students with higher levels of listening comprehension were more likely to do better in English and Mathematics achievement.

Looking at reading comprehension from a student profile perspective, gender made no difference to reading comprehension but typically developing students performed better than their SEN peers. Those students living in deprivation show lower average attainment than their peers in more affluent homes. In comparison, when measures related to reading comprehension were examined, high levels of language ability, and single word reading were associated with higher reading comprehension across Years Seven to Nine.

Understanding how reading comprehension mediates the relationship between language abilities and academic achievement, is complex and not all paths of influence could be considered in the mediation model (Agler and De Boeck, 2017). The model showed that at the start of KS3, deprivation did not appear to be a barrier to good reading comprehension. Partial mediation indicated that students in Year Seven, despite high levels of deprivation, performed well in both reading comprehension and English attainment. By the end of Year Nine, reading comprehension no longer mediated the relationship between deprivation and teacher assessed academic outcomes (TA) indicating that students with higher levels of deprivation were doing less well. The direct effect of single-word reading and understanding spoken paragraphs on TA, showed students with higher levels of single-word reading and understanding spoken paragraphs were more likely to be awarded higher marks by teachers in their assessments.

The results reflect the complexity of the relationships underpinning reading comprehension and the findings are discussed in Chapter Seven.

Chapter Seven

Discussion

7.0 Overview

The thesis set out to explore the relationships between oral language ability, non-verbal ability, socio-economic status and academic attainment with reading comprehension and to understand what may influence these relationships.

Four hundred and forty-three students aged 11-14 years in three cohorts (Y7, Y8 and Y9) participated in the study. Data was collected in the first year of the study for each cohort and the following year for the C7 cohort who moved into Year Eight (C7+1), and the C8 cohort which moved into Year Nine (C8+1). Data on GCSE attainment was collected for the C9 cohort, marking the end of compulsory education (Year 11). Due to the impact of COVID-19 on school examinations, GCSE data was not collected for the C8 and C7 cohorts. Retrospective school data was also considered from two cohorts (C8-1, C9 – 1; C9-2) (See Design of the Study, Table 4.1, Chapter 4).

The study design allowed the exploration of changes in the oral language ability, non-verbal ability, academic attainment and reading comprehension of these students as they moved through key academic stages in their education.

The main aim of the research was to identify the extent that oral language skills explain reading comprehension in this group of students, in a large mainstream secondary school in an area of high social deprivation. Secondary aims were to examine the overall language and literacy performances of students across their first three years of secondary education; to identify the relationships between verbal and nonverbal language, single-word reading, social deprivation and reading comprehension and to explore which measures were predictors of reading comprehension and academic outcomes in the group.

In the current chapter, section 7.1 discusses the language and reading performances of the student sample, comparing the results of this study to other studies in the literature. Section 7.2 investigates how gender, special educational needs or deprivation are related to different performances in language and literacy over time. Section 7.3 discusses the relationships between verbal and nonverbal skills, single-word reading, social deprivation and reading comprehension in these students. Section 7.4 discusses the predictors of reading comprehension and academic outcomes in the sample. Section 7.5 explores what influences the relationships between oral language ability, non-verbal ability, socio-economic status and academic attainment with reading comprehension.

7.1 Language and reading performances of the student sample across the three cohorts and prospectively into the following year

The aim of RQ1 was to determine whether there were significant differences in the language and reading performances across the three cohorts (C7, C8 and C9). Findings showed students in each cohort were staying within their ability range relative to the norm for reading comprehension and word reading. Language measures indicated a low-average performance in a measure of syntax ability (Recalling Sentences) and below average performance on a measure of listening comprehension (Understanding Spoken Paragraphs) demonstrating a discrepancy between underlying language ability measured by RS subtest (Klem et al., 2015) and pragmatic language skills measured by USP subtest (Wilson and Bishop, 2022).

The below average performance on the USP subtest for the overall sample suggests that children living in areas of high deprivation, or being taught in a school with a high density of students living in deprivation, present different oral language profiles compared to students with DLD, who tend to perform poorly on the RS subtest. The USP subtest relies on the student listening and making sense of spoken narratives. Working out the meaning within a spoken narrative depends not only on retaining important pieces of information, but using prior knowledge and experience to make inferences, and pragmatic skills to understand events and actions based on how language is used. The finding that students who live in areas of high deprivation show below-average performance on the USP subtest, indicates they may be missing world knowledge, with weaker inferencing abilities possibly impacting on pragmatic skills. Meaningful access to a range of experiences such as visiting a bookshop, theatre, cinema, museum, art gallery, department store benefits world knowledge, necessary for successful comprehension. The USP subtest refers to the Heimlich manoeuvre, talent show auditions, jugglers and art shows: world knowledge that may be more familiar to middle-class children than those from deprived homes. Although language ability measured through RS is necessary for understanding the content of spoken paragraphs, pragmatic processing is also necessary to infer the intended meaning. For example, accurately inferring what 'good news' means following an audition, allows the student to answer the question asking what she told her family ('The Talent Show Audition,' USP subtest, p16).

The disparity between the below-average performance on USP subtest and the average performance on the reading comprehension test can possibly be explained through the difference between spoken and written text. Whereas the USP subtest is spoken and hence transitory, the NGRT test is not timed and students can re-read passages and questions in order to clarify their understanding.

As the C7 and C8 cohort moved into the next year of education, their language and reading comprehension performance remained consistent, in line with the prediction. Reading comprehension remained within the age-appropriate range, indicating the students maintained rates of average reading development as they progressed through their education. This finding is similar to other longitudinal studies including adolescents from mainstream schools which reported growth in reading comprehension across adolescence, (Francis et al., 1996; Mancilla-Martinez et al., 2009; Ricketts et al., 2020).

In comparison to the current study which used a standardised score to measure reading comprehension, Francis et al., (1996) used an individual achievement measure (Rasch-scaled reading cluster score, Rasch, 1960) which allows for the unequal difficulties of test questions. Mancilla-Martinez et al., (2009) similarly used a growth scale value score which indicates the probability that a student will answer a question correctly based on the difficulty of the question and the ability of the student. A later study by Ricketts et al., (2020) measuring reading comprehension in 210 typically developing adolescents over three time points, used ability scores calculated from the Rasch model for reading comprehension, and raw scores for word recognition and oral vocabulary knowledge. The researchers reported minimal growth in reading comprehension, word reading and oral vocabulary with lower attaining readers showing more growth in reading than higher attaining readers. The authors suggest the reduction in attainment gap between better and poorer readers was due to a compensatory pattern of growth in early adolescence, whereby better readers plateau in their achievement and poorer readers accelerate, although this may be also due to ceiling effects on the reading test. As reading comprehension was captured through a single reading comprehension test (YARC), with the same test being taken by the students on the three testing occasions, it could be argued that the better readers reached ceiling on the test and the poorer readers benefited from rereading the same passages over the three testing periods, therefore showing an improvement.

In comparison, Huslander et al., (2010) used both raw and standardised scores to predict individual differences in word recognition, spelling and reading comprehension for 324 adolescents at the age of 16 years, from reading related skills, including reading comprehension at the age of 10 years. The study reported students showed significant improvement in raw scores for reading comprehension but when standardised scores were used, measures were consistent across the two points indicating stable rates of average reading development. These findings are in line with the current study which also showed stable rates of reading development on average, in comparison to same-age peers.

In contrast to longitudinal studies which report growth in word reading (Cain and Oakhill, 2011; Huslander et al., 2010; Mancilla-Martinez et al., 2011; Ricketts et al., 2020), the current study showed single-word reading measures decreased for two cohorts (C7+1, and C8+1), suggesting that students in this sample were finding it harder to read single words over time. Whereas three of the longitudinal studies used raw scores for word reading (Cain and Oakhill, 2011, Huslander et al., 2010 and Ricketts et al., 2020), both the current study and Mancilla-Martinez et al., (2011) used a standardised measure of word reading (TOWRE2). Comparison of raw scores show an improvement in individual word reading abilities but does not allow comparison between individuals performing at different ability levels. In addition, very good and very poor readers were excluded from the Cain and Oakhill (2011) study and Huslander et al., (2010) recruited from a longitudinal twin study of reading disability (Wadsworth et al., 2007). Ricketts et al., (2020) recruited from a socially diverse area with students' and those students from hard-to-reach families may not have opted-in to the study. Unlike the Mancilla-

Martinez et al., (2011) study which excluded SEN readers, the sample in the current study contained both good and poor readers, and the inclusion of deprivation as a measure which allowed the influence of socio-economic factors to be examined. Although the current sample showed average word reading within the ability range, the decrease in word reading over time reflected the ‘Matthew effect’ whereby poor readers do less well over time (Duff et al., 2015; Pfost et al., 2014). Meta-analysis of longitudinal studies in primary-aged children by Pfost et al., (2014) found that a Matthew effect or a pattern of stable achievement differences described the development of word recognition (based on decoding efficiency) in primary-aged children. This suggests that not all children arrive at secondary education with age-appropriate word reading.

The below-average levels of listening comprehension seen in the current sample, as measured by the understanding spoken paragraphs subtest, and low-average levels of Recalling Sentences indicate that participants have some difficulties in recalling syntactic information, understanding the meaning of sentences, and making inferences (Semel et al., 2006). The Simple View of Reading implies that when word recognition and listening comprehension are poor, reading comprehension is restricted. Although the sample showed age-appropriate word reading, the decrease in average word reading over time, and below-average achievement in Understanding Spoken Paragraphs (listening comprehension) alongside age-appropriate reading comprehension seen in the sample, challenges this view. It may be that other skills are implicated in the reading comprehension process, which are not mediated by word recognition and listening comprehension (Lervag et al., 2018). Alternatively, it may be that the Simple View of Reading does not reflect the full complexities of the developmental nature of reading comprehension (Nation, 2019).

7.2 Student performances in language and literacy over time

In order to examine reading comprehension as a process developing over time, students' growth trajectories based on differences in gender, special educational needs and deprivation were compared. The following discussion is based on the hierarchical data, whereby the assessments were nested within the individual students allowing an examination of how individual students change over time and differences in development between groups of individual students. In line with the prediction, results showed different developmental patterns between groups of students with regards to language and literacy achievement and development.

7.2.1 Differences in student performances based on gender

In terms of gender, girls did better in English attainment as predicted and showed a faster rate of improvement in English attainment over time. Comparison to national and international statistics shows a similar pattern. In 2019, before the COVID pandemic, Department of Education statistical release for KS4 (DFE, 2020) reported that girls made more progress in their Average Progress 8 score than boys, and a higher proportion of girls (46.6%) achieved a grade 5 or above in English and Mathematics compared to boys (40.0%). Chiu and McBride Chang (2006) in their large-scale study of 199,097 adolescents, aged 15 years, across 43 countries found that girls consistently outscored boys in reading and that enjoyment in reading mediated 42% of the gender effect. Their findings indicated that an advantage in reading supports performance in English.

In this study, not only did we find girls at an advantage for literacy, but results also revealed a decreasing growth rate in single word reading ($p = .048$) for boys. A recent UK cohort study by Russell et al., (2018) reported that 25% of the variation seen in word reading scores was explained by the child, family and socio-economic factors measured in the model. The study examined the predictors of word-reading ability in a sample of 13,680 seven-year-olds, identified through the Millenium Cohort Study (Plewis, 2007). Standardised word reading was measured through the graded word-reading subtest, from the British Ability Scales (Elliot and Smith, 1979). Boys, along with preterm birth, poor naming vocabulary and parental concerns about speech and language at five years of age, were independently associated with poorer reading at age seven ($p < .01$). Three socio-economic factors were significant predictors of poorer word reading at age seven: lower levels of maternal education, living in social housing and single parenting. It is possible that one or more of these same risk factors identified in the cohort study are affecting the current study's sample of older boys' word reading performance as they move through secondary education. For example, those students who lived in higher deprivation did less well in average CAT4-verbal performance and NGRT reading comprehension; both measures reliant on word reading.

The Simple View of Reading (Gough and Tunmer, 1986) places word recognition as essential to reading. However, a decline in word reading over time, as seen in the current study, points to the bi-directional nature between language and reading development, seen in the reciprocal models of reading (Nation, 209; Tunmer and Hoover, 2019). As Tunmer and Hoover (2019) point out, less successful word reading may lead to students reading less, avoiding difficult text and as a consequence, missing out on the growth in language and word recognition that successful reading comprehension provides.

7.2.2 Differences in student performances based on Special Education Needs

In the current study, participants with SEN performed significantly less well on all measures and were shown on average to be poor readers with low language levels, in line with the prediction. Students with SEN showed a trend towards lower growth rates in verbal reasoning, and a significant decreasing performance in single-word reading and English attainment. Surprisingly, listening comprehension showed a higher average growth rate but the data showed that some SEN students performed at the highest levels of the Understanding Spoken Paragraphs test. Nippold (2017) also found individual exceptions in performance, and reported that some adolescents with specific language impairment and nonspecific language impairment performed at the highest level on some test measures. As Nippold (2017) points out, this finding shows it is important to look at individual differences as well as group differences, and not make assumptions on performance based on group labels.

Research shows that children living in deprived areas are more likely to be assessed as needing SEN support (Hutchinson, 2021). This implies that schools serving communities of high deprivation will have higher clusters of students identified with SEN, as seen in this sample of students. Schools with a high density of students requiring SEN support may be better at supporting at these students but it is predictable for the SEN group to show lower average reading comprehension performance. Reading comprehension and Recalling Sentences showed a stable performance over time indicating that those students with below-average reading comprehension, neither improved nor fell in performance but continued to remain as poor readers. This agrees with the longitudinal findings of Ricketts et al., (2020) and Mancilla-Martinez et al., (2011) who also reported that students with poor reading performance remained poor readers. Mancilla-Martinez et al., (2011) highlight the issue that consistently low reading comprehension skills occurring in early adolescence coincides with a critical reading time, whereby students are expected to read increasingly complex material. Therefore, this is a key time to build in support for these students before their reading difficulties make it harder for them to learn from print.

It is important to note that children identified as SEN, have a wide range of difficulties encompassing communication and interaction; social, emotional and mental health difficulties and sensory or physical needs as well as cognition and learning (DFE, 2015). These differences were not explored in the current study. Nevertheless, the findings of the current study show that students identified as SEN showed difficulties with language and reading comprehension.

7.2.3 Differences in student performances based on deprivation

National statistics highlight the fact that disadvantaged students in England attain lower reading comprehension outcomes when they leave primary education, than their more affluent peers (DFE, 2019). Statistics, released by the DFE in 2019, the last time since 2022 that children sat the Reading SAT due to the COVID pandemic, showed that 51% of disadvantaged pupils reached the expected standard in reading compared to 71% of all other pupils. This gap of 20% has remained stable since 2016, meaning that approximately half the population of disadvantage children, move into secondary education below the expected national standard in reading. Results from the current study showed that as predicted participants living in higher deprivation did less well in their average reading comprehension achievement and verbal reasoning performance. Although both measures are assessed via reading, the CAT-verbal test used in the current study is designed to measure 'thinking with words,' (Smith and Strand, 2003, p.5). This implies not only an association with vocabulary but an awareness of how word order affects meaning (syntactic awareness), how words can vary in their meaning and that words are made up of different meaningful parts (morphological awareness). In relation to the current sample, the significance of verbal reasoning (CAT-verbal) may indicate that those students who live in areas of deprivation were finding it difficult to apply their verbal reasoning skills to support their reading comprehension, but it should be noted that this test is delivered via reading.

As predicted, those students who lived in the more deprived areas showed differences in development for listening comprehension and English attainment indicating that some were doing better than others. However, students who lived in greater deprivation demonstrated significantly less growth over time in verbal reasoning and English attainment. The decelerating growth of verbal comprehension knowledge through to the age 15 years was also reported by Reynolds and Turek (2012). Their study demonstrated that verbal reasoning exerted a positive change in reading comprehension whilst reading volume mediated some of the effects of SES. According to Kintsch and Rawson (2009), individuals need to learn and practise applying verbal reasoning to develop their reading comprehension. Based on the Construction-Integration model of reading comprehension (Kintsch, 1998), deeper understanding of the text happens when the reader integrates information in the text with relevant background knowledge retrieved from their working memory. In the current study, students at higher levels of deprivation demonstrated less growth over time in verbal reasoning (CAT-verbal) than their more affluent peers suggesting that deprivation was having a significant effect on how students in the sample, *learnt* to apply verbal knowledge to print.

Contradictory to the prediction, the finding in this study that some students at the higher levels of deprivation demonstrated slightly more growth in reading comprehension compared to other students in more affluent homes can possibly be explained through individual differences or the measure of deprivation used. The IDACI measure used in the study is not specific to the child or family but an indicator of deprivation based on governmental data

(Prady et al., 2015). It is possible that some students living in more deprived postcodes but within a literate home environment will have developed language skills and proficiencies necessary for reading. According to Ridings et al., (2017) protective factors tend to lessen risk factors associated with deprivation. Examples of protective factors include parenting competencies and/or community support helping children to work well in school. Protective factors may support some children in primary education to develop good reading skills enabling the better readers to be grouped into the top ability sets in secondary thus mediating the relationship between deprivation and reading. Furthermore, at the time of the study, state maintained secondary schools were given Year Seven literacy and numeracy catchup funding (DFE, 2016). The funding spent on individual, small group and summer school tuition may have benefited readers from more deprived areas. Reynold and Turek (2012) demonstrated that students who were good readers in primary and read more, mediated some of the effects of SES. It is possible that this may have occurred with this sample. However, by Year Nine, students living in deprivation are no longer reading as well as their more affluent peers indicating that the effects of deprivation become obvious at the later stages of education.

7.3 The relationships between language skills, non-verbal skills, single-word reading, deprivation and reading comprehension.

The use of multi-level modelling (MLM) showed a nuanced developmental pattern in language, word-reading and reading comprehension between groups of individuals within the time of the study. According to Vellutino et al., (2007) in their Convergent Skills Model, the skills supporting reading comprehension change over the course of reading development. The following discussion is based on the students' position in their school journey as the current study looks at the skills supporting reading comprehension over time.

RQ3 sought to explore the relationships between language skills, non-verbal skills, single word reading, deprivation and reading comprehension and if these relationships differed over the first three years of secondary education. Overall, the amount of variance in reading comprehension explained by language, non-verbal skills, single-word reading and deprivation seen in the current study, compares favourably with that of the meta-analysis by Quinn and Wagner, 2018. The authors report that in studies involving older children (average age at or above 11 years), decoding, linguistic and cognitive factors accounted for 52.6% of variance in reading comprehension compared to that of the current study: 62.9% in Year Seven; 45.4% in Year Eight and 68.3% in Year Nine.

More variance is explained in the Year Nine model, than in Year Seven indicating a difference in the pattern of predictors over the educational journey of the students in this sample. Similar to the findings of Foorman et al., (2015) and Quinn and Wagner (2018), the linguistic measures for this sample account for a significantly larger proportion of variance in reading comprehension than word reading, in line with the prediction. The variance in linguistic measures increased as participants moved from Year Seven to Year Nine, and the proportion of single-word measures declined. In Year Nine, verbal reasoning continued to uniquely explain reading comprehension accounting for 10.18% of the variance, followed by Recalling Sentences (2%) and Understanding Spoken Paragraphs (1.5%). This finding reflects the argument that verbal reasoning supports the reading of vocabulary and application of verbal knowledge and reasoning to print (Reynolds and Turek, 2012).

As students got older, and/or better readers they appeared to require enhanced verbal reasoning to access harder levels of texts, as demonstrated by the data that showed students to be reading within age-related expectations. These findings support both the Simple View of Reading (1986) and the Convergent Skills Model (Vellutino et al., 2007) in that both linguistic comprehension and word recognition support reading comprehension, and developmental differences contribute to the relative contribution made by each measure to reading comprehension achievement.

Word-reading contributed unique significance in this sample of students, declining from 5.8% in Year Seven to 1.59% in Year Nine, with high levels of word reading associated with higher levels of reading comprehension. Foorman et al., (2018) also reported that word reading made a small but significant effect of less than one percent in Grades Six to Eight (11 to 14 years of age) suggesting that for some students, word reading is still significant in reading comprehension. Results from the current study, indicated some readers were struggling with word reading throughout KS3 as demonstrated in the trending decline in word reading achievement for boys. Oslund et al., (2018) also found that struggling adolescent readers showed a greater relationship between word reading and reading comprehension than good readers, who showed a negligible relationship.

Alongside the fall in unique contribution of word reading to reading comprehension (Y7 = 5.8%; Y9 = 1.59%), there was a rise in the proportion of variance accounting for verbal reasoning (Y7 = 4%; Y9 = 10.18%) suggesting that more variance in later reading comprehension was explained by a measure of verbal reasoning than word reading. This implies that word reading is important but the ability to understand more complex language reflected in verbal reasoning is necessary to understand complex secondary texts and to read for pleasure in adulthood. Possibly, the Simple View of Reading fails to capture this complex interrelationship between word recognition and language comprehension when reading.

The ability to read and understand more complex text in a standardised reading comprehension test distinguishes the good from the struggling reader (Kulesz et al., 2016). The complexity of the text depends not only on the vocabulary but the sentence structure or syntax. Longer and more complex sentences carry more information which needs to be understood, and have been shown to be more difficult to understand than simpler sentences (Zipoli. 2016). Syntactic ability, measured in the current study through the Recalling Sentences subtest (CELF44, 2006), showed the unique contribution of Recalling Sentences to explaining reading comprehension declined slightly over Year Seven to Year Nine, from three to two percent. This slight decline in the contribution of syntactic ability to explain variance of reading comprehension, may be associated with a possible lack in reading practice, both at home and at school. In the current study, greater deprivation was associated with lower average reading comprehension achievement and lack of exposure to reading material, might limit exposure to complex grammar (Hsiao et al., 2022; Montag and MacDonald, 2015).

One way in which schools could mitigate against this lack of exposure to reading material, is through the use of the school text book. However, Oates (2014, p8) reported an 'antitextbook ethos' in English schools. An earlier survey of teachers in 2011, showed four percent of teachers used a textbook for Science in England, compared to 68% in Singapore and 94% in Finland (Martin et al., 2011). The reluctance of some teachers to use text books in lessons in England, means that students may not be getting opportunities to read expository text, thus missing out on the growth of language skills that repeated reading exposure produces, such as understanding complex syntactic structures necessary to convey complex ideas (Nippold and Scott, 2015; Tunmer and Hoover, 2019).

Finally, listening comprehension as measured through the Understanding Spoken Paragraphs subtest, showed a small, but significant unique contribution (1.5%) to reading comprehension in Year Nine, but not Year Seven. According to the Simple View of Reading, listening comprehension along with word recognition is fundamental to reading comprehension across the lifespan, and those students who have become more skilled at word reading will draw on listening comprehension to understand written text. Moreover, component theories point to various skills underpinning the development of listening comprehension supported by research (Kim, 2015; Lervag et al., 2018; Cain and Oakhill, 2012). In this study, the unique contribution of listening comprehension to reading comprehension seen in Year Nine, but not Year Seven, may also indicate a difference in underlying language skills such as vocabulary, verbal reasoning, syntax *or* processing skills, such as comprehension monitoring. As Lonigan et al., (2018) point out, the reading assessment will favour those with better reading comprehension as their linguistic comprehension will allow them to perform at enhanced levels. Therefore, it could be assumed that those better and/or older readers in the sample were associated with better skills in listening comprehension.

Findings from the Systematic Review (chapter five) point to poor listening comprehension skills implicated in struggling adolescent readers (Myers & Botting, 2008; Brasseur-Hock et al., 2011; Mancilla-Martinez et al., 2011; Barth et al., 2016). The following section discusses the current findings that performance on a measure of listening comprehension significantly predicted reading comprehension in Year Nine in a sample of mainstream secondary-aged students.

7.4 Predictors of reading comprehension and academic outcomes in adolescent students.

RQ4a sought to explore if performance on a measure of listening comprehension significantly predicts reading comprehension in secondary school students. In the current sample, results demonstrated that a measure of listening comprehension is an important predictor of reading comprehension in Year Eight and Nine, but not Year Seven. The model as a whole was statistically significant and explained 62.90% variability in Year Seven; 48.70% in Year Eight (without inclusion of CAT measures) and 73.50% in Year Nine. Contrary to the prediction, in Year Seven, single-word reading and verbal reasoning (CAT-verbal) were significant in explaining reading comprehension achievement as opposed to listening comprehension, suggesting that 'word consciousness' is an important factor in explaining successful reading comprehension in Year Seven (Baumann, 2009, p334).

Baumann refers to 'word consciousness' as an individual's awareness not only of the meaning of words but also an understanding of how words can be used effectively. The relationship between words and text is outlined in Frith's (1986) model of reading acquisition, whereby retrieval of word meaning through orthographic representation and integration with text meaning, builds reading comprehension. The process thus mirrors the word activation phase of the Construction-Integration model (Kintsch & Rawson, 2009). The reciprocal nature of reading means that readers learn new words through inferring meaning from the overall text. Described as a memory-driven process, Perfetti and Stafura's (2014) word-knowledge-comprehension process presents skilled readers as better able to integrate meaning into their mental model of the text, and constantly learn new words as they read harder text. The rise in verbal reasoning across Year Seven to Nine seen in the current study supports this interrelationship.

Research shows that prior levels of vocabulary knowledge act as predictors of reading comprehension. Quinn et al., (2015) in their three-year longitudinal study of primary-aged children showed that initial levels and growth in vocabulary knowledge predicted later reading comprehension. Similarly, Reynolds and Turek (2012) demonstrated that higher levels of prior verbal comprehension-knowledge in children aged nine-years predicted better reading comprehension scores when they were 15 years old. These findings imply that those readers in Year Seven, who apply good levels of word recognition and verbal reasoning to their reading comprehension, should do well in Year Eight and Year Nine. Results from the current study showed that the unique contribution of verbal reasoning (CAT4-verbal) increased from Year Seven to Year Nine indicating some readers were learning to apply their increased verbal skill to their learning.

In the current study, Year Seven hierarchical multiple regression showed that reading comprehension performance for this sample of students, was due to their overall abilities to read, understand and manipulate the meaning of words. Student factors of deprivation, Special Educational Needs or gender did not predict performance in reading comprehension in Year Seven. The following figure (7.1) models the relationship between measures predicting reading comprehension achievement at Year Seven.

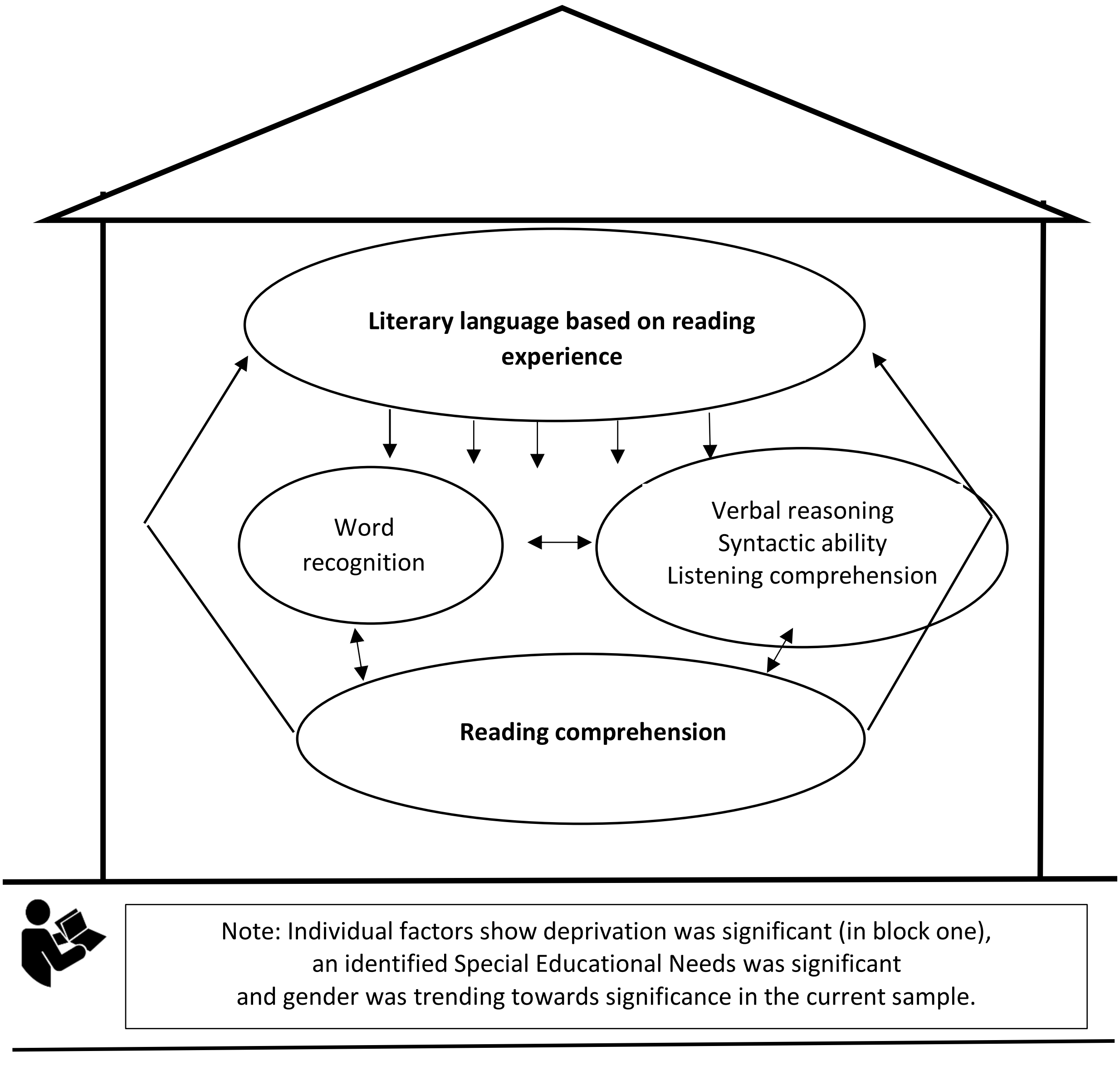
Figure 7.1 Relationship between significant predictors of reading comprehension (based on reciprocal models of reading by Nation, 2019 and Tunmer & Chapman, 2019) and the reader (an adaptation of The Language House, Snow, 2021; p. 224) in Year Seven

At Year Nine, the pattern of predictors changes as a measure of listening comprehension emerges to predict reading comprehension, in line with the prediction (See Figure 7.2). Listening comprehension is the ability to understand spoken language (Lonigan et al., 2018), drawing together a range of oral skills to build a coherent and integrated representation of what has been uttered (Oakhill and Cain, 2012). Therefore, the ability to perform well on a measure of listening comprehension demonstrates an ability to draw on a range of oral language skills to understand the information presented (Semel et al., 2006). Studies demonstrate that better listening comprehension is associated with better readers (Verlaan et al., 2017) and low levels of listening comprehension with struggling readers (Hock et al., 2011).

Why a measure of listening comprehension emerges as a predictor of reading comprehension in Year Nine, and not in Year Seven suggests a developmental shift in underlying oral language skills or a shift in the relationship between language and literacy. According to Reynolds and Turek (2012), verbal reasoning is associated with an increased ability to acquire more vocabulary knowledge from print. Findings from the current study shows the unique contribution of verbal reasoning (CAT-verbal) increases from Year Seven to Year Nine indicating some readers will be learning to apply this increased verbal skill to their learning. Meanwhile, as reading comprehension develops from Year Seven to Year Nine exposing students to new vocabulary and more complex grammatical structures, better readers may be demonstrating the ability to interpret the interrelationships between words and sentences as measured by the Understanding Spoken Paragraph subtest, hence a stronger predictive relationship between listening comprehension and reading comprehension in Year Nine than Year Seven,

Unlike Year Seven, student factors made a difference in Year Nine: students with SEN performed significantly less well in reading comprehension than their peers, and boys showed a trend towards a decreasing performance ($p = .032$). Deprivation was a predictor of reading comprehension in block one.

Figure 7.2 Relationship between significant predictors of reading comprehension (based on reciprocal models of reading by Nation, 2019 and Tunmer and Chapman, 2019) and the reader (an adaptation of The Language House, Snow, 2021; p.224) in Year Nine



Reading assessments are used by schools to support students in their academic journey. The General Certificate in Secondary Education (GCSE) marks the end of compulsory education in England. English, Mathematics and Science GCSE results for the C9 cohort were analysed to find evidence for any unique predictors of academic performance.

7.4.1 The unique predictors of academic outcomes at General Certificate of Secondary Education (GCSE) level, in students' final year of compulsory year education.

The aim of RQ4.b was to examine the unique predictors of academic outcomes of measures of gender, SEN, IDACI, literacy (KS2 Reading SAT, reading comprehension and single word reading), verbal reasoning, non-verbal abilities, oral language (Recalling Sentences and Understanding Spoken Paragraphs). As a group, the C9 cohort performed below the national and county average attainment in English and Mathematics at band grade 4 (See Chapter Five, section 5.2.3) demonstrating weak educational outcomes. In the sample of 101 students, the measures explained 59.0% of the variance in the English GCSE; 65.0% of the variance in the Mathematics GCSE and 57.6% of the variance in the Science GCSE.

Higher levels of literacy and language were associated with higher levels of attainment in English Language, Mathematics and Science. This suggests that literacy and language are necessary skills for supporting students in demonstrating their knowledge and understanding of the respective subjects and supports literature showing the links between language and later academic outcomes (Conti-Ramsden et al., 2009; Dockrell et al., 2011; Snowling et al., 2001; Spencer et al., 2017).

In line with the prediction, reading comprehension at Year Nine uniquely explained five percent of the variance in GCSE English Language at Year Eleven, but not in Mathematics or Science. The findings show the relevance of reading to understanding English. Dockrell et al., (2011) also reported that literacy at Year Nine was significant predictor of GCSE academic attainment, suggesting that academic attainment is influenced by earlier reading ability, reflecting the ability to learn from print. In the current study, non-verbal cognitive skills at Year Nine uniquely explained five percent of the variance in GCSE Mathematics and three and a half percent of the variance in GCSE Science indicating the importance of reasoning in those subjects. The association of non-verbal skills with GCSE Mathematics was also demonstrated by Spencer et al., (2017).

The results demonstrate that effective word reading skills were important in English and Science but not Mathematics, possibly reflecting the importance of accurate sight-reading linked to vocabulary knowledge in these subjects. In Mathematics, the use of symbols and understanding of specialist vocabulary may confound the association between word reading and mathematical achievement. Good mathematicians may tend to rely on symbolic representations as opposed to alphabetic representations to access understanding and communication (Morgan, 1998), and therefore there is less reliance on text decoding in Mathematics.

The effect of gender was apparent in English Language and Mathematics GCSE with girls doing better. Deprivation was associated with the English Language GCSE, with those students living in less deprived households performing better. Spencer et al., (2017) in their exploration of a cohort of 151 adolescents' language skills and GCSE outcomes also reported better outcomes in English Language were associated with girls and lower deprivation. These findings suggest that cultural influences of family and area, including the school are important influences on educational outcomes (Rasbash et al., 2010).

Having an identified SEN was not related to performance at GCSE level possibly reflecting multiple influences at student, home and school level. This study did not look at the quality of teaching and support SEN students received from KS3 to KS4 or the impact of either 'access arrangements' which gives up to 25% extra time to read and complete an examination paper, or 'special consideration' which compensates a student with extra marks for suffering from change in circumstance at the time of the examination (Joint Council for Qualifications (JCR), 2021). Ricketts et al., (2014) in a study exploring educational attainment at GCSE in poor comprehenders also found no significant differences between the experimental group and control group on educational attainment. Although this was a small sample (n=11 poor comprehenders; n=10 control), the findings illustrate the difficulty in separating poor examination performance with poor reading comprehension, for example.

An alternate reason that SEN did not predict academic performance may be due to the overall low attainment of the 9C cohort compared to national averages for English and Mathematics. Although the findings that literacy and language are necessary skills for supporting students in demonstrating their knowledge and understanding of the respective subjects, other factors such as attendance, motivation to learn and examination performance were not considered in this study and would also be important considerations of performance. Understanding the relationships explaining differences in reading comprehension and academic outcomes is discussed in the final section.

7.5 The relationships between oral language ability, non-verbal ability, single-word reading, socio-economic status and academic attainment with reading comprehension in students in secondary aged students

RQ5 sought to determine the extent to which oral language ability, non-verbal ability, single-word reading and socio-economic status explain the relationship between academic attainment and reading comprehension in a sample of adolescent students. It was predicted that oral language skills would significantly explain the differences in academic attainment and reading comprehension; non-verbal skills would affect both reading comprehension and academic attainment and that socio-economic status would make a difference to reading comprehension and therefore to academic attainment. The findings point to a shifting developmental pattern between oral language, word recognition, reading comprehension and academic outcomes significantly influenced by socio-economic factors.

As predicted, the effect of deprivation on reading comprehension, alongside the protective influence of prior learning in primary education, is seen in the current study. The students in this sample showed below-average performance in the USP subtest and average performance in the RS subtest indicating that difficulties in understanding spoken language may co-exist with typical grammatical development. This suggests that children living in areas of deprivation, or being taught in a school with a high density of students living in deprivation face different language challenges compared to students with DLD who tend to perform poorly on the RS subtest. Findings demonstrate that in the Year Seven sample, students with better word reading and verbal reasoning ability were more likely to perform well in a reading comprehension assessment, which in turn resulted in a better test outcome in their teacher assessments, irrespective of where they lived.

Contrary to the prediction, mediation showed students who lived in areas of high deprivation were more likely to perform better than their peers in both reading comprehension and English Teacher assessments. However, by Year Nine, the influence of deprivation was affecting reading comprehension. Those readers who lived in areas of higher deprivation were no longer performing better in reading comprehension or English TA than their more affluent peers. Moreover, those students living in areas of less deprivation were now doing slightly better than those in higher levels of deprivation, although not to a statistically significant degree. This reversal in the influence of socio-economic factors from Year Seven to Year Nine raises questions as to why students from deprived areas, who were good readers in Year Seven, were no longer reading as well as their more affluent peers in Year Nine.

This slowing of reading growth, evident in this study, was also reported by Kieffer (2012). In a longitudinal study exploring the relationship between socioeconomic status and student reading growth in a U.S. cohort of 9,189 students from kindergarten to Grade Eight, deprived students attending schools in areas of high deprivation showed a slowing of reading growth after third grade. The study suggested that any potential compensatory effects of schooling may not extend into later stages of education and the effect of deprivation may limit the development of the reading comprehension skills necessary for secondary education.

The effectiveness of prior primary education in England was explored in a school-effectiveness study (Rabash et al., 2010). The study explored adolescents' progress during secondary school and reported that the effect of schooling (primary and secondary) accounted for between 16% to 18% of variance in students learning between two test occasions: KS2 tests and GCSE outcomes in England. The study examined the progress of a cohort of 551,555 students, modelling the effects of family, wider shared environments (primary and secondary school, plus neighbourhood) and individual variation at student level (gender, age, SEN). Findings demonstrated 8.5% of the variance in secondary progress was due to carry-over effects from primary school indicating the importance of good teaching and learning. A later report by Sammons et al., (2014) on the influences on students' GCSE attainment, similarly showed that primary school academic effectiveness influenced secondary outcomes three to five years later.

In the current study, the KS2 Reading SAT showed that cohorts C8 and C9 left primary education with age-appropriate reading attainment; cohort C7 demonstrated below average attainment based on the new 2016 Reading SAT (section 5.2.1). Based on KS2 attainment, Y7 students were grouped by ability across classes for some academic subjects, including English, Mathematics and Science meaning that students in the top sets were better readers. As students in the sample moved through KS3, it was notable that every student placed in the Y7 top ability set remained in the same class up to Y11, whereas students placed in the bottom two ability sets were more likely to be excluded, educated off-site or be moved across classes over the five years. Grouping the best readers together may have given an academic advantage to those already good readers, as better readers have more exposure to reading, and better reading is associated with better language. It is possible that teacher's perceptions of student attainment, based on the better language used by students in the classroom may enable the better readers to remain in the top set, positively affecting their educational outcomes. Alternatively, grouping smart and motivated students together enables the students to learn through interactions with others, including teachers, teaching materials and other students. The Reciprocal framework points to reading developing oral language through exposure to vocabulary, and more complex syntactic structures (Nippold, 2007). Therefore, better readers become more fluent in both word recognition, which in turn supports vocabulary learning (Perfetti, 2007) and language comprehension, and increased language comprehension enables readers to read more challenging texts.

On the other hand, placing a greater number of poorer readers together in lower ability sets based on prior attainment may not only influence perceptions of themselves as learners as they move through secondary education, but affect their language learning opportunities. Deprivation was associated with reading comprehension in Year Nine, but not in Year Seven reflecting Kieffer's (2011) finding that deprived students attending schools with high concentrations of poverty demonstrate slower reading growth than their more advantaged peers. One explanation may be due to the reciprocal nature of reading (Nation 2019; Tunmer and Hoover, 2019) as low levels of spoken language limit reading comprehension, which in turn affects oral language resulting in greater disparities in spoken language between good and poor readers. Placing students in more diverse class groups may support their language development and hence reading comprehension through richer social interactions with teachers and other students.

Another issue to consider is motivation, and motivation to continue to read is associated with reading for pleasure (Chiu and McBride-Chang, 2006). However, in order to support a culture of reading for pleasure, readers need access to literate environments (Snow, 2021). In areas of high deprivation, limited access to reading material, is a major obstacle to reading practice or to reading new or challenging or quality text.

Access to reading material may also be limited in the classroom. Most teachers in the study used interactive whiteboards as the main method of teaching knowledge. From the student perspective, learning from an interactive whiteboard means concentrating on a fleeting digital experience: listening to and following the teacher talk about new ideas or knowledge whilst simultaneously reading and understanding text before the screen is moved on. Reading from a text book, on the other hand, provides a tangible, permanent structure of the curriculum, opportunities to re-read text in order to check understanding and most importantly, exposure to and learning of academic language. By limiting access to expository text in classrooms, students have fewer opportunities to learn new academic language and complex sentence structures unique to each curriculum subject; essential for explaining abstract thought and written language.

Restricted reading opportunities may also be affecting improvements in word recognition. In Year Seven, students in the sample with better word recognition were more likely to show a better understanding of texts and more likely to perform better in English, Mathematics and Science attainment. At the end of Year Eight, global mediation showed students with lower word reading were less likely to do well in a measure of reading comprehension. According to Perfetti and Stafura (2014), understanding word meanings through their orthographic representation and integration into the overall text, is essential to reading comprehension. Some students in the sample showed a decline in terms of raw scores in their performance in the TOWRE2 (Torgesen et al., 2012). During individual assessments, it was noticed that students who demonstrated this drop in raw scores tended to be male, from hard-to-reach families and in lower ability sets. It was also observed by the researcher that they exhibited distracted and fidgety behaviours. Reasons for this notable decline in reading accuracy could be due to difficulties in maintaining motivation, and/or emotional, social and physical challenges faced in the home and school environment. Research shows that motivation to read is a factor in reading success, and those students who find reading difficult avoid opportunities to read in and out of school (Gilson et al., 2018).

In addition, the transition from primary education with its focus on the home/school reading book and guided reading sessions to secondary education, where individual reading performance is not a focus and teaching is based around the interactive white board, mean some students may never engage in formal reading. These are challenges for students who are already poor readers and may discourage motivation and engagement with reading single words out of context, in a timed test. A decline in word recognition means that students are less likely to learn new words from text which in turn affects later reading comprehension.

In addition to the influence of deprivation and opportunities to read a lot, learning how to apply vocabulary knowledge to print is associated with verbal reasoning and cognitive skills (Reynolds and Turek, 2012). As predicted, findings from the current study demonstrate that those students in Years Seven and Eight with lower levels of non-verbal and verbal reasoning skills are less likely to be good readers and perform well academically, highlighting the importance of continued reading support during secondary education.

At the end of Year Nine, current findings demonstrated the longitudinal relationship between word reading and reading comprehension changed in a sample of adolescents. Word recognition skills no longer mediated the relationship between reading comprehension and academic attainment. Instead, those students with better word recognition skills performed well both academically and on an assessment of reading comprehension.

Both reading and writing depend on word knowledge. Theoretical frameworks point to lexical knowledge appearing through word processing (Perfetti and Stafura, 2014) and to the reciprocal effects of reading comprehension on the growth of word recognition (Nation, 2019; Tunmer and Hoover, 2019). This implies the importance of word recognition does not lessen over time, or as readers become more skilled but becomes interconnected with language learning. Considering these findings, the expanded view of the Simple View of Reading (Nation, 2019) is recommended for training teachers. Nation's (2019) model takes into account the bi-directional influence between word recognition and language comprehension, and that reading experience is essential for learning new vocabulary and grammar. Through discussion around Nation's 2019 model, teachers may become more aware of the importance of reading experience and how this is particularly relevant for students living and learning in areas of high deprivation where access to books and written material is scarce.

Similar findings of the changing contribution of word recognition in predicting adolescents' reading comprehension was reported by Foorman et al., (2020). Their cross-sectional study examined how decoding and language predict reading comprehension one year later, in students aged on average 10.67 years (Grade Five), 12.73 years (Grade Seven) and 14.56 years (Grade Nine) at the beginning of the data collection. In Grade Five, decoding significantly predicted Grade Six reading comprehension, whereas decoding in Grade Nine did not predict reading comprehension in Grade Ten. In Grade Nine, the language factor comprising of grammar and vocabulary measures (Recalling Sentences (RS) subtest of the Clinical Evaluation of Language Fundamentals–4, CELF-4; Semel et al., (2003); The Grammaticality Judgment subtest (GJT) of the Comprehensive Assessment of Spoken Language, CASL; Carrow-Woolfolk, 2008 and The Peabody Picture Vocabulary Test–4, PPVT–4; Dunn and Dunn, 2007) predicted Grade Ten reading comprehension. Their findings that the contribution of word recognition to reading comprehension shifts through early adolescence points to the influence of word recognition on later word knowledge, as readers learn to apply their knowledge to new literacy learning.

Alongside the influence of word recognition, the current results showed the increasing importance of oral language skills across Years Seven to Nine in explaining the relationship between reading comprehension and academic attainment. In Year Seven, students who demonstrate a better syntactic ability (Recalling Sentences) and listening comprehension (Understanding Spoken Paragraphs) were more likely to perform better on a measure of reading comprehension. In turn, good readers are more likely to do better on academic assessments. The findings that a good level of grammatical knowledge is related to reading comprehension development has been found by other studies of adolescent readers (Brimo et al., 2017; Nippold et al., 2008).

In line with the prediction, findings show that by Year Nine, oral language is influencing both reading comprehension and academic attainment in English, Mathematics and Science. Those students with better oral language skills are proficient users of literacy, as demonstrated through performance on measures of reading comprehension and written attainment tests. These findings are similar to those longitudinal studies of adolescents, which point to language skills and reading comprehension at the age of 14 years, being represented by a single construct (Foorman et al, 2020; Ricketts et al., 2020). This viewpoint supports the Simple View of Reading, as it suggests that once students develop skills in word recognition, their linguistic comprehension allows them to access and derive meaning from reading.

Alternatively, it could be argued that good oral language skills in Year Seven, leads to better reading comprehension and academic attainment in Year Nine reflecting a process of learning (Nippold, 2005). Viewed through the reciprocal framework, this suggests that students with better underlying language skills, who have greater opportunities to practise and develop their language skills using more complex syntactic structures, vocabulary and knowledge of different genres of reading and writing will continue to develop as readers (Tunmer and Hoover, 2019).

The current finding that listening comprehension, based on a measure of Understanding Spoken Paragraphs emerges in Year Nine as exerting significant influence on reading comprehension and written academic attainment may show growth in underlying component language skills. Lervag et al., (2018) in their five-year longitudinal study, showed student differences in listening comprehension was explained through variance in vocabulary, grammar, verbal working memory and inference skills. The current study did not use separate measures of vocabulary or inference skills, but the proportion of unique variance related to listening comprehension (Understanding spoken Paragraph) and verbal reasoning (CAT-verbal) showed small but significant increases over time, rising one percent and six percent respectively. A measure of syntactic ability (Recalling Sentences) demonstrated a dip of one percent in unique variance, falling from three percent to two percent. The findings demonstrate that for some students in the sample, growth in language-related skills over a key period in adolescence is influencing development in reading comprehension.

Chapter Eight

Conclusions and Implications for research and practice

The main aim of the current thesis was to identify the extent that oral language skills explain reading comprehension in a group of 443 students, in a large mainstream secondary school in an area of high socio-economic deprivation. There is limited longitudinal research into adolescent reading comprehension, with a 'forgotten third' of children aged 16 years of age, failing to gain a good level of literacy after 12 years of compulsory education (Association of School and College Leaders, 2019, p. 5). Secondary aims were to examine the overall language and literacy performances of students across their first three years of secondary education; to identify the relationships between verbal and nonverbal language, single-word reading, social deprivation and reading comprehension and to explore which measures were predictors of reading comprehension and academic outcomes.

In the current chapter, section 8.1 presents a summary of the conclusions. Section 8.2 discusses the implications for research and clinical and educational practice. Section 8.3 describes the limitations of the study and section 8.4 describes the reflective journey of the researcher.

8.1 Conclusions

To the researcher's knowledge, this is the first UK longitudinal study to track oral language, verbal and non-verbal reasoning, word reading, reading comprehension and academic attainment in the first three years of a mainstream secondary school serving low socio-economic communities. The findings show four main conclusions.

Uniquely, the study demonstrated a decline in word reading, particularly for boys. This conflicts with the longitudinal study of Ricketts et al. (2020), tracking oral vocabulary and reading comprehension in early adolescence. The reason for the difference may be due to the differing performance in word reading reported at the start of each study. The current study reported word reading at the low- average age level whereas students in the Rickett's study were performing at age-appropriate level indicating they were already proficient at reading single words out of context. Second, the study showed the increasing importance of verbal reasoning to the development of reading comprehension across Year Seven to Year Nine, in line with the longitudinal findings of Reynolds and Turek (2012). Third, deprivation was associated with a decline in both verbal reasoning and reading comprehension performance. The current findings align with other researchers for the association between deprivation and reading comprehension (Kieffer, 2012; Myers and Botting, 2002). However, this study additionally found deprivation influenced verbal reasoning, which has not been reported. Four, oral language skills made an increasing contribution to both reading comprehension and English academic attainment across Year Seven to Year Nine, in line with the longitudinal findings of Foorman et al., (2020).

The findings demonstrate that at the start of secondary education, words are important. The ability to read, understand and reason with words predicts reading comprehension. Aptitude with words is more important than socioeconomic factors, gender or SEN suggesting primary education may be providing an initial protective buffer against any socio-economic disadvantages relating to reading practice and exposure to print. Students who are good readers in primary and are given opportunities to read more, may have mediated some of the effects of socioeconomic factors (Reynold and Turek, 2012). Studies point to the positive impact of early literacy on later academic outcomes, indicating the positive effect of reading on language (Conti-Ramsden et al., 2009; Dockrell et al., 2011). These findings suggest that those readers in Year Seven, who apply good levels of word recognition, verbal reasoning and syntactic awareness to their reading comprehension, should do well in Year Eight and Year Nine.

The increase in the unique contribution of verbal reasoning (CAT-verbal) from Year Seven to Year Nine indicates some readers are learning to apply this increased verbal skill to their learning. As reading comprehension develops from Year Seven to Year Nine exposing students to new vocabulary and more complex grammatical structures, better readers may be demonstrating the ability to interpret the interrelationships between words and sentences as measured by the Understanding Spoken Paragraph subtest, which measures listening comprehension. The importance of verbal reasoning in supporting the development of listening comprehension may be a possible explanation for why a measure of Understanding

Spoken Paragraphs emerges as a predictor of reading comprehension in Year Nine. The importance of recognising and teaching underlying linguistic skills supporting both word recognition and language comprehension are highlighted in component models of reading comprehension (Babayiit and Shapiro, 2020).

The current study shows deprivation influences the development of underlying skills associated with good reading comprehension and reading comprehension outcomes. At Year Nine, students living at the higher levels of deprivation demonstrate a decline in verbal reasoning suggesting they are failing to learn **how** to apply meaning to print and readers living in areas of higher deprivation are no longer performing better in reading comprehension or English TA than their more affluent peers, as they were doing in Year Seven. Moreover, those Year Nine students living in areas of less deprivation are now doing slightly better than those in higher levels of deprivation, although not to a statistically significant degree. At Year Eleven, lower levels of SES are associated with higher English Language attainment.

This decline in verbal reasoning and reading comprehension is possibly due to multiple factors. Research points to the importance of the language environment, both at home and school (Snow, 2021), the compensatory influence of primary education (Kieffer, 2012) and the 'Matthew effects' of reading more, and reading more challenging texts. Harnessing the motivation to continue to read is associated with reading for pleasure (Chiu and McBride-Chang, 2006). In order to support a culture of reading for pleasure, readers need access to literate environments (Snow, 2021). In areas of high deprivation, limited access to reading material is a major obstacle to reading practice or to reading new or challenging or quality text.

Increases in listening comprehension are seen in Year Nine. The unique contribution of listening comprehension to reading comprehension seen in Year Nine, but not in Year Seven suggests a shift in the language skills, including vocabulary, verbal reasoning, syntax *or* in processing skills, such as comprehension monitoring, underpinning reading comprehension (Lervag et al., 2018). Based on the Simple View of Reading (Gough and Tunmer, 1986), those students who become more skilled at word reading draw on their linguistic comprehension to understand written text. At Year Nine, students with better oral language skills (Recalling

Sentences and Understanding Spoken Paragraphs) are more likely to do well academically, as well as being a better reader. At Year Eleven, reading comprehension makes the largest unique contribution across all analyses indicating that good levels of reading comprehension are necessary for academic attainment in English, Mathematics and Science. The interplay between language and literacy learning is therefore an important factor in educational success, and in shaping the social and economic future of these adolescents.

The findings reinforce arguments that the relationship between word recognition, language and reading comprehension is not uni-directional. Reciprocal models of reading comprehension suggest improvements in reading comprehension drives growth in word recognition and language comprehension, which in turn enables readers to read more complex text (Nation, 2019, Tunmer and Hoover, 2019). Good readers benefit from this reciprocal mechanism and gain an advantage in later academic study, as demonstrated in the current thesis. Linguistic comprehension developed through their reading habits mean good readers read and understand novel vocabulary, encounter more complex syntactic structures and this helps them understand different and more complex genres of text.

Reading assessments favour students with better levels of reading comprehension as their linguistic comprehension allows them to perform at higher levels on the test (Lonigan et al., 2018). The ability to read and understand more complex text in a standardised reading comprehension test distinguishes the good from the struggling reader (Kulesz et al., 2016). In the current study, verbal reasoning makes an increasing contribution to reading comprehension indicating that increases in knowing how to apply language supports subsequent increases in reading comprehension (Reynolds and Turek, 2012).

In this mainstream secondary school sample, different developmental patterns become apparent as the students moved through secondary education. Girls did better in English attainment and showed a faster rate of improvement in English attainment over time whereas some boys trended towards a decline in word recognition. Therefore, secondary schools need to do more to encourage practise in reading, introduce students to reading material that develops the learning of new vocabulary or support individual students with strategies to learn new words.

In conclusion, the current study demonstrates verbal reasoning (CAT verbal) makes an increasing contribution to reading comprehension, and improvements in reading comprehension are supported by improvements in listening comprehension as children get older. Deprivation negatively influences verbal reasoning and is associated with poorer reading outcomes over time. In support of reciprocal models of reading (Nation, 2019, Tunmer and Hoover, 2019), fewer opportunities to practise reading skills and fewer opportunities to read new and challenging texts may be further depriving students' chances to develop word recognition and language skills. Oral language skills at Year Nine explain the relationship between reading comprehension and written academic attainments, and are necessary skills for supporting students in demonstrating their knowledge and understanding of the key subject areas of English, Science and Mathematics.

8.2 Implications for Research and Clinical and Educational Practice

There are a number of implications for future research from the study's findings. An important further study would be to explore the results showing the declining contribution of word recognition to reading comprehension in a sample of mainstream students living in high deprivation. The interdependent relationship between word recognition on later word knowledge means some adolescents in deprived areas are not learning to apply their knowledge to new literacy learning. More research examining motivation and exposure of reading habits/ and reading cultures on adolescent word recognition will raise awareness in secondary education of a need to support at-risk students.

In the current study, students with SEN performed as well as their peers at GCSE outcomes. Future research could investigate the impact of intervention and support given to students with and without SEN, and the impact of any training given to teachers. This will help those students who underperform and to devise support in the classroom. More longitudinal data and research into employment, health and well-being is required for those students at Year Eleven who underperform, both in reading comprehension and academically.

Additionally, more longitudinal research comparing the reading trajectories of good readers living in different socio-economic areas should be undertaken, including measures of vocabulary and working memory. The finding that deprivation influenced reading outcomes for a sample of good adolescent readers needs further investigation in order to challenge social inequality. Future longitudinal research is needed to gain more insight into the impact of SES on good readers as well as poor readers, in schools with high concentrations of deprived students. Further research should involve teachers' beliefs and practices in how they teach language and literacy in mainstream secondary education.

The findings of the current study have implications for secondary education. At a general level, they suggest that in order to sustain language growth throughout secondary education, students must continue to read. Every student should have the opportunity to read written text in the classroom, allowing them to re-read text at their own pace. Good readers living in poverty, require access to a rich-literate environment during the school day and opportunities to read both more, and more widely in order to continue their development as good readers. This means access to a good school library open after school hours, access to current academic text books and access to Wi-Fi in certain areas of the school or school day. Poor readers on the other hand, who may be resistant to reading need support on many levels: word reading, increased exposure to print, reading practice and support with the cognitive effort of reading comprehension. The current findings that oral language ability was an important factor in their reading and literacy success suggests that oral language needs should be supported by a whole-school language approach. Teachers should become aware of the importance of scaffolding language and literacy learning for poor readers so that they can access new and complex academic language. By giving students time for thinking and providing opportunities to develop verbal reasoning skills through discussion in mixed ability groups, teachers can support students develop their language skills. There is a need for collaboration between SLT's and teachers in training teachers in language and the role of language in literacy.

At secondary school level, school leaders should be more aware of the effect of socio-economic deprivation on language development and its potential to limit reading comprehension growth, which in turn influences academic outcomes. Continuing professional development for all secondary teachers should develop an awareness of the language-related skills underpinning reading comprehension. The idea that there is not one perfect model of reading, but rather that all models and frameworks of reading comprehension incorporate important components, with each bringing unique perspectives, should be presented to teachers for discussion. Training secondary teachers to understand the importance of language skills and identifying strategies that can be used effectively in the classroom requires collaborative partnership working with Speech and Language Therapists, who bring knowledge and skills on language development to complement teachers' skills of showing students what and how to learn.

8.3 Limitations of the study

The study has a number of limitations. First, attrition rate in the sample was high due to student absences and students either leaving the school or being excluded. Nevertheless, overall student recruitment was good due to the opt-out nature of recruitment, meaning parents had to actively ask for their children to be removed from the study. This resulted in students from homes of high deprivation and hard-to-reach parents being included in the sample.

Second, the sample was recruited from one school meaning findings cannot be generalised to other school populations. However, the school is unique in serving an all-White British, low-income population and therefore results can be interpretated as representative of a sample of this population.

Third, the assessments of oral language were relatively limited with the use of only two measures. The Recalling Sentences subtest of the CELF4 measures the student's ability to repeat sentences accurately. Research has shown this to be a robust test for identifying children with DLD. Klem et al., (2015) report that repeating a sentence is easier for sentences that are understood and this depends on phonological knowledge, vocabulary knowledge and grammatical knowledge including morphological awareness. This suggests that students in the sample who scored poorly on the RS subtest may have difficulties in any one of the underlying language comprehension components.

However, in addition to using students' overall standardised score based on the sum of their errors, conducting an error analysis on the RS subtest may be valuable. For example, it was observed by the researcher that students in the sample made more errors recalling and repeating passive sentence structures, such as 'After the children *had finished* the book, the teacher asked them to write a report' than active structures, e.g. 'The teacher asked the children to write a report after they finished the book.' Whereas active sentence structures are commonly used in spoken conversation, passive sentence structures develop later in typical development (Berman and Nir, 2015) and are more commonly encountered in literary language. Thus, children who read widely may be more familiar with passive sentence structures than children with less opportunities to engage with language from books. Differences in test scores could be therefore partly due to exposure to written language associated with socio-economic background, and not DLD. This is a topic for future investigation.

The Understanding Spoken Paragraph subtest of the CELF4 measures how well a student understands longer sections of spoken language. The subtest uses questions commonly asked in the classroom, such as 'What happened…?', How did…?', 'Why do you think…? and, 'What do you think…? to assess students' understanding. Therefore, the USP subtest is a useful measure of how well the student may perform in the classroom.

However, performance on the USP is dependent on vocabulary, prior knowledge and inferencing abilities. For example, a passage called 'Pepper and Sam,' is about a pet dog's reaction to a bath. The passage only refers to a *cocker spaniel* requiring the listener to have prior knowledge of specific nouns as opposed to the general noun, *dog* in order to access the passage. In addition, students with experience of pets and knowledge of a dog's behaviour may find it easier to make inferences than students with no pets. The example highlights the importance of prior knowledge central in each passage of the USP subtest, in identifying relevant information to support inferences and predictions. Prior knowledge, gained through numerous experiences and interactions with books, is associated with socio-economic status

(Hogan et al., 2014). Students with a poor performance on the USP subtest may have limited prior knowledge reflecting deprived home backgrounds, as opposed to a difficulty in listening comprehension Likewise, those students with experiences of, for example washing a dog, may perform better on the passage than they should.

The study did not include measures of receptive or expressive vocabulary, no syntactic comprehension other than the Recalling Spoken Sentences subtest and no short-term working memory task shown to be important skills supporting reading comprehension. This was primarily due to time constraints on the researcher and students within the school timetable. Including these measures may have altered the study's findings and provided further insights into the factors that predict reading comprehension.

Income Deprivation Affecting Children Index (IDACI) was included as the single measure of deprivation. After examining the Free School Meals and Pupil Premium data for all students in the sample, it was decided that IDACI was a more comprehensive measure of deprivation. This is because not every student eligible for a Free School Meal is in receipt of the benefit. Parents need to apply online through the local authority website and therefore require a level of literacy to find and complete the form, along with proof of qualifying evidence. The Pupil Premium is designed to improve educational outcomes for students living in disadvantage, but again parents need to apply and as the money goes to the school, there is no direct benefit for families. IDACI, on the other hand, is widely used in research and measures the proportion of children living in income deprived households, based on government administrative data and provides a more objective indicator of child poverty. The benefit of the IDACI measure is its simplicity as a relative income measure of poverty. Income poverty points to families finding it hard to share the minimum levels of living, spending power and social activities that the rest of the society have (Schels, 2020).

However, there are limitations to the extent an income-based measure can capture all aspects of deprivation across an area-based measure. First, as IDACI only measures the proportion of children likely to live in an income deprived home, the measure is not specific to the individual child. Living in a deprived postcode area, does not make the child, necessarily 'poor'. Income poverty associated with lack of resources may not mean that the family is living in isolation, suffering from discrimination, battling addiction, suffering from health problems or lacking in education.

Second, the reliability of an area-based measure depends on whether it equally indicates child poverty across areas of differing socio-economic and demographic characteristics. Benefit uptake, used as a basis of the IDACI may differ across areas of high density ethnic populations and low density, white rural/ coastal postcodes (Prady et al., 2016). In the study sample, gentrification may have made a difference as younger families, priced out of local market towns, bought or rented first homes in less affluent postcodes.

Future research could benefit from using two measures of SES: student SES, reflecting the effects of deprivation and school SES, using traditional income-based measures. Student SES measured through IDACI, library access and use, book reading behaviour, maternal education and parent's occupation would allow future investigation into the association between individual student deprivation and performance. Whereas a school SES measure, comprising a percentage of how many students are in receipt of the income-based measures of FSM and PP, would allow future investigation into the association between high density, highly deprived school populations and individual student performance.

Fourth, the Cognitive Abilities Test (CAT4, Smith et al., 2003) included in the current study and use routinely by school is mediated by the written word making it difficult to disentangle oral language performance from the ability to read.

Finally, changes to national statutory testing made it difficult to show comparative progress of the three cohorts. Changes to the Key Stage Two Statutory Assessment Tests in May 2016 with scaled scores replacing levels, made it difficult to show equivalent progress of the C7 cohort with C8-1, and C9-2. Likewise, the impact of COVID-19 on the GCSE outcomes for the C8 and C7 cohort meant their results were not considered, as changes from examination to teacher assessment were not comparable.

8.4 Reflective Account

Good readers enjoy benefits such as reading for pleasure, learning new information or ease in accessing information. Snow (2021, p,221) points to the 'transformative' value of reading as health, well-being and socio-economic status are associated with good levels of literacy. However, some children fail to learn to read, and the latest estimate suggests a third of children living in England fail to gain competency in literacy (Association of School and College Leaders (2019). In an effort to tackle low levels of literacy, the British Government (2022) published a white paper on 'Levelling up the United Kingdom', in which they set a target of 90% of children leaving primary school having achieved the expected standard in reading (i.e., a scaled score of 100) by 2030, and the percentage of children in worst performing areas to increase by a third. Currently, only 74% of primary children met the expected target of reading, in the academic year 2021/22 (DFE, 2022), so the question of how to support children to become readers is a pertinent one.

As a teacher, I believe children should leave primary being able to read. I have always been interested in teaching children how to read and explaining why some children fail to understand what they are reading. My interest in this research began when I started to train both primary and secondary teachers in teaching reading. During teacher training sessions, I used the Simple View of Reading (Gough and Tunmer, 1986) to point out variation in readers and discussed with teachers, the need to promote oral language. Teachers' opinions of reading comprehension tended to focus on reading output or the quality of answers to questions, or strategies to improve reading itself. This made me wonder if we were thinking about the end product of reading comprehension, rather than any supporting processes. I decided to research reading comprehension from a language perspective, as opposed to an educational perspective, to better understand the skills and processes contributing to language and reading comprehension.

I started my research in 2016 exploring different models of reading comprehension. As a teacher, the Construction-Integration Model (Kintsch and Rawson, 2007) fitted with my understanding around building a coherent representation of the text through integrating meaning from words and sentences. When I encountered Component Models of Reading describing the skills underpinning word recognition and linguistic comprehension, the Simple View of Reading (Gough and Tunmer, 1986) began to make sense. I could now fit skills to both axes but also realised that the skills of word recognition and language comprehension were generally taught in primary school, albeit through written methods such as spelling and grammar tasks. Something was still missing in my understanding of why some children fail in reading comprehension. When two reciprocal models of reading were published in 2019 by Nation, and Tunmer and Hoover respectively, their theory that reading comprehension alters word recognition and language comprehension seemed to fit with what was appearing in my data.

Gathering my data on an individual basis, and retesting the following year allowed me to see that some of the students, generally boys living in more deprived homes, were declining in their word reading skills. From a school perspective, this was worrying as it appeared the students were actively withdrawing from engaging with any encounters with print.

I had never tested any students on their language skills before and was surprised at both their performance and the range of abilities evident on the measures of Recalling Sentences and Understanding Spoken Paragraphs subtests. I learnt not to prejudge who would do well in the language tests as some students with SEN performed at the top level for Understanding Spoken Paragraphs. I also learnt that students who had been put in exclusion for the day, tended to show low levels of Recalling Sentences or Understanding Spoken Paragraphs. One student told me I was speaking a ‘heap of words, and that’s what it’s like in the classroom’. I began to realise the reality of the limited learning opportunities for someone with poor listening comprehension, the impact on motivation to learn and subsequent attainment and success.

Learning to use various statistical approaches to the data turned out be very similar to examining different theories of reading comprehension, as analysis allowed the exploration of different perspectives. At first, it was not easy. It was complicated and messy as results that did not confirm to expectations appeared, such as readers in areas of high deprivation doing well. This made me challenge prior misconceptions and labels: children who live in deprivation may have barriers to success, but they can also be clever. I learnt that using different statistical analysis allowed me to see different patterns in my data, and I found I could apply this knowledge to reading academic papers.

At the end of the research project, I understand more about the theories of reading comprehension, and contributing skills and processes. All the theories are relevant and by presenting just one theory of reading prevents teachers from understanding the complexity of reading comprehension. Based on findings from the current research, schools in areas of high deprivation need to think *how* to allow students in secondary education, time to read, or time to practise reading. Time spent sampling the language skills of some readers in partnership with Speech and Language Therapists would provide a basis for intervention and/or allow teachers to alter their teaching strategies. Despite all I have learnt, the research has thrown up more questions, than solved answers. I don't leave the study feeling 'job done', but rather there is more to be done.

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Appendices

Page

Appendix 3A Joanna Briggs Critical Appraisal Tools (Moola et al., 2020)
Cross-sectional critical appraisal

Critical Appraisal checklist	Yes	No	Unclear	Not applicable
A Inclusion criteria	Clear and detailed inclusion and exclusion criteria	No inclusion or exclusion criteria given	Brief statement of inclusion based on test results or teacher selection	
B Participants and setting	Clear description of participants and setting to determine population of interest	No description of participants and setting	Brief statement of participants and setting.	
C Method of measurement	Clear description of methods of measurement including validity and reliability	No description of methods	Brief description of methods. Validity and/or reliability not reported	
D Objective standard criteria used in measurement	Clear definition of participants based on specified criteria e.g., struggling readers, language impaired or grade of schooling	No specified definition used to describe the participants.	No definition of participants but evidence of matching the groups by key characteristics	
E Confounding factors	Potential confounders identified e.g., home background, reading habits, different teachers/ schools	Identification of confounding factors is difficult for studies where behavioural, attitudinal or home factors may impact on the results		

F Strategies to deal with confounding factors	Strategies such as matching or stratifying sample identified; multivariate regression	No strategies identified to deal with stated confounding factors		No confounding factors identified and therefore no strategies stated
G Valid and reliable outcomes	Valid reading comprehension and language tests carried out by trained researchers	Reading comprehension or language measures assessed using non-validated measures	Objective outcome measure but no mention of test procedure	
H Appropriate statistical analysis	Detailed method section identifying appropriate analytical techniques	No mention of appropriate statistical methods	Statistical methods unclear	

Quasi- Experimental critical appraisal

Critical Appraisal checklist	**Yes**	**No**	**Unclear**	**Not applicable**
A Clear 'cause' and 'effect'	Clear temporal relationship; the treatment delivered before the effect	Unclear which variable is being manipulated as the potential cause; which is being measured as effect of potential cause		
B Similar participants included in comparisons	Participants from the same group similar in terms of age, characteristics e.tc	Participants from compared groups different	No description of compared groups	
C No reported extra/other interventions happening	No difference between groups in terms of other interventions, other than the intervention of interest	Different interventions occurring at the same time		

Critical Appraisal checklist	Yes	No	Unclear	Not applicable
D Control group	At least one independent, separate control group	No comparison group reported		One single group pre-test/ post test study where participants are the same group
E Comparison of results before and after the intervention	Clear results of measurements before and after the intervention	Only pre-test or post- test measures reported		
F Follow up complete and if not, differences between groups described and analysed	Attrition reported, with reasons for loss. If differences between groups, then analysis of patterns of loss to follow up	No report or description of attrition. No analysis of patterns of loss to follow up		
G Outcomes of participants included in comparisons measured in the same way	All outcomes measured in the same way, using the same scale, timings, procedures and instructions	Differences reported in how the outcomes were measured.	No description of how the outcomes of compared groups were measured	
H Reliability of the measurement	Clear reliability reported: number of raters, training, intra- and inter-rater reliability	No description of procedures or reliability of the performance of measurement	Procedures mentioned but unclear detail on the reliability of the performance measurement	
I Appropriate statistical analysis used	Appropriate statistical analysis used	Inappropriate statistical analysis		

Longitudinal critical appraisal studies

Critical Appraisal checklist	Yes	No	Unclear	Not applicable
A Similar groups recruited from same population	The groups were similar in characteristics relevant to the study – school population and/or inclusion criteria	No description of participants given. No inclusion/ exclusion criteria reported	A brief statement of the participants.	
B Exposure measured similarly	Description/ mention of how the exposures were measured	No mention of how the exposures were measured		
C Description of the method of measurement of exposure	Clear description of the method of measurement of exposure	No mention of the method of measurement of exposure		
D Confounding factors identified	Specific mention of home background, reading habits, teachers, classes, schools etc	Difficult to identify in a school study, when home background, library visits, different schools, teachers can all influence reading.		
E Strategies to deal with confounding factors	Strategies identified such as matching, stratifying participants; nesting in multivariate models	No confounding factors identified and therefore no strategies		
F Participants free from outcomes at the start of the study				Unless a birth cohort, students can not be free from reading at the start of the study

Critical Appraisal checklist	Yes	No	Unclear	Not applicable
G Outcomes measured in valid and reliable way	Clear description of reading comprehension and oral language measurement and how the measurements were conducted	No description of methods or procedure		
H Follow up time reported and long enough to enable outcomes	Appropriate length of time for follow up	Inappropriate length of time for follow up		
I Follow up complete	Clear and justifiable description of attrition	No description or statement of attrition		
J Strategies to address incomplete follow up	Analysis shows modelling for missing data	No strategies shown for incomplete data due to attrition		No attrition and therefore full data for all participants
K Appropriate statistical analysis used	Clear description of analytical techniques	No mention of analytical techniques		

Appendix 3B Risk of Bias Assessment

36 studies

Study		Selection Bias	Performance Bias	Detection Bias	Attrition Bias	Reporting Bias
Barth et al., 2016	***Judgement***	low	high	low	low	low
	Description	Students were randomly assigned within schools	Blinding not possible	Outcome group: For proximal measures - 2 members blind to the group were trained on the scoring	Because of the high attrition rate prior to the initiation of intervention, we used all available pretest and demographics variables to create 1000 imputed data sets with MPLUS v7	No indication of reporting bias
Brasseur-Hock et al., 2011	***Judgement***	low	high	unclear	low	low
	Description	Part of a larger descriptive study of adolescent readers. The authors obtained data on a single cohort of 345 students entering their 9th grade. Students came from two small urban junior high schools and two urban middle schools feeding into three urban schools in two cities. Students were recruited at the end of their 8th grade year.	Not possible	Participants were tested individually. 16 examiners participated in administering the test battery. Two scorers independently scored 10% of the student responses. *Unclear if scores were blind to the groups*	The original sample of 345 students reduced to the 319 students with complete data: Excluded students were not significantly different from included students on a range of demographic indicators.	No indication of reporting bias
Carlisle, 1989	***Judgement***	high	high	unclear	low	low
	Description	Selected though performance on standardised reading comprehension test; small	Blinding not reported	Researchers administered the PILAR Listening and Reading subtests to	Complete data set	No indication of reporting bias

		numbers, unequal groups		the students in groups. The Gates-MacGinitie Reading Test (MacGinitie 1978) had been given earlier in the school year		
Catts et al.,2006	***Judgement***	**high**	**high**	**unclear**	**low**	**low**
	Description	The overall sample a higher proportion of children with a history of language and nonverbal cognitive deficits than that found in the general population. 8th grade reader subgroups were selected on the basis of their performance on the reading comprehension and word recognition composite scores in eighth grade	Blinding not reported	Participants were administered a battery of assessments in kindergarten, second, fourth, and eighth grades	Complete data set	No indicatio n of reporting bias
Clemens et al., 2020	***Judgement***	**low**	**high**	**unclear**	**high**	**low**
	Description	Students were participating in RCT of a RC intervention. From the sample, researcher identified a subsample.	Assessment conducted by research staff …. Blinding not possible	Test administrator s were required to demonstrate 100% procedural fidelity and 95% inter-scorer agreement before being permitted to administer	The mean percentage of cases with missing data on at least one measure was 7.07% (range = 0%–13.8%). Data were missing due to student absences on testing days that could not be made up.	No indicatio n of reporting bias
Davis et al., 2016	***Judgement***	**high**	**high**	**unclear**	**low**	**low**
	Description	Teacher selected with reward incentive	Not possible	Students were administered the	Data collection for full sample	No indicatio n of

				assessments and surveys at their schools by research personnel in group and individual sessions during the school day.		reporting bias
Denton et al., 2008	***Judgement***	**low**	**low**	**unclear**	**low**	**low**
	Description	Once identified, students were randomly assigned within classrooms to one of two conditions: the treatment group (n=20) or the typical practice group (n=18)	The treatment groups were taught by two teachers who participated in at least 10 hours of training. Each teacher who provided the research intervention was observed by the second author three times using a treatment integrity checklist to determine the degree that the intervention was implemented as planned. Average fidelity ratings were between 91% and 98% for both interventionists.	All assessments were administered by trained graduate students.	During the course of the study, one student was sent to an alternative school or misbehaviour and one student moved out of the school, resulting in a total of 38 participants who completed the study	No indication of reporting bias
Foorman et al., 2015	***Judgement***	**low**	**high**	**unclear**	**high**	**low**
	Description	1792 participating students from 18 schools in two	Not possible	Students were individually administered	A planned missing data design was employed.	No indication of

		large urban districts		the study measures	Grade 6 Cohort 1, showed **the FCAT 2.0 measure, which had 39.6%** missing data. & Grade 9 Cohort 1, FCAT 2.0 measure, which had **33.7%** missing data. Between 8.8%–15.9% of Cohort 2 students and between 52.8%–58.2% of Cohort 3 students had missing GMRT outcome data. While FCAT 2.0 missing data ranged from 4.8% to 20.6% across all grades, only 2.6%–5.3% of each grade-level sample was found to have no outcome measure (i.e., no FCAT 2.0 or GMRT measure). FCAT = measure of RC; GMRT = RC	reporting bias
Foorman et al., 2018	***Judgement***	**low**	**high**	**unclear**	**unclear**	**low**
	Description	Schools were recruited through meetings with the principles of 18	Not possible	One session was for individual administratio	Data were assumed to be missing at random in	No indicatio n of

		schools in two large urban districts. The 2938 participating students received parental consent to participate. A high participation rate of higher than 80% was obtained.		n of the language and decoding measures. The other session was for group-administration of the nationally norm-referenced reading comprehension measure. The state test was administered by the teachers in a computer laboratory per state administration requirements and the archival data were obtained from the districts	grades 5, 6, 8 and 9 with full information maximum likelihood used in all grades to account for missing data	reporting bias
Foorman et al., 2018	***Judgement***	**unclear**	**high**	**unclear**	**unclear**	**low**
	Description	Participants were 372 students in grade 1, 299 students in grade 7, and 122 students in grade 10 in general education classrooms from 18 schools in two large urban districts in Florida (one in northern Florida and the other in central Florida	Not possible	Not reported	Planned missing design study – not reported	
Foorman et al., 2020	***Judgement***	**unclear**	**high**	**unclear**	**high**	**low**
	Description	The 757 participants in the present study were part of a	Not possible	Trained research assistants administere	A planned missing data design was	No indication of

		two-year data collection effort across a large grade range. The sample included 321 students in grade 5 (Cohort 1), 299 students in grade 7 (Cohort 2), and 137 students in grade 9 (Cohort 3). During the two-year data collection, students came from six elementary schools, three middle schools and one high school in two school districts in Florida		d the language comprehension and decoding measures individually to students and the norm-referenced reading comprehension test (i.e., GMRT) to groups of students. Classroom teachers administered the state reading comprehension test (i.e., FCAT) as part of normal end-of-year testing.	employed. Data shows that 32% of grade 7 students sat the GMRT and 41% of grade 9 students.	reporting bias
+ Hock et al., 2009	***Judgement***	**high**	**high**	**unclear**	**unclear**	**low**
	Description	Participating students from the urban schools were recruited from their English classes during the end of their eighth or the beginning of their ninth-grade year. They were selected for inclusion in the study based upon their Kansas Reading Assessment (KRA) scores. Student participants received a monetary compensation of	Not possible	Participants were tested individually. 16 examiners participated in administering the test battery. Two scorers independently scored 10% of the student responses. *Unclear if scorer were blind to the groups*	not reported	No indication of reporting bias

		$30.00 each for completing the test battery.				
Klecan-Aker and Caraway, 1997	***Judgement***	**high**	**unclear**	**unclear**	**low**	**low**
	Description	A total of 80 subjects, 46 from the fourth-grade and 34 from the sixth-grade were chosen. 13 males and 21 females so unequal group; middle class sample	Narrative samples were collected by graduate students in speech and language pathology, trained in the procedure and supervised by an individual holding the 'Certificate of Clinical Competence'	All narratives were transcribed by the interviewer. 20% of stories were scored by another individual.	No missing data	No indication of reporting bias
Klinger et al., 1996	***Judgement***	**low**	**high**	**unclear**	**low**	**low**
	Description	Students were randomly assigned to the tutoring group or the cooperative learning group, so that there were 13 students in each group.	Not possible	All of the tests were scored by two independent raters, the researcher and an assistant trained in the scoring procedure	There was no attrition of subjects in this study	No indication of reporting bias
Larsen and Nippold 2007	***Judgement***	**unclear**	**high**	**unclear**	**low**	**low**
	Description	All study participants were enrolled in a public school located in a middle-income neighbourhood in western Oregon. According to the children's teachers, all children were	Not possible	Graduate student research assistants who were trained by the first author administered the hearing screening and the	No incomplete data	No indication of reporting bias

		typical achievers who represented a range of ability levels, as is commonly found in today's public schools		PPVT–III. To ensure consistency with the experimental measure, the first author always administered the dynamic assessment task.		
Lesaux et al., 2010	***Judgement***	**high**	**high**	**unclear**	**low**	**low**
	Description	313 students (54%) scored at or below the 35th percentile and were then selected to be assessed with a diagnostic battery of language and literacy measures	Not possible	A team of trained graduate students administered the assessments. The Gates-MacGinitie reading comprehension test and the Test of Academic Vocabulary were group-administered in all participating classrooms. All other measures were then individually administered to struggling readers in a quiet location in the school	Only sample with complete data used	No indication of reporting bias
Lesaux et al., 2017	***Judgement***	**unclear**	**high**	**unclear**	**low**	**low**
	Description	Students were drawn from a	Not possible	Six college educated	Descriptive analysis	No indicatio

		larger sample of students participating in a longitudinal study conducted in four school districts in the Northeastern US. For the current study, the 35th percentile was chosen as a cutoff for defining the subsample		Spanish-English bilingual research assistants were trained to administer the individual assessments in a quiet room at the children's schools, homes, community libraries, or after-school programs.	shows full number of students	n of reporting bias
Li et al., 2014	***Judgement***	**high**	**high**	**unclear**	**unclear**	**low**
	Description	Participants selected from a sample of Chinese students enrolled in school that requires English entrance exam	Not possible	Four trained testers including the first author, all graduates. Individual testing lasted about 50 min (one session), during which the participant was tested by one tester in a quiet room. Group testing took approximately 200 min (four sessions, spaced over several weeks), with a classroom teacher and two testers present in	Not reported	No indication of reporting bias

				the classroom.		
Lipka et al., 2012	***Judgement***	**low**	**high**	**unclear**	**low**	**low**
	Description	The entire longitudinal population of 674 students (572 first language and 102 ESL) was included. The students were from 30 different schools	Not possible	Trained graduate students conducted the assessments in the schools. Each child was individually assessed in a quiet room. The reading comprehension tasks were administered in group settings in classrooms.	No missing data based on descriptive statistics	
Logan et al., 2017	***Judgement***	**high**	**high**	**unclear**	**low**	**low**
	Description	Participants recruited from three public schools with high concentrations of students classified as ELLs. Participants were limited to students whose caregivers indicated on a home language survey that their family spoke Spanish at home to some extent	Not possible	Not reported	Descriptive statistics show same number as in sample	No indication of reporting bias
Mancilla-Martinez et al., 2011	***Judgement***	**unclear**	**high**	**unclear**	**low**	**low**
	Description	Data collected in a school in North-eastern United States.	Not possible	Not reported	students reported as leaving between 6-7th grade (10%). Authors found no significant	No indication of reporting bias

					differences in literacy performances	
Marinova-Tood et al., 2013	***Judgement***	**unclear**	**high**	**unclear**	**low**	**low**
	Description	Students were from 30 schools in one urban school district in Canada	Not possible	Individual test based session by trained graduate. 10% of scoring done by two raters independently and the consistency was at least 90%	No incomplete data	No indication of reporting bias
Miller et al., 2014	***Judgement***	**high**	**high**	**unclear**	**low**	**low**
	Description	Open recruitment:advertised the study in schools, clinics, and paediatricians' offices	Not possible	Testing occurred in two sessions. Session 1 included a battery of cognitive and academic achievement tests; session 2 included a 1-hour reading comprehension task	Due to administration procedure changes, passage fluency data were available for 91 students and passage comprehension data were available for 85/94 students. Linear mixed methods model used 9,168 response data, low attrition assumed	No indication of reporting bias
Myers et al, 2008	***Judgement***	**high**	**high**	**unclear**	**low**	**low**
	Description	Students who expressed an interest in taking part were given an information pack.	Not possible	Assessment took place in a quiet room within the school and was carried out by a qualified	no participants withdrew	No indication of reporting bias

				speech and language therapist (SLT). The assessments were carried out individually over two one-hour sessions on separate days		
Nellenbach, 2012	***Judgement***	**high**	**high**	**unclear**	**low**	**low**
	Description	60 participants from a single school site: unequal distribution of boys (35%) and girls (65%), grades treated as single group	Not possible	The primary investigator observed the research assistant as she administered and scored the screening battery independently. The research assistant had to administer each assessment using the appropriate procedures and obtain an inter-rater agreement of 90% or higher for the scores obtained on each of the two assessments.	No missing data	No indication of reporting bias
Nippold, 2017	***Judgement***	**low**	**unclear**	**unclear**	**unclear**	**low**
	Description	Epidemiological sampling	Not reported	Not reported	Not reported	No indicatio

		techniques designed to represent the population of monolingual English-speaking kindergarten children in the United States. Large sample				n of reporting bias
Ouellette et al., 2010	***Judgement***	**unclear**	**high**	**unclear**	**low**	**low**
	Description	Participants were recruited from three English speaking schools in eastern Canada	Not possible	All participants were administered the test battery individually. Sessions ranged from 50 to 65 min. Assessment was conducted by one of four trained research assistants	All participants were administered the test battery, therefore low attrition assumed	No indication of reporting bias
Ouellette et al., 2014	***Judgement***	**Unclear**	**high**	**unclear**	**low**	**low**
	Description	Participants were recruited from two English-speaking schools in eastern Canada	Not possible	Assessment was conducted by one of three research assistants, trained by the first author.	100 students assessed for the study; 4 did not complete. The final sample reported was 96.	No indication of reporting bias
Penning et al., 1991	***Judgement***	**unclear**	**high**	**high**	**low**	**low**
	Description	30 PC and 30 NA students participated in the study	Not possible	Nine measures were individually administered by the first author to participating students over two sessions lasting approximately 75 minutes each. RC	none	No indication of reporting bias

				measures are researcher designed.		
Ricketts et al., 2020	***Judgement***	**low**	**high**	**unclear**	**low**	**low**
	Description	Participants were recruited from three socially mixed mainstream schools. 210 adolescents were unselected for ability; longitudinal design	Blinding not possible	At each time point, participants completed a battery of standardized assessments to characterize the sample. Tasks were administered individually in a fixed order across two 60-minute sessions	Descriptive stats show 210 participants T1 dropping to 187 participants T3. FIML was used to handle missing data	No indication of reporting bias
Roberts et al., 2013	***Judgement***	**unclear**	**unclear**	**unclear**	**high**	**low**
	Description	Data from a large intervention study of struggling readers attending 6 middle schools in 2 large urban cites. A sample of 214 treatment students and 113 comparison students	Professional interventionists, hired and carefully supervised by the research team, delivered the treatment	Not reported	110 students left (34%).	No indication of reporting bias
Shaywitz et al., 1999	***Judgement***	**low**	**high**	**unclear**	**low**	**low**
	Description	For the current study, 2 groups of Connecticut Longitudinal Study subjects were selected for participation when students were in Grade 9: 1) met criteria for persistent reading disability and 2) a comparison group of typically developing children	Blinding not possible	In grade 9, each child received a comprehensive assessment of academic, language, and other cognitive skills	Not reported but as tracked longitudinal study assuming no attrition	No indication of reporting bias
	Judgement	**high**	**high**	**unclear**	**low**	**low**

Skebo et al., 2013	***Description***	Participants drawn from longitudinal data base. 234 families. Criteria determined from subtests on CELF4-3	Blinding not possible	Tests were administered and scored by two licensed SLT's according to the instructions in the test manuals. Unclear if test administrators were unaware of students' experimental status	No attrition reported. As cross-sectional study, it is assumed low attrition	No indication of reporting bias
Srivastava et al., 2012	***Judgement***	**high**	**high**	**unclear**	**low**	**low**
	Description	All participants recruited from public or charter school classrooms. A total of 46 students (25 TLD; 21 LLD) consented to take part.	Blinding not possible	Speech and Hearing Science graduate students served as RAs. The RA was present to answer any questions from the participants and to monitor the progression of the experimental tasks. The RA did not answer any questions that might have directly or indirectly helped the participants with the assessments. *Unclear if scoring was blinded or not*	No attrition reported. One can assume no attrition as nothing reported and based on assessments administered on first 2 days on study	No indication of reporting bias
Wright et al., 2015	***Judgement***	**high**	**high**	**high**	**unclear**	**low**
	Description	Subjective teacher judgements' teacher with	Blinding not possible.	The post-assessment was carried	Not reported	No indication of

		responsibility for SEN within the school was provided with information regarding the nature of the intervention and profiles of participants sought	Assessment and intervention carried out by two final-year master's SLT students under the supervision of the principal researcher, who was a qualified SLT.	out in each case by the researchers who had provided the intervention		reporting bias

Appendix 4A Indemnity letter pertaining to ethical approval

Research Office
Northampton Square
London EC1V 0HB

Tel: +44 (0) 20 7040 5704

www.city.ac.uk

Reference Number: LCS/PR/PhD/16-17/01

Name: Morag Boyes and Vicky Joffe

Title: The relationship between language and reading comprehension in secondary school students

21 October 2016

Dear Morag and Vicky

Re: Full Ethical Approval

Following on from LCS proportionate review, I am pleased to confirm that your application has full ethical approval. Please also find attached details of the full indemnity cover for the studies.

Under the School Research Governance guidelines the applicants are requested to contact me once the projects have been completed, and they may be asked to complete a brief progress report six months after registering the project with the School.

If you have any queries please do not hesitate to contact me as below.

Yours sincerely

AWelton

Alison Welton

Research Governance Officer

a.welton@city.ac.uk

020 7040 5704

City, University of London

Dear Morag

Reference: ETH1920-0377

Project title: The relationship between oral language ability, non-verbal ability and socio-economic status with reading comprehension in mainstream school age students, 11 0 14 years

Start date: 9 Sep 2016

End date: 31 Jan 2021

I am writing to you to confirm that the amendment to the research proposal detailed above has been granted formal approval from the Language & Communication Science Proportionate Review Committee. The Committee's response is based on the protocol described in the application form and supporting documentation. Approval has been given for the submitted application only and the research must be conducted accordingly. You are now free to start recruitment.

Please ensure that you are familiar with City's Framework for Good Practice in Researchand any appropriate Departmental/School guidelines, as well as applicable external relevant policies.

Please note the following:

Project amendments/extension

You will need to submit an amendment or request an extension if you wish to make any of the following changes to your research project:

- Change or add a new category of participants;
- Change or add researchers involved in the project, including PI and supervisor;
- Change to the sponsorship/collaboration;
- Add a new or change a territory for international projects;

- Change the procedures undertaken by participants, including any change relating to the safety or physical or mental integrity of research participants, or to the risk/benefit assessment for the project or collecting additional types of data from research participants;
- Change the design and/or methodology of the study, including changing or adding a new research method and/or research instrument;
- Change project documentation such as protocol, participant information sheets, consent forms, questionnaires, letters of invitation, information sheets for relatives or carers;
- Change to the insurance or indemnity arrangements for the project;
- Change the end date of the project.

Adverse events or untoward incidents

You will need to submit an Adverse Events or Untoward Incidents report in the event of any of the following:

a) Adverse events

b) Breaches of confidentiality

c) Safeguarding issues relating to children or vulnerable adults

d) Incidents that affect the personal safety of a participant or researcher

Issues a) and b) should be reported as soon as possible and no later than five days after the event. Issues c) and d) should be reported immediately. Where appropriate, the researcher should also report adverse events to other relevant institutions, such as the police or social services.

Should you have any further queries relating to this matter, please do not hesitate to contact me. On behalf of the Language & Communication Science Proportionate Review Committee, I do hope that the project meets with success.

Kind regards

Rachel Holland

Language & Communication Science Proportionate Review Committee

City, University of London

Ethics ETH1920-0377: Morag Boyes (Low risk)

Appendix 4C **School information leaflets and consent forms for head teacher, parents, and students.**

Consent form for Head teacher

CITY UNIVERSITY LONDON

An investigation into the relationship between oral language and reading comprehension in mainstream secondary school students

Please initial box

1.	I agree to take part in the above City University London research project. I have had the project explained to me, and I have read the participant information sheet, which I may keep for my records. I understand this will involve: • Identifying, in collaboration with the researcher, key stage three student participants according to the inclusion criteria of the study. • Facilitating communication with parents during the recruitment process. • Making available to the researcher relevant information from school records i.e. demographic information and attainment levels, subject to parental approval. • Arranging an appropriate place and time for individual assessments to take place.	
2.	I understand that any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party. No identifiable personal data will be published. The identifiable data will not be shared with any other organisation.	
3.	I understand that my participation is voluntary, that I can choose not to participate in part or all of the project, and that I can withdraw at any stage of the project without being penalized or disadvantaged in any way.	
4.	I agree to City University London recording and processing this information about me. I understand that this information will be used only for the purpose(s) set out in this statement and my consent is conditional on the University complying with its duties and obligations under the Data Protection Act 1998.	
5.	I agree to take part in the above study.	

Name of Participant	Signature	Date
Name of Researcher	Signature	Date

When completed, 1 copy for participant; 1 copy for researcher file

Informal Information letter for Head teacher

CITY UNIVERSITY LONDON

An investigation into the relationship between oral language and reading comprehension in mainstream secondary school students

I agree to take part in the above City University London research project. I understand this will involve:

- Identifying, in collaboration with the researcher, appropriate student participants according to the inclusion criteria of the study.
- Identifying, in collaboration with the researcher, appropriate teachers to approach for recruitment to the study.
- Facilitating communication with parents during the recruitment process.
- Making available to the researcher relevant information from school records i.e. demographic information and attainment levels, subject to parental approval.

I understand that my participation is voluntary, that I can choose not to participate in part or all of the project, and that I can withdraw at any stage of the project without being disadvantaged in any way.

I understand that this study will form part of the researcher's PhD thesis, and that any reports published will not identify any individuals.

I consent to take part in the above study.

Formal information letter to Head Teacher

CITY UNIVERSITY LONDON

Dear Head teacher,

An investigation into the relationship between oral language and reading comprehension in mainstream secondary school students

As part of my professional development at The Northumberland Church of England Academy, I am a part time PhD student at City University London. I would like to invite you to take part in a research study on investigating the relationship between oral language and reading comprehension in mainstream secondary students. Before you decide whether you would like to take part it is important that you understand why the research is being done and what it would involve for you. Please take time to read the following information carefully and discuss it with others if you wish. Please ask if there is anything that is not clear or if you would like more information. This study has been approved by City University London School of Health Sciences Research Ethics Committee.

What is the purpose of the study?
Some studies with secondary aged pupils have linked low literacy skills to low academic outcomes and some studies have shown that adolescents with reading comprehension problems have underlying language difficulties. The purpose of the study is to highlight the difficulties some students encounter in their oral language and its impact on literacy, which will in turn develop teacher training and educational policy.

Why have I been invited?
I currently work as the Strategic Director of Literacy at the Northumberland Church of England. This project is designed to improve an issue around achievement in key stage three.

Do I have to take part?
Participation is voluntary. It is up to you to decide whether or not to take part. If you agree, you will be asked to sign a consent form. If you decide to take part, you are still free to drop out at any time, at any stage of the project, without giving a reason and without being disadvantaged in any way.

What will happen if I take part?
The project will run from the autumn term 2016 until the summer term 2018. It will involve all students from Y7, Y8 and Y9 in the academic year 2016-2017, and Y8 and Y9 in the following academic year. Alongside existing school assessments, two extra tests assessing listening comprehension and reading accuracy will carried out in both academic years. These tests will last 30 minutes and 15 minutes respectively. The tests will be carried out within the English break-out area.

All parents and students will be sent information about the study.

What are the possible benefits of taking part?

Your staff will gain increased understanding of the importance, and the role of language in expressing ideas, and how a language difficulty may restrict attainment and progress. In the longer term, your students will benefit from a higher awareness of how language difficulties may affect reading difficulties and impact on their GCSE scores.

What will happen when the research study stops?

Information will be stored securely for at least ten years. After this time the data will be securely destroyed.

Will my taking part in the study be kept confidential?

We will keep all information collected in confidence. Names will be changed to code numbers, and information will be kept in a locked filing cabinet and password-protected computer, with only research team members having any access to person-identifiable information. Exceptions to confidentiality include information concerning the personal safety of the student participants.

What will happen to results of the research study?

You will receive a leaflet giving a summary of the project. The results of the research study will form part of my PhD thesis. It will be presented at conferences, and published in teaching and speech and language therapy journals and magazines. Anonymity and confidentiality will be kept at all times and published reports will not mention individuals.

What do I have to do?

If you agree to take part in this project, please return the signed consent form to Mrs Morag Boyes.

If you have any questions at any time, please contact:
Mrs Morag Boyes
Division of Language and Communication Science
School of Health Sciences
City University London
Northampton Square, London EC1V 0HB
020 7040 5045
morag.boyes@city.ac.uk

You can also contact:
Professor Victoria Joffe
Associate Dean, Taught Postgraduate Studies, and International
School of Health Sciences
City University London
Northampton Square, London
EC1V 0HB
020 7040 4629
v.joffe@city.ac.uk

What if there is a problem?

If you have any problems, concerns or questions about this study, you should ask to speak to a member of the research team (see below). If you remain unhappy and wish to complain formally, you can do this through the University complaints procedure. To complain about the study, you need to phone 020 7040 3040. You can then ask to speak to the Secretary to Senate Research Ethics Committee and inform them that the name of the project is: "Vocabulary intervention in adolescents with language difficulties: How to help young people learn and remember new words".

You could also write to the Secretary at:

Anna Ramberg
Secretary to Senate Research Ethics Committee
Research Office, E214
City University London

Northampton Square
London
EC1V 0HB
Anna.Ramberg.1@city.ac.uk

City University London holds insurance policies which apply to this study. If you feel you have been harmed or injured by taking part in this study you may be eligible to claim compensation. This does not affect your legal rights to seek compensation. If you are harmed due to someone's negligence, then you may have grounds for legal action.

Thank you for taking the time to read this information sheet.

Parent/carer consent form

An investigation into the relationship between oral language skills and reading comprehension in mainstream secondary school students.

1.	I agree to take part in the above City University London research project. I have read the parent information leaflet, which I may keep. I understand this will involve my child taking part in a listening comprehension assessment and a reading accuracy assessment.
2.	I understand that the Academy may share with the researcher relevant information from my child's school records. I understand that all information provided is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party. No identifiable personal data will be published or shared with any other organisation.
3.	I understand that my participation is voluntary, that I can choose not to participate in part or all of the project, and that I can withdraw at any stage of the project without myself or my child being disadvantaged in any way.
4.	I understand that this study will form part of the researcher's PhD thesis, and that any reports published will not identify any individuals.
5.	I understand that this information will be used only for the purposes set out in this statement, and that my consent is conditional on the University complying with its duties and obligations under the Data Protection Act 1998.

If you are **not** happy for your child's assessments to be used in the research project, please return the attached proforma to their Form Tutor.

I do / do not (*Please circle)* want my child's assessments used in the research project.

Name of child: ____

Form Class: ____

Signature of parent/carer: ____

Student consent form

An investigation into the relationship between oral language skills and reading comprehension in mainstream secondary school students

1.	I agree to take part in the above City University London research project. I have read the student information sheet, which I may keep. I understand this will involve an extra listening comprehension assessment and a reading accuracy assessment.	
2.	I understand that any information I provide is confidential and that no information that says who I am will be shared in any reports on the project, or with anyone outside the project team.	
3.	I understand that I can choose whether or not to take part in the project, and that I can drop out at any stage without getting into any trouble.	
4.	I understand that the researcher will write up the project, and that any reports published will not say who I am.	
5.	I agree to City University London recording and processing this information about me. I understand that this information will be used only for the purposes set out in this statement, and that the University must also carry out its duties under the Data Protection Act 1998.	
6.	If I have any questions I can ask Mrs Boyes, or my Form Tutor or my Head of Year	

Please print your name: ____

Form Class: _______________

Signature: ____

Please return this form to Mrs Boyes

Before any research is allowed to happen it has to be checked out by a group of people called a Research Ethics Committee. They make sure the research is fair. This study has been checked and accepted by City, University of London's Language and Communication Science Proportionate Review Research Ethics Committee

If you have any questions, please get in touch with me:

Morag Boyes
Josephine Butler Campus
The Northumberland Church of England Campus
Academy Way
Ashington
NE63 9FZ
01670 816 111
E-mail: morag.boyes@ncea.org.uk

You can also contact:

Professor Victoria Joffe
Associate Dean, Taught Postgraduate Studies, and International
School of Health Sciences
City University London
Northampton Square, London, EC1V 0HB
020 7040 4629
v.joffe@city.ac.uk

CITY
UNIVERSITY OF LONDON
EST 1894

An investigation into the relationship between oral language skills and reading comprehension in mainstream secondary school students

Information leaflet for Parents

What is Research?
Research is the way we find out answers to questions. I am asking if you will help me with a piece of research.

Who am I?
I belong to the Academy and I am studying at City University London. I am interested in the development of young people's communication and reading

Do you have to say yes?
It is completely up to you to decide whether to say yes or no to helping with my research. There is a form attached, which you can sign if you do not want your child to take part - or you can text their form tutor to say no. If you decide to take part, your child can still drop out at any point.

What is the project about?
Some young people find it difficult to understand what they are reading. This affects their performance in exams. Looking at all this information will help me to support teachers and other schools, to understand how important language is to reading.

Why has my child been invited?
All students in Years 7, 8 & 9 have been invited to take part. The Academy has agreed to take part in the project.

What will happen if my child takes part?
Your child will still take part in the Academy's assessments but there will be two extra assessments. The first will last 30 minutes and involve listening to a paragraph and answering some questions. The second will last 10 minutes and involve reading a paragraph out loud.

What are the possible benefits of taking part?
Your child will have their results given to them, and you will get a copy at Parents night. This will help them with their progress at the Academy.

What happens afterwards?
I will study the results from all the school data I have collected to help me answer my questions. I will not use any of your names when I do this. All the information will be securely destroyed after a period of 10 years

I will send you a newsletter telling you what I have found out. I will not use your name in this.

Student Information leaflet

Before any research is allowed to happen it has to be checked out by a group of people called a Research Ethics Committee. They make sure the research is fair. This study has been checked and accepted by the School of Community & Health Sciences Research Ethics Committee at City University, London.

How to get in touch with me

Mrs Boyes at:

[redacted]

[redacted] morag.boyes@ncea.org.uk

You can also contact:

Professor Victoria Joffe

Information for KS3 Students

An investigation

into the relationship

between oral language skills

and reading comprehension

in mainstream secondary school students

	Associate Dean, Taught Postgraduate Studies, and International School of Health Sciences City University London Northampton Square, London, EC1V 0HB 020 7040 4629 v.joffe@city.ac.uk	

Back page

Inside page

What is Research?	What will happen if you do say yes?	What happens afterwards?
Research is the way we find out answers to questions. I am asking if you will help me with a piece of research. **Who am I?** I belong to the Academy and am also studying at City University London. I am interested in the development of young people's language and reading. **Do you have to say yes?** It is completely up to you and your family to decide whether to say yes or no to helping with my research.	I will see you at school, during your English lessons. I will ask you to listen to a short paragraph and answer some questions. I will also ask you to read a short passage aloud. I will use some information the school has, such as the results of your digital reading tests. **How long will it take?** I will see you once in the academic year for both assessments. One will last for about 30 mins and one for 10 mins. You can also stop the session and you can tell me if you don't want to take part at any time.	I will study the results from all the school data I have collected to help me answer my questions. I will not use any of your names when I do this. I will send your family a newsletter telling you what I have found out. Again, I will not use your name in this.

Appendix 4D

Conversion table from pre-2016 levels thresholds to scaled score

<table>
<tr><th>Old Grade</th><th>KS3</th><th colspan="2">New Grade</th><th>KS2 Scale Score</th></tr>
<tr><td>A*+</td><td></td><td colspan="2">9</td><td></td></tr>
<tr><td rowspan="2">A*</td><td rowspan="2"></td><td colspan="2">9-</td><td rowspan="2"></td></tr>
<tr><td colspan="2">8+</td></tr>
<tr><td rowspan="2">A*-</td><td rowspan="6"></td><td colspan="2">8</td><td rowspan="2"></td></tr>
<tr><td colspan="2">8-</td></tr>
<tr><td rowspan="2">A</td><td colspan="2">7+</td><td rowspan="2"></td></tr>
<tr><td colspan="2">7</td></tr>
<tr><td rowspan="2">A-</td><td colspan="2">7-</td><td rowspan="2"></td></tr>
<tr><td colspan="2">6+</td></tr>
<tr><td rowspan="2">B+</td><td rowspan="2">8a</td><td colspan="2">6</td><td rowspan="2"></td></tr>
<tr><td colspan="2">6-</td></tr>
<tr><td>B</td><td>8b</td><td colspan="2">5+</td><td></td></tr>
<tr><td>B-</td><td>8c</td><td colspan="2">5</td><td></td></tr>
<tr><td>C+</td><td>7a</td><td colspan="2">5-</td><td></td></tr>
<tr><td rowspan="2">C</td><td rowspan="2">7b</td><td colspan="2">4+</td><td rowspan="2"></td></tr>
<tr><td colspan="2">4</td></tr>
<tr><td>C-</td><td>7c</td><td colspan="2">4-</td><td></td></tr>
<tr><td>D+</td><td>6a</td><td colspan="2">3+</td><td></td></tr>
<tr><td>D</td><td>6b</td><td colspan="2">3</td><td>120</td></tr>
<tr><td>D-</td><td>6c</td><td colspan="2">3-</td><td>116</td></tr>
<tr><td>E+</td><td>5a</td><td colspan="2">2+</td><td>113</td></tr>
<tr><td>E</td><td>5b</td><td colspan="2">2</td><td>110</td></tr>
<tr><td>E-</td><td>5c</td><td colspan="2">2-</td><td>106</td></tr>
<tr><td>F+</td><td>4a</td><td>1.5+</td><td rowspan="2">1+</td><td>103</td></tr>
<tr><td>F</td><td>4b</td><td>1.4+</td><td>100</td></tr>
<tr><td>F-</td><td>4c</td><td>1.3</td><td rowspan="2">1</td><td>96</td></tr>
<tr><td>G+</td><td>3a</td><td>1.2</td><td>93</td></tr>
<tr><td>G</td><td>3b</td><td>1.1-</td><td>1-</td><td>90</td></tr>
</table>

Appendix 4E Table of Measures used in the current study

Measure	Description	Scoring
Income deprivation affecting children index (IDACI) (Department for Community and Local Government, 2015)	The IDACI measures the proportion of all children aged 0 to 15 living in income deprived families. It is a subset of the income deprivation domain which measures the proportion of the population in an area experiencing deprivation relating to low income	Between 0 and 1. For example, a score of 0.38 means that 38% of families are income deprived and have children under the age of 16.
Key Stage Two Reading Standard Assessment Test (SAT)	A timed test of reading comprehension sat by all children in mainstream education, England at the end of primary education. The test contains three passages, two fiction and one non-fiction. Children have 60 minutes to complete it.	Scaled score between 80 and 120. Students with a scaled score of 100 have met the expected standard in the test.
Teacher Assessment (TA)	Teacher assessments based on students' understanding of the KS3 subject content, The national curriculum in England Framework document, 2016 (DFE).	Raw scores from 0-20. TA of 5 = KS2 scaled score of 100 – 103 TA of 7 expected by end of Y7 TA of 9 by the end of Y8 TA of 11 by the end of Y9 TA of 13 = GCSE Band 4 TA of 16 = GCSE Band 5
General Certificate of Secondary Education (GCSE)	An academic qualification taken by students at the end of compulsory education in in England, Wales, and Northern Ireland.	Scaled score between 9 to 1, with 9 being the highest grade.
Cognitive Assessment Tests, Fourth Edition (CAT4) (Smith et al., 2003)	CAT4 comprises of 4 assessments, each of which contains 2 subtests: 1.**Verbal Reasoning**: Verbal Classification & Verbal Analogies 2.**Quantitative Reasoning**: Number Analogies & Number Series 3.**Non-verbal Reasoning**: Figure Classification & Figure Matrices 4.**Spatial Ability**: Figure Analysis & Figure Recognition	Scaled score between 70 and 130 The overall test, and subtests have a mean of 100 and a standard deviation of 15.
Cognitive verbal reasoning subtest (CAT4-V)	Assesses reasoning ability with words representing objects or concepts. The test needs to be read in order to access the questions.	
Cognitive non-verbal reasoning subtest (CAT4 -NV)	Assesses the ability to think and reason with non-verbal material. The test uses shapes to reason with shapes and design and needs to be read in order to access the questions.	

Measure	Description	Scoring
New Group Reading Test (NGRT) (Burge et al., 2014)	Measures reading comprehension. Untimed, adaptive test, containing two sections: sentence completion and passage comprehension.	Scaled score between 60 to 140. The test has a mean of 100 and a standard deviation of 15
Sight Word Efficiency subtest, Test of Word Reading Efficiency (TOWRE2) (Torgesen et al., 2012)	Measures the ability to read real words out of context. The student has 45 seconds to accurately read a number of real words.	Scaled score between 55 and 141 The subtest has a mean of 100 and a standard deviation of 15
Recalling sentences subtest (CELF4-RS) (Clinical Evaluation of Language Fundamentals,Recalling Sentences) (Semel et al., 2006)	Measures the ability to recall and reproduce sentence structures of varying length and complexity. The student imitates sentences spoken by the examiner.	Scaled score between 1 and 19 The subtest has a mean of 10 and a standard deviation of 3.
Understanding spoken paragraphs subtest (CELF4-USP) (Clinical Evaluation of Language Fundamentals, Understanding Spoken Paragraphs) (Semel et al., 2006)	Measures the ability to understand information presented in spoken paragraphs. The student answers questions about a paragraph presented orally. The questions probe the student’s understanding of the paragraph’s main idea, detail and sequence of events, and the student’s ability to make inferences and predictions from the information presented.	Scaled score between 1 and 19 The subtest has a mean of 10 and a standard deviation of 3.

Appendix 5A Teacher Assessment data

In 2016, a new set of measures were introduced for all state funded secondary schools in England. These included a change in the GCSE scoring system and introduction of 'Progress 8' and 'Attainment 8' measures. The change in scoring between the new numerical scale (9 - 1) of the reformed GCSEs and the previous alphabetic grading (A* - G) system of the unreformed GCSEs reflects the new GCSE content. Progress 8 aims to show the progress that students in a state funded school in England make from the end of primary school to the end of KS4. Students' results are compared to other pupils nationally with similar prior attainment. Attainment 8 measures students' attainment across 8 qualifications including: Mathematics, English, Science subjects, Computer Science, History, Geography, Languages or DFE approved technical and vocational qualifications.

In 2017, pupils sat reformed GCSEs in English language, English literature and mathematics for the first time, graded on a 9-1 scale. Table 5A.1 shows the comparison of the new reformed to GCSEs from the previous unreformed GCSEs, previous KS3 national curriculum levels and teacher assessment (DFE, 2017). In order to support each student achieve their eight qualifications, the school in the study set individual attainment targets against the expected learning progression of each student (see the pink shaded cells in Table 5A.1 indicating the students who were making the 'expected level of progress').

Reflecting the change to curriculum content and reformed GCSEs, the school measures student progress from Y7 to Y11 using the new numerical GCSE scale. The Y7, Y8 and Y9 summative assessments, taken at the end of every half term under examination conditions, are designed to support students' achievement towards KS4 outcomes and identify the next sequence of teaching and learning within the curriculum. As teachers tend to mark their own students' test outcomes, inaccurate or inconsistent judgements on a 'standard' represented by a scale can lead to skewed understanding on national norms. These KS3 assessments based on a numerical scale were converted by the researcher to an SPSS scale to capture the sub-levels of progress (Table 5A.)

Table 5A.1 Comparison of reformed GCSE, unreformed GCSE, National Curriculum levels, Teacher Assessment, SPSS Conversion and expected student progression from end of primary to end of compulsory education (DFE, 2017)

2017 New reformed GCSEs					1				2				3				4		5		6		7		8		9	
Pre-2016 Unreformed GCSEs					G				F		E			D			C				B		A				A*	
Pre 2016 KS3 National Curriculum levels		Level 2			Level 3				Level 4		Level		5	Level 6			Level		7	Level 8			Level 9					
		2c	2b	2a	3c	3b	3a	4c	4b	4a	5c	5b	5a	6c	6b	6a	7c	7b	7a	8c	8b	8a						
KS3 Teacher assessment scores									1+	1+	2-	2	2+	3-	3	3+	4-	4	5-	5	5+	6-						
Conversion into SPSS									5	5	6	7	8	9	10	11												
Y6	10 -11								*																			
Y7	11-12											*																
Y8	12-13													*														
Y9	13-14															*												
Y10	14 -15																	*										
Y11	15- 16																			*								
Leaving School	16+																			*	*	*						

Key: Y6 = end of Primary education; Y7, Y8, Y9 = KS3; Y10 & Y11 = KS4; * - progress of average student leaving primary education with a scaled scored of 100/4b and gaining a level 5/6 pass at GCSE level. The pink shaded cells indicate students who are making the ‘expected level of progress’ towards a level 5 GCSE pass.

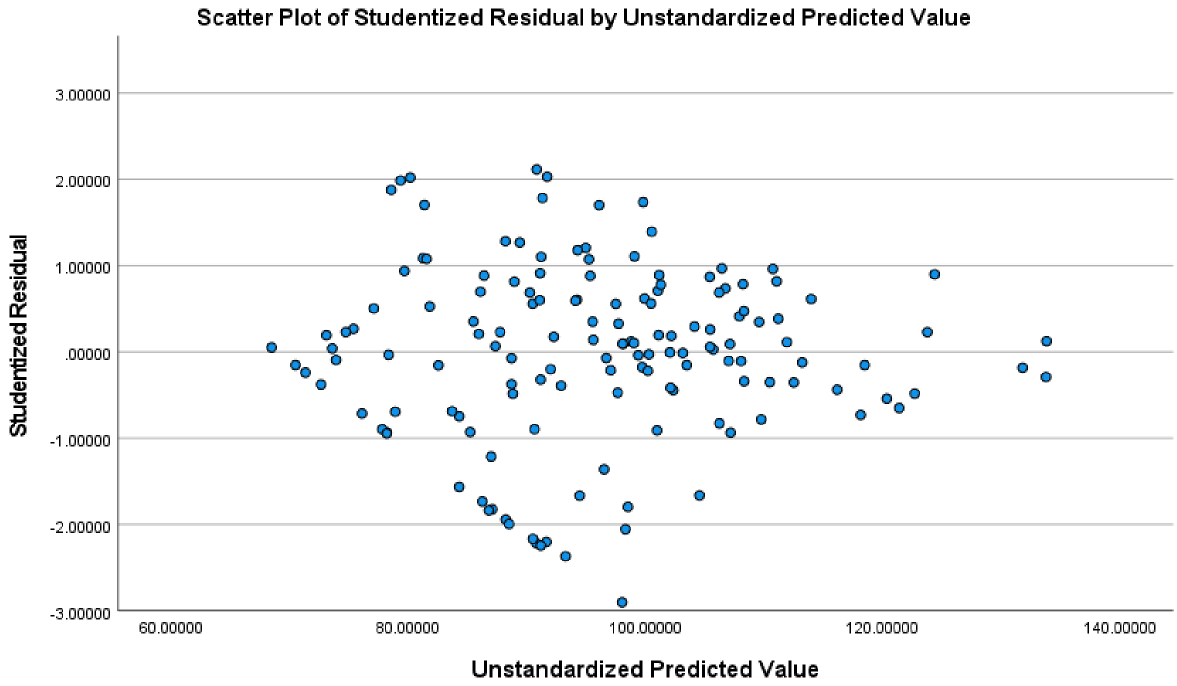
Appendix 5B Cross-sectional descriptive statistics for average academic scores based on teacher assessment on each of six measurement occasions for the three cohorts in the school year-group, Seven, Eight and Nine

Academic assessment (academic year & term) (cohort)	**No in sample**	**95% Confidence Interval for Mean**		**Mean academic score based on TA**	**Std. Deviation**
		Minimum	**Maximum**		
English					
English assessment: academic year Seven, autumn term (Y7, Y8-1, Y9-2)	403	0.00	11.00	4.89	1.71
English assessment; academic year Seven, summer term (Y7, Y8-1, Y9-2)	393	0.00	13.00	6.23	2.19
English assessment: academic year Eight, autumn term (Y7+1, Y8, Y9-1)	405	0.00	13.00	6.78	2.30
English assessment: academic year Eight, summer term (Y7+1, Y8, Y9-1)	399	0.00	15.00	8.18	2.49
English assessment: academic year Nine, autumn term (Y8+1, Y9)	264	3.00	15.00	8.62	2.41
English assessment: academic Year Nine, summer term (Y8+1, Y9)	262	1.00	18.00	9.99	3.05
Mathematics					
Maths assessment: academic year Seven, autumn term (Y7, Y8-1, Y9-2)	404	1.00	10.00	5.28	1.51
Maths assessment: academic year Seven, summer term (Y7, Y8-1, Y9-2)	388	2.00	12.00	6.49	2.03
Maths assessment: academic year Eight autumn term (Y7+1, Y8, Y9-1)	405	.00	14.00	7.07	2.41
Maths assessment: academic year Eight, summer term (Y7+1, Y8, Y9-1)	398	.00	16.00	8.20	2.80

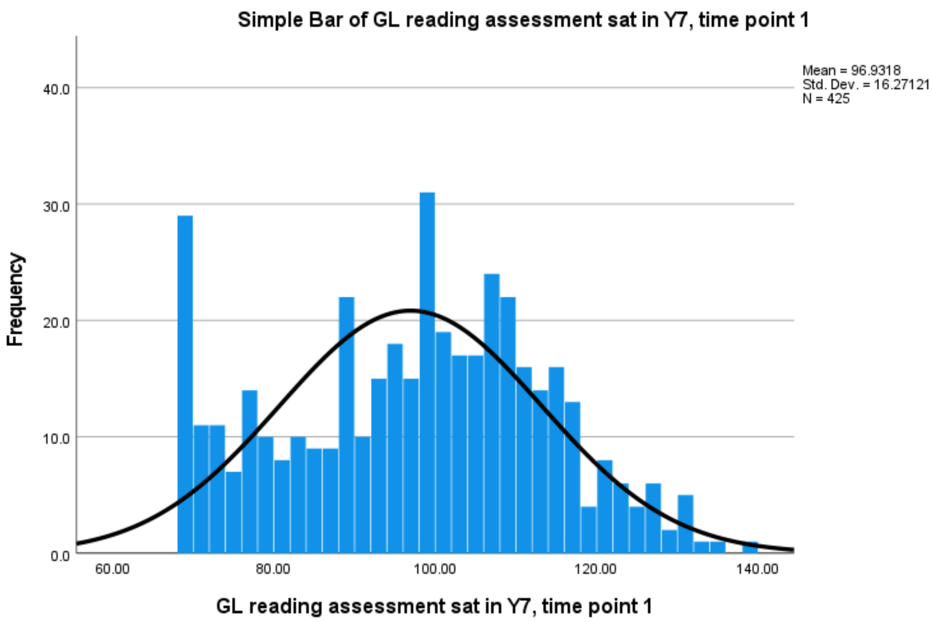
Maths assessment: academic year Nine, autumn term (Y8+1, Y9)	265	3.00	18.00	9.22	3.09
Maths assessment: academic year Nine, summer term (Y8+1, Y9)	263	.00	19.00	10.23	3.54
Science					
Science assessment: academic year Seven, autumn term (Y7, Y8-1, Y9-2)	404	1.00	11.00	5.19	1.42
Science assessment: academic year Seven, summer term (Y7, Y8-1, Y9-2)	389	.00	55.00	6.58	3.04
Science assessment: academic year Eight, autumn term (Y7+1, Y8, Y9-1)	405	.00	19.00	7.35	2.85
Science assessment: academic year Eight, summer term (Y7+1, Y8, Y9-1)	396	.00	19.00	9.07	3.24
Science assessment: academic year Nine, autumn term (Y8+1, Y9)	264	1.00	18.00	9.40	3.33
Science assessment: academic year Nine, summer term (Y8+1, Y9)	259	3.00	23.00	10.98	3.76
Note: school predictor performance scores to enable students to reach GCSE Pass (equivalent score 16) School year-group Seven: end of autumn term = 5; end of summer term = 6 School year-group Eight: end of autumn term = 8; end of summer term = 9 School year-group Nine: end of autumn term = 9; end of summer term = 11					

6A RQ3: Explanation of non- homoscedasticity

A) Year seven showing heteroscedasticity



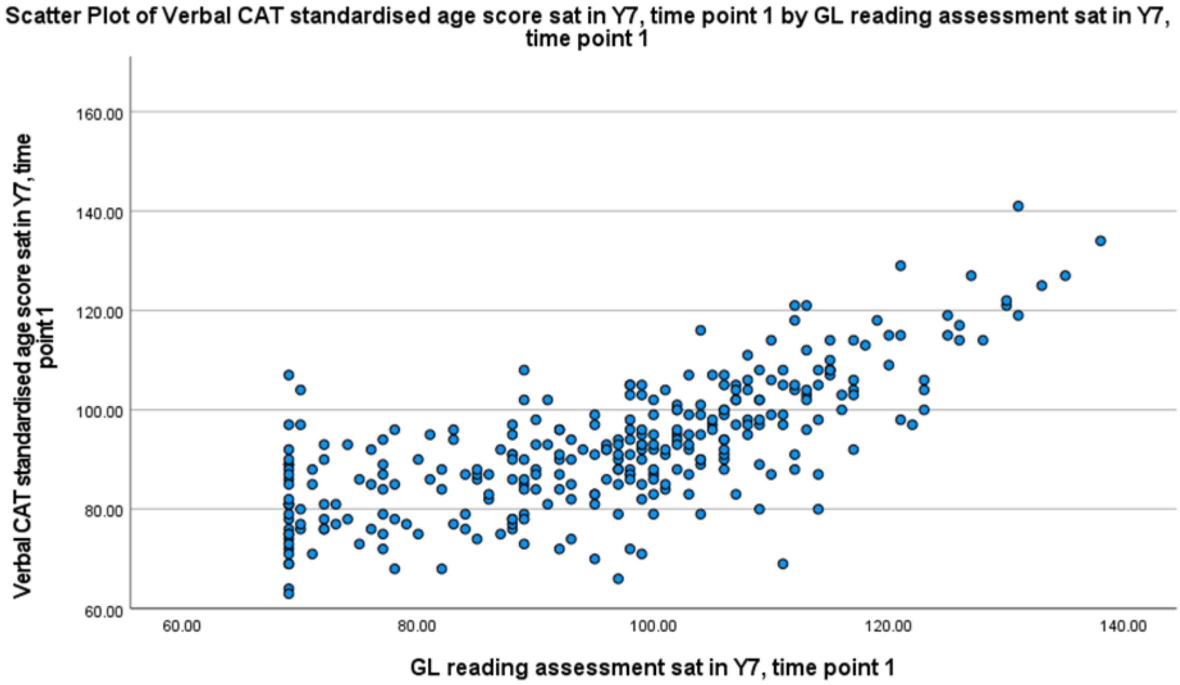
1) Histogram showing discrepant distribution in Y7 reading as measured by NGRT

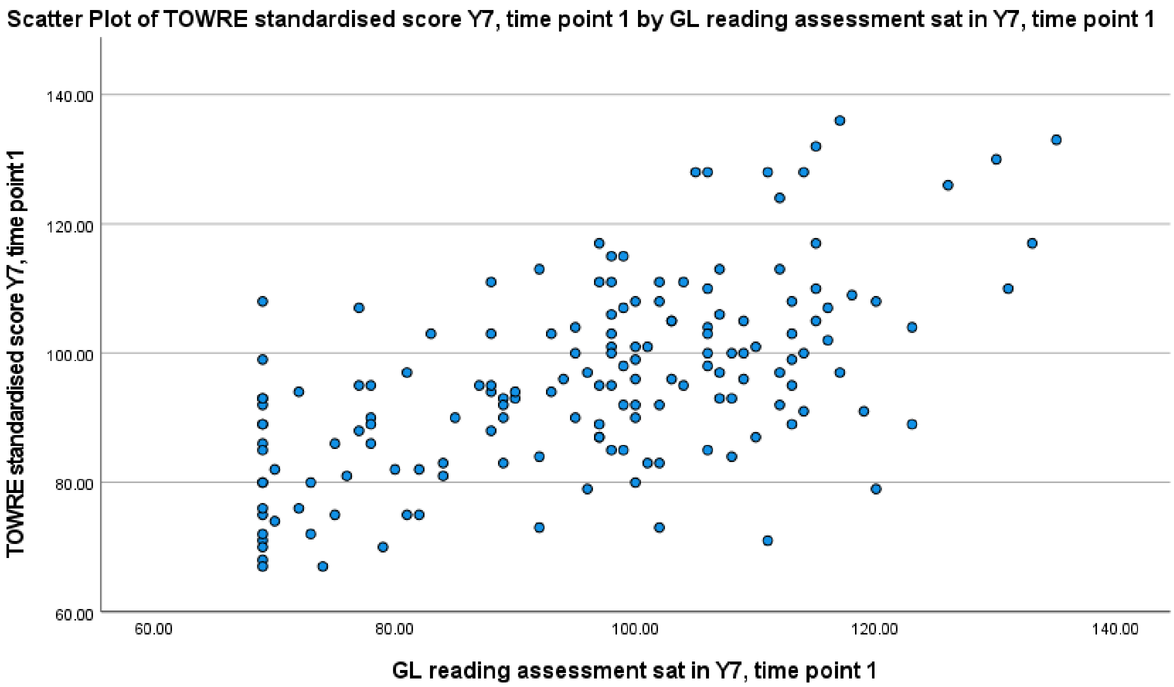


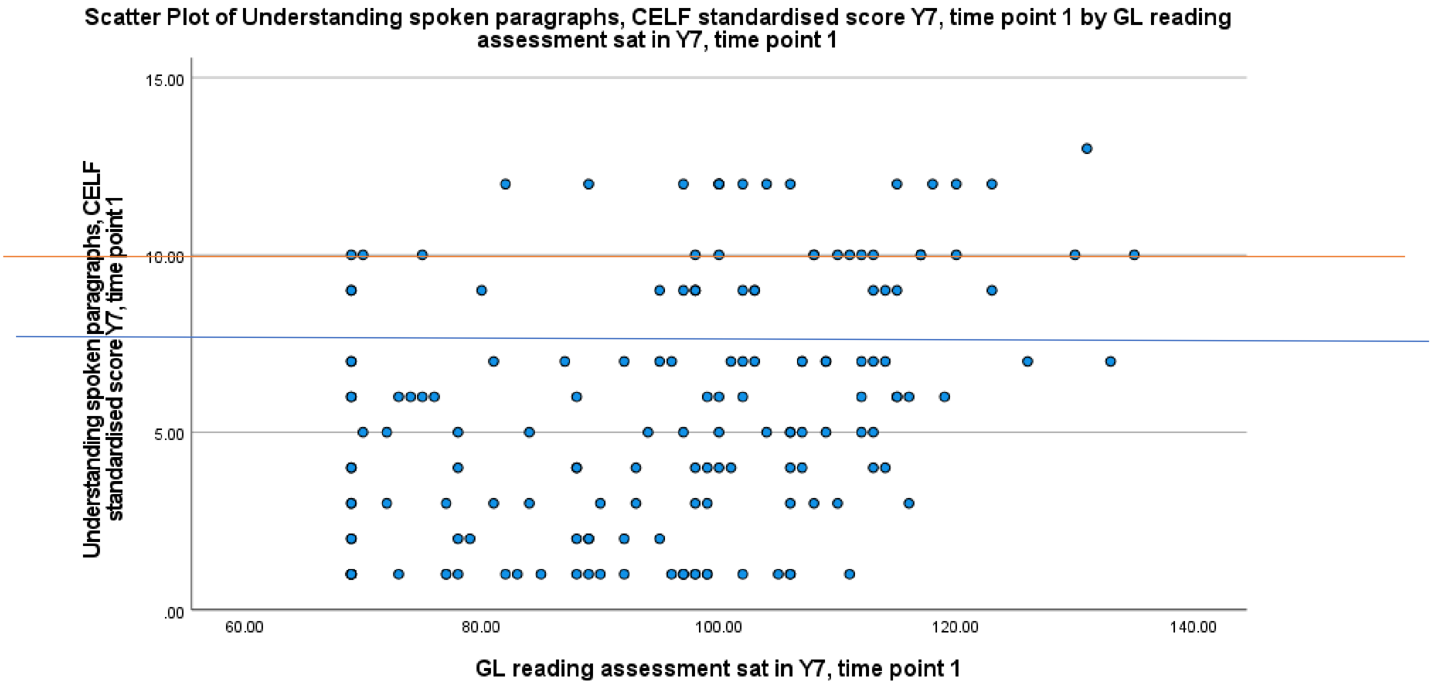
2) SPSS GRAPH to check the bivariate scatter plots. Asymmetry of distribution is apparent from the slight pile up of scores at the low end of the variable. Both NGRT

with CAT-V and NGRT with TOWRE2 show a pileup of scores at the low values of NGRT. **OR** Heteroscedasticity is evident in the greater variability in NGRT scores for low rather than high values of USP (mean 10, SD 3)

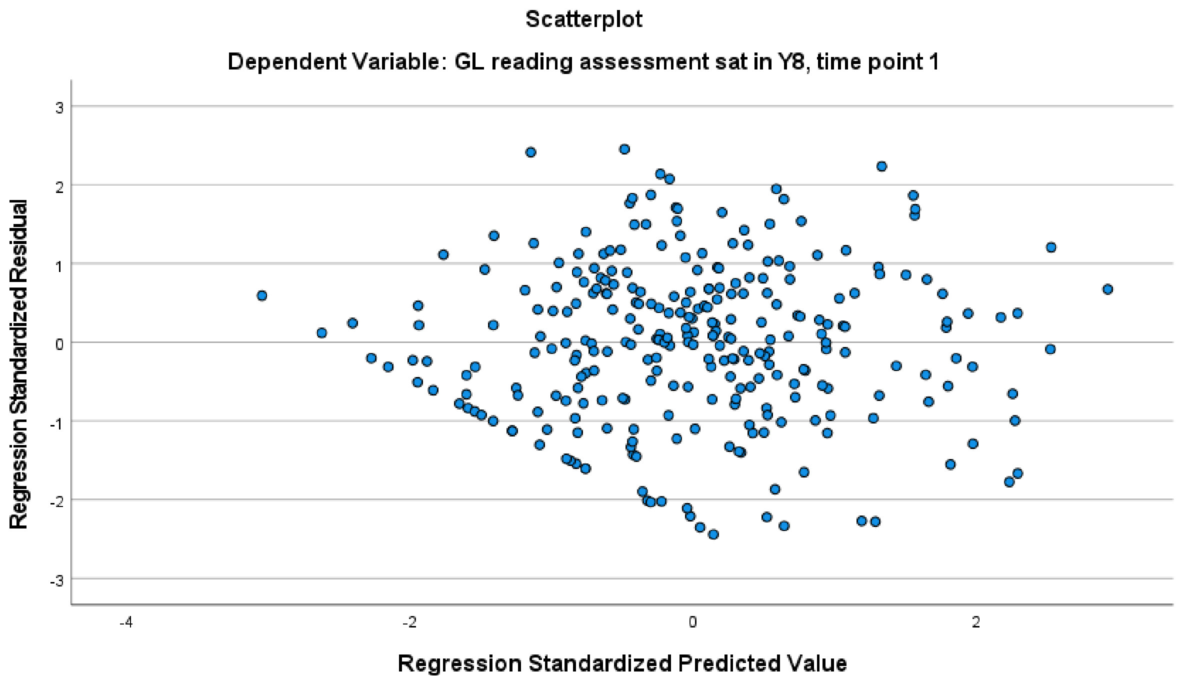
3)



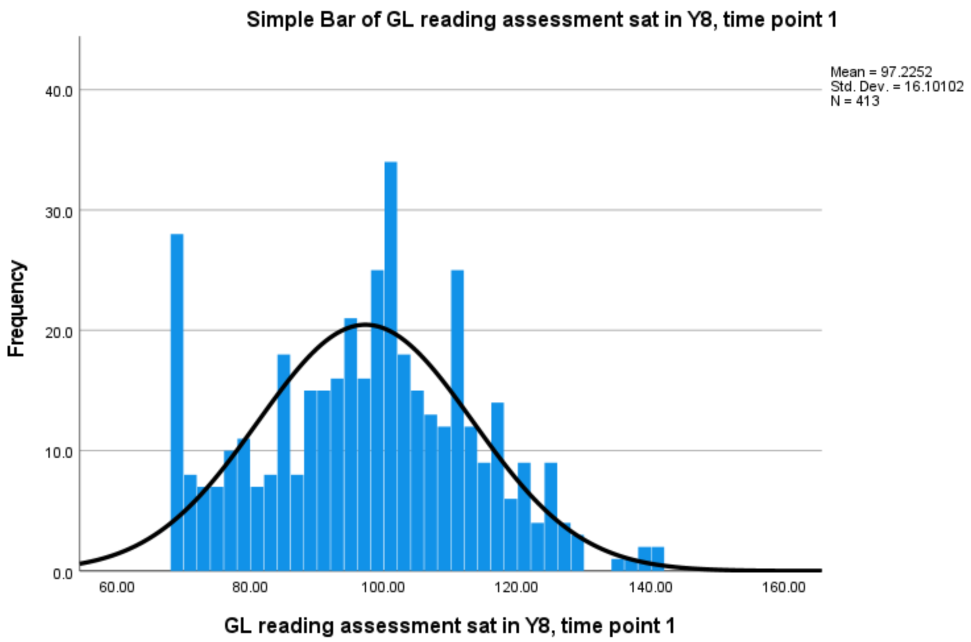


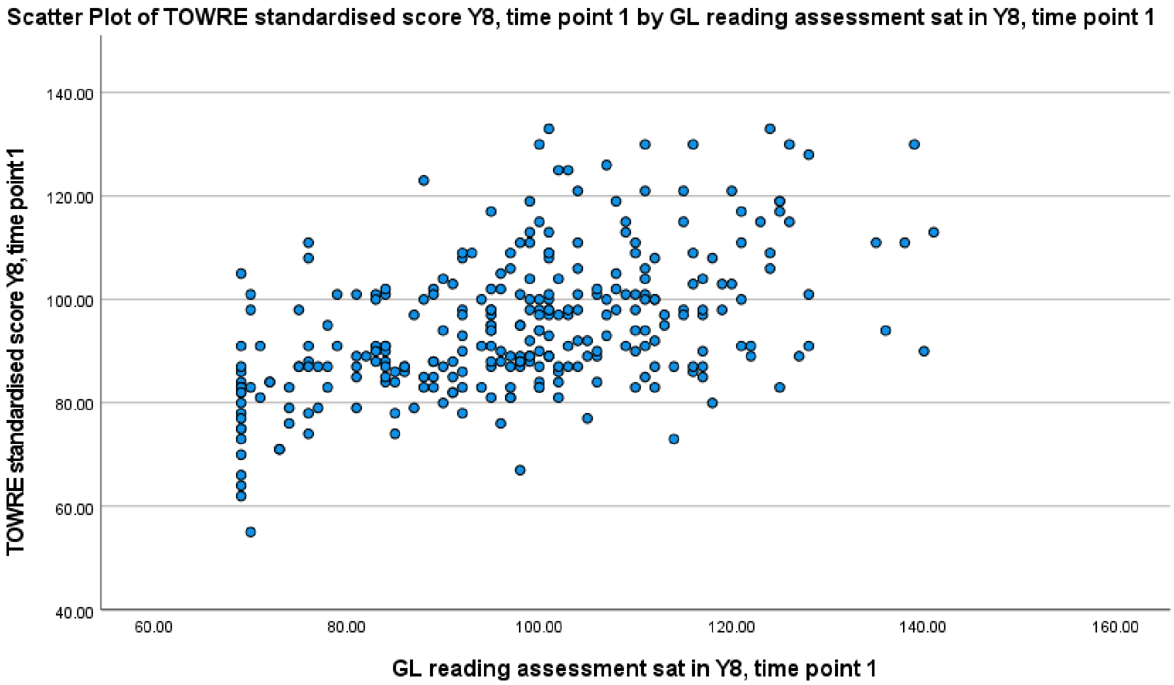


B) Year eight showing heteroscedasticity

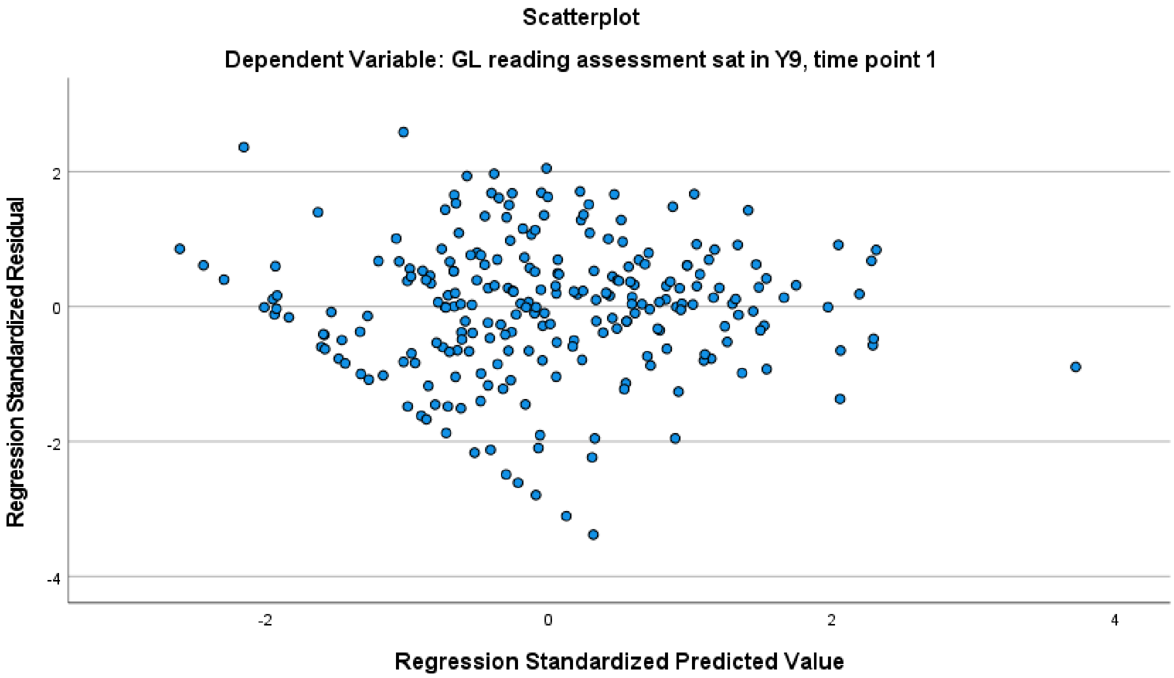


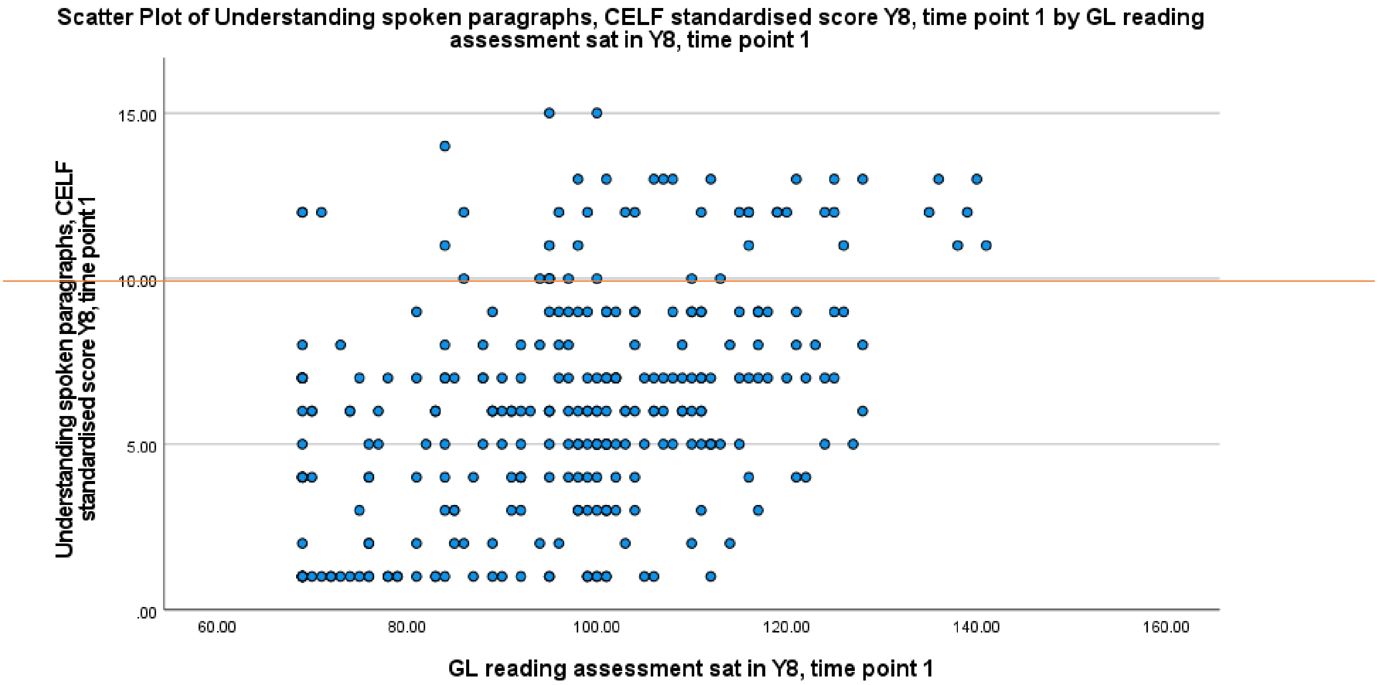
Histogram showing discrepant distribution in Y8 reading as measured by NGRT



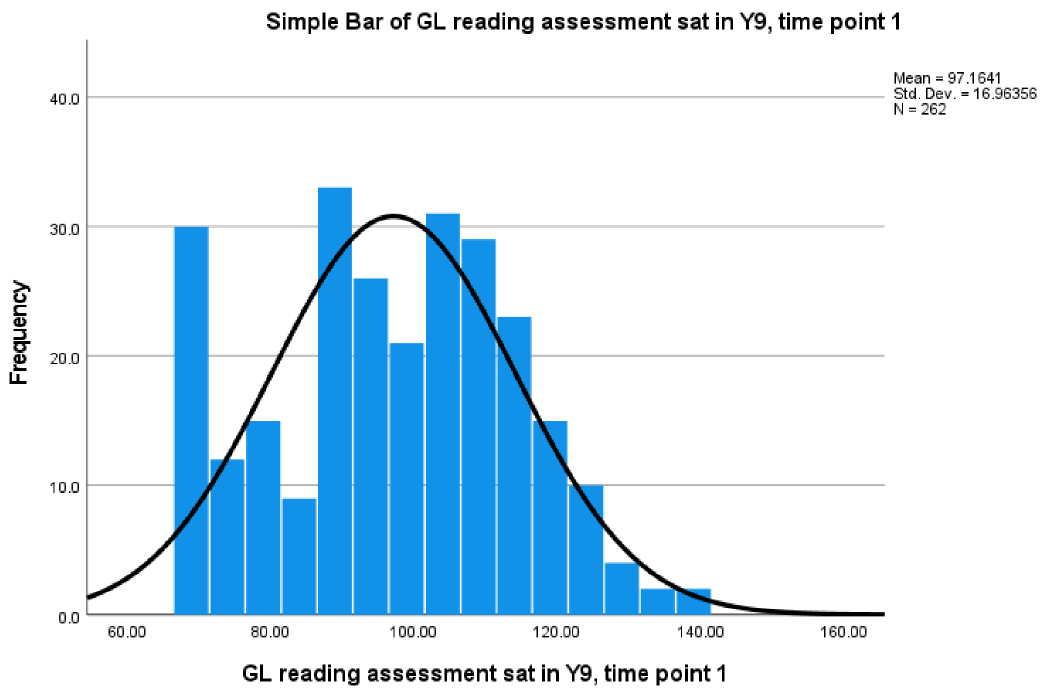


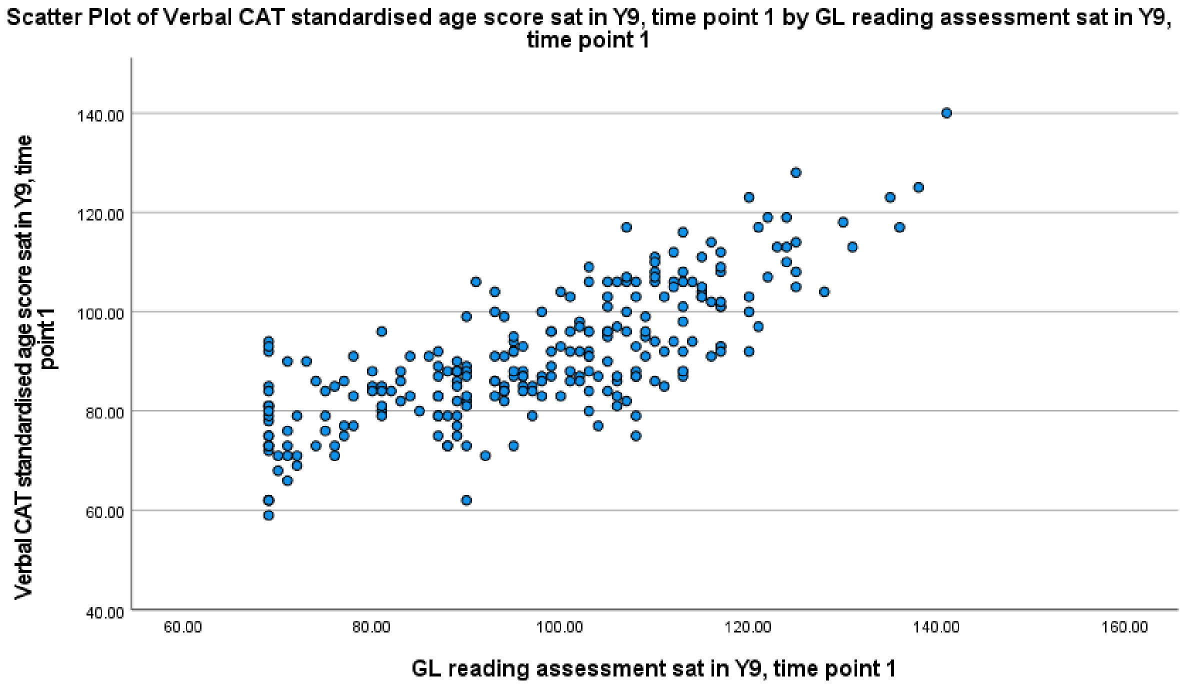
C) Year nine showing heteroscedasticity

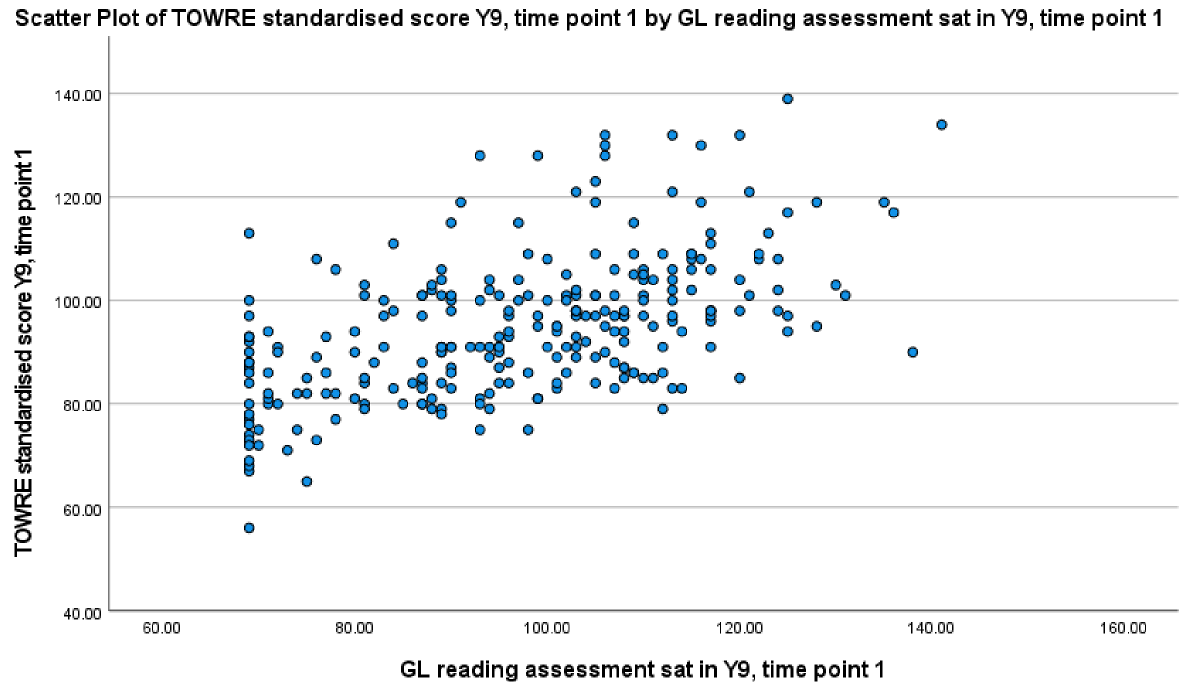




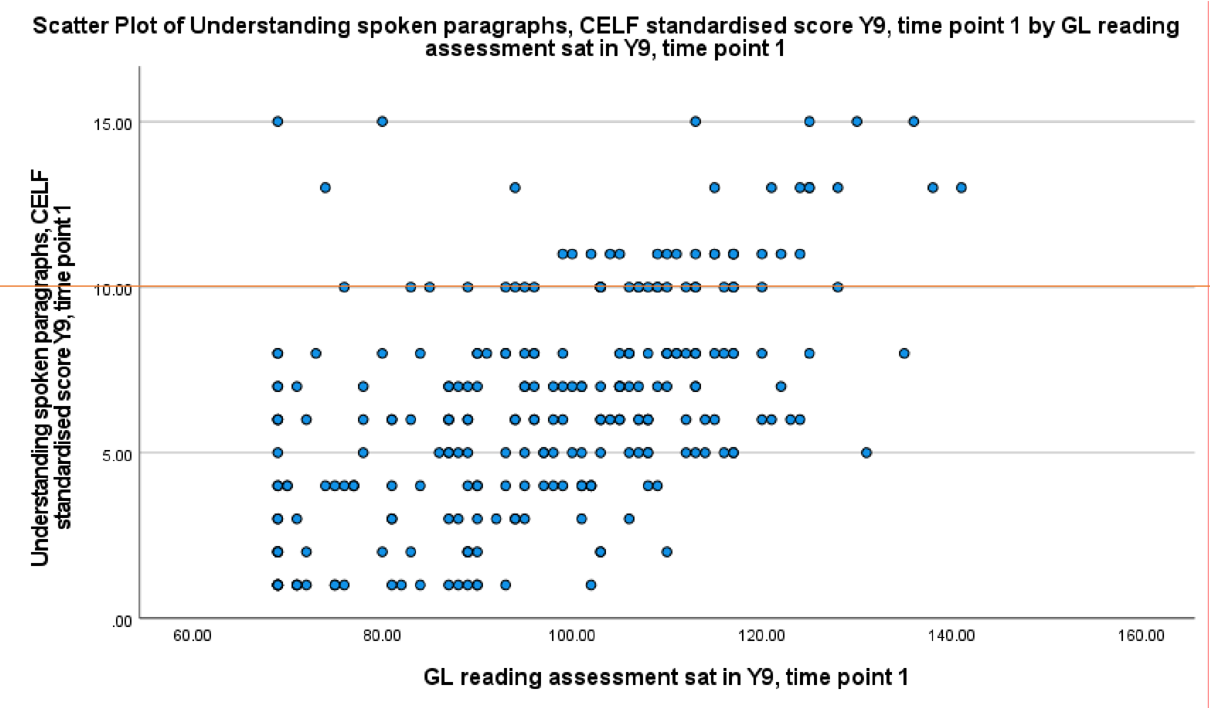
Histogram showing discrepant distribution in Y9 reading as measured by NGRT







USP (mean of 10 SD3) Greater variability in the NGRT scores for low than high values of USP


Scatter Plot of Understanding spoken paragraphs, CELF standardised score Y9, time point 1 by GL reading assessment sat in Y9, time point 1
Understanding spoken paragraphs, CELF standardised score Y9, time point 1
15.00
10.00
5.00
.00
60.00
80.00
100.00
120.00
140.00
160.00
GL reading assessment sat in Y9, time point 1

Appendix 6B Tests of Assumption

A) RQ3, Y7

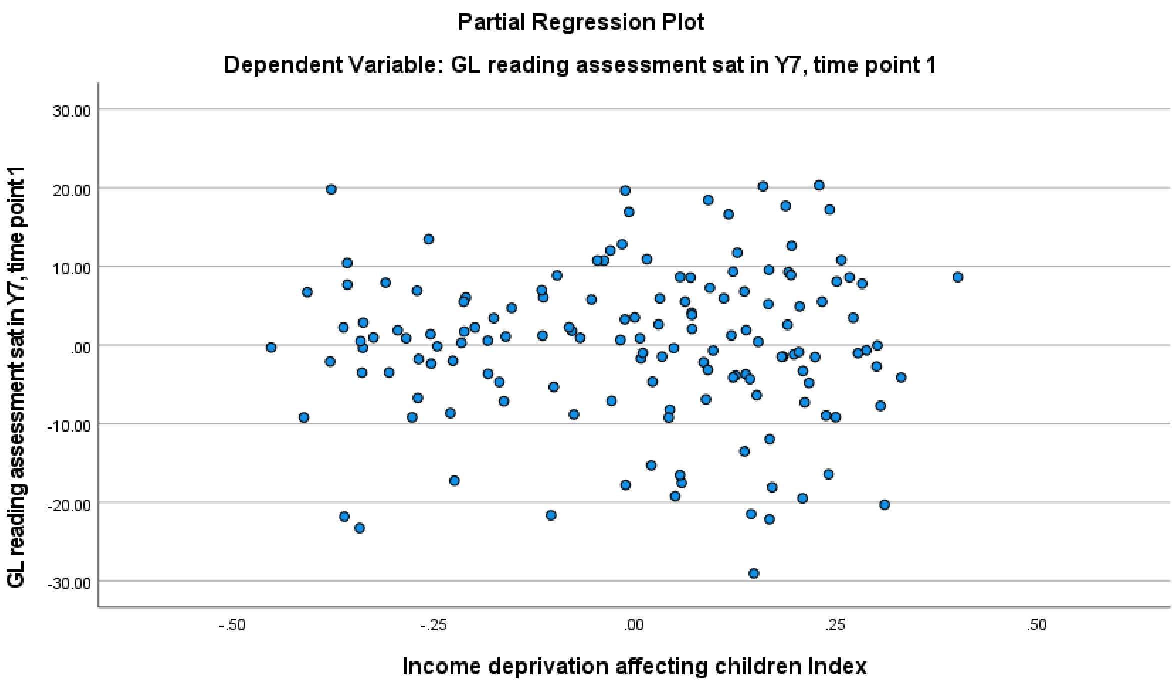
1. Independence of observations

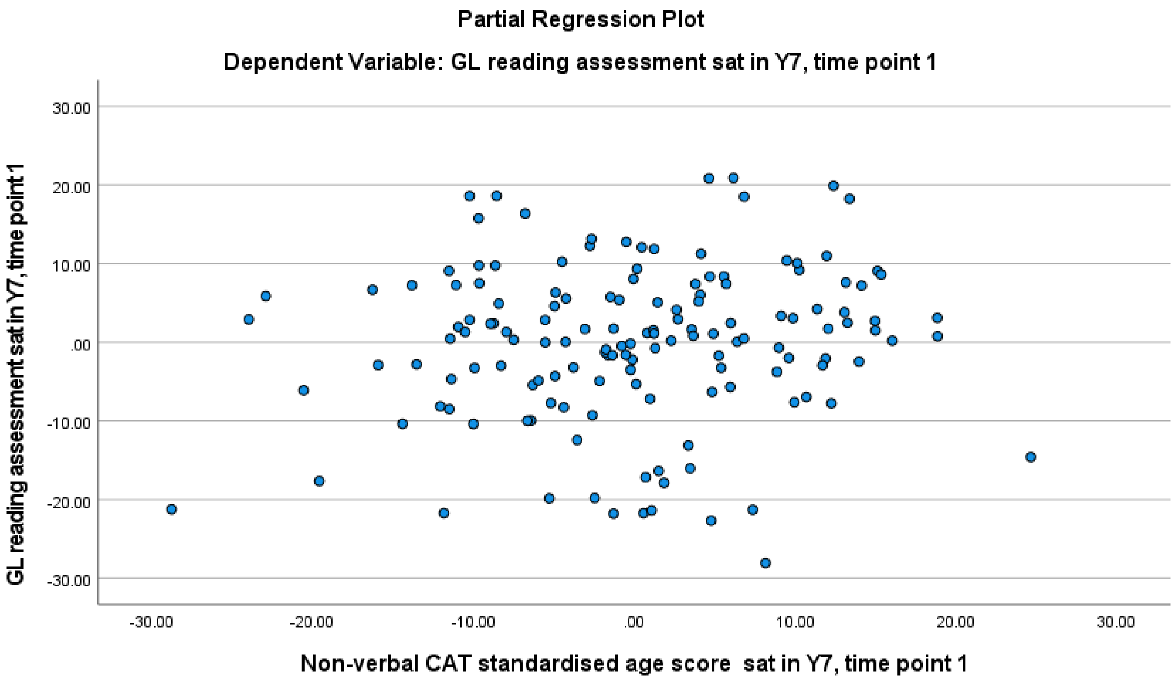
There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.552.

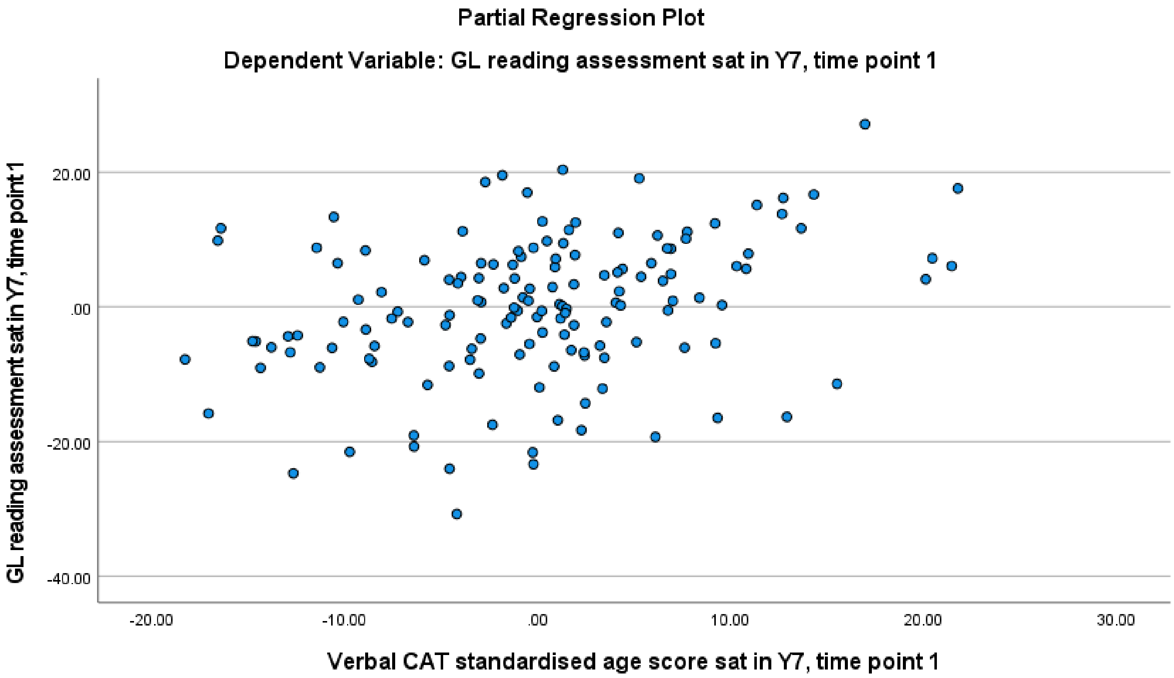
Model Summary					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.803a	.644	.629	10.08130	1.552
a. Predictors: (Constant), Understanding spoken paragraphs, CELF4 standardised score Y7, time point 1, Income deprivation affecting children Index, TOWRE2 standardised score Y7, time point 1, Non-verbal CAT standardised age score sat in Y7, time point 1, Recalling sentences, CELF4 standardised score Y7, time point 1, Verbal CAT standardised age score sat in Y7, time point 1					
b. Dependent Variable: GL reading assessment sat in Y7, time point 1					

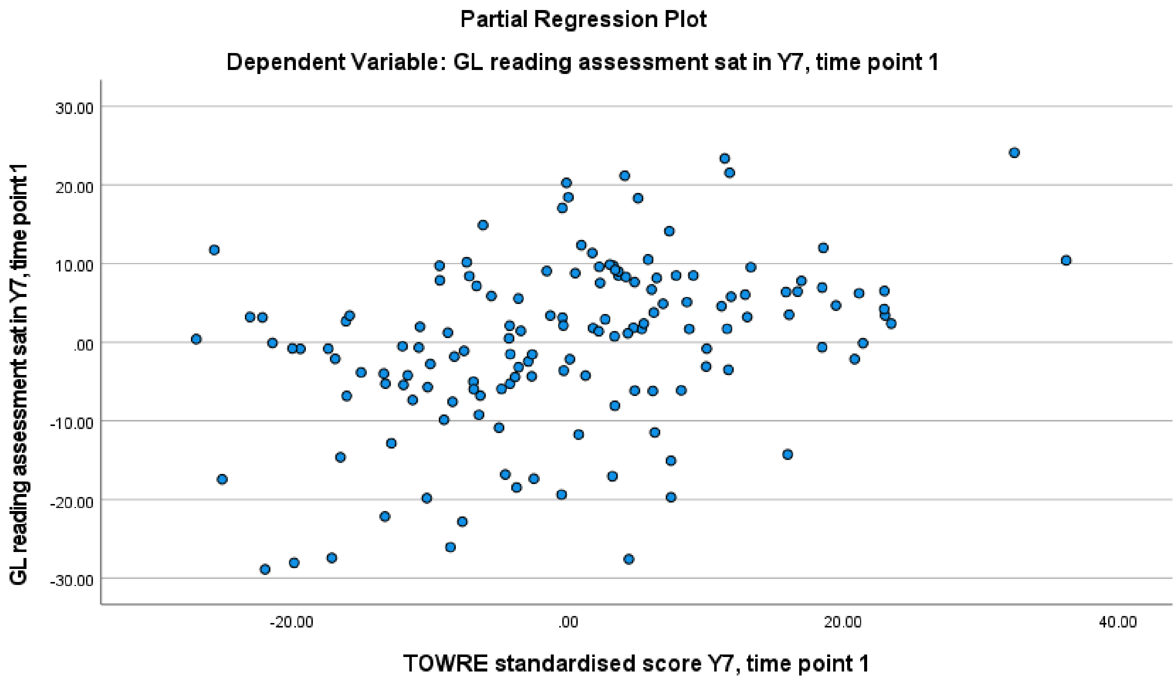
2. Testing for linearity

The residuals form a horizontal band, as shown in the scatterplots below, therefore the relationship between the dependent variable and independent variables is likely to be linear.

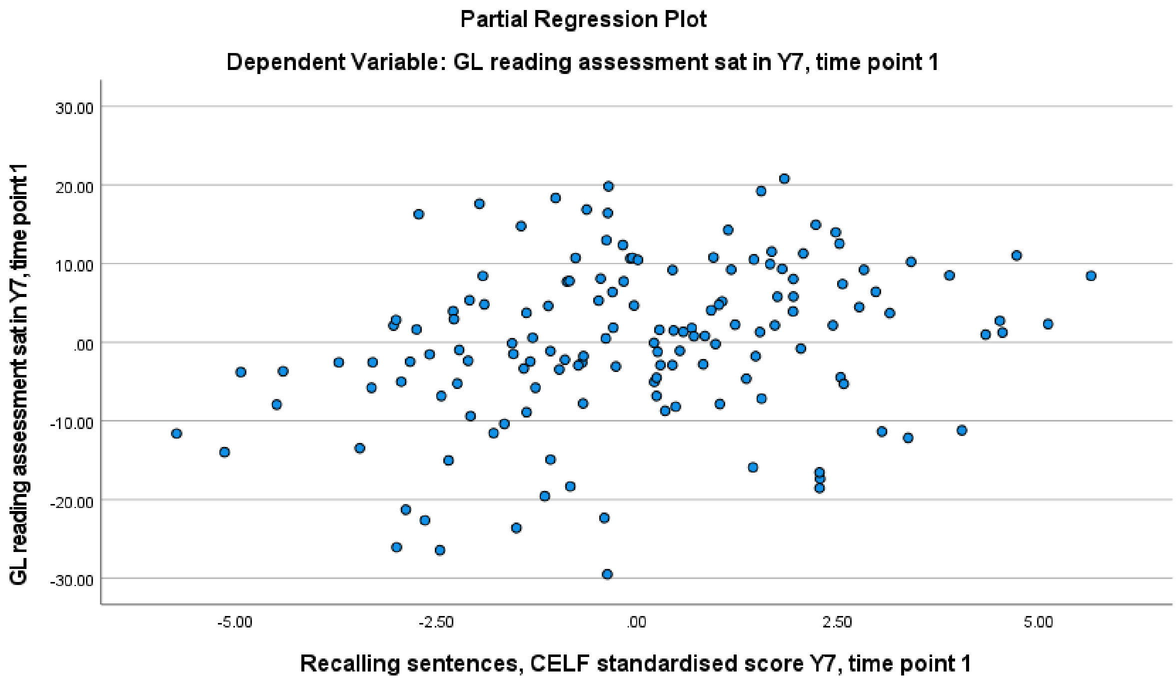



Partial Regression Plot
Dependent Variable: GL reading assessment sat in Y7, time point 1
30.00
20.00
10.00
.00
-10.00
-20.00
-30.00
GL reading assessment sat in Y7, time point 1
-30.00
-20.00
-10.00
.00
10.00
20.00
30.00
Non-verbal CAT standardised age score sat in Y7, time point 1

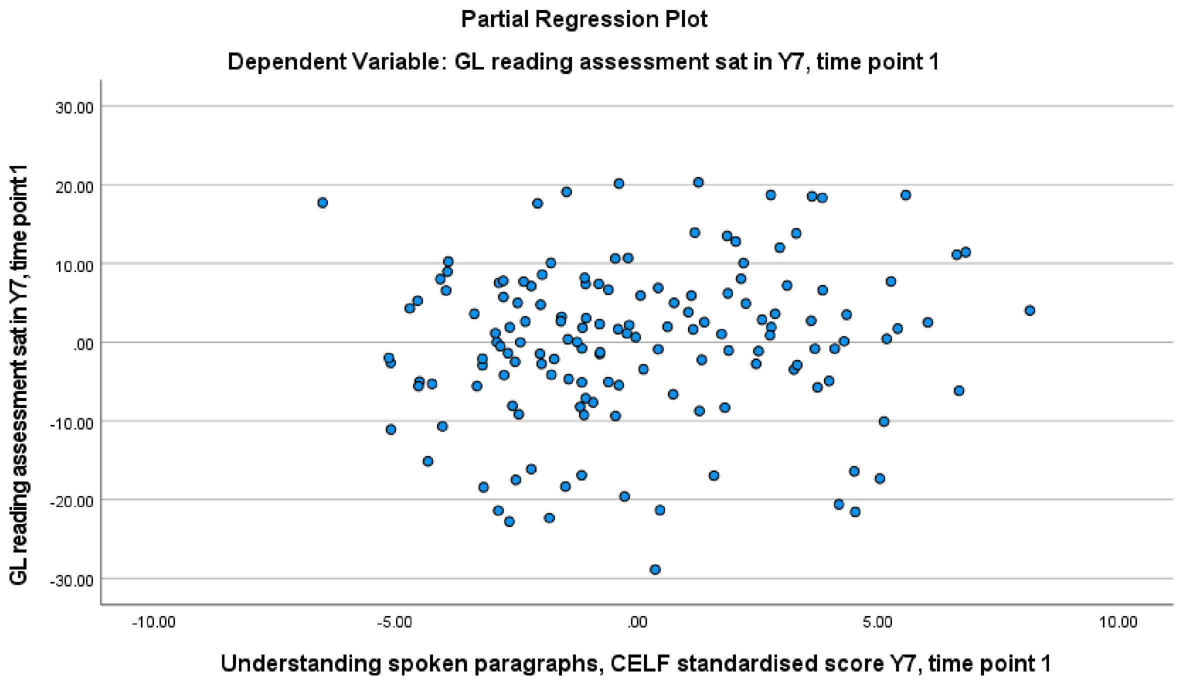

Partial Regression Plot
Dependent Variable: GL reading assessment sat in Y7, time point 1
20.00
.00
-20.00
-40.00
GL reading assessment sat in Y7, time point 1
-20.00
-10.00
.00
10.00
20.00
30.00
Verbal CAT standardised age score sat in Y7, time point 1



Partial Regression Plot
Dependent Variable: GL reading assessment sat in Y7, time point 1
GL reading assessment sat in Y7, time point 1
30.00
20.00
10.00
.00
-10.00
-20.00
-30.00
-20.00
.00
20.00
40.00
TOWRE standardised score Y7, time point 1

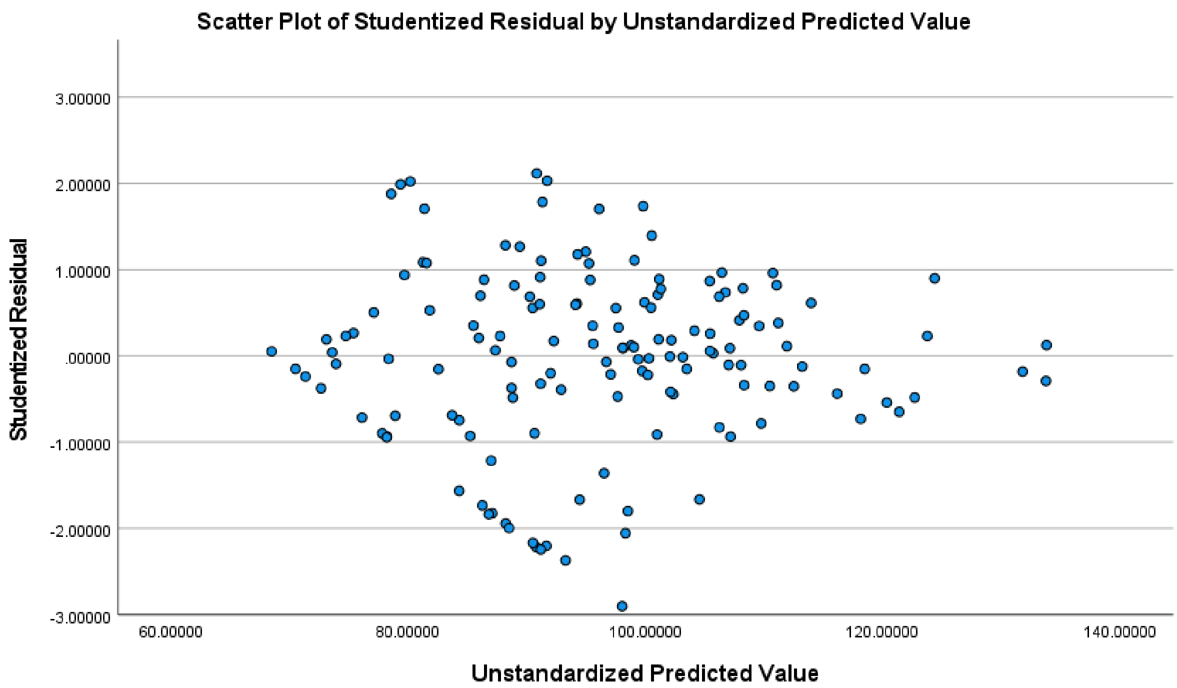


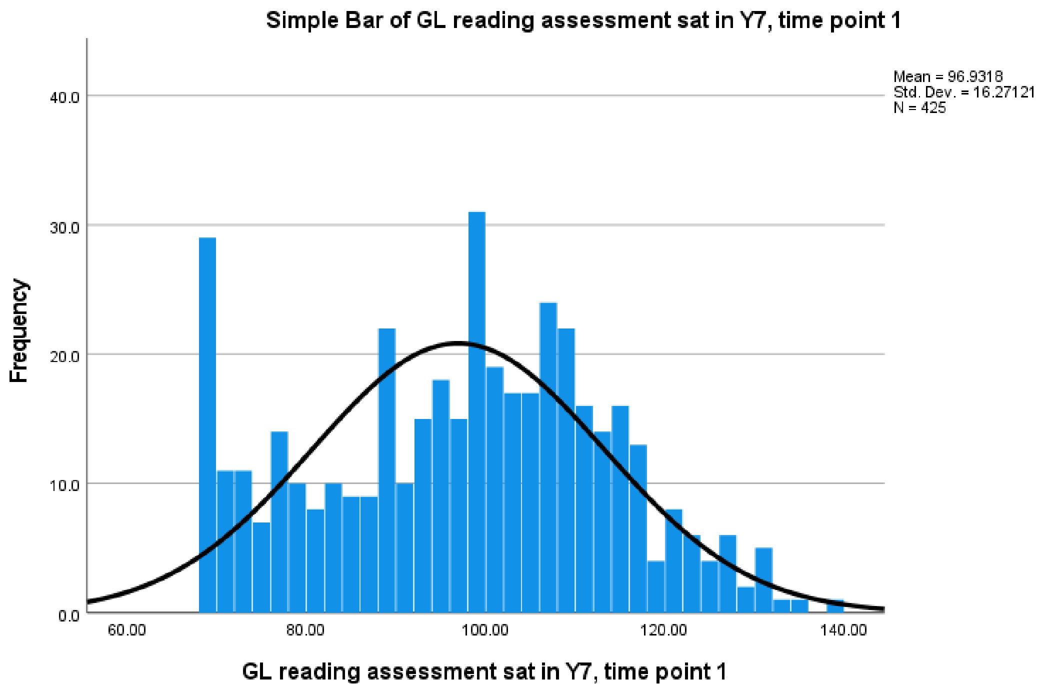
Partial Regression Plot
Dependent Variable: GL reading assessment sat in Y7, time point 1
GL reading assessment sat in Y7, time point 1
30.00
20.00
10.00
.00
-10.00
-20.00
-30.00
-5.00
-2.50
.00
2.50
5.00
Recalling sentences, CELF standardised score Y7, time point 1



3. Testing for homoscedasticity

The residuals are not evenly spread, but differ in height (e.g., an increasing a funnel shape). According to Tabachnick and Fidell (2014, p119), the linear relationship between variables is captured by the analysis but there is more predictability if the heteroscedasticity is accounted for. Following Tabachnick and Fidell (2014), SPSS GRAPH is run to check the bivariate plots: Y7 NGRT and CAT-V; NGRT and TOWRE2 show a pileup of scores at the low values of the variable. The relationship between reading comprehension, word reading and CAT-V are all dependent on the ability to read text.





4. Checking for multicollinearity

All the Tolerance values are greater than 0.1 (the lowest is 0.351), indicating no problems with collinearity in this particular data set.

Collinearity Statistics	
Tolerance	**VIF**
.932	1.073
.484	2.067
.351	2.849
.677	1.477
.576	1.735
.766	1.306

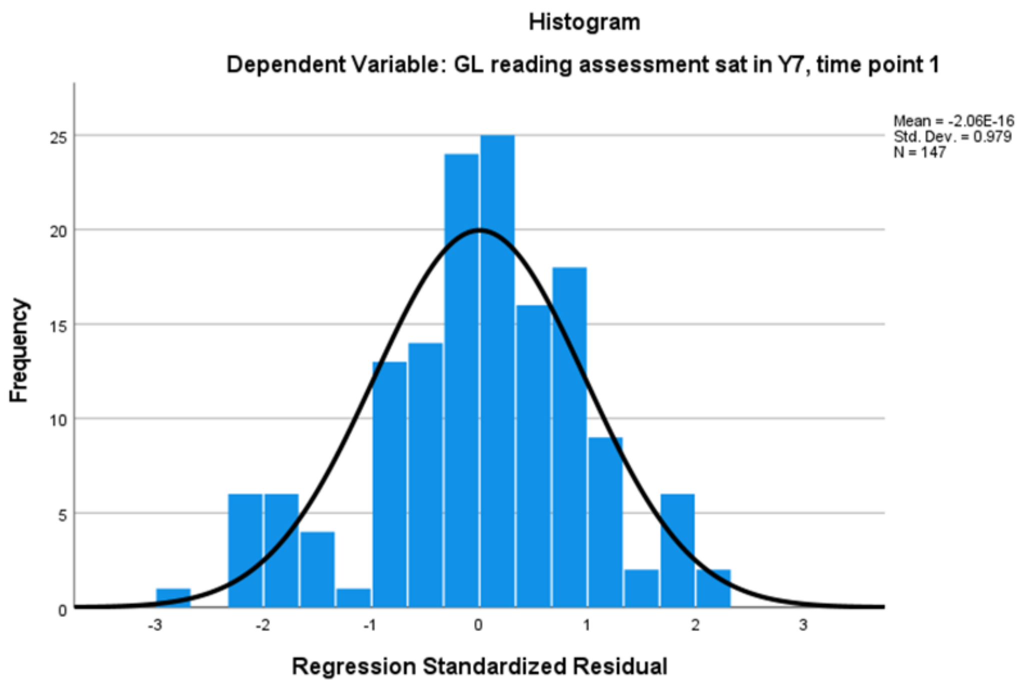
5. Outliers

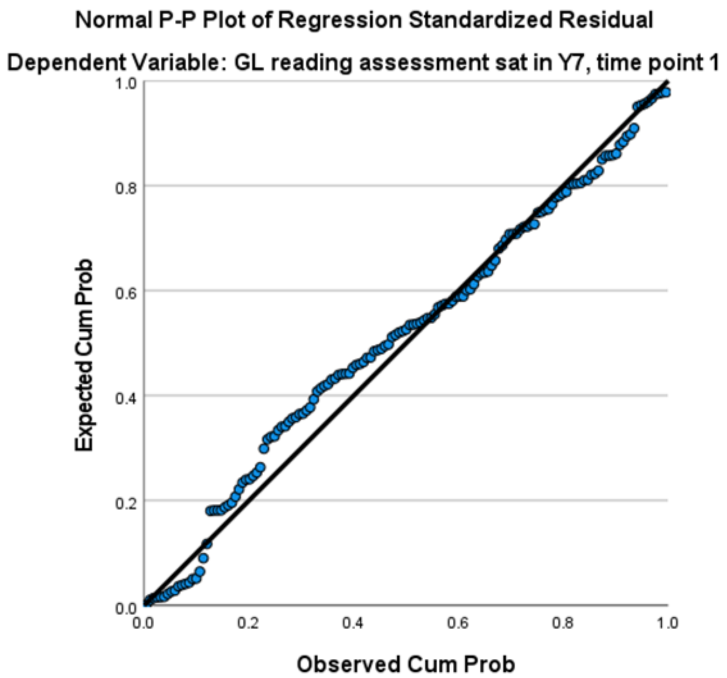
The maximum value for Cook's distance is 0.077, which is less than 1.0 suggesting no problems.

Residual Statistics					
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	68.4897	133.7934	96.0612	13.27937	147
Std. Predicted Value	-2.076	2.841	.000	1.000	147
Standard Error of Predicted Value	.965	3.509	2.150	.466	147
Adjusted Predicted Value	68.4577	134.1109	96.0639	13.29364	147
Residual	-29.02885	20.29753	.00000	9.87197	147
Std. Residual	-2.879	2.013	.000	.979	147
Stud. Residual	-2.904	2.117	.000	1.002	147
Deleted Residual	-29.52607	22.58106	-.00263	10.34489	147
Stud. Deleted Residual	-2.985	2.144	-.002	1.010	147
Mahal. Distance	.345	16.691	5.959	3.026	147
Cook's Distance	.000	.077	.007	.011	147
Centered Leverage Value	.002	.114	.041	.021	147

6. Checking for normality

The histogram and P-P Plot show that although the points are not aligned perfectly along the diagonal line, they are close enough to indicate that the residuals are close enough to normal for the analysis to proceed. This shows that there is no violation of the assumption of normality.





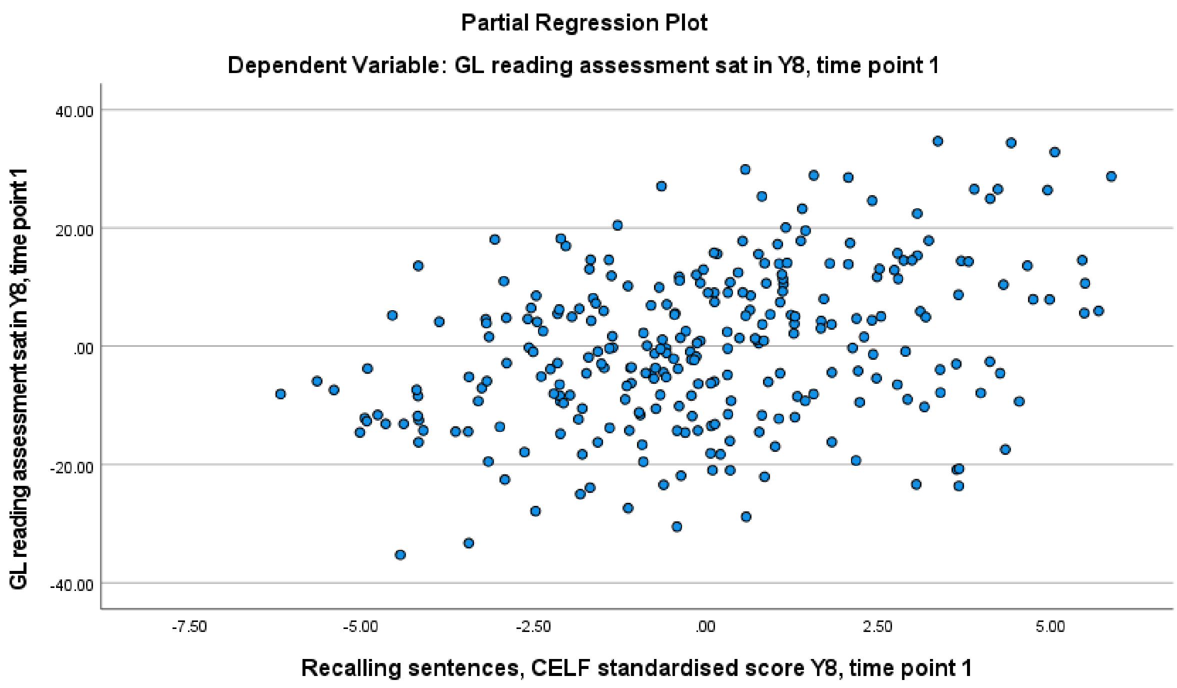
B) Assumption Test for RQ3, Y8

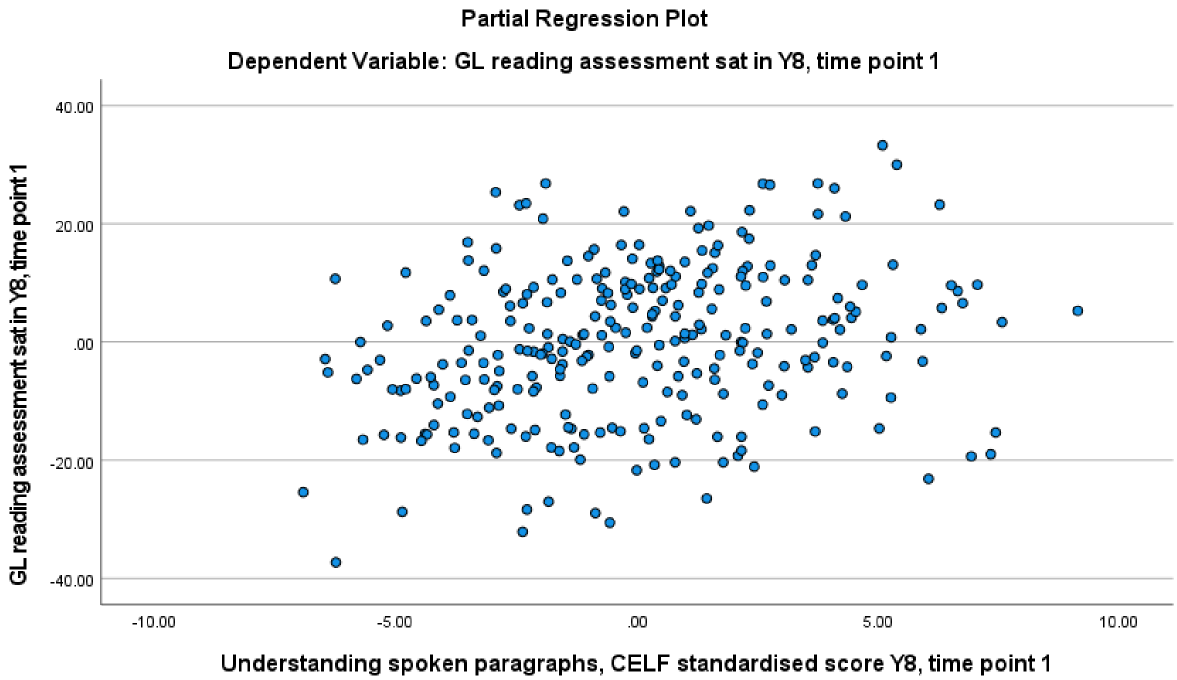
1. **Independence of observations**
   There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.494

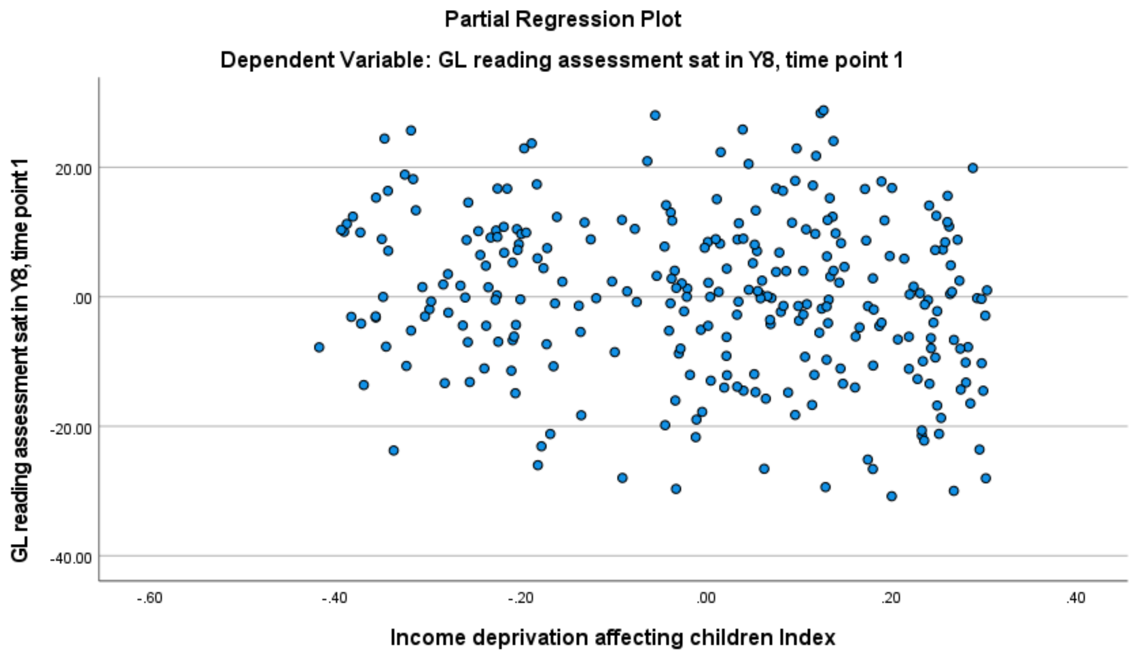
Model Summary					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	671	.450	.442	12.47137	1.494
Predictors: (Constant): TOWRE, IDACI, USP, RS					
Dependent Variable: GL reading assessment sat in Y8, time point 1					

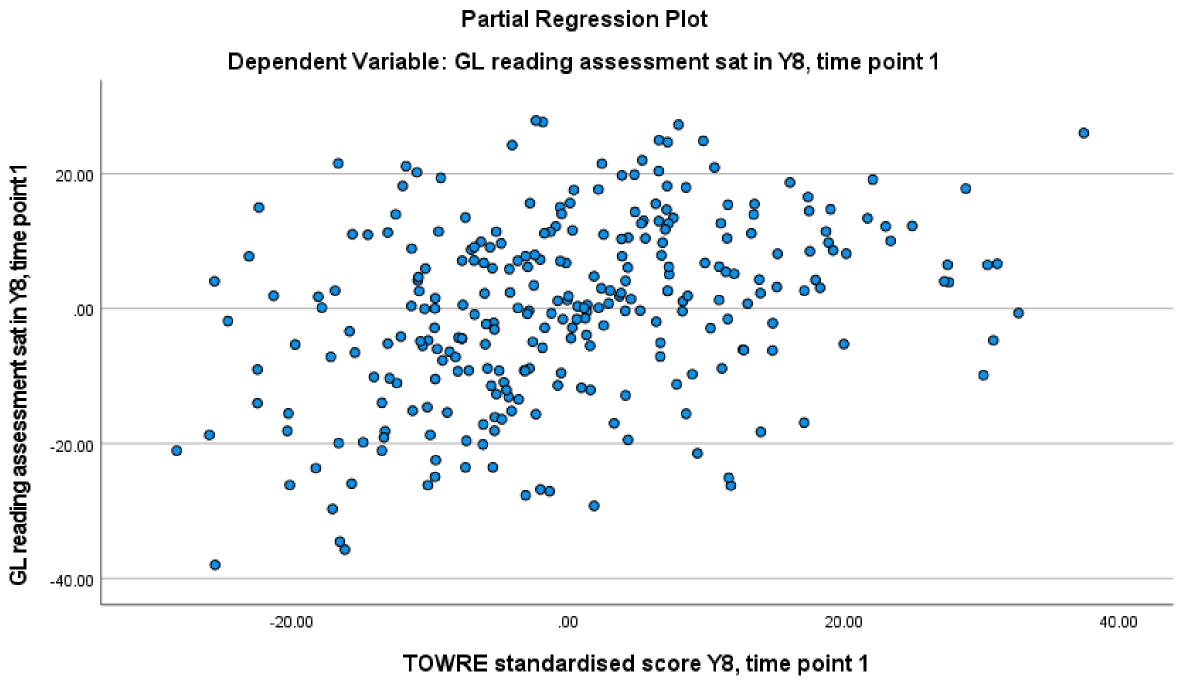
2. **Testing for linearity**

The residuals form a horizontal band, as shown in the scatterplots below, therefore the relationship between the dependent variable and independent variables is likely to be linear.



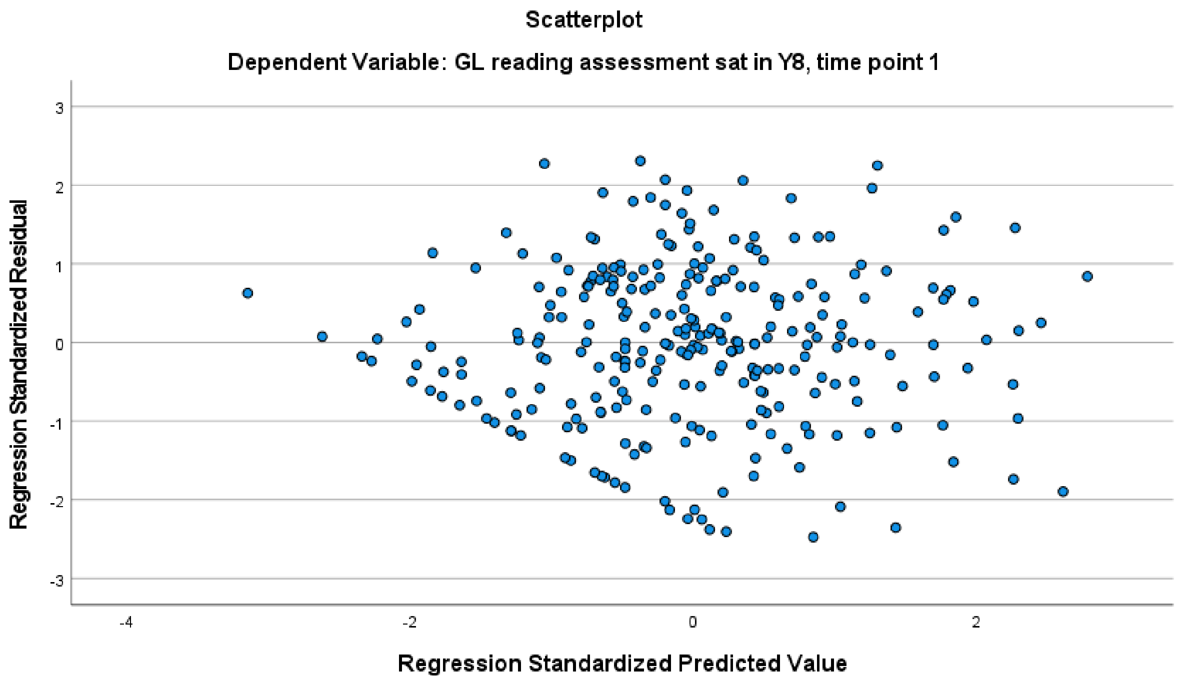

Partial Regression Plot
Dependent Variable: GL reading assessment sat in Y8, time point 1
GL reading assessment sat in Y8, time point 1
40.00
20.00
.00
-20.00
-40.00
-10.00
-5.00
.00
5.00
10.00
Understanding spoken paragraphs, CELF standardised score Y8, time point 1

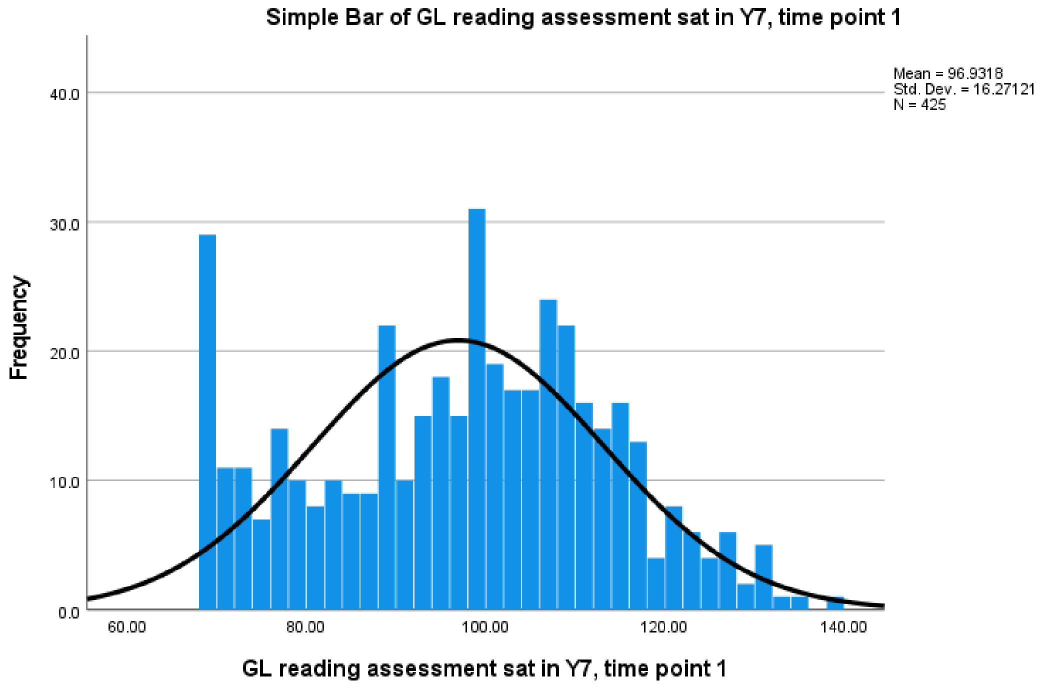

Partial Regression Plot
Dependent Variable: GL reading assessment sat in Y8, time point 1
GL reading assessment sat in Y8, time point 1
20.00
.00
-20.00
-40.00
-.60
-.40
-.20
.00
.20
.40
Income deprivation affecting children Index



3.Testing for homoscedasticity

The residuals are not evenly spread, but differ in height (e.g., an increasing funnel shape). According to Tabachnick and Fidell, (2014, p119), heteroscedasticity may weaken an analysis of ungrouped data but not invalidate it. It may occur due to the skewness of the Y8 NGRT data. The linearity between variables is captured by the analysis.





4. Checking for multicollinearity

All the Tolerance values are greater than 0.1 (the lowest is 0.736), indicating no problems with collinearity in this particular data set.

Collinearity Statistics	
Tolerance	VIP
.736	1.359
.824	1.213
.987	1.013
.810	1.235

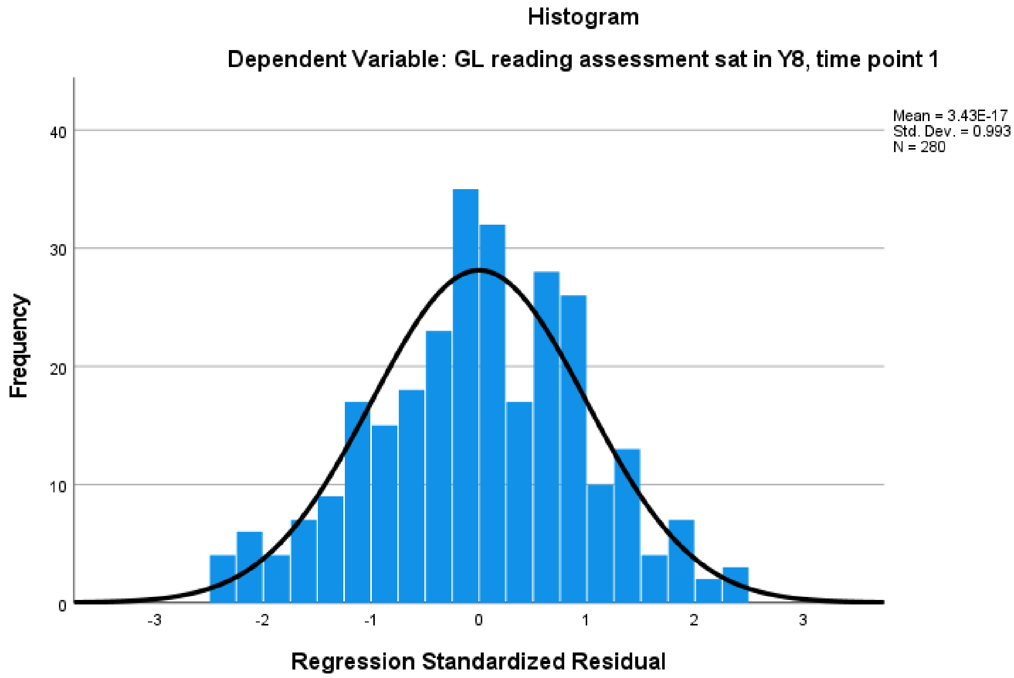
5. Outliers

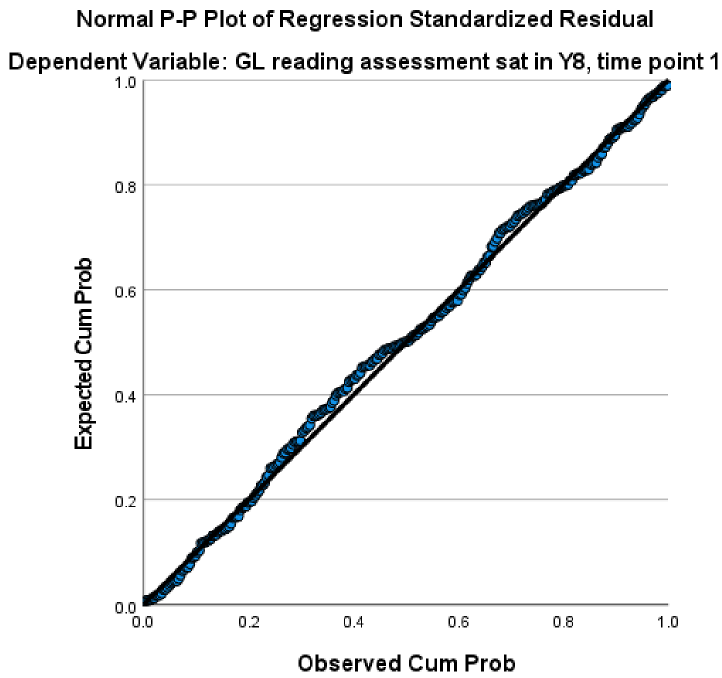
The maximum value for Cook's distance is 0.036, which is less than 1.0 suggesting no problems.

Residual Statistics					
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	62.7068	130.6981	97.3571	11.38567	280
Std. Predicted Value	-3.043	2.928	.000	1.000	280
Standard Error of Predicted Value	.786	2.518	1.592	.405	280
Adjusted Predicted Value	62.3874	130.3804	97.3737	11.38899	280
Residual	-30.01099	30.15067	.00000	12.20356	280
Std. Residual	-2.442	2.453	.000	.993	280
Stud. Residual	-2.452	2.461	-.001	1.002	280
Deleted Residual	-30.26450	30.35112	-.01657	12.42710	280
Stud. Deleted Residual	-2.475	2.484	-.001	1.005	280
Mahal. Distance	.146	10.707	3.986	2.423	280
Cook's Distance	.000	.036	.004	.006	280
Centered Leverage Value	.001	.038	.014	.009	280

6. Checking for normality

The histogram and P-P Plot show that although the points are not aligned perfectly along the diagonal line, they are close enough to indicate that the residuals are close enough to normal for the analysis to proceed. This shows that there is no violation of the assumption of normality.





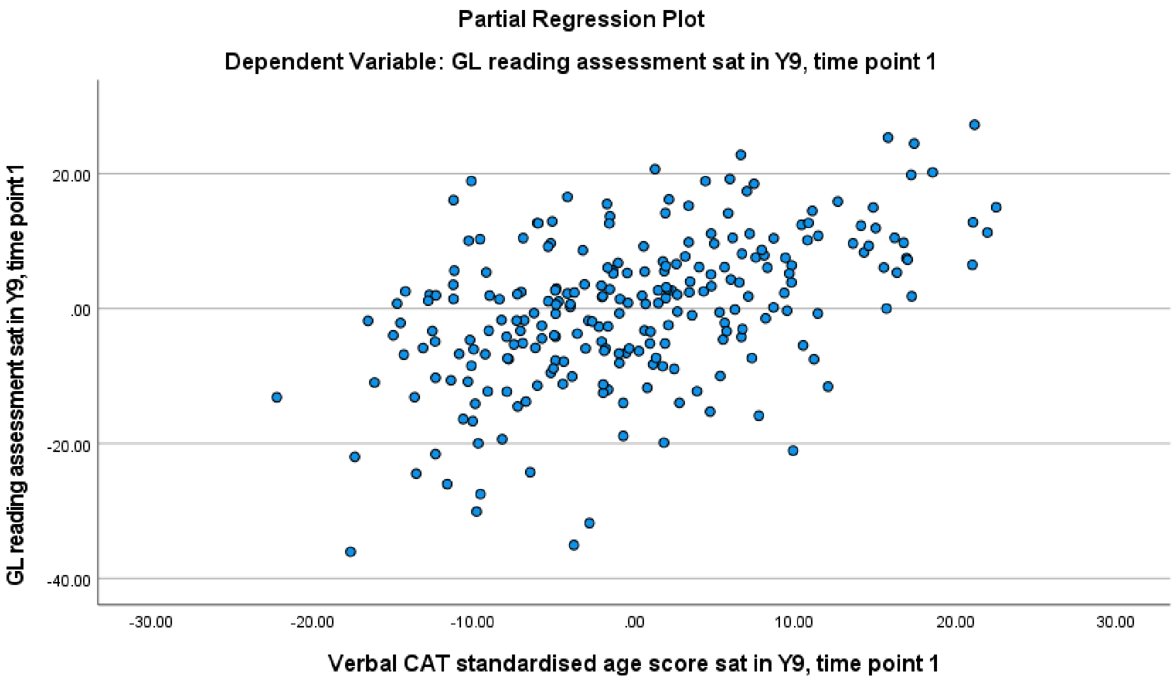
Assumption Test for RQ3, Y9

1. **Independence of observations**
   There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.9.15

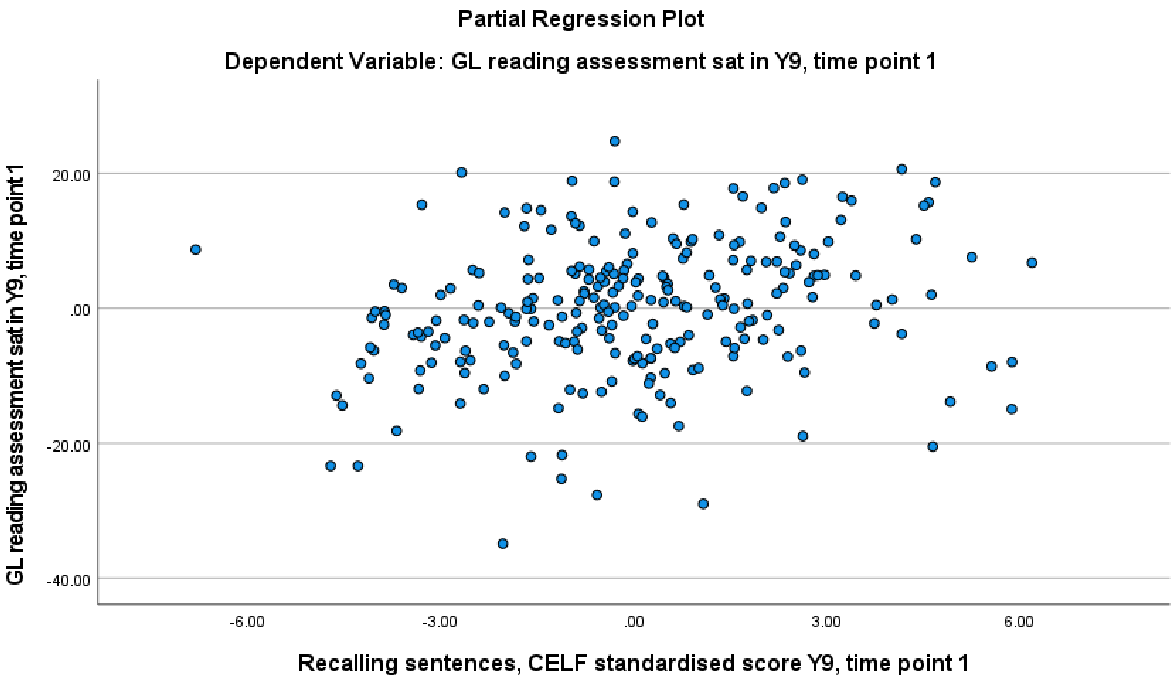
Model Summary					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.827[a]	.683	.675	9.69442	1.915
Predictors: (Constant), TOWRE2 standardised score Y9, time point 1, Income deprivation affecting children Index, Understanding spoken paragraphs, CELF4 standardised score Y9, time point 1, Non-verbal CAT standardised age score sat in Y9, time point 1, Recalling sentences, CELF4 standardised score Y9, time point 1, Verbal CAT standardised age score sat in Y9, time point 1					
b. Dependent Variable: GL reading assessment sat in Y9, time point 1					

2. **Testing for linearity**

The residuals form a horizontal band, as shown in the scatterplots below, therefore the relationship between the dependent variable and independent variables is likely to be linear.



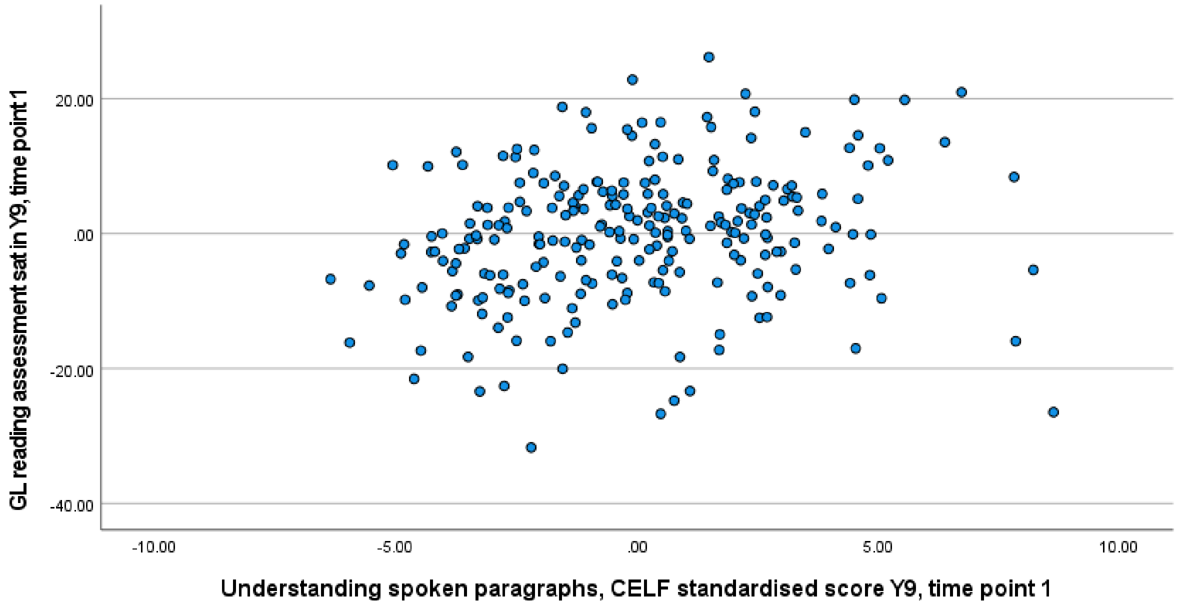
Partial Regression Plot
Dependent Variable: GL reading assessment sat in Y9, time point 1
GL reading assessment sat in Y9, time point 1
20.00
.00
-20.00
-40.00
-30.00
-20.00
-10.00
.00
10.00
20.00
30.00
Verbal CAT standardised age score sat in Y9, time point 1



Partial Regression Plot
Dependent Variable: GL reading assessment sat in Y9, time point 1
GL reading assessment sat in Y9, time point 1
20.00
.00
-20.00
-40.00
-6.00
-3.00
.00
3.00
6.00
Recalling sentences, CELF standardised score Y9, time point 1

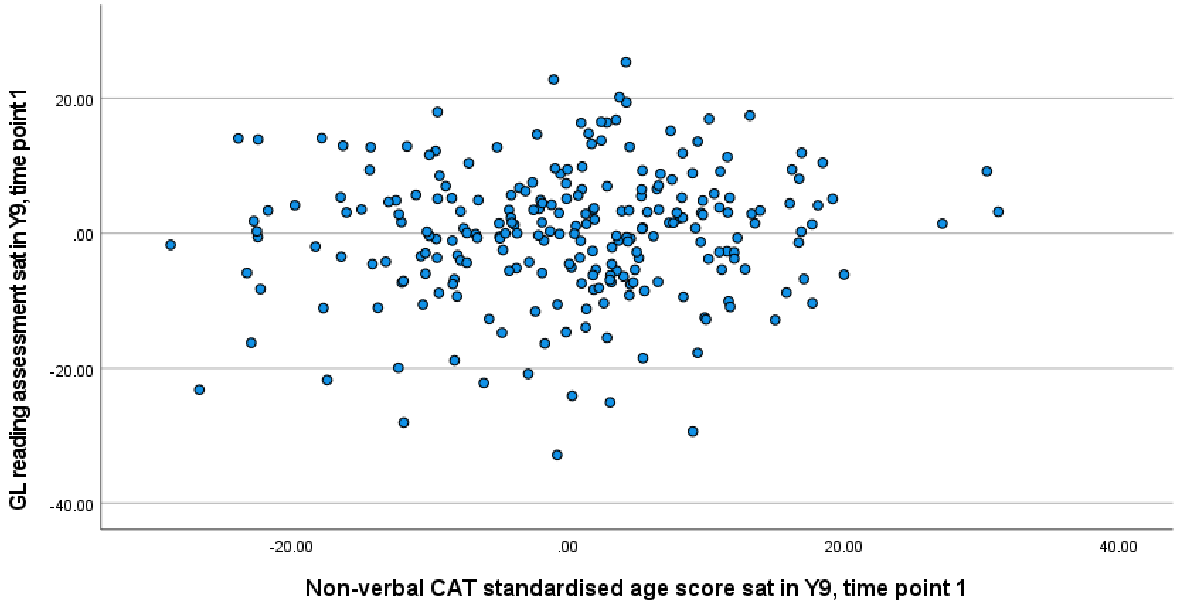
Partial Regression Plot

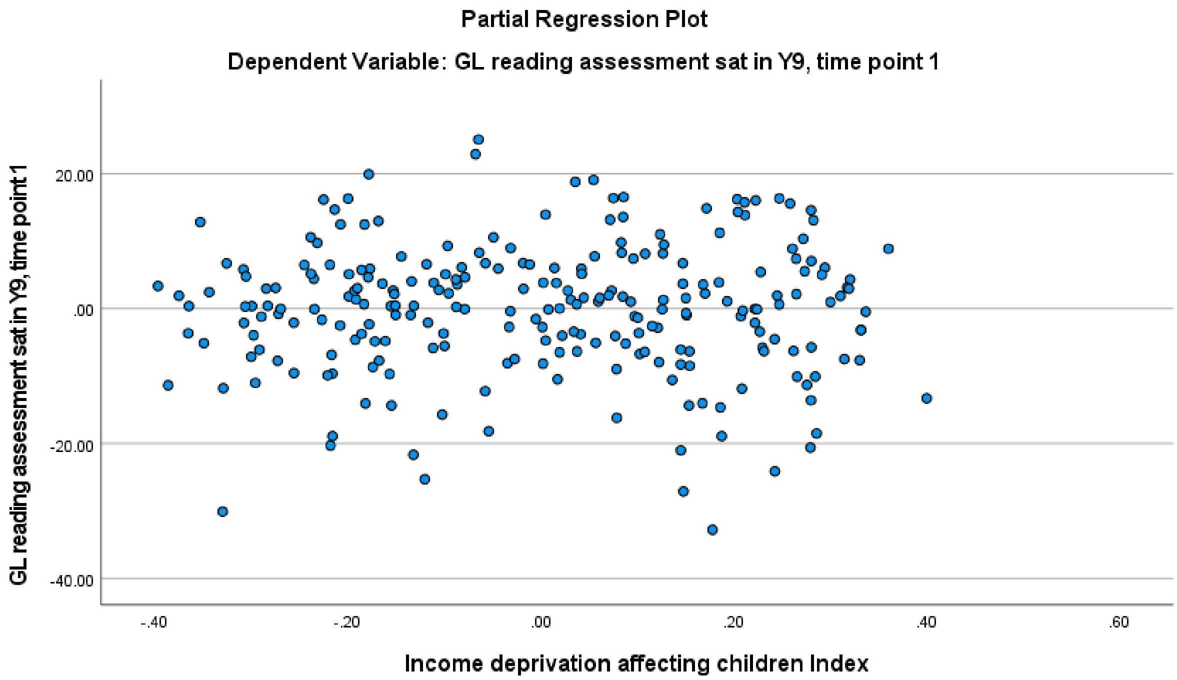
Dependent Variable: GL reading assessment sat in Y9, time point 1

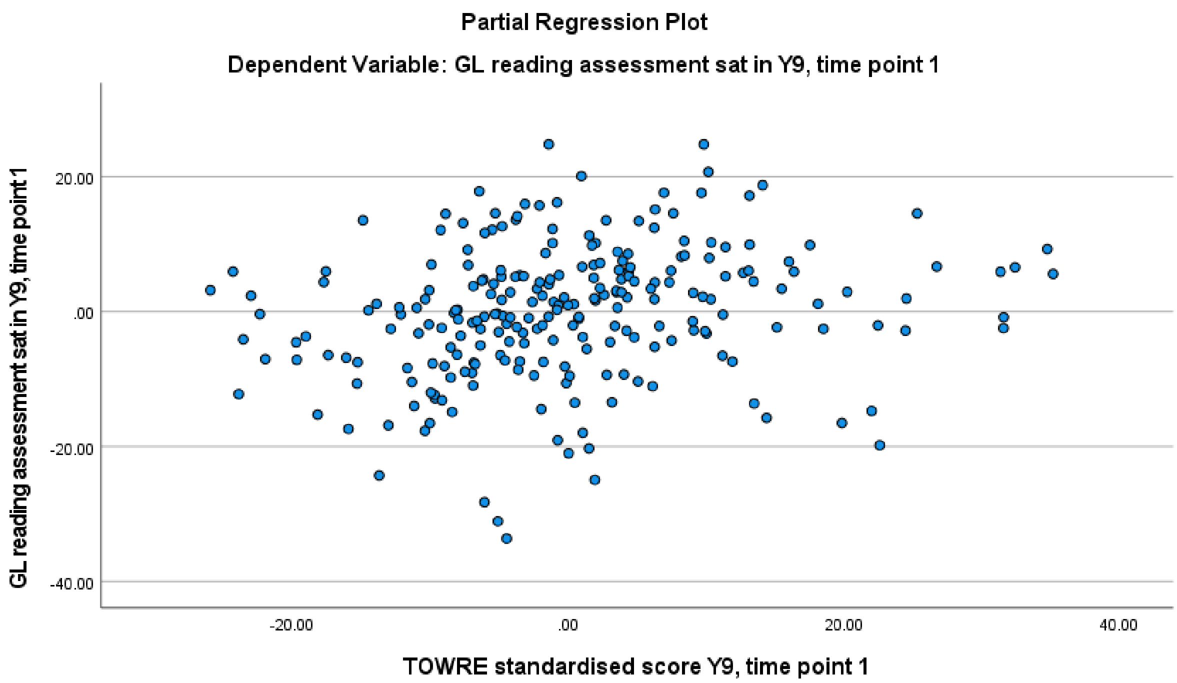


Partial Regression Plot

Dependent Variable: GL reading assessment sat in Y9, time point 1

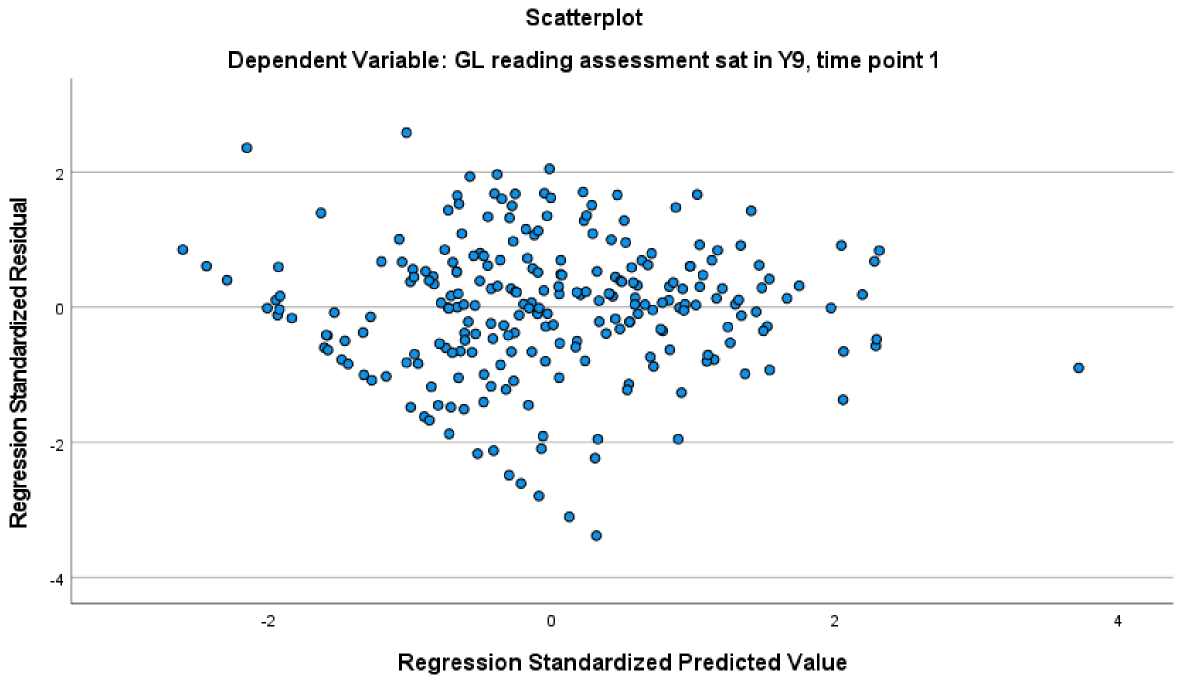


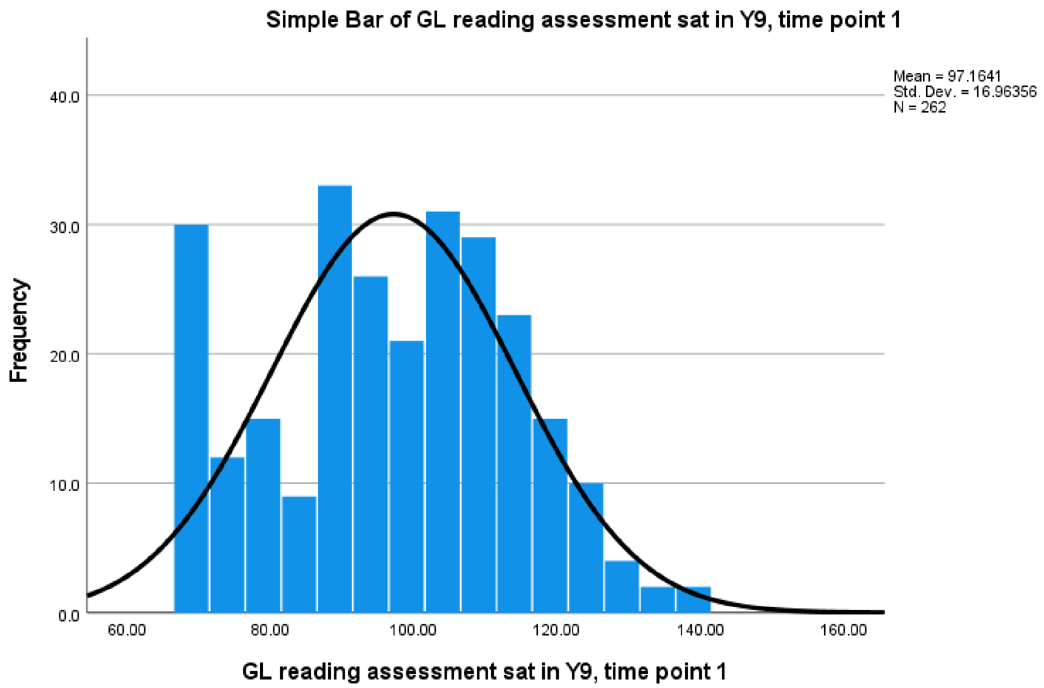




3.Testing for homoscedasticity

The residuals are not evenly spread, but differ in height (e.g., an increasing funnel shape). According to Tabachnick and Fidell, (2014, p119), heteroscedasticity is not fatal to an analysis of ungrouped data and the linearity between variables is captured by the analysis.





4. Checking for multicollinearity

All the Tolerance values are greater than 0.1 (the lowest is 0.436), indicating no problems with collinearity in this particular data set.

Collinearity Statistics	
Tolerance	VIF
.436	2.291
.621	1.611
.705	1.418
.620	1.613
.939	1.065
.660	1.515

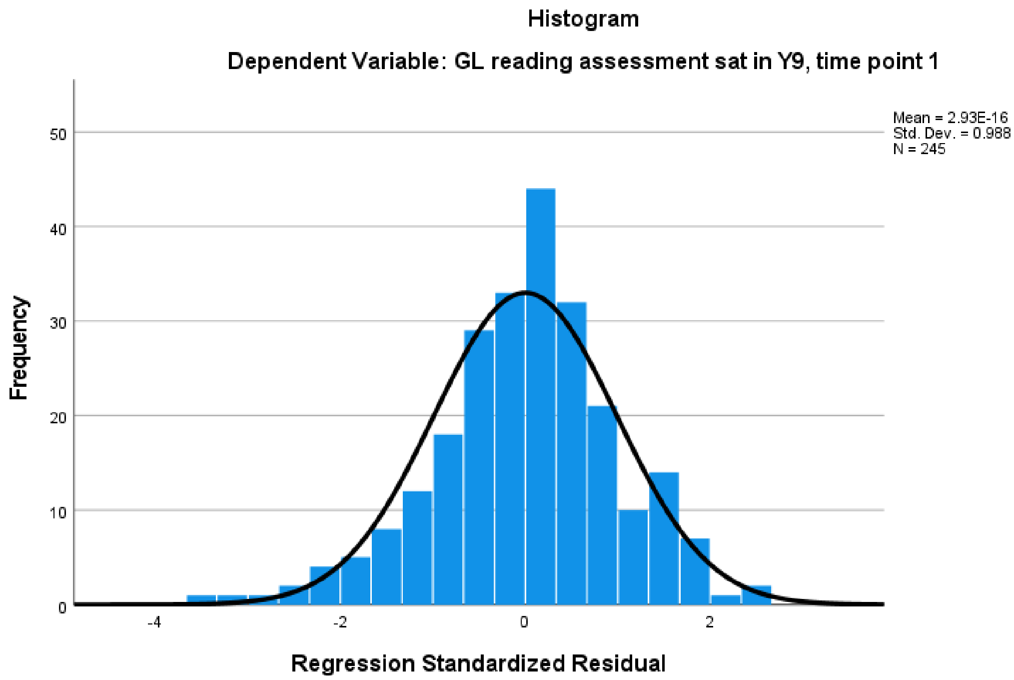
5.Outliers

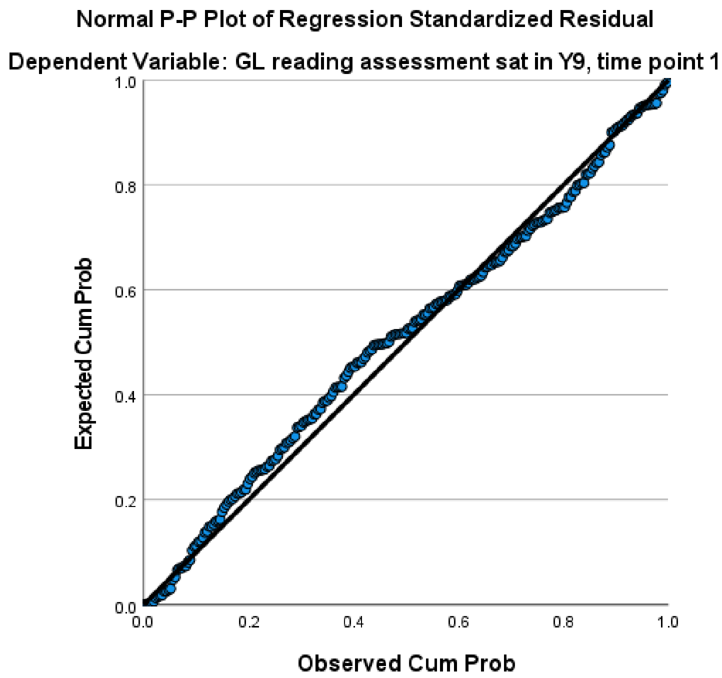
The maximum value for Cook's distance is 0.084, which is less than 1.0 suggesting no problems.

Residuals Statistics					
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	60.7223	149.6898	97.3224	14.06074	245
Std. Predicted Value	-2.603	3.724	.000	1.000	245
Standard Error of Predicted Value	.681	2.661	1.594	.381	245
Adjusted Predicted Value	60.3785	150.3420	97.3449	14.06872	245
Residual	-32.79482	25.06219	.00000	9.57448	245
Std. Residual	-3.383	2.585	.000	.988	245
Stud. Residual	-3.464	2.601	-.001	1.002	245
Deleted Residual	-34.39667	25.37243	-.02244	9.86578	245
Stud. Deleted Residual	-3.548	2.633	-.002	1.008	245
Mahal. Distance	.207	17.383	5.976	3.378	245
Cook's Distance	.000	.084	.004	.009	245
Centered Leverage Value	.001	.071	.024	.014	245

6.Checking for normality

The histogram and P-P Plot show that although the points are not aligned perfectly along the diagonal line, they are close enough to indicate that the residuals are close enough to normal for the analysis to proceed. This shows that there is no violation of the assumption of normality.

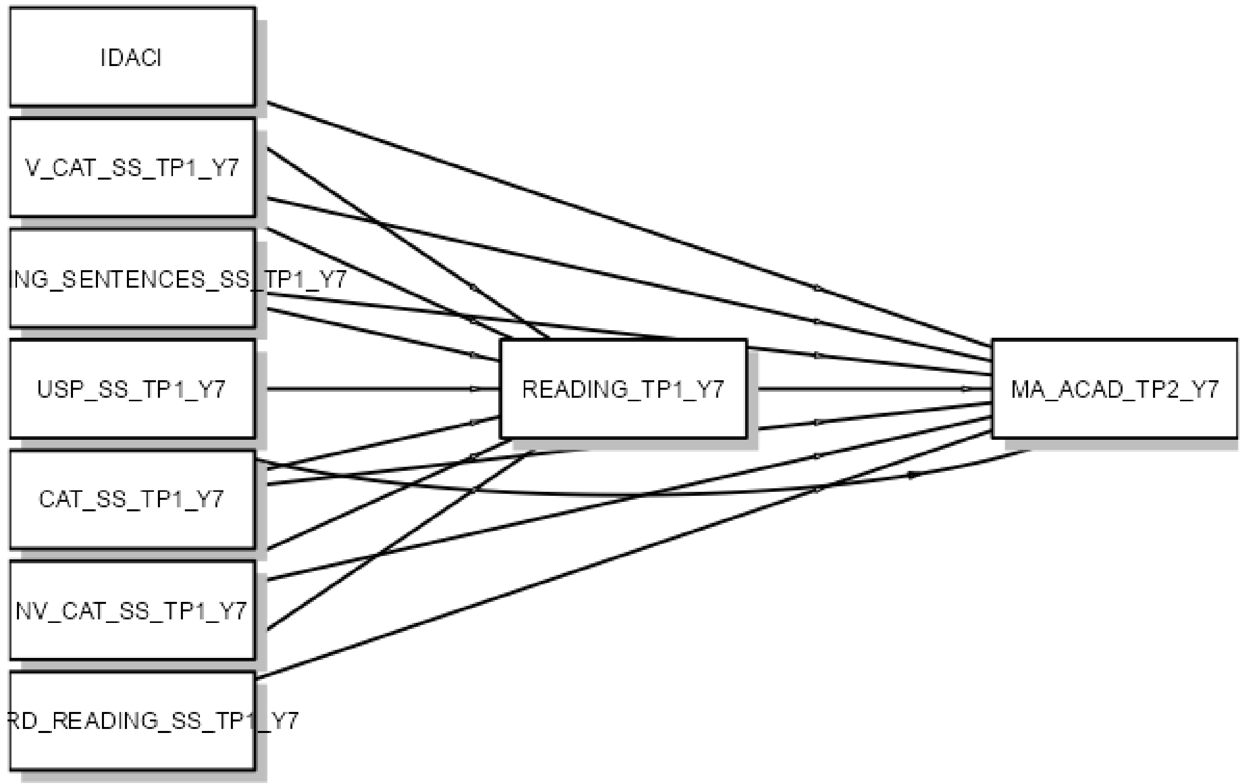



Normal P-P Plot of Regression Standardized Residual
Dependent Variable: GL reading assessment sat in Y9, time point 1
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

Appendix 6C, Mediation Year Seven

Mathematics

Mediators Models		
	m1	READING_TP1_Y7 ~ IDACI + V_CAT_SS_TP1_Y7 + RECALLING_SENTENCES_SS_TP1_Y7 + USP_SS_TP1_Y7 + CAT_SS_TP1_Y7 + NV_CAT_SS_TP1_Y7 + WORD_READING_SS_TP1_Y7
Full Model		
	m2	MA_ACAD_TP2_Y7 ~ READING_TP1_Y7 + IDACI + V_CAT_SS_TP1_Y7 + RECALLING_SENTENCES_SS_TP1_Y7 + USP_SS_TP1_Y7 + CAT_SS_TP1_Y7 + NV_CAT_SS_TP1_Y7 + WORD_READING_SS_TP1_Y7
Indirect Effects		
	IE 1	IDACI ⇒ READING_TP1_Y7 ⇒ MA_ACAD_TP2_Y7
	IE 2	V_CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ MA_ACAD_TP2_Y7
	IE 3	RECALLING_SENTENCES_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ MA_ACAD_TP2_Y7
	IE 4	USP_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ MA_ACAD_TP2_Y7
	IE 5	CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ MA_ACAD_TP2_Y7
	IE 6	NV_CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ MA_ACAD_TP2_Y7
	IE 7	WORD_READING_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ MA_ACAD_TP2_Y7


IDACI
V_CAT_SS_TP1_Y7
NG_SENTENCES_SS_TP1_Y7
USP_SS_TP1_Y7
CAT_SS_TP1_Y7
NV_CAT_SS_TP1_Y7
RD_READING_SS_TP1_Y7
READING_TP1_Y7
MA_ACAD_TP2_Y7

Mediation, Y7 Mathematics

Indirect and total effects								
				95% C.I. (a)				
Type	**Effect**	**Estimate**	**SE**	**Lower**	**Upper**	**β**	**z**	**p**
Indirect	IDACI ⇒ READING_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	0.289	0.0363	0.2175	0.3600	0.256	7.945	**< .001**
	V_CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	1.173	0.9386	-0.6666	3.0125	1.864	1.250	0.211
	RECALLING_SENTENCES_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	2.847	2.4147	-1.8853	7.5800	5.121	1.179	0.238
	USP_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	-3.279	2.2375	-7.6640	1.1067	-5.911	-1.465	0.143
	CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	-0.554	1.5114	-3.5164	2.4082	-0.881	-0.367	0.714
	NV_CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	-0.565	0.9294	-2.3870	1.2563	-0.899	-0.608	0.543
	WORD_READING_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	0.512	0.6161	-0.6951	1.7201	0.840	0.832	0.406
Component	IDACI ⇒ READING_TP1_Y7	0.365	0.0259	0.3140	0.4154	0.540	14.099	**< .001**

	READING_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	0.792	0.0823	0.6304	0.9531	0.475	9.617	**< .001**
	V_CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7	1.482	1.1754	-0.8223	3.7853	3.925	1.260	0.208
	RECALLING_SENTENCES_SS_TP1_Y7 ⇒ READING_TP1_Y7	3.596	3.0269	-2.3362	9.5290	10.784	1.188	0.235
	USP_SS_TP1_Y7 ⇒ READING_TP1_Y7	-4.141	2.7931	-9.6155	1.3332	-12.448	-1.483	0.138
	CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7	-0.700	1.9076	-4.4388	3.0390	-1.855	-0.367	0.714
	NV_CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7	-0.714	1.1716	-3.0103	1.5822	-1.894	-0.609	0.542
	WORD_READING_SS_TP1_Y7 ⇒ READING_TP1_Y7	0.647	0.7753	-0.8723	2.1669	1.770	0.835	0.404
Direct	IDACI ⇒ MA_ACAD_TP2_Y7	0.136	0.0539	.0301	0.2416	0.121	2.518	**0.012**
	V_CAT_SS_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	2.775	2.0403	-1.2239	6.7741	4.409	1.360	0.174
	RECALLING_SENTENCES_SS_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	-8.841	5.2531	-19.1370	1.4548	-15.899	-1.683	0.092
	USP_SS_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	11.260	4.8516	1.7506	20.7688	20.298	2.321	**0.020**
	CAT_SS_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	-4.766	3.3059	-11.2450	1.7140	-7.576	-1.442	0.149
	NV_CAT_SS_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	1.934	2.0309	-2.0469	5.9140	3.076	0.952	0.341

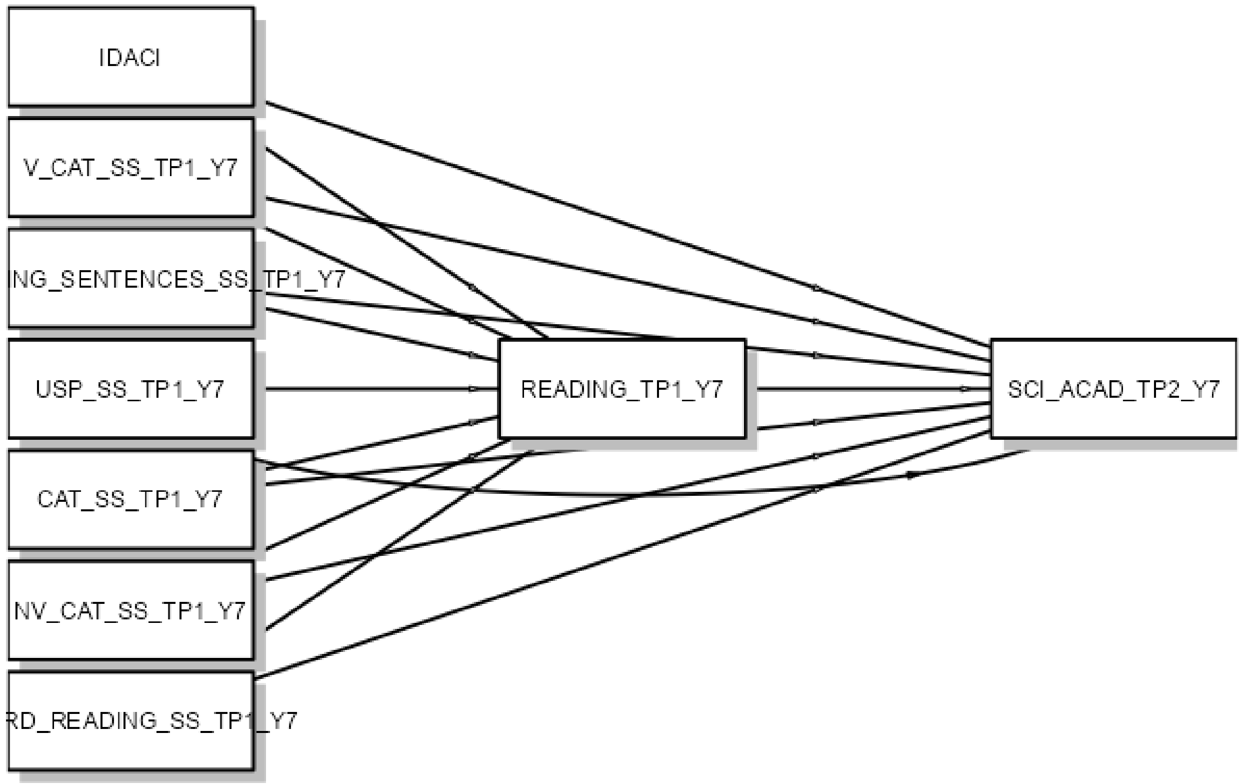
	WORD_READING_SS_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	-2.656	1.3445	-5.2915	-0.0212	-4.355	-1.976	0.048
Total	IDACI ⇒ MA_ACAD_TP2_Y7	0.425	0.0594	0.3081	0.5410	0.322	7.146	**< .001**
	V_CAT_SS_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	3.968	2.6998	-1.3231	9.2599	5.378	1.470	0.142
	RECALLING_SENTENCES_SS_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	-6.020	6.9523	-19.6459	7.6068	-9.235	-0.866	0.387
	USP_SS_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	8.007	6.4153	-4.5670	20.5807	12.314	1.248	0.212
	CAT_SS_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	-5.361	4.3816	-13.9485	3.2271	-7.270	-1.223	0.221
	NV_CAT_SS_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	1.389	2.6909	-3.8853	6.6630	1.885	0.516	0.606
	WORD_READING_SS_TP1_Y7 ⇒ MA_ACAD_TP2_Y7	-2.144	1.7808	-5.6343	1.3463	-2.999	-1.204	0.229

Note. Confidence intervals computed with method: Standard (Delta method)

Note. Betas are completely standardized effect sizes

Science

Mediators Models		
	m1	READING_TP1_Y7 ~ IDACI + V_CAT_SS_TP1_Y7 + RECALLING_SENTENCES_SS_TP1_Y7 + USP_SS_TP1_Y7 + CAT_SS_TP1_Y7 + NV_CAT_SS_TP1_Y7 + WORD_READING_SS_TP1_Y7
Full Model		
	m2	SCI_ACAD_TP2_Y7 ~ READING_TP1_Y7 + IDACI + V_CAT_SS_TP1_Y7 + RECALLING_SENTENCES_SS_TP1_Y7 + USP_SS_TP1_Y7 + CAT_SS_TP1_Y7 + NV_CAT_SS_TP1_Y7 + WORD_READING_SS_TP1_Y7
Indirect Effects		
	IE 1	IDACI ⇒ READING_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7
	IE 2	V_CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7
	IE 3	RECALLING_SENTENCES_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7
	IE 4	USP_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7
	IE 5	CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7
	IE 6	NV_CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7
	IE 7	WORD_READING_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7


IDACI
V_CAT_SS_TP1_Y7
NG_SENTENCES_SS_TP1_Y7
USP_SS_TP1_Y7
CAT_SS_TP1_Y7
NV_CAT_SS_TP1_Y7
RD_READING_SS_TP1_Y7
READING_TP1_Y7
SCI_ACAD_TP2_Y7

Mediation for Y7 Science

Indirect and total effects

				95% C.I. (a)				
Type	**Effect**	**Estimate**	**SE**	**Lower**	**Upper**	**β**	**z**	**p**
Indirect	IDACI ⇒ READING_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	0.288	0.0387	0.2124	0.364	0.219	7.444	**< .001**
	V_CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	1.171	1.1172	-1.0190	3.360	1.595	1.048	0.295
	RECALLING_SENTENCES_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	2.809	2.8747	-2.8252	8.443	4.331	0.977	0.328
	USP_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	-3.243	2.6604	-8.4569	1.972	-5.012	-1.219	0.223
	CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	-0.553	1.8032	-4.0873	2.981	-0.754	-0.307	0.759
	NV_CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	-0.564	1.1084	-2.7368	1.608	-0.770	-0.509	0.611
	WORD_READING_SS_TP1_Y7 ⇒ READING_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	0.515	0.7345	-0.9248	1.954	0.723	0.701	0.483
Component	IDACI ⇒ READING_TP1_Y7	0.365	0.0309	0.3041	0.425	0.479	11.796	**< .001**

	READING_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	0.791	0.0824	0.6291	0.952	0.459	9.596	**< .001**
	V_CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7	1.481	1.4048	-1.2724	4.234	3.478	1.054	0.292
	RECALLING_SENTENCES_SS_TP1_Y7 ⇒ READING_TP1_Y7	3.553	3.6175	-3.5367	10.643	9.446	0.982	0.326
	USP_SS_TP1_Y7 ⇒ READING_TP1_Y7	-4.102	3.3380	-10.6442	2.441	-10.930	-1.229	0.219
	CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7	-0.700	2.2798	-5.1680	3.769	-1.644	-0.307	0.759
	NV_CAT_SS_TP1_Y7 ⇒ READING_TP1_Y7	-0.714	1.4002	-3.4580	2.031	-1.678	-0.510	0.610
	WORD_READING_SS_TP1_Y7 ⇒ READING_TP1_Y7	0.651	0.9266	-1.1650	2.467	1.578	0.703	0.482
Direct	IDACI ⇒ SCI_ACAD_TP2_Y7	0.138	0.0614	0.0173	0.258	0.105	2.241	0.025
	V_CAT_SS_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	2.767	2.4388	-2.0135	7.546	3.768	1.134	0.257
	RECALLING_SENTENCES_SS_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	-10.600	6.2792	-22.9066	1.708	-16.342	-1.688	0.091
	USP_SS_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	12.726	5.7978	1.3622	24.089	19.668	2.195	0.028
	CAT_SS_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	-4.451	3.9535	-12.1993	3.298	-6.066	-1.126	0.260
	NV_CAT_SS_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	1.627	2.4285	-3.1323	6.387	2.220	0.670	0.503

	WORD_READING_SS_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	-2.333	1.6075	-5.4834	0.818	-3.279	-1.451	0.147
Total	IDACI ⇒ SCI_ACAD_TP2_Y7	0.426	0.0590	0.3104	0.324	0.324	7.223	**< .001**
	V_CAT_SS_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	3.937	2.6800	-1.3155	5.363	5.363	1.469	0.142
	RECALLING_SENTENCES_SS_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	-7.790	6.9014	-21.3168	-12.011	-12.011	-1.129	0.259
	USP_SS_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	9.483	6.3683	-2.9986	14.657	14.657	1.489	0.136
	CAT_SS_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	-5.004	4.3495	-13.5285	-6.820	-6.820	-1.150	0.250
	NV_CAT_SS_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	1.063	2.6712	-4.1723	1.450	1.450	0.398	0.691
	WORD_READING_SS_TP1_Y7 ⇒ SCI_ACAD_TP2_Y7	-1.818	1.7678	-5.2827	-2.555	-2.555	-1.028	0.304

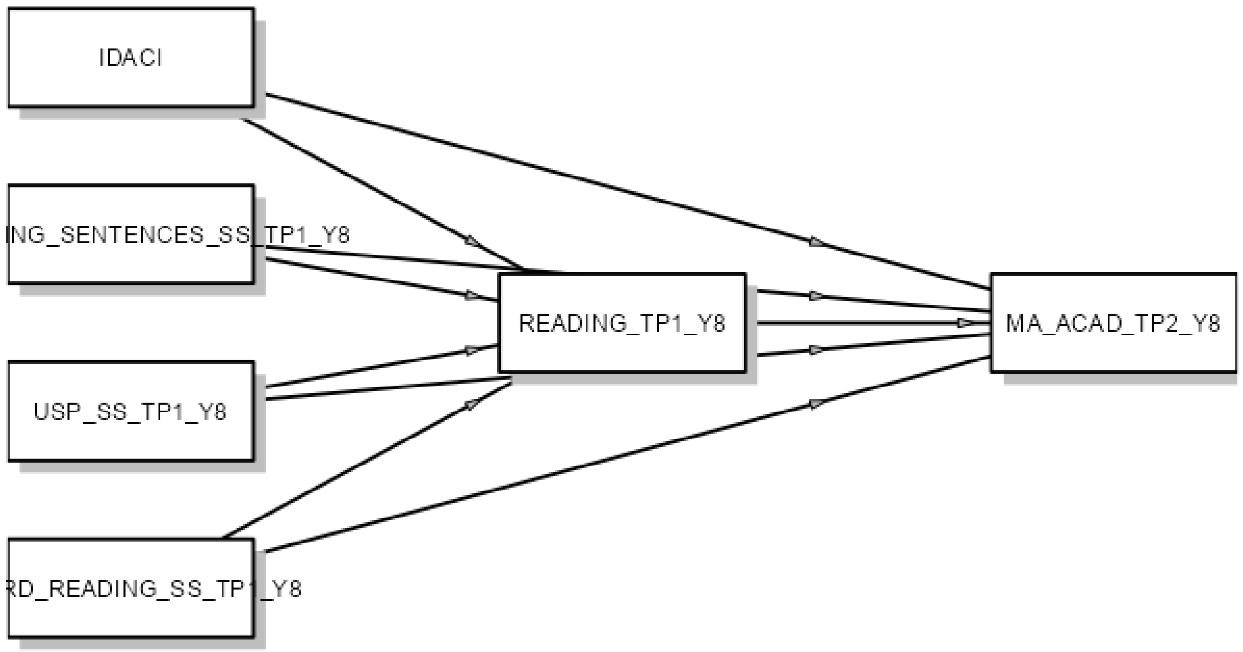
Note. Confidence intervals computed with method: Standard (Delta method)

Note. Betas are completely standardized effect sizes

Appendix 6D Mediation effects for Year Eight

Mathematics

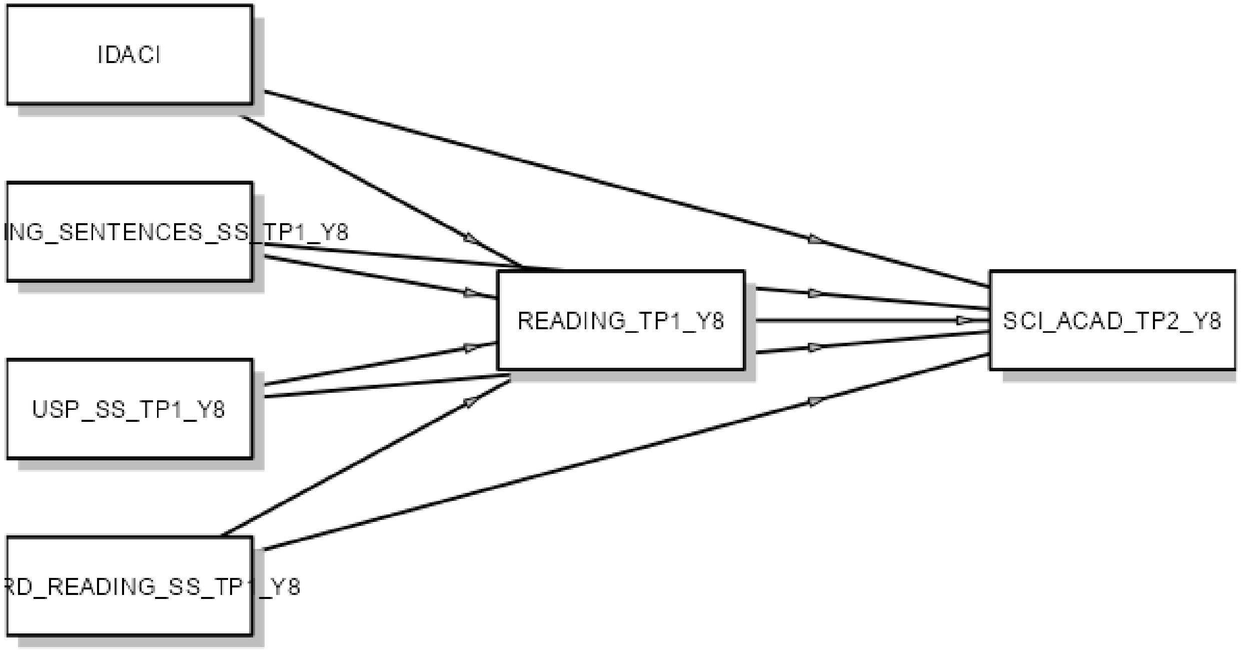
Mediators Models		
	m1	READING_TP1_Y8 ~ IDACI + RECALLING_SENTENCES_SS_TP1_Y8 + USP_SS_TP1_Y8 + WORD_READING_SS_TP1_Y8
Full Model		
	m2	MA_ACAD_TP2_Y8 ~ READING_TP1_Y8 + IDACI + RECALLING_SENTENCES_SS_TP1_Y8 + USP_SS_TP1_Y8 + WORD_READING_SS_TP1_Y8
Indirect Effects		
	IE 1	IDACI ⇒ READING_TP1_Y8 ⇒ MA_ACAD_TP2_Y8
	IE 2	RECALLING_SENTENCES_SS_TP1_Y8 ⇒ READING_TP1_Y8 ⇒ MA_ACAD_TP2_Y8
	IE 3	USP_SS_TP1_Y8 ⇒ READING_TP1_Y8 ⇒ MA_ACAD_TP2_Y8
	IE 4	WORD_READING_SS_TP1_Y8 ⇒ READING_TP1_Y8 ⇒ MA_ACAD_TP2_Y8


IDACI
ING_SENTENCES_SS_TP1_Y8
USP_SS_TP1_Y8
RD_READING_SS_TP1_Y8
READING_TP1_Y8
MA_ACAD_TP2_Y8

Mediation Y8 Mathematics

Indirect and total effects								
				95% C.I. (a)				
Type	**Effect**	**Estimate**	**SE**	**Lower**	**Upper**	**β**	**z**	**p**
Indirect	IDACI ⇒ READING_TP1_Y8 ⇒ MA_ACAD_TP2_Y8	0.1566	0.0258	0.1060	0.207	0.1453	6.061	**< .001**
	RECALLING_SENTENCES_SS_TP1_Y8 ⇒ READING_TP1_Y8 ⇒ MA_ACAD_TP2_Y8	1.6914	1.6597	-1.5615	4.944	3.0139	1.019	0.308
	USP_SS_TP1_Y8 ⇒ READING_TP1_Y8 ⇒ MA_ACAD_TP2_Y8	-0.1805	1.6240	-3.3635	3.003	-0.3222	-0.111	0.912
	WORD_READING_SS_TP1_Y8 ⇒ READING_TP1_Y8 ⇒ MA_ACAD_TP2_Y8	-1.5925	0.3211	-2.2220	-0.963	-2.5821	-4.959	**< .001**
Component	IDACI ⇒ READING_TP1_Y8	0.2633	0.0342	0.1962	0.330	0.3222	7.692	**< .001**
	READING_TP1_Y8 ⇒ MA_ACAD_TP2_Y8	0.5950	0.0604	0.4765	0.713	0.4508	9.843	**< .001**
	RECALLING_SENTENCES_SS_TP1_Y8 ⇒ READING_TP1_Y8	2.8428	2.7745	-2.5950	8.281	6.6858	1.025	0.306
	USP_SS_TP1_Y8 ⇒ READING_TP1_Y8	-0.3033	2.7294	-5.6528	5.046	-0.7148	-0.111	0.912
	WORD_READING_SS_TP1_Y8 ⇒ READING_TP1_Y8	-2.6766	0.4663	-3.5904	-1.763	-5.7281	-5.741	**< .001**

Direct	IDACI ⇒ MA_ACAD_TP2_Y8	0.0592	0.0464	-0.0317	0.150	0.0549	1.276	0.202
	RECALLING_SENTENCES_SS_TP1_Y8 ⇒ MA_ACAD_TP2_Y8	-2.2977	3.5341	-9.2244	4.629	-4.0941	-0.650	0.516
	USP_SS_TP1_Y8 ⇒ MA_ACAD_TP2_Y8	3.7966	3.4726	-3.0096	10.603	6.7790	1.093	0.274
	WORD_READING_SS_TP1_Y8 ⇒ MA_ACAD_TP2_Y8	-1.6181	0.6149	-2.8232	-0.413	-2.6236	-2.632	**0.009**
Total	IDACI ⇒ MA_ACAD_TP2_Y8	0.2158	0.0481	0.1215	0.310	0.2001	4.484	**< .001**
	RECALLING_SENTENCES_SS_TP1_Y8 ⇒ MA_ACAD_TP2_Y8	-0.6062	3.9012	-8.2525	7.040	-1.0802	-0.155	0.877
	USP_SS_TP1_Y8 ⇒ MA_ACAD_TP2_Y8	3.6161	3.8378	-3.9059	11.138	6.4568	0.942	0.346
	WORD_READING_SS_TP1_Y8 ⇒ MA_ACAD_TP2_Y8	-3.2106	0.6556	-4.4956	-1.926	-5.2057	-4.897	< .001


IDACI
ING_SENTENCES_SS_TP1_Y8
USP_SS_TP1_Y8
RD_READING_SS_TP1_Y8
READING_TP1_Y8
SCI_ACAD_TP2_Y8

Indirect and total effects Y8 Science								
				95% C.I. (a)				
Type	**Effect**	**Estimate**	**SE**	**Lower**	**Upper**	**β**	**z**	**p**
Indirect	IDACI ⇒ READING_TP1_Y8 ⇒ SCI_ACAD_TP2_Y8	0.1914	0.0291	0.1343	0.2485	0.1728	6.568	**< .001**
	RECALLING_SENTENCES_SS_TP1_Y8 ⇒ READING_TP1_Y8 ⇒ SCI_ACAD_TP2_Y8	2.0667	2.0236	-1.8996	6.0329	3.5852	1.021	0.307
	USP_SS_TP1_Y8 ⇒ READING_TP1_Y8 ⇒ SCI_ACAD_TP2_Y8	-0.2205	1.9843	-4.1096	3.6687	-0.3833	-0.111	0.912
	WORD_READING_SS_TP1_Y8 ⇒ READING_TP1_Y8 ⇒ SCI_ACAD_TP2_Y8	-1.9458	0.3724	-2.6757	-1.2160	-3.0716	-5.225	**< .001**
Component	IDACI ⇒ READING_TP1_Y8	0.2633	0.0342	0.1962	0.3304	0.3222	7.692	**< .001**
	READING_TP1_Y8 ⇒ SCI_ACAD_TP2_Y8	0.7270	0.0576	0.6141	0.8399	0.5362	12.619	**< .001**
	RECALLING_SENTENCES_SS_TP1_Y8 ⇒ READING_TP1_Y8	2.8428	2.7745	-2.5950	8.2807	6.6858	1.025	0.306
	USP_SS_TP1_Y8 ⇒ READING_TP1_Y8	-0.3033	2.7294	-5.6528	5.0462	-0.7148	-0.111	0.912
	WORD_READING_SS_TP1_Y8 ⇒ READING_TP1_Y8	-2.6766	0.4663	-3.5904	-1.7627	-5.7281	-5.741	**< .001**

Direct	IDACI ⇒ SCI_ACAD_TP2_Y8	0.0997	0.0442	0.0131	0.1863	0.0900	2.255	0.024
	RECALLING_SENTENCES_SS_TP1_Y8 ⇒ SCI_ACAD_TP2_Y8	-3.1971	3.3682	-9.7987	3.4044	-5.5462	-0.949	0.343
	USP_SS_TP1_Y8 ⇒ SCI_ACAD_TP2_Y8	4.3477	3.3096	-2.1390	10.8344	7.5579	1.314	0.189
	WORD_READING_SS_TP1_Y8 ⇒ SCI_ACAD_TP2_Y8	-1.2353	0.5860	-2.3839	-0.0867	-1.9500	-2.108	0.035
Total	IDACI ⇒ SCI_ACAD_TP2_Y8	0.2911	0.0484	0.1961	0.3860	0.2628	6.008	**< .001**
	RECALLING_SENTENCES_SS_TP1_Y8 ⇒ SCI_ACAD_TP2_Y8	-1.1305	3.9270	-8.8272	6.5663	-1.9611	-0.288	0.773
	USP_SS_TP1_Y8 ⇒ SCI_ACAD_TP2_Y8	4.1272	3.8632	-3.4444	11.6989	7.1746	1.068	0.285
	WORD_READING_SS_TP1_Y8 ⇒ SCI_ACAD_TP2_Y8	-3.1811	0.6599	-4.4746	-1.8877	-5.0216	-4.820	**< .001**

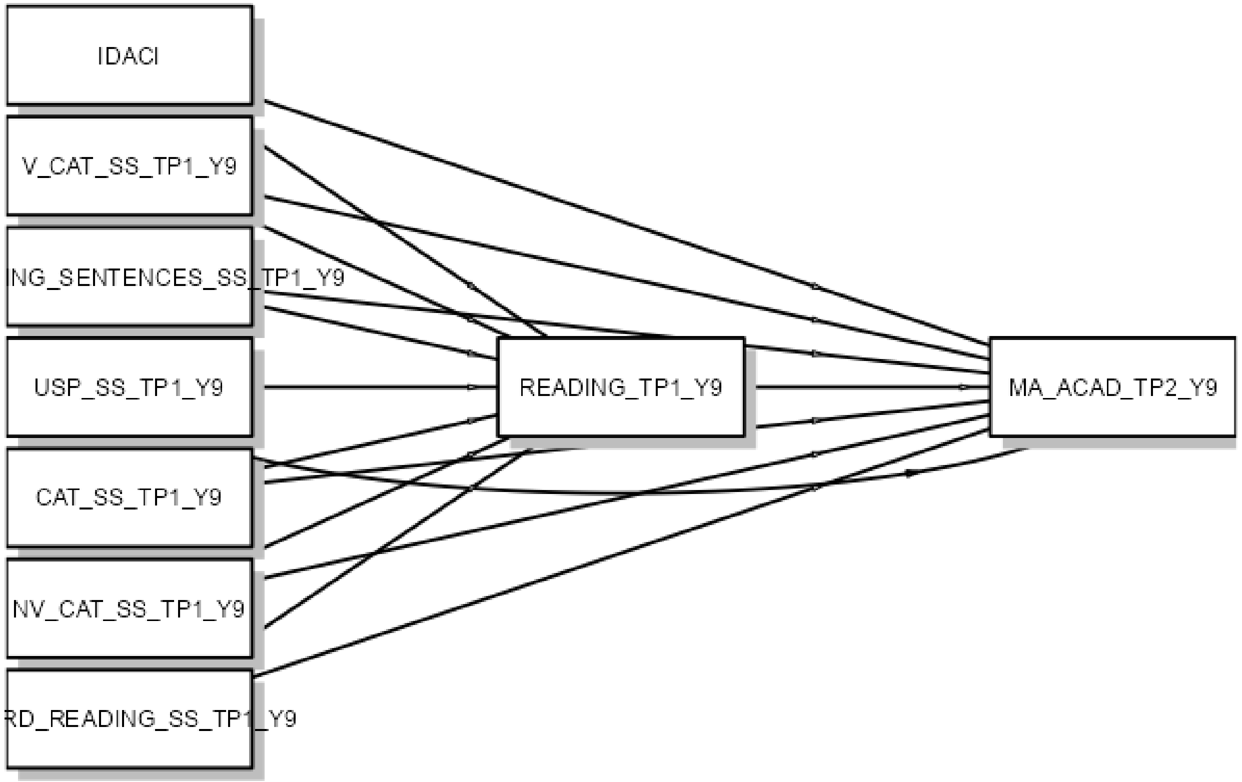
Note. Confidence intervals computed with method: Standard (Delta method)

Note. Betas are completely standardized effect sizes

Appendix 6E Mediation effects for Year Nine, Mathematics and Science

Year Nine Maths

Mediators Models		
	m1	READING_TP1_Y9 ~ IDACI + V_CAT_SS_TP1_Y9 + RECALLING_SENTENCES_SS_TP1_Y9 + USP_SS_TP1_Y9 + CAT_SS_TP1_Y9 + NV_CAT_SS_TP1_Y9 + WORD_READING_SS_TP1_Y9
Full Model		
	m2	MA_ACAD_TP2_Y9 ~ READING_TP1_Y9 + IDACI + V_CAT_SS_TP1_Y9 + RECALLING_SENTENCES_SS_TP1_Y9 + USP_SS_TP1_Y9 + CAT_SS_TP1_Y9 + NV_CAT_SS_TP1_Y9 + WORD_READING_SS_TP1_Y9
Indirect Effects		
	IE 1	IDACI ⇒ READING_TP1_Y9 ⇒ MA_ACAD_TP2_Y9
	IE 2	V_CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ MA_ACAD_TP2_Y9
	IE 3	RECALLING_SENTENCES_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ MA_ACAD_TP2_Y9
	IE 4	USP_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ MA_ACAD_TP2_Y9
	IE 5	CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ MA_ACAD_TP2_Y9
	IE 6	NV_CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ MA_ACAD_TP2_Y9
	IE 7	WORD_READING_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ MA_ACAD_TP2_Y9


IDACI
V_CAT_SS_TP1_Y9
NG_SENTENCES_SS_TP1_Y9
USP_SS_TP1_Y9
CAT_SS_TP1_Y9
NV_CAT_SS_TP1_Y9
RD_READING_SS_TP1_Y9
READING_TP1_Y9
MA_ACAD_TP2_Y9

Mediation, Y9 Mathematics

Indirect and total effects

				95% C.I. (a)				
Type	**Effect**	**Estimate**	**SE**	**Lower**	**Upper**	**β**	**z**	**p**
Indirect	IDACI ⇒ READING_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	-5.45e−4	0.00105	-0.00261	0.00152	-2.70e−4	-0.5172	0.605
	V_CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	5.59e-4	0.00200	-0.00336	0.00448	5.17e-4	0.2792	0.780
	RECALLING_SENTENCES_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	-0.01562	0.03026	-0.07492	0.04368	-0.01568	-0.5163	0.606
	USP_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	0.00206	0.00788	-0.01340	0.01751	0.00206	0.2608	0.794
	CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	-0.02478	0.04790	-0.11867	0.06911	-0.02288	-0.5172	0.605
	NV_CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	0.02468	0.04767	-0.06875	0.11811	0.02278	0.5177	0.605
	WORD_READING_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	-0.00369	0.00966	-0.02262	0.01525	-0.00337	-0.3816	0.703
Component	IDACI ⇒ READING_TP1_Y9	0.02948	0.01747	-0.00477	0.06372	0.01596	1.6870	0.092

	READING_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	-0.01848	0.03400	-0.08512	0.04817	-0.01693	-0.5434	0.587
	V_CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9	-0.03023	0.09292	-0.21234	0.15188	-0.03053	-0.3254	0.745
	RECALLING_SENTENCES_SS_TP1_Y9 ⇒ READING_TP1_Y9	0.84551	0.51023	-0.15453	1.84555	0.92625	1.6571	0.097
	USP_SS_TP1_Y9 ⇒ READING_TP1_Y9	-0.11129	0.37435	-0.84500	0.62241	-0.12197	-0.2973	0.766
	CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9	1.34101	0.79459	-0.21635	2.89837	1.35165	1.6877	0.091
	NV_CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9	-1.33577	0.78314	-2.87070	0.19915	-1.34606	-1.7057	0.088
	WORD_READING_SS_TP1_Y9 ⇒ READING_TP1_Y9	0.19953	0.37216	-0.52989	0.92895	0.19916	0.5361	0.592
Direct	IDACI ⇒ MA_ACAD_TP2_Y9	0.06107	0.01254	0.03649	0.08566	0.03029	4.8686	**< .001**
	V_CAT_SS_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	-0.00199	0.06651	-0.13234	0.12836	-0.00184	-0.0299	0.976
	RECALLING_SENTENCES_SS_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	-0.19663	0.36630	-0.91457	0.52131	-0.19733	-0.5368	0.591
	USP_SS_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	0.86607	0.26794	0.34091	1.39123	0.86951	3.2323	0.001
	CAT_SS_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	-0.50728	0.57051	-1.62545	0.61089	-0.46840	-0.8892	0.374
	NV_CAT_SS_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	0.47641	0.56233	-0.62573	1.57855	0.43980	0.8472	0.397

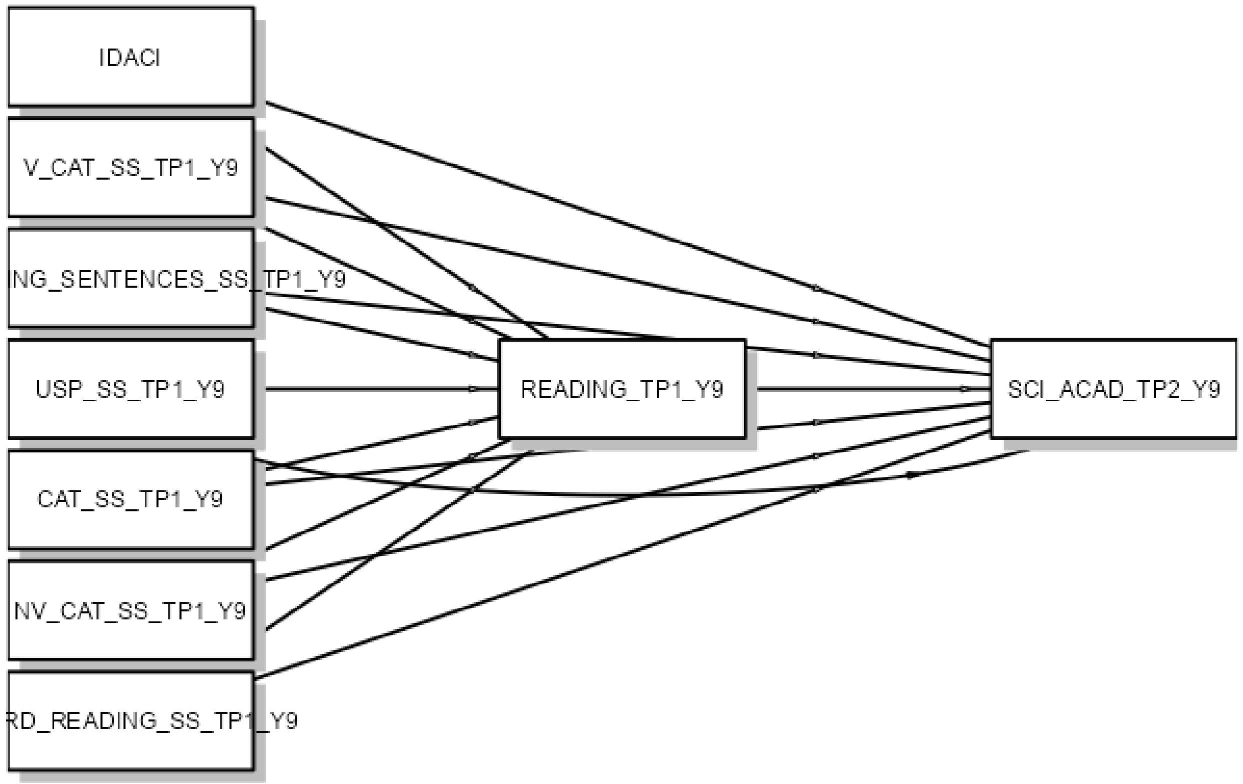
	WORD_READING_SS_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	0.39803	0.26644	-0.12418	0.92024	0.36396	1.4939	0.135
Total	IDACI ⇒ MA_ACAD_TP2_Y9	0.06053	0.01252	0.03599	0.08507	0.03002	4.8336	**< .001**
	V_CAT_SS_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	-0.00143	0.06660	-0.13196	0.12910	-0.00132	-0.0215	0.983
	RECALLING_SENTENCES_SS_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	-0.21225	0.36571	-0.92902	0.50452	-0.21301	-0.5804	0.562
	USP_SS_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	0.86812	0.26831	0.34225	1.39400	0.87157	3.2355	0.001
	CAT_SS_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	-0.53206	0.56951	-1.64829	0.58416	-0.49129	-0.9342	0.350
	NV_CAT_SS_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	0.50110	0.56131	-0.59905	1.60124	0.46259	0.8927	0.372
	WORD_READING_SS_TP1_Y9 ⇒ MA_ACAD_TP2_Y9	0.39434	0.26674	-0.12846	0.91715	0.36059	1.4784	0.139

Note. Confidence intervals computed with method: Standard (Delta method)

Note. Betas are completely standardized effect sizes

Year Nine Science

Mediators Models		
	m1	READING_TP1_Y9 ~ IDACI + V_CAT_SS_TP1_Y9 + RECALLING_SENTENCES_SS_TP1_Y9 + USP_SS_TP1_Y9 + CAT_SS_TP1_Y9 + NV_CAT_SS_TP1_Y9 + WORD_READING_SS_TP1_Y9
Full Model		
	m2	SCI_ACAD_TP2_Y9 ~ READING_TP1_Y9 + IDACI + V_CAT_SS_TP1_Y9 + RECALLING_SENTENCES_SS_TP1_Y9 + USP_SS_TP1_Y9 + CAT_SS_TP1_Y9 + NV_CAT_SS_TP1_Y9 + WORD_READING_SS_TP1_Y9
Indirect Effects		
	IE 1	IDACI ⇒ READING_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9
	IE 2	V_CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9
	IE 3	RECALLING_SENTENCES_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9
	IE 4	USP_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9
	IE 5	CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9
	IE 6	NV_CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9
	IE 7	WORD_READING_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9


IDACI
V_CAT_SS_TP1_Y9
NG_SENTENCES_SS_TP1_Y9
USP_SS_TP1_Y9
CAT_SS_TP1_Y9
NV_CAT_SS_TP1_Y9
RD_READING_SS_TP1_Y9
READING_TP1_Y9
SCI_ACAD_TP2_Y9

Mediation Y9 Science

Indirect and total effects								
Type	**Effect**	**Estimate**	**SE**	**Lower**	**Upper**	**β**	**z**	**p**
Indirect	IDACI ⇒ READING_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	-0.00114	0.00287	-0.00675	0.00448	-4.67e−4	-0.39700	0.691
	V_CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	7.03e-4	0.01294	-0.02466	0.02607	5.38e-4	0.05429	0.957
	RECALLING_SENTENCES_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	-0.01287	0.07294	-0.15583	0.13010	-0.01069	-0.17642	0.860
	USP_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	-0.01213	0.05448	-0.11892	0.09465	-0.01008	-0.22274	0.824
	CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	-1.15e−4	0.11038	-0.21645	0.21622	-8.81e−5	-0.00104	0.999
	NV_CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	4.17e-4	0.10879	-0.21281	0.21364	3.19e-4	0.00384	0.997
	WORD_READING_SS_TP1_Y9 ⇒ READING_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	-0.01152	0.05395	-0.11726	0.09422	-0.00872	-0.21353	0.831
Component	IDACI ⇒ READING_TP1_Y9	0.02939	0.06270	-0.09350	0.15228	0.01317	0.46870	0.639

	READING_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	-0.03871	0.05183	-0.14029	0.06287	-0.03547	-0.74686	0.455
	V_CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9	-0.01815	0.33344	-0.67169	0.63539	-0.01517	-0.05443	0.957
	RECALLING_SENTENCES_SS_TP1_Y9 ⇒ READING_TP1_Y9	0.33243	1.83106	-3.25637	3.92124	0.30133	0.18155	0.856
	USP_SS_TP1_Y9 ⇒ READING_TP1_Y9	0.31349	1.34340	-2.31953	2.94652	0.28427	0.23336	0.815
	CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9	0.00298	2.85150	-5.58586	5.59182	0.00248	0.00104	0.999
	NV_CAT_SS_TP1_Y9 ⇒ READING_TP1_Y9	-0.01078	2.81042	-5.51912	5.49755	-0.00899	-0.00384	0.997
	WORD_READING_SS_TP1_Y9 ⇒ READING_TP1_Y9	0.29761	1.33555	-2.32002	2.91524	0.24579	0.22283	0.824
Direct	IDACI ⇒ SCI_ACAD_TP2_Y9	0.07700	0.06842	-0.05710	0.21109	0.03161	1.12541	0.260
	V_CAT_SS_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	0.01341	0.36374	-0.69951	0.72633	0.01027	0.03686	0.971
	RECALLING_SENTENCES_SS_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	0.31371	1.99750	-3.60132	4.22875	0.26058	0.15705	0.875
	USP_SS_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	0.33067	1.46556	-2.54177	3.20311	0.27477	0.22563	0.821
	CAT_SS_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	0.05546	3.11059	-6.04119	6.15210	0.04238	0.01783	0.986
	NV_CAT_SS_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	0.06449	3.06578	-5.94433	6.07331	0.04927	0.02103	0.983

	WORD_READING_SS_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	0.26827	1.45698	-2.58736	3.12390	0.20303	0.18413	0.854
Total	IDACI ⇒ SCI_ACAD_TP2_Y9	0.07508	0.01902	0.03781	0.11235	0.03727	3.94841	**< .001**
	V_CAT_SS_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	-0.00488	0.10113	-0.20308	0.19332	-0.00452	-0.04826	0.962
	RECALLING_SENTENCES_SS_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	0.26726	0.55532	-0.82114	1.35567	0.26840	0.48128	0.630
	USP_SS_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	0.69539	0.40742	-0.10314	1.49393	0.69863	1.70681	0.088
	CAT_SS_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	-0.79677	0.86479	-2.49174	0.89819	-0.73620	-0.92134	0.357
	NV_CAT_SS_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	0.94045	0.85234	-0.73010	2.61100	0.86876	1.10337	0.270
	WORD_READING_SS_TP1_Y9 ⇒ SCI_ACAD_TP2_Y9	-0.12429	0.40504	-0.91816	0.66958	-0.11373	-0.30686	0.759

Note. Confidence intervals computed with method: Standard (Delta method)

Note. Betas are completely standardized effect sizes