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Measuring phonological and morphological awareness and children with and without developmental language disorder

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Measuring Phonological and Morphological Awareness and Children with and without Developmental Language Disorder

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Abbreviations

Continuum of Awareness for Morphological Processing Tasks (CAMPT)

Continuum of Awareness for Phonological Processing Tasks (CAPPT)

Developmental Language Disorder (DLD)

Developmental Language Disorder and comorbid literacy difficulties (DLD+)

English as an Additional Language (EAL)

Intelligence Quotient (IQ)

Mean (M); Standard Deviation (SD)

Principal Component Analysis (PCA)

Response time (RT)

Specific Language Impairment (SLI)

Typically Developing (TD)

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Abstract

This thesis sought to achieve three key objectives. Firstly, it sought to develop and evaluate implicit-to-explicit continua for phonological and morphological awareness tasks. Next, it sought to develop our understanding of children with Developmental Language Disorder (DLD) by examining their profiles of strengths and weaknesses on these continua. Finally, it sought to develop our understanding of how having additional literacy difficulties, low IQ and/or English as an additional language (EAL) affect the profile of those with DLD.

Recently there have been several papers that have noted that we do not know enough about precisely what our measures of phonological and morphological awareness are measuring (e.g., Duncan et al., 2013; Critten, Pine and Messer, 2013; Protopapas, 2014; Carroll and Breadmore, 2017). However, research has indicated that there may be implicit-to-explicit differences between task types, particularly for phonological awareness tasks (e.g., Roberts and McDougall, 2003; Gombert, 1992, Yopp, 1988; Ramus et al., 2013). This thesis further investigated this possibility by developing a phonological and morphological continuum for implicit-to-explicit task differences through the application of Karmiloff-Smith's (1992) Representation Redescription Model's framework and other task classification systems that are already present in the literature. These continua are then evaluated through a factor analysis study conducted with 81 typically developing children aged five years to

twelve years old. The factor analysis indicated that both phonological and morphological tasks vary according to implicit-to-explicit task requirements.

The findings from the continua were then applied, allowing for a fine-grained evaluation of the profile of strengths and weaknesses of 70 children aged six years to eleven years old with DLD-only and compared them against individuals who are typically developing, DLD with literacy difficulties, DLD with low IQ and DLD with English as an Additional Language. Overall, these findings suggest that individuals with DLD have a profile of strengths and weaknesses for their phonological awareness in relation to their typically developing peers, but are much more wholly impaired in their morphological awareness than their phonological awareness abilities. However, the precise profile of difficulty varied considerably according to the diagnostic criteria used. Alongside the developments in our understanding of DLD, these findings have important implications for the support of those with DLD, as they can allow for more targetted interventions. These implications are especially important due to the new changes in the definition of DLD which now includes those children with broader difficulties (i.e., low IQ, reading difficulties or EAL). Furthermore, these findings suggest the importance of taking a fine-grained approach when investigating profiles of strengths or difficulties, as task selection could lead to large differences in results.

General Introduction

Background Information and Overall Rationale

Within the research literature, there has been a relatively new realisation that we do not know enough about precisely what measures of phonological and morphological awareness are measuring (Duncan et al., 2013; Critten, Pine and Messer, 2013; Carroll and Breadmore, 2017). It has been noted that tasks can vary according to the task demands they place on individuals, as well as differences in stimulus and response type (Ramus et al., 2013; Cunningham et al., 2015). Implicit and explicit levels of knowledge and understanding have been empirically supported in domains of language (Karmiloff-Smith, 1992; Ellis, 2008) and literacy (Critten, Pine and Messer, 2013; Critten, Pine and Steffler, 2007; Critten, Sheriston and Mann, 2016), including areas of phonology (Ramus and Ahissar, 2012; Mundy and Carroll, 2013) and morphology (Dienes et al., 1991). There are several different models and frameworks for understanding cognitive development. However, Karmiloff-Smith's (1992) Representational Redescription (RR) Model can account for how individuals can have both implicit and explicit knowledge/understanding within a given domain and how usage of the different types of knowledge may vary according to task demands.

The RR Model provides a framework for cognitive development where learning can be understood as a process of implicit representations, becoming redescribed into increasingly explicit representations. The model also advocates a multi-representational cognitive system where earlier levels of representation remain intact following redescription. This model allows individuals to access representations at each level, and to use the most appropriate for the tasks at hand. For example, implicit representations are much better for tasks that require automaticity and fast speed of retrieval; whereas explicit representations are more necessary when individuals need to verbalise their actions and/or generalise their knowledge to a new situation. Overall, the RR Model provides an in-depth account of how individuals can have a difference between their level of understanding compared to their performance and that it is possible for individuals to have intact representations and complete some tasks but not others. Therefore, the RR Model could offer several insights into the measurement and development of phonological and morphological skills.

Moreover, it has been suggested that understanding these task type differences will enable researchers to better understand language and literacy impairments (Protopapas, 2014; Duncan et al., 2013). Especially as knowledge of phonology and morphology are both key for the acquisition of language and literacy (Hulme and Snowling, 2014; Casalis, Cole and Sopo, 2004). Furthermore, the implicit-to-explicit approach to task differences has received some support within the domains of language (Karmiloff-Smith, 1992), as well as differentiating between those with language and/or literacy difficulties (Ramus et al., 2013).

Up until recently, Specific Language Impairment (SLI) was the accepted term used to describe children who had difficulties with expressive or receptive language, despite adequate learning opportunities, normal IQ and normal hearing (Leonard, 1998). However, now the accepted term is Developmental Language Disorder (DLD: Bishop et al., 2017). Furthermore, in addition to the changes in terminology, the definition has also changed. The previous definition of SLI had several exclusionary clauses (i.e., average nonverbal IQ and first language requirements), whereas the new

DLD definition does not. DLD can be defined as unexplained language difficulties that are unlikely to resolve without support (Bishop et al., 2017).

Children with DLD often show a delay in their language development and have pervasive difficulties in components of language; such as vocabulary (Marshall, Ramus and van der Lely, 2010), morphological awareness and sentence structure (Fletcher and Ingham, 1995) and phonological difficulties (van Alphen et al., 2004). These difficulties can be expressed in many ways, including restricted vocabulary and difficulties understanding complex language, the use of simplified grammar structures, and the production of immature or deviant speech sounds (Bishop, 2006). Phonological and morphological awareness tasks have been found to be useful in gaining a further understanding of the difficulties experienced by those with DLD.

Previously it was expected that those with SLI would only experience difficulties with language, however more recently it has been understood that this is the exception and not the rule (Bishop et al., 2012). In fact, those with language impairments are highly likely to have additional difficulties in other domains, such as literacy and nonverbal intelligence. This realisation is partly responsible for the change in definition particularly as there was a large discrepancy between the old SLI criteria and the reality faced by clinicians, for example previously children could not be given a diagnosis of SLI if they had below average nonverbal IQ but, many children presenting with language difficulties also had an additional difficulty here. Furthermore, although previous definitions of SLI excluded those with English as an additional language (EAL), the new DLD definition does not. Due to these recent changes in terminology and definition, not much is known about the precise profile of strengths and weaknesses individuals with DLD face. Therefore, the current thesis seeks to look precisely at the profile of phonological and morphological awareness of the individuals with DLD using newly developed theoretical continua. Furthermore, this will also be explored in relation to the individual differences in literacy-level, nonverbal IQ and EAL status.

Research Questions and Contributions to Knowledge

In summary, there are several gaps in the literature in which the current thesis will try to address. Firstly, it seeks to address implicit and explicit differences in phonological and morphological awareness tasks. Secondly, it seeks to address how those with DLD fare on these tasks, when considering their implicit-to-explicit differences. Thirdly, this thesis seeks to address how differences in the new DLD definition effect performance of those with language difficulties. These areas will be examined through the following research questions:

1. Can implicit-to-explicit continua be developed and evaluated for phonological awareness and morphological awareness tasks?
2. How will children with DLD-only, DLD with literacy difficulties and typical controls compare on an extensive range of tasks drawn from these continua?
3. Whether individual differences in literacy-level, nonverbal IQ and EAL status will affect performance on implicit-to-explicit continua for phonological and morphological awareness tasks for those with DLD or DLD with literacy difficulties?

From this thesis, there are several unique contributions to knowledge. The first contribution is the development and validation of implicit-to-explicit phonological and morphological awareness continua. This contribution will develop our understanding of how tasks can vary. The next contribution relates to DLD, and its frequent comorbidity with literacy difficulties; specifically, how those with DLD and DLD with literacy difficulties will compare on their profiles of phonological and morphological awareness using the more finely-grained implicit to explicit continua. Finally, the next contribution relates to the new definition and diagnostic criteria applied to DLD; especially whether individual differences in nonverbal IQ and EAL status affect the phonological and morphological profile of those with DLD. This contribution will develop our understanding of the potential implications of the new, more inclusive definition of DLD and enable the development of more specialised interventions.

Thesis Structure

The literature review for the current thesis has been split into two parts. Chapter 1 reviews the literature in relation to phonological and morphological awareness both in general and in relation to children with language difficulties. Throughout this Chapter, the term SLI will be used to describe language difficulties, as this is more in line with the research under discussion. The second part of the literature review forms Chapter 2 and will outline the debate and controversies concerning SLI and introduce the new term DLD. This term will then be used for the remainder of the thesis to describe unexplained language difficulties. Furthermore, this Chapter will introduce the different diagnostic criteria that were commonly used in previous SLI research.

Chapter 3 outlines the development of the Continuum of Awareness for Phonological Processing Tasks (CAPPT) and the Continuum of Awareness for

Morphological Processing Tasks (CAMPT). This Chapter outlines the theoretical framework for each continuum, which was informed by Karmiloff-Smith's (1998) RR Model. The Chapter also reviews previous research assessing task demand differences in phonological and morphological awareness tasks. Finally, it outlines the CAPPT and the CAMPT and the tasks that have been mapped on to each continuum.

Due to the limited number of pre-existing morphological awareness tasks and due to the specific requirements needed for tasks, the current thesis had to adapt several existing morphological awareness tasks to map them onto the CAMPT. Chapter 4 outlines the processes involved in this; the measure adaptations and the reasons for them, as well as the methods and results of a pilot study conducted on typically developing children to evaluate these tasks.

Chapter 5 outlines the evaluation processes involved for the CAPPT and the CAMPT. In order to assess whether the theoretical CAPPT and CAMPT were supported, an empirical study was conducted on typically developing children and those with DLD and analysed using factor analysis. The methods and results of this study are outlined and discussed in this Chapter.

Chapter 6 compares the performance of those with DLD-only, DLD and literacy difficulties and typically developing children on the CAPPT and the CAMPT. Furthermore, this also investigates how individual differences in nonverbal IQ and EAL status affect the phonological and morphological profile of those with DLD and DLD with literacy difficulties. Moreover, in addition to these group-based analyses, this Chapter investigates the relationship between the factors of the CAPPT and CAMPT and language and reading ability using hierarchical regression.

Chapter 7 sought to investigate whether item-type differences, in addition to task demands, can affect the phonological or morphological profile of those with DLD or DLD and literacy difficulties. This Chapter reviews the literature and outlines the item-type differences within the tasks used in the current thesis before exploring item-type effects in children with DLD, DLD and literacy difficulties, and typically-developing controls.

Finally, Chapter 8 (the General Discussion) discusses the results of each analysis in relation to the research questions and considers the broader implications of the overall findings for the measurement of phonological and morphological awareness, and our understanding of DLD. Finally, it reviews the potential limitations of the current thesis and outlines several suggestions for future research.

Chapter One: Literature Review Part One - Measuring Phonological and Morphological Awareness and Children with and without Developmental Language Disorder

The focus of this Chapter is to outline the rationale and background information for the first two research question of the current thesis. Moreover, this Chapter seeks to outline and define phonological and morphological awareness, focusing on their development and the importance of these skill to language and literacy ability. Furthermore, this Chapter will briefly outline the difficulties in the assessment and measurement of phonological and morphological awareness. Building upon this, it will suggest a new framework for measurement. Finally, this Chapter will outline the first two research questions of the current thesis.

Phonological Awareness: Definition, Development and Importance

Within language, there is a complex structure of sound units, which are formed together to create words. Syllables are the largest units of speech that words can be divided into (e.g., 'purple' can be divided into the two syllables 'pur' and 'ple'). Onset-rime is seen as the next smallest unit of speech and these refer to the phoneme(s) before the first vowel, and the vowel plus any remaining phonemes (e.g., 'gr-een'). Finally, phonemes are the smallest units of speech, (e.g., the word 'cat' consists of three phonemes: c/ a/ t). Phonological awareness is understood as the awareness of this sound structure within language (Treutlein et al., 2008; Wagner and Torgesen, 1987; and Nithart et al., 2011; Kirby et al., 2008); it is seen as being a multilevel skill comprising of syllable awareness, onset-rime awareness (sensitivity to rhyme) and phoneme awareness (Gillon, 2004; and Kirby et al., 2008). Phonological awareness is a skill where children can vary in their ability. Individuals with a lower level of this skill may only be able to detect different units (e.g. syllables and phonemes) (Phillips, Clancy-Mechetti and Lonigan, 2008), whereas those with a higher level of understanding can explicitly attend to, judge and manipulate speech sounds (Ramus and Ahissar, 2012).

Phonological awareness has been argued to develop in a large-to-small fashion (Anthony et al., 2003), whereby awareness of larger units, such as syllables, emerges before awareness of phonemes. The Lexical Restructuring (LR) model (Metsala and Walley, 1998) outlines that phonological awareness develops alongside the lexicon. Initially, spoken words are unanalysed wholes where global acoustic and prosodic structure are used for recognition, but when individuals' vocabulary expands, there is an increased need for sub-lexical analyses of words. These initially start out at the syllabic level but then get fine-tuned down to onset and rime and, finally, phoneme-level representations. Indeed, children only tend to acquire proficiency with the latter following direct instruction programmes in school (Kirby, Descrochers, Roth & Lai, 2008).

As well as being a critical skill in its own right, not least because of its importance for later literacy development (e.g. Bishop and Snowling, 2004), phonological awareness is also crucial for the acquisition of broader oral language skills (Protopapas, 2014; Hulme and Snowling, 2014). Phonological development starts in infancy and consists of two basic components: cognitive-linguistic understanding (phonological awareness) and speech-motor skills. Overall language ability develops alongside this phonological development. However, children start to develop their speech-motor skills first. For example, by around six to seven months old infants begin to produce consonant-vowel (CV) syllables that are modelled on adult speech, although non-meaningful (Stoel-Gammon and Sosa, 2008). Infants then associate these motor commands for the non-meaningful syllables with their acoustic output, creating a "feedback loop" which is crucial for speech development throughout life (Fry, 1996). This feedback loop is then also used to transform the non-meaningful vocalisation into meaningful speech, for example, children begin to match the babble *ma* with the real word *mama* (Stoel-Gammon and Sosa, 2008). Phonological awareness is implicated in this early language development, as this forms the basis of the feedback loop (within the lower level, detection skills).

Furthermore, it has been found that the phonological structure of infants' babbles carries through to their first words; the individual sound pattern preferences in babble form the building blocks of the child's first words (Schwartz and Leonard, 1982). This finding further suggests the importance of early phonological development for broader language skills.

Additionally, the Cognitive Theory of phonological development explains how this process is used to form the base of one's linguistic abilities and how this is used to build one's lexicon (Ferguson and Farwell, 1975). The cognitive theory outlines that children play an active role in their vocabulary development, choosing words to say based on their articulatory abilities which they then manipulate and test (Stoel-

Gammon and Sosa, 2008). The lexicon is the term used to describe the internal 'dictionary' one uses to store words; which is an essential construct for the mental representation of words and phonological units. The lexicon is essential for language as this is where all words and word meanings are stored; which is essential for one's vocabulary. Overall this suggests the importance of phonological awareness in language development, as this helps build the feedback loop, speech production and vocabulary.

As well as being implicated in the typical development of oral language, it has also been noted that phonological awareness is impaired in individuals with language difficulties (Ramus et al., 2013; de Bree and Kerkhoff, 2010). For example, individuals with language difficulties have been found to struggle with phonological awareness tasks, such as phoneme deletion, phoneme substitution and spoonerism tasks (Vandewalle et al., 2012). Furthermore, they have also been found to struggle with verbal short-term memory and lexical access (i.e., rapid naming tasks), which are also seen as highly related to phonological processing skills (Vandewalle et al., 2012). Performance on a non-word repetition task has been claimed to be a reliable marker of language impairments (Gathercole et al., 1994).

Aside from strong links with language development, phonological awareness is the primary focus of several accounts of reading acquisition and reading disability. Furthermore, there is now an impressive body of research linking phonological awareness and reading together (e.g., Coltheart, 2005; Bishop and Snowling, 2004; and Ehri et al., 2001). The strong association between these skills has been noted in a variety of orthographies, beyond individual differences in IQ, vocabulary, chronological age and reading experience (Gillon, 2004:57; Wagner, Torgeson and Rashotte, 1994; Lonigan, Burgess and Antony, 2000).

The Alphabetic Principle is the notion that all letters represent specific phonological units and speech sounds (McBride-Chang, 2004; Stahl, Duffy-Hester and Stahl, 1998). The Alphabetic Principle has been argued to be crucial for children's reading development (Adams, 1990) and it has also been found to have high cross-cultural importance in many different languages and orthographies (Duzy et al., 2013). Once a child has fully acquired the Alphabetic Principle they can learn to associate letters and symbols with the correct phoneme; then children can learn to apply these correspondences to decode unfamiliar text; deficits in children's phonological awareness have been found to impair individuals' Alphabetic Principle (Zhang and McBride-Chang, 2013:73). As the Alphabetic Principle relies on the ability to associate symbols and phonemes, individuals with deficits in their phonological awareness struggle to apply aspects of phonology that are manifested within reading, specifically the abilities to understand that graphemes represent phonemes in a written context (Byrne, Samuelsson and Olson, 2013:301).

Morphological Awareness: Definition, Development and Importance

In alphabetic systems, words carry morphological as well as phonological information, and there is now growing evidence for the importance of morphological as well as phonological knowledge for typical language development (Casalis, Cole and Sopo, 2004). A morpheme is the smallest unit of meaning within language, and morphological awareness is an awareness of how units of meaning are constructed within language (e.g., '*walked*' can be broken down to '*walk*' and '*ed*': Schiff, Schwartz-

Nahshon and Nagar, 2011). There are two different types of morpheme: free and bound. Free morphemes are stand-alone words that hold independent meaning and consist of either open-class content words (e.g., apple, walk, lovely) or closed-class function words (e.g., the, on, and).

In contrast, bound morphemes are not (in themselves) words and in English mainly consist of affixes that can be further divided into two types: inflectional suffixes or derivational prefixes and suffixes. However, occasionally bound morphemes can form root morphemes too, such as the '*nov'* in 'innovate' and the '*rupt'* in 'interrupt'. Inflectional morphemes provide grammatical information about the base words they are bound to through marking, for example, verb agreement, adding the regular plural –*s*, or by adding the regular past tense marker *-ed*. By contrast, derivational morphemes produce semantic changes by transforming the grammatical form of a word, for example, adding *–ent* to the verb '*differ'* creates the adjective '*different'*.

Morphemes carry phonological, semantic and syntactic information; this makes morphological awareness important to both language and literacy development. Morphological awareness is another important aspect of language development for young children, as it allows individuals to determine the meaning of unfamiliar words or to even create new words (Larsen and Nippold, 2007). Morphological awareness has been described as a metalinguistic skill (i.e., one that requires reflection), that is based on underlying epilinguistic abilities (Casalis, Cole and Sopo, 2004). For example, Anglin (1993) conducted a study where children aged six to eleven years were asked to define unfamiliar morphologically complex words (i.e., *beastly*, *fearsome*, *oddity*). The older children were much more likely to break the words into their morphemes to understand them (e.g., explaining *beast*, and the suffix –*ly*); whereas younger children were less inclined to analyse words in this way. This finding shows that the older children had sufficient morphological awareness and could use their previous knowledge of morphemes to help decipher the meaning of the new words. However, this type of morphological analysis has been found only to be helpful to children when they are familiar with the root word (Anglin, 1993). Dissimilarly to phonological awareness, which is argued to develop from large-to-small (Anthony et al., 2003; Gombert, 1992) it has been argued that morphological awareness develops in a non-linear fashion (Casalis, Cole and Sopo, 2004); this is because levels of morphological complexity are not mastered simultaneously but according to their frequency and their utility in new tasks. For example, children may not learn the derivational morphemes *-ful* and *-ly* until they learn about adverbs and descriptive writing in school whereas the inflectional morphemes *-s* and *-ed* may be learnt much sooner as they are more important for comprehension.

One factor that may help shape the development of children's morphological awareness is their level of literacy development. Children encounter up to 3,000 unfamiliar words each year while reading and as much as 80% of these are morphologically complex (Nagy and Anderson, 1984). Therefore, morphological awareness will develop in line with the most frequently encountered roots and affixes. However some words that have low-frequency roots or affixes may be learnt as a whole, for example, the affix –*some* (i.e., in handsome, fearsome and awesome) returned only five words whilst searching the Children's Printed Word Database (Masterson, Dixon and Stuart, 2003), whereas the affix –*ly* returned over two hundred and fifty. Therefore as some affixes are far less productive, it might be more useful for children to learn this as a whole, instead of as an affix. Indicating that although children need to learn high-frequency affixes, they do not necessarily need to learn low-frequency ones.

Furthermore, the role of morphology in literacy development is itself an area of increasing research. Morphological awareness has been found to be essential to both reading and spelling skills, even in early school years. However, this is an area that has been relatively neglected by researchers (Carlisle, 1995). Although phonological awareness has been found to be the most reliable predictor of early reading development, morphological awareness has been found to be more important for later reading development (Casalis, Cole and Sopo, 2004; Kuo and Anderson, 2006; Nagy, Berninger and Abbott, 2006). Morphological awareness has also been found to be a stronger predictor of comprehension, whereas phonological awareness has been found to be a stronger predictor of word analysis (Carlisle, 1995).

Language Difficulties

As summarised in the opening sections of this Chapter, phonological and morphological awareness have been implicated in typical development of both oral language and literacy. Phonological and morphological awareness skills have also been measured in children with diagnosed language and literacy difficulties in an attempt to, firstly, elucidate which skills children with these disorders may struggle with, secondly, help develop theories of what may cause these disorders and, finally, attempt to differentiate between overlapping disorders.

Unexplained language difficulties are common in children, with prevalence estimates of up to 7% (Tomblin et al., 1997). These difficulties have been well documented, both in research and clinical settings. However, there is little agreement over the terminology and criteria that should be used to identify and classify these language difficulties. Previously, there was a large range of terms available to label children with these difficulties. Specific Language Impairment (SLI) was the most common and accepted term. However, the term SLI recently became central to the debate over the criteria that should be used for identifying this disorder and has become controversial. Ebbels (2014) outlined how the term had become controversial as it did not seem to reflect clinical realities and excluded many children from services.

The work of the RALLI (Raising Awareness of Language Learning Impairments) thesis led by Bishop et al. (2012) has sought to add some clarity to this debate (the work of RALLI (now RADLD) will be outlined more fully in Chapter 2). The result of this work is a new consensus among researchers, clinicians and teachers over the correct terminology and criteria that should be used to describe the unexplained language difficulties many children face. Developmental Language Disorder (DLD) is now the accepted term and is defined as a persistent language problem which impacts on everyday social and educational progress (Bishop et al., 2017).

Furthermore, it is now understood that DLD is quite likely to co-occur with several other disorders, such as literacy impairments, attentional difficulties and motor skill impairments. This was something that was not encompassed in previous definitions of SLI. Children with DLD often show a delay in language development and have pervasive difficulties in components of language such as vocabulary (Marshall, Ramus and van der Lely, 2010), morphological awareness and sentence structure (Fletcher and Ingham, 1995), and phonological difficulties (van Alphen et al., 2004). These difficulties can be expressed in many different ways, including restricted vocabulary and difficulties understanding complex language, the use of simplified grammar structures, and the production of immature or deviant speech sounds (Bishop, 2006). These problems are often combined with a delay in starting to talk and a weak verbal short-term memory (Bishop et al., 2016). Phonological and morphological awareness capabilities have therefore been found to be useful in gaining a further understanding of the difficulties experienced by those with DLD.

Language Impairments and Phonological Abilities

Prior to the debate outlined briefly above and the adoption of the DLD terminology for unexplained language difficulties, a number of studies had explored the phonological and morphological abilities of children meeting the diagnostic criteria for SLI. Indeed, measurement of phonological abilities and awareness has been a very important part of understanding the difficulties experienced by children with SLI. Many of these children have been found to have a phonological deficit, and therefore it has been proposed that this deficit is a primary cause of their language difficulties due to the wider impact on higher level language skills, such as lexical, semantic and syntactic abilities (Joanisse and Seidenberg, 1998). Additionally, children with SLI have been found to have a deficit in nonword repetition as well as word recall (Gathercole and Baddeley, 1990; Graf Estes, Evans and Else-Quest, 2007). This finding suggests that children with SLI have degraded verbal short-term and working memory which may affect their phonological awareness. Individuals with SLI have also been found to have problems with understanding of segmental phonology at a rhyme level (Briscoe, Bishop and Norbury, 2001), and expressive phonology, often experiencing difficulties with speech output processes and pronunciation (Bishop and Snowling, 2004).

Despite the findings outlined above, not all individuals with SLI have been found to have a phonological deficit. Gardner et al. (2006) conducted a large-scale study with just under 700 participants; they found that of those children with SLI one-third had both a grammatical and a phonological deficit, one-third with only a grammatical deficit and one-third with only a phonological deficit. This finding shows the heterogeneity of this disorder possibly suggesting that there are a variety of different subtypes of SLI, which present differently in some individuals. Another potential explanation for this diversity in phonological abilities may be due to comorbidities with other disorders, such as Dyslexia, which co-occurs in around 50% of individuals with SLI, and is itself strongly associated with phonological difficulties (Bishop and Snowling, 2004). This finding could pose an explanation for the findings of Gardner et al. (2006) as they did not screen their participant's literacy and language abilities directly. Instead, they relied on professional diagnosis from Speech and Language Therapists (SLTs) and other professionals. Therefore, the distinct subtypes of SLI found by Gardner et al. (2006) could potentially be explained by comorbidities with Dyslexia. Particularly as, several studies have shown that when SLI does not co-occur with reading difficulties, it is not associated with a phonological deficit (Catts et al., 2005; Kamhi and Catts, 1986; Snowling, Bishop and Stothard, 2000).

Language Impairments and Morphological Abilities

Measurement of morphological abilities and awareness in children with SLI has also been a strong research focus. In fact, difficulties with morphology are arguably more pervasive than those for phonology among individuals with SLI. For example, it has been noted that only children with language and literacy impairments have consistent deficits in their phonological abilities, with some individuals with language-only impairments not having phonological difficulties at all (Ramus et al., 2013; Bishop et al., 2009; Wijnen et al., 2015). The cognitive profile of deficits individuals with SLI experience differs cross-linguistically (Leonard, 1998). However, in English-speaking children, the grammatical deficit manifests itself as a deficit in acquiring appropriate tense marking which results in the omission of past tense -*ed* and third person singular -*s* suffixes, copula and auxiliary *be* forms and auxiliary *do* forms (van der Lely and Ullman, 2001). This appears to be a particularly marked area of difficulty for regular words (Krok and Leonard, 2015). Studies have also shown that children with SLI often experience deficits in acquiring derivational morphemes such as agentive –*er* (*singer*), the comparative –*er* (*faster*), the superlative –*est* (*fastest*), the diminutive –*let* (*piglet*), and the adjectival –*y* (*dirty*: Larsen and Nippold, 2007). A deficit in thematic role assignment (who did what to whom) has also been noted to be an area of difficulty within individuals with SLI (Bishop, 2004). These deficits lead to problems with children's expressive and receptive language.

Furthermore, the development and use of tense marking morphemes emerge much later in English children with SLI than in their typically developing peers, and these morphemes are used far more inconsistently when they are acquired (Rice, Wexler and Cleave, 1995; van der Lely and Ullman, 1991). This deficit is also present in several other Germanic languages, including Dutch, German, Norwegian and Swedish (see Krok and Leonard, 2015 for review). One of the theories proposed for this is that individuals with SLI have a difficulty acquiring implicit grammatical rules and learn regular items in the same item-by-item manner as irregular words (Gopnik and Crago, 1991). However, more recent studies have stated that this may be due to difficulties with the underlying implicit skills, such as procedural memory (Ullman and Pierpoint, 2005). Furthermore, another suggestion is that children with SLI have difficulties with segmenting words into their phonemes and therefore learn items such as '*walked'* as a whole instead of recognising the root word and the past tense affix (Joanisse and Seidenberg, 1998).

Literacy Difficulties

As alluded to earlier in this Chapter there are often high levels of comorbidity between oral language and literacy disorders. In the present thesis groups of children with DLD-only and DLD and Dyslexia will be tested. Therefore, the nature of children's literacy difficulties and research which has explored phonological and morphological abilities within this population will now be discussed before the implications of comorbidity are presented.

Developmental Dyslexia is a literacy difficulty and is commonly defined as a specific reading difficulty occurring despite otherwise average intellectual functioning and adequate learning environment (Ramus et al., 2013). Individuals with Dyslexia typically display difficulties with their reading and spelling. Several different theoretical accounts have been developed to try to explain Dyslexia. Dyslexia has been found to have a prevalence, in school-aged children, of around 10% (Snowling and Bishop, 2004). Currently, there is a widespread agreement for the phonological account for Dyslexia. This account states that Dyslexic individuals' literacy difficulties stem from underlying phonological difficulties, for example, the phonological representations hypothesis (Snowling and Bishop, 2004) and the phonological access deficit (Ramus and Szenkovits, 2008). Myriad alternative theories, on the other hand, argue that Dyslexia may stem from deficits in rapid temporal processing (Tallal, Miller and Fitch, 1993), magnocellular function (Stein and Welsh, 1997), or the cerebellum (Nicholson and Fawcett, 1990), sluggish attentional shifting (Hari and Renvall, 2001), a noise exclusion deficit (Sperling et al., 2005), a perceptual-centre perception deficit (Goswami, 2003), an anchoring deficit (Ahissar, 2007), or procedural learning difficulties (Nicholson and Fawcett, 2007). However, these alternative theories have faced intense criticism due to their limited supporting evidence and inconsistent findings (Ramus and Ahissar, 2012). It has been suggested that the abundance and diversity of these new theories derive from the varied cognitive deficits individuals with Dyslexia have been found to have and because these do not fit into a single coherent theoretical framework (Ramus and Ahissar, 2012). Recent theoretical accounts of Dyslexia have moved away from 'core deficit' accounts and now refer to multiple risk models, with phonological awareness representing one very important factor alongside other skills such as rapid naming (Pennington, 2006; Moll, Loff and Snowling, 2013).

Poor performance of Dyslexic individuals has been consistently demonstrated in three broad areas involving phonology: phonological awareness (tasks involving the manipulation, judgment or understanding of speech sounds), verbal short-term and working memory (tasks that involve short-term storage, manipulation, and repetition of words or pseudowords), and rapid automatised naming (speeded retrieval and naming tasks: Ramus and Ahissar, 2012). Ramus and Szenkovits (2008) referred to this as the "Dyslexic triad", and it has been argued that the difficulties Dyslexic individuals' experience in these domains reflects underlying problems with the ability to form and access robust phonological representations. As, the first, phonological awareness dimension concerns problems with access, attention to and manipulation of those phonological presentations. The second, memory dimension refers to problems with the storage of phonological representations. Finally, the third dimension involves the retrieval of phonological representations from long-term memory. This hypothesis of degraded (fuzzier, noisier or underspecified; Ramus and Szenkovits, 2008) phonological representations quickly became the most commonly accepted account for Dyslexia.

Currently much more is known about the phonological awareness abilities of Dyslexic individuals than their morphological awareness abilities, as relatively few studies have investigated morphological awareness in individuals with Dyslexia. It appears that when individuals with Dyslexia are compared against age-matched controls, they perform poorly in morphological tasks; however, when they are compared against reading-matched controls, there is no difference. Casalis, Cole and Sopo (2004) suggested that individuals with Dyslexia experience poor performance on these tasks as a result of their degraded phonological and reading abilities, instead of weak morphological abilities per se. In support of this notion, there has been an interaction found between morphological and phonological awareness; it has even been suggested that phonology may (partly) affect morphological abilities (de Bree and Kerkhoff, 2010).

Morphological regularities often have irregular phonology, for example, the past tense *-ed* which can be pronounced with three forms *-t*, *-d* and *-id* (as in baked, tugged and patted; Joanisse et al., 2000). Therefore, difficulty analysing the phonological structure can impact the acquisition of morphological patterns as they affect generalisation. This has been suggested as a potential reason why individuals with Dyslexia are poor at generating novel past tense words (i.e., *wug* to *wugged*), as their phonological deficits hinders their ability to choose the correct pronunciation of *-ed* (Joanisse and Seidenberg, 1999). Furthermore, within the English language, morphological derivations can often incur phonological changes (e.g., explode and explosion). These phonological changes have been found to be more complex for children to learn and understand (Carlisle, Stone and Katz, 2001).

Additionally, it has also been suggested that morphological awareness may develop more typically for Dyslexic individuals than phonological awareness because morphemes are meaningful, increasing their salience, and may be produced in isolation and thus represent a more natural segmentation point cut in fluent speech (Fowler and Liberman, 1995). This implication could explain why many individuals with Dyslexia are less impaired on morphological tasks. More recent findings have supported this notion. For example, Breadmore and Carroll (2016) found that in spelling tasks Dyslexic children showed a difficulty using morphological suffixes in comparison to their typically develop peers. They found that the Dyslexic participants had not yet recognised or learnt to generalise the orthographic patterns of these suffixes and argued that this is due to difficulty generalising across different phonological, orthographic and semantic contexts instead of difficulty with morphology itself.

Comorbid Literacy and Language Difficulties

As discussed previously in this Chapter, phonological and morphological awareness deficits have been implicated in language and literacy difficulties. Dyslexia has primarily been associated with a phonological deficit while SLI is considered to impact upon a broader range of oral language skills (de Bree and Kerkhoff, 2010). However, differentiating between SLI and Dyslexia is problematic due to their unusually high rates of comorbidity and overlap in the language profiles of children with each diagnosis (Ramus et al., 2013; Bishop and Snowling, 2004).

Children with Dyslexia have often been found to have early deficits in language, frequently displayed in studies conducted with children in the pre-school years or children with familial risk of Dyslexia (Catts et al., 2005; Joanisse et al., 2000). Likewise, it has also been noted that individuals with SLI often experience reading difficulties in addition to their language difficulties (de Bree and Kerkhoff, 2010; Catts et al., 2005). McArthur et al. (2000) noted that SLI and Dyslexia comorbidity rates ranged considerably between studies with studies finding these disorders to occur between 12.5 and 85% of the time. In order to bring some clarity to this, they conducted a blind re-evaluation study, where participants with formal diagnoses of

SLI or Dyslexia were recruited and then were blindly, re-diagnosed. They found that many of children with Dyslexia and children with SLI fulfilled the criteria for the alternative diagnosis, with over 50% receiving the alternative diagnosis in the second diagnosis. This finding led researchers to question the distinctiveness of these disorders.

Studying comorbidity is beneficial as it allows for reflection on how disorders are categorised and what causes them (Marshall, 2009). Several theories and models have been developed to attempt to explain the unusually high comorbidity between SLI and Dyslexia. First, there is the Severity Model initially outlined by Kamhi and Catts (1986) and later developed by Tallal et al. (1997). This model argues that Dyslexia and SLI are both caused by the same underlying phonological processing deficit. However, individuals with SLI have more severe deficits, and therefore, these individuals also experience difficulty with their oral language skills in addition to their reading difficulties. This model would explain why some Dyslexic individuals also have difficulties with aspects of language. However, this model fails to explain individuals with SLI who only present difficulty with their oral language and not with their literacy abilities. Therefore, as the Severity Model cannot account for this, arguably it cannot adequately describe the relationship between literacy and language impairment. This model has also been criticised due to its unidimensional nature, as it predicts that the linguistic abilities of Dyslexic individuals and SLI individuals vary only on one variable (Ramus et al., 2013).

A further model that has been developed to attempt to explain this comorbidity is the Additional Deficit Model (Bishop and Snowling, 2004). This model suggests that individuals with Dyslexia have a phonological deficit which only impacts their literacy skills whereas individuals with SLI also have an additional deficit that causes further problems with other aspects of oral language. This model has some similarities to the Severity Model, as this model implies that individuals with Dyslexia are much less impaired than individuals with comorbid SLI and Dyslexia. However, this model also fails to predict SLI-only individuals, as it would predict that all individuals would experience literacy impairment. Also, this model suggests that the phonological impairment that individuals with Dyslexia and SLI experience are identical. However, this has been found not to be the case (see later discussion of Ramus et al., 2013).

A further conceptualisation, the Comorbidity Model, was proposed by Catts et al. (2005). This model proposes that Dyslexia and SLI are two distinct and separable disorders and occasionally individuals with SLI also have phonological difficulties that cause additional difficulties with their word reading abilities. In contrast to the Additional Deficit Model, this model proposes that those with SLI only do not have a phonological deficit and if there is a phonological deficit this leads to literacy impairments. However, some SLI-only children have been found to have a phonological deficit without any literacy difficulties (Ramus et al., 2013); therefore, a phonological deficit can cause language difficulties in exclusion of literacy difficulties. Similarly, to the Severity and Additional Deficit Model, the Comorbidity Model cannot fully explain the relationship between literacy and language impairment.

Finally, and most recently, there is the Multiple Deficit Model, which was initially developed by Pennington (2006) from a genetic perspective. This model outlines a multifactorial approach, where there is a partial overlap of risk factors underlying the interactive development and comorbidity of the two disorders. This model shares some similarities with the Additional Deficit and Comorbidity Models. However, this model is probabilistic, and this model recognises the interaction of multiple deficits could cause the comorbidity instead of associating a single 'core' deficit with each disorder. Marshall (2009) further developed this model stating that individuals with Dyslexia and SLI both have a phonological deficit. However, crucially, this deficit may be qualitatively different in each condition. In addition to one or more of these phonological deficits, individuals with SLI also experience morphological, semantic and syntactic deficits. As depicted in *Figure 1* (adapted from Marshall, 2009) those with SLI and Dyslexia have partly similar phonological and morphological profiles. However, the difficulties experienced in each disorder are not entirely equivalent. Individuals with SLI or Dyslexia have the same core deficit in phonology and morphology (type B). However, those with SLI have the additional deficits in one type of phonology and morphology (type A) where those with Dyslexia do not have any difficulties. Those with Dyslexia have deficits in another type of phonology and morphology (type C) where those with SLI do not have any difficulties. Finally, individuals with comorbid SLI and Dyslexia have difficulties which encompass all areas of phonology and morphology.

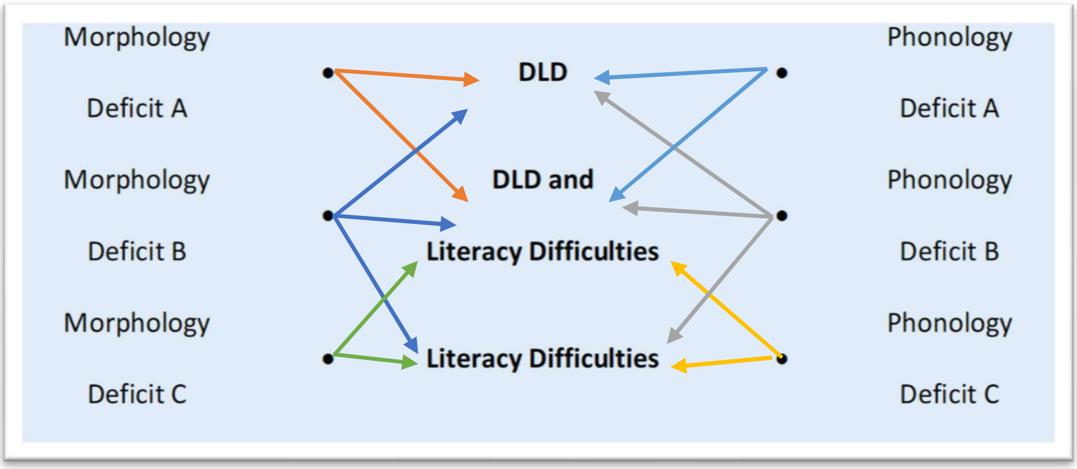

Figure 1. Proposed Model for DLD and Dyslexia's Overlap (adapted from Marshall, 2009).

This model more clearly explains the connection between the two disorders and can more easily account for each disorder and comorbid disorders. For example, this model can account the phonological deficits that have been found in both disorders, however, while also accounting for the differences found in this phonological profile (e.g. Ramus et al., 2013). Additionally, this model can also account for SLI without language difficulties. However, this theory does not attempt to explain and define the difference in the phonological deficits; even though the precise nature of the phonological deficit is the key to distinguishing between the disorders. Therefore, the mapping of the phonological and morphological deficits of children with SLI and/or Dyslexia more precisely is a promising direction for future research and is something that is addressed in this thesis.

<u>The Assessment of Phonological and Morphological Awareness</u>

A further issue complicating the elucidation of the phonological and morphological awareness profiles which characterise SLI and Dyslexia is the sheer number of ways that each can be measured. Several researchers have argued that we require more fine-grained understanding of the demands posed by language tasks commonly used in research and, furthermore, that this is a necessary step towards improving our understanding of different language and literacy disorders (Duncan et al., 2013; Protopapas, 2014; Ramus et al., 2013). The following sections of the literature review consider measurement issues in phonological and morphological awareness and examine how the type of task utilised can impact the pattern of performance observed in these groups of children.

As already outlined, phonological awareness is an oral language skill, and it is measured by testing individuals' abilities to manipulate, recognise and understand phonological units. Currently, there are a large variety of measures used to assess phonological awareness, and there are several themes that can be highlighted in these tasks. Several tasks look at the individuals' ability to isolate and manipulate phonological units directly, for example, phoneme deletion tasks (say cake without the /c/, *ache*) or phoneme addition tasks (say rake with a /b/ at the front, *brake*). Other tasks look at individuals' ability to segment and blend phonological units, for example, segmenting tasks (which sounds make up the word cat? *C-A-T*) or blending tasks (what word am I trying to say? /d/ one-second pause –oll, *doll*). Some tasks also look at individuals' ability to recognise similarities and differences in the phonological structure of words, for example, oddity tasks (which word is the odd one out? rake, *sock*, bake) or matching tasks (which word starts with the same sound as cow? girl, chest, *card*). Also, pseudoword repetition tasks are also commonly used as a test of phonological awareness.

Morphological awareness, an individual's ability to manipulate, recognise and understand morphemes - is also measured in several ways. Although morphological awareness has been relatively neglected in comparison to phonological awareness in some research literature, morphological awareness tasks can also vary immensely. Several tasks look at the application of morphological rules to novel stimuli, for example, asking children to define unfamiliar, morphological compound words (i.e., beastly) where the child will recognise the root and the suffix but has not encountered them previously as one word. Another common morphological awareness task is sentence completion. These often use a variety of different word types, for example, regular words (here is one book, here are two *books*), irregular words (here is one mouse, here are two *mice*) and pseudowords (here is one wug, here are two *wugs*). These sentence completion tasks can also vary to focus on inflectional or derivational changes. There are also judgement based tasks which assess children's ability to use morphological relationships to judge whether words share similar meanings. These tasks can vary according to the type of phonological change that occurs, for example, transparent (which word has a real connection to the word sign? singer, *assignment*, line) vs opaque items (which word has a real connection to the word sign? sight, *signal*, line).

While the tasks listed above would all be considered measures of phonological or morphological awareness, even a brief analysis indicates that there are substantial differences between them. Tasks can vary on several different dimensions including; the level of analysis, memory load and degree of conscious awareness required. These tasks can also vary according to stimulus type (e.g., lexicality, linguistic level, phonological transparency). These and other variants can make comparisons between different measures problematic, especially when trying to compare across different studies. Additionally, as these tasks vary on so many dimensions, this makes it challenging to understand precisely what each task is measuring, and exactly which aspects of the task are affecting performance. These observations lead us to question how children with SLI, children with Dyslexia, and children with comorbid language and literacy difficulties may perform across a comprehensive battery of phonological and morphological awareness tasks, whether impairments would be evident for all or just some of the tasks, and whether the pattern of impairment across tasks might vary in the different groups of children. Some researchers have already begun to explore these questions, and the findings of these studies are reviewed in the following sections.

Phonological Awareness

Phonological abilities have been central to the debate surrounding the unusually high comorbidity between SLI and Dyslexia (Messaoud-Galusi and Marshall, 2010) and it has been noted that, although individuals with Dyslexia and SLI do both have phonological difficulties, these difficulties may vary both qualitatively and quantitatively as outlined in the Multiple Deficit Model (Pennington, 2009; Marshall, 2009). Recently there have been questions about the precise nature of the phonological deficit in individuals with Dyslexia and the findings of these studies have led to a refinement of our understanding of the phonological deficit in Dyslexia, as well as SLI individuals. For example, Ramus and Szenkovits (2008) noted that the phonological difficulties individuals with Dyslexia face have traditionally been attributed to a phonological representation deficit (e.g., Snowling, 2000; Manis et al., 1997; Adlard and Hazan, 1998), and that such a deficit would predict poor performance in all aspects of phonological processing. However, contrary to this prediction, Ramus and Szenkovits were able to demonstrate typical patterns of performance across several phonological tasks in their sample of adults with Dyslexia. They concluded that this indicated intact phonological representations in adults with Dyslexia. Boets et al. (2010, 2011) found similar results and building upon this Boets (2014), argued that phonological representations are only impaired initially because they are slower to develop in children with Dyslexia but gradually they reach normal levels. However, the difficulty that remains in adulthood is slower access to phonological representations. This finding could explain the results of Ramus and Szenkovits, as although representations were intact the Dyslexic adults were still slower at retrieval tasks.

In addition to intact phonological representations, individuals with Dyslexia have been found to have an intact sensitivity to spelling-sound regularity at segmental and suprasegmental levels in a similar way to controls (Metsala, Stanovich and Brown, 1998; Mundy and Carroll, 2012). Further findings suggest preserved phonological abilities in adults with Dyslexia in pseudoword repetition, prosodic perception and phonological grammar, however, these were only found when additional task demands were controlled (Ramus and Ahissar, 2012).

Ramus and Szenkovits (2008) concluded that although their findings suggest intact phonological representations in Dyslexic individuals, that this is still not proven and further research is still required in order to determine the exact nature of the phonological deficit in Dyslexia. Furthermore, it should be noted that intact phonological representations do not mean there is no phonological deficit. However, this indicates that the deficit is narrower and more specific than previously thought, at least in adults. These implications emphasis the need for further research here. Although this literature focused only on individuals with literacy impairments, these studies underline the importance of examining more closely the profile of strengths and difficulties that characterise different language and literacy disorders.

Ramus et al. (2013) built upon this work by comparing children with SLI and/or Dyslexia across an extensive battery of phonological tasks, in order to account for variability in the skills and knowledge required to complete them. They concluded that rather than being a singular construct, phonological awareness is comprised of different levels: the first being phonological representations (i.e., implicit, underlying knowledge and abilities) as assessed through tasks such as, articulation, non-word discrimination, and non-word repetition and the second being phonological skills (i.e., the explicit understanding of and ability to manipulate phonological units) as assessed through tasks such as, spoonerisms and rhyme identification.

Crucially, Ramus et al. also observed distinct phonological profiles for each group of children. While the SLI-only group showed deficits in their phonological skills and phonological representations, those with Dyslexia-only showed deficits purely in their phonological skills. Individuals with comorbid SLI and Dyslexia also showed deficits in both areas, but these seemed more pronounced for tasks tapping phonological representations. In interpreting these findings, they argued that Dyslexic participants are only impaired in the domain of phonological skills because of specific demands that these tasks impose, such as conscious manipulation of phonological units, rapid access and retrieval of phonological representations and a high short-term or working memory load. In contrast, those in the SLI and comorbid groups showed a broader impairment that extended to their ability to form robust phonological representations. However, it should be noted that five of thirteen of the children with SLI-only, were found to have no phonological deficit at all. It has been suggested that this may be due to different subtypes of SLI, as previous studies have found a similar pattern (Catts et al., 2005; Gardner et al., 2006). Ramus et al. focus more on the profiles on those with Dyslexia-only or SLI-only than those with comorbid difficulties. Therefore, their interpretations of the participants with combined SLI and literacy difficulties was limited. However, the comorbid group seems to resemble the SLI group but have more pronounced difficulties in the domain of phonological representations.

Furthermore, much of the focus of Ramus et al., 2013 study was on the phonological profile of difficulty and therefore not much attention was given to the individual's performance on the non-phonological language skills. All groups were found to score significantly differently on these tasks, with those with SLI and literacy difficulties being most impaired. Additionally, the typically developing controls and those with Dyslexia-only were found to score higher on their non-phonological language skills than both their phonological skills and phonological representations. However, the groups including participants with SLI did not score significantly different between their non-phonological language skills and their phonological ones.

This suggests that phonology is not the only area of difficulty individuals with language impairments face.

Furthermore, the non-phonological language skills factor encompassed a large variety of task types, such as vocabulary, morphological, syntactical tasks. More research to clarify how the non-phonological language skills relate to these disorders is needed, as those with SLI and literacy difficulties had significantly larger deficits than those with SLI-only in this factor.

Nithart et al. (2009) conducted a similar study with SLI-only and Dyslexia-only children. They found that SLI-only children, but not Dyslexia-only children, performed worse than controls on phonological discrimination tasks, in which participants had to discriminate between pairs of CV or CVC syllables (e.g., different pairs /*ta*/-/*da*/ or matching pairs /*bra*/-/*bra*/). According to Ramus et al. (2013) study, this task would be classified as a phonological representation task. Therefore, this finding supports Ramus et al. as they also found that those with Dyslexia were compensated in phonological representation tasks whereas those with SLI had difficulties. Joanisse et al. (2000) reported similar findings with comorbid SLI and Dyslexia participants. They found that individuals with comorbid SLI and Dyslexia exhibited less distinct perceptual categories for speech sounds on a similar task where participants had to discriminate between pairs of items differing in their initial or medial phoneme (e.g., /*tug*/-/*dug*/ or /*spy*/-/*sky*/). In contrast, individuals with Dyslexia-only did not struggle with this task. Nithart et al. (2009) also stated that phonological discrimination could be a useful tool for distinguishing between SLI and other reading impaired individuals. Understanding this type of subtle difference between these groups is essential in improving understanding of these conditions and, ultimately, making diagnosis more reliable and interventions more efficient.

Also, within Nithart et al.'s (2009) study, they found that individuals with SLI-only performed worse than the Dyslexic-only children on measures of rhyme and phoneme detection. The distinctions made by Ramus et al., (2013) between phonological representation and phonological skill tasks may explain this finding, as rhyme and phoneme detection tasks are representation tasks, and only those with SLI were found to have impairments here. Overall, these findings are indicating that phonological impairment is restricted to certain tasks in those with Dyslexia-only whereas those with SLI or comorbid difficulties seem to have far broader impairments. Nithart et al.'s study presents some interesting findings for detection tasks, and it would be highly useful for future research to expand upon this and explore group differences in a broader range of tasks, particularly those that involve explicit manipulations (i.e. spoonerism tasks).

Most studies examining these differences focus on single deficit groups in the interpretation of their results, far fewer studies explore the differences between those with comorbid difficulties and those with a singular difficulty. However, Vandewalle et al. (2012) conducted a three-year longitudinal study investigating the phonological profile of those with SLI-only and SLI with literacy difficulties. They delivered a full test battery of phonological awareness tasks, including non-word repetition, rhyme production, phoneme deletion, spoonerism and rapid naming tasks. They found that overall individuals with SLI with literacy difficulties are more impaired, as they were impaired on all tasks; whereas the SLI-only participants mainly experienced difficulties on the more explicit tasks (i.e., spoonerisms). These findings are very similar to those of Ramus et al. (2013). However, only those in the SLI with literacy difficulties group were impaired on the verbal short-term memory task (nonword repetition) which is classed as an implicit, phonological representation task. This finding does not support Ramus et al. (2013) as they found that those with SLI-only to have impaired on implicit and explicit phonological awareness tasks. Therefore, this implication further suggests the need for more research.

Although most studies found those with comorbid disorders were more impaired than their typically developing peers on measures of phonological awareness, Marshall, Ramus and van der Lely (2010) did not find any difference at all between these groups on an implicit mispronunciation task. They conclude that for individuals with Dyslexia and/or SLI that both groups had intact phonological representations. This finding challenges research that did find impairments in the phonological representations of those with SLI and/or Dyslexia. However, task differences may account for these differences in findings. In Ramus et al. (2013) they used repetition and discrimination tasks, whereas Marshall, Ramus and van der Lely used a mispronunciation task. Although both studies defined these as implicit or representation phonological tasks, these differences in findings imply differences between these tasks which highlights limitations to the comparisons between studies using different measures. The current thesis seeks to develop our understanding of task differences further, which will make comparisons between studies more viable.

Morphological Awareness

Morphological awareness, although relatively neglected in the research literature in comparison to phonological awareness, is another area in which researchers have investigated the similarities and differences within SLI and Dyslexia. De Bree and Kerkhoff (2010) investigated morphological awareness in young children (around five years old) with SLI and children at-risk of Dyslexia and their performance on real and non-word stimuli on a plural elicitation task (similar to the *wug* task devised by Berko, 1958). They found individuals with SLI performed distinctly differently from those with at-risk of Dyslexia. Individuals with SLI were found to perform more poorly on morphological inflections with real words, producing fewer plurals than controls or individuals at-risk of Dyslexia. Both the SLI and the at-risk group were found to produce fewer plurals for nonwords than controls, with the at-risk group showing the most substantial discrepancy between words and nonwords.

Interestingly, de Bree and Kerkhoff (2010) found that individuals with SLI were not affected by the lexical frequency of the target words (in the real word condition) whereas controls and individuals at-risk of Dyslexia performed better as the frequency increased. This finding shows that individuals with SLI may have degraded phonotactic skills as well. It also demonstrates that individuals with Dyslexia are sensitive to lexical characteristics in the same way as controls.

Joanisse et al. (2000) compared the performance of slightly older children (around eight years old) with Dyslexia and those with Dyslexia and language impairments on a similar task to de Bree and Kerkhoff (2010) however this included both plural and past tense marking. They found that although both groups were impaired in relation to controls, they did not perform significantly different to each other. They argued that the poor performance of those with Dyslexia-only on this task was due to their phonological deficit, whereas those with language impairments was partly due to a phonological deficit as well as broader language deficits (e.g. morphology and vocabulary). Unfortunately, this is an area of the literature that is severely lacking, not many studies have made a direct comparison of the performance of individuals with SLI and/or Dyslexia on morphological awareness tasks.

Additionally, as morphological awareness tasks (as well as phonological awareness tasks) can vary immensely and are very sensitive to the stimuli used. Unlike phonological awareness tasks (e.g. Ramus et al., 2013), there have not been any formal attempts to distinguish systematically between task types. Therefore, it is hard to make a precise and accurate comparison between the literature that is looking at the disorders singularly. However, in summary, research has shown that individuals with literacy impairments have mainly had difficulties with aspects of morphology that interact with their phonological awareness (de Bree and Kerkhoff, 2010; Joanisse et al., 2000; Casalis, Cole and Sopo, 2004; Breadmore and Carroll, 2016). Whereas for those with language impairments have broader difficulties, showing difficulties with inflectional morphology in tense marking and plural elicitation tasks as well as difficulties with derivational morphology (van der Lely and Ullman, 2001; Krok and Leonard, 2015; Larsen and Nippold, 2007).

A New Framework for Measurement: Implicit-to-Explicit Continua

As indicated by the literature reviewed above, although individuals with SLI-only and SLI with literacy difficulties have been found to have impaired phonological and morphological awareness, recent research has suggested that their precise profiles of strengths and difficulties do show both quantitative and qualitative differences (e.g. Ramus et al., 2013; Nithart et al., 2013; de Bree and Kerkhoff, 2010; Joanisse et al., 2000). Therefore, to aid in the classification and definition of these disorders, these profiles of difficulty need to be examined further to make clear where exactly these individuals experience a deficit. In particular, there are not yet any studies which systematically investigate the performance of children with SLI and children with SLI and additional literacy difficulties across a broad range of phonological and morphological awareness tasks which have been systematically selected on the basis of their processing demands.

Improved understanding of the overlap between these groups of children could potentially be facilitated through more fine-grained understanding of the differences between different phonological and morphological awareness tasks as this would help develop our understanding not just of SLI but literacy and language development (Protopapas, 2014; Duncan et al., 2013; Ramus et al., 2013). Researchers have tried to pull apart these disorders from many different angles, for example, Yopp (1988) examined how a variety of phonological awareness tasks compared and highlighted key differences between tasks that assess simple phonemic awareness and compound phonemic awareness. Yopp (1988) outlined that simple phonemic awareness tasks require only one step for completion whereas compound tasks require more steps. Compound tasks require individuals to perform an operation and then hold the resulting sound in memory while performing another operation. A phoneme deletion task is an example of a compound task, and it requires one to isolate a sound, remove it and blend the remaining sounds. Similar distinctions have been made by other researchers, such as Protopapas (2014) who outlined that many phonological tasks are also laden with task demands other than sensory registration, such as explicit judgement tasks which introduce the potential interference from memory processes. Protopapas noted this could be particularly concerning as those with literacy and language disorders often have difficulties with short-term memory or retrieval.

Building upon this, Gombert (1992) proposed a model that distinguishes between the levels of phonological awareness tasks, according to their requirements for cognitive control. The first level, epilinguistic refers to tasks which require automaticity and refers to the underlying skills. The second level, metalinguistic refers to tasks which require conscious access and application of those underlying skills. Furthermore, Gombert (2003) also suggested these metalinguistic differences could explain the phonological deficits of those with literacy difficulties. As discussed above, Ramus et al. (2013) also explored the differences between tasks in relation to their requirements for metalinguistic skills. They highlight two different types of tasks, those that assess phonological representations and those that assess phonological skills. Phonological representation tasks are implicit and assess underlying knowledge and abilities through tasks such as non-word repetition, which is epilinguistic according to Gombert (1992). Phonological skills are the explicit understanding of and ability to manipulate phonological units as assess through tasks such as spoonerisms, which is metalinguistic according to Gombert (1992). This approach also strikes several similarities with Yopp (1988).

Although Ramus et al. (2013) explains the discrepancy between phonological task types to be due to the requirement for meta-linguistic skills, this discrepancy could be due to differences in the level of explicit knowledge/understanding needed to be able to complete the tasks. According to Karmiloff-Smith (1992), implicit knowledge is important for underlying skills that do not require any conscious understanding while explicit knowledge is important when conscious understanding is required. Therefore, the pattern Ramus et al. are outlining is the implicit-to-explicit differences in the tasks, as phonological representations signify more implicit abilities while phonological skills involve more explicit understanding. Furthermore, this implicit-to-explicit approach has already been applied to phonological awareness tasks in a similar way (i.e., Roberts and McDougall, 2003). Therefore, following on from the Ramus et al. (2013) paper implicit-to-explicit task distinctions will be a key focus of the present thesis.

Summary and Research Questions

In summary, phonological and morphological awareness are two key skills in the development of adequate language and literacy abilities. Recent research suggests that these skills are impaired in SLI and Dyslexia and that children with language difficulties appear to have a distinct profile of impairment in comparison to children with comorbid difficulties. However, as outlined above, there are concerns that we do not currently know enough about commonly used measures of phonological and morphological awareness to fully explore the overlapping phonological and morphological profiles of these children. Indeed, several researchers have pointed out that not enough is known about what is being measured due to differences in task demands or the stimuli used (e.g. Protopapas, 2014; Duncan et al., 2013). This leads to further difficulties in understanding whether any two tasks are equivalent and whether good performance or bad performance is due to real strengths or weakness or due to the task itself. This is particularly concerning as, for phonological awareness measures at least, the wealth of tasks available limits how comparable results from different studies using different measures can be. The work described in this thesis attempts to address these issues by developing and evaluating a new classification system for phonological and morphological awareness measures so that comparisons can be drawn across studies more easily and the phonological and morphological profiles of children language and literacy impairments mapped in a more fine-grained fashion.

Furthermore, there appears to be research support for developing implicit-to-explicit continua for these tasks, at least for phonological awareness tasks. Therefore, the current thesis aims to develop and evaluate implicit-to-explicit continua for phonological and morphological awareness tasks based on Ramus et al. (2013) findings. The continua will plot precisely where phonological and morphological tasks differ, and this will show the incremental changes from the most implicit tasks to the fully explicit tasks, while also exploring how they differ between implicit and fully explicit. This will be accomplished through an extensive review of existing tasks and of existing implicit-to-explicit classification systems and mapping them against the implicit-to-explicit levels outlined in the Representation Redescription Model (Karmiloff-Smith, 1992). The continua and associated tasks will then be used to compare groups of children with and without DLD.

This endeavour will address the first two research questions of the thesis:

1. Can implicit-to-explicit continua be developed and evaluated for phonological awareness and morphological awareness tasks?
2. How will children with DLD-only, children with comorbid DLD and Dyslexia, and typically developing controls compare on an extensive range of tasks drawn from these continua?

The background to the third research question of the thesis will be outlined in Chapter 2.

Chapter Two:

Literature Review Part Two - The Challenges of Understanding Language Difficulties in Children: Definitions and Diagnostic Criteria

This Chapter will outline the controversies in the literature with regards to exclusionary criteria and terminology used to explain unexplained language impairments in children. Previously, Specific Language Impairment (SLI) was the accepted terminology for these difficulties. However, this has recently changed to Developmental Language Disorder (DLD). This progression and change of thinking will be outlined in this Chapter. This Chapter will also inform the rationale for research question three: Whether individual differences in literacy-level, nonverbal IQ and EAL status will affect performance on implicit-to-explicit continua for phonological and morphological awareness tasks for those with DLD or DLD with literacy difficulties?

Children's language disorders can often go unrecognised. It has been suggested that this may be due to lack of awareness of language disorders, as well as confusion over terminology (Bishop et al., 2012). Terms such as Specific Language Impairment (SLI), development dysphasia, language delay were being used interchangeably to describe children who were having difficulty with language problems that interfere with everyday life and/or educational outcomes.

There are several different proposed theories for SLI, including genetic, linguistic and cognitive factors. Twin studies indicate a strong genetic component (Bishop, 1994). However, this relationship is complicated as there is no gene for language although evidence suggests there are several genes that have small influences on different aspects of language development. For example, there is a gene for physical development that appears necessary for speech and language, such as Broca's area (*FOXP2* gene; Fischer, 2005). However, research has indicated that *FOXP2* is not implicated in most cases of language impairment (Newbury et al., 2002).

The linguistic theories are based on the assumption that individuals are born with an "innate" ability to acquire grammar (see Chomsky, 1981). This ability is universal and changes according to the language the individual acquires. Individuals with language difficulties do not have this innate ability and therefore struggle to acquire typical language (Rice et al., 1995; van der Lely and Stollwerck, 1997).

In contrast, cognitive accounts explain SLI as a core difficulty with phonological short-term memory and vocabulary (Graf Estes, Evans and Else-Quest, 2007); and difficulties with procedural memory (Ullman and Pullman, 2015). The Procedural-Declarative Model suggested by Ullman and Pierpont (2005) outlines the differences in the two memory systems; with declarative memory used for high-level and explicit learning, such as facts (semantic memory) and events (episodic memory), whereas procedural memory is implicit learning of underlying skills, such as remembering sequences, rules and categories (grammar and syntax) (Ullman, 2016). The grammar deficit in individuals with SLI has been directly linked to implicit, procedural memory deficits (Ullman, 2015; Hedenius et al., 2011). Additionally, individuals with SLI may also show enhanced explicit, declarative memory (Lukacs et al., 2017). These findings further support the idea of exploring implicit versus explicit differences in phonological and morphological awareness in this population. SLI has an estimated prevalence, in school-aged children, of around 7% (Tomblin et al., 1997).

Leonard (1981) first coined the label of SLI for children who experience unexplained language problems. However, there is still no universally agreed upon view or definition of what precisely SLI is. Most definitions for what SLI is rely on exclusionary criteria, that is, outlining what SLI *is not* more than defining what it is. This lack of clarity in understanding SLI, therefore, poses challenges for both psychologists and educators and currently, there are several arguments over what the proper terminology, label and exclusionary criteria should be for children who experience unexplained language difficulties (see Bishop, 2014). The omission of SLI as a specifier of language disorder from the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) has further extended this debate (e.g. Ebbels, 2014; Rice, 2016; Bishop, 2014). Despite over 30 years of research and practice, SLI was removed as a specifier from the latest edition of the DSM, based on the recommendations of the American Speech-Language and Hearing Association (ASHA, 2012). They recommended that SLI should be omitted from DSM-5 because it is a "controversial diagnosis" with lack of consensus for the appropriate diagnostic criteria or formal testing procedure. This clearly shows the extent of the debate over SLI, and what the correct terminology is and what the correct diagnostic criteria and exclusionary criteria should be. Although SLI was removed from the DSM-5 because of these problems, this only underlines the need for more research in this area to refine our definitions and diagnostic criteria. Furthermore, within the DSM-5 there is a new specifier, Language Disorder, which is defining the same language impairment. However, this encompasses a more general level of impairment (Bishop, 2014).

RALLI and Exclusionary Criteria

The Raising Awareness of Language Learning Impairments (RALLI) initiative was set up by Bishop et al. in 2011, although it is now known as the Raising Awareness of Developmental Language Disorder (RADLD) reflecting the later change in terminology to DLD. This initiative was set-up because it was noted that in comparison to other similar conditions that SLI was under-researched and poorly understood. For example, Bishop et al. (2012) outline how, although SLI and Attention Deficit and Hyperactivity Disorder (ADHD) have comparable frequency and severity, that funding was 19 times higher for ADHD research and with around 11 times more publications. It was felt that the lack of research further led to the poor understanding of the disorder, which in turn led to the varied terminology and diagnostic criteria that was used. The work of the RADLD initiative has led to a progression of thinking about unexplained language difficulties, refining our understanding of the appropriate term, definition and exclusionary criteria that should be used. This progression of thinking will be outlined in this Chapter.

Exclusionary criteria are defined as a set of cutoff criteria that are used to separate typically developing children from those with an unexplained difficulty. However, the exclusionary criteria for SLI varied a great deal between empirical studies, and this was a central feature of the debate over the appropriate label for SLI (see Bishop, 2014; Bishop et al., 2016; and Bishop et al., 2017); this has led to further variability in the literature for what criteria researchers use and the reasons why.

Additionally, multiple factors interlink with language that makes setting clear criteria complicated, such as potential nonverbal IQ deficiencies (Gallinat and Spaulding, 2014), attention deficits, social communication problems and complications arising from children having English as an additional language (EAL) (Rice, 2016). These additional factors can increase the complexity still further as SLI can present in a variety of different ways with children's language difficulties masked by co-occurring problems with poor academic attainment, social problems and behavioural difficulties (Cohen et al., 1998).

Bellair et al. (2014:401) outlined that the populations that comprise test samples of SLI children recruited for research purposes were often very different from those observed in practice. Bellair et al. explain that, for example, researchers often only included children with language problems in their SLI samples if they had an IQ above 85 (i.e. within the normal range) and were not individuals with EAL. Bellair and colleagues are all speech and language therapists (SALTs) working in Central London, and therefore, provide a very different perspective on this argument to researchers, as they deal directly with children with a variety of language difficulties. They suggested that the narrow populations targeted by researchers are too dissimilar to those encountered in practice, as practitioners often work with children with low IQ and often include children with EAL. The principal aim of practice is to identify who will benefit from intervention (Bishop, 2014), whereas researchers are looking for a precise cognitive profile where potential confounds are controlled. However, given research is intended to inform practice, this contrast in definition makes research less informative than it should be.

Bellair et al. (2014) argue that more research needs to be conducted with a broader group of SLI children that is more in line with the children they diagnose and support every day, to bring some consistency between research and practice. This call for broader groups of children with SLI to be included in research has been echoed in other work (Bishop et al., 2012; Bishop et al., 2016; and Bishop et al., 2017). The current Chapter will review the different exclusionary criteria used for SLI samples, to inform the different cut-offs that will be used in the later analysis in this thesis.

Definitions for Language Difficulties in Children

An essential part of this thesis is to explore terminology, definitions and exclusionary criteria used for children with unexplained language difficulties. There are a large variety of different terminologies used to explain the sort of language difficulties this thesis is examining. These include Specific Language Impairment, Language Disorder, Primary Language Disorder, Language Learning Disorder and Developmental Language Disorder, the latter being what is predominantly used now. Previously Specific Language Impairment (SLI) was the most frequently used and widely accepted label.

Bishop (2014) conducted a large-scale review of all the terminology used in the literature on language impairment. She found 132 different terms were used to describe unexplained language problems, 33 of which returned over 600 articles on Google Scholar. The terminology consisted of 16 different words that fall into three different categories (see Table 1), each category serving a different purpose and changing the meaning of the chosen terminology. These words form the core vocabulary of the terminology used for unexplained language problems and can be compounded to make 132 different terms.

Table 1. *Terminology for Children with Unexplained Language Problems*

Prefix	Descriptor	Noun
Specific	Language	Needs
Primary	Speech and Language	Difficulties
Developmental	Speech/Language	Problems
(No prefix)	Language Learning	Impairment
	Speech, Language and Communication	Disability
	Communication	Disorder
		Delay

Bishop (2014) concluded that the use of the prefix 'Specific' in the terminology used typically indicates that the individual only has difficulty with language and are typically developing within other areas; whereas 'Primary' indicates that language is the main area of difficulty but suggests that there could be difficulties with other areas. The final prefix 'Developmental' indicates that there is some abnormality occurring across development more generally.

The descriptors also indicate several different meanings as Bishop (2014) outlined. For example, the descriptor 'Language' indicates problems with the use, storage and retrieval of expressive and receptive language whereas 'Language

Learning' suggests problems with the acquisition of language. Furthermore, the descriptor 'Communication' indicates problems are not isolated to expressive and receptive language and perhaps link more broadly to skills involved in the pragmatic language. Finally, the descriptor 'Speech' suggests problems only with the production of speech sounds.

Bishop (2014) further outlined how the noun also further affects the meaning derived from the term used. The noun 'Needs' indicates that the individual has different requirements for learning than their peers. The nouns 'Difficulties', 'Impairment', 'Problems', 'Disorder' and 'Disability' also indicate a difficulty in a similar manner. Whereas, 'Delay' suggests that one is behind but may have the capacity to catch up.

In addition to this, the terminological complexities are further aggravated by the differences in understanding the terminology of how *specific* the language problem is. Although, it is presumed that *specific* means there are no other problems beyond the language domain it is more useful to understand the term *specific* meaning *idiopathic*. Bishop (2014) concluded her review with this notion, suggesting that *specific* should be taken to mean of unknown origin, rather than as an indication that language is the sole area of impairment. This viewpoint seems inherently sensible since the additional difficulties of individuals with SLI have long been documented. For example, Dyslexia has been found to be highly comorbid with SLI, so much so that it was previously debated whether they were the same disorder (e.g., Catts et al., 2005). However, now it is agreed that although they are frequently comorbid (up to 50%, McArthur et al., 2000), they are distinct disorders that share highly related causal factors. It is intuitive that if someone has a difficulty with spoken language that he or she would have additional difficulties with written language as well. Further to this point, language is such a critical cognitive skill that it would be incredibly hard to disentangle it from other skills. So much so in fact that, SLI does not always present as a language difficulty and can be diagnosed as many different things, such as low cognitive functioning, poor attainment, attentional and behavioural difficulties (Bishop, 2014; Gallinat and Spaulding, 2014; Rice, 2016).

Despite these problems with the terminology of *specific*, the label SLI was still the most popular and frequently used. Some researchers have outlined concern that changing the label from SLI will break the link with previous research (Gallagher, 2014; Rice, 2014; Taylor, 2014). However, given it is now an outdated term for the children with language problems that participate in this thesis will be referred to as having DLD in line with current recommendations. However, essentially SLI and DLD will be used interchangeably as a spoken language disorder of an idiopathic nature.

The Criterion for Establishing Language Problems

The issues discussed in the previous section highlight the scale of the variability in terminology used and the different diagnostic definitions and therapeutic implications derived from it. Leonard (1998) defined DLD as a spoken language disorder that manifests itself as a difficulty in acquiring expressive and receptive language despite normal hearing, normal nonverbal cognitive abilities and an adequate learning environment. Therefore, in its most basic form, DLD is unexpectedly low language ability as measured against a benchmark of developmentally appropriate language performance. However, there are some controversies over how to set this benchmark with two opposing ideologies for this. The first is everyday functioning, in essence, whether a child's language ability is failing the needs of the child on a daily basis (e.g., understanding instructions and communicating clearly). SALTs and teachers often adopt this ideology, as they have the benefit of knowing children on a deep enough level to gauge whether their language abilities are failing them; this is something that researchers would struggle to do. The second ideology is measuring performance on standardised measures of language ability, i.e. to see whether the child is performing significantly below average on measures of language processing associated with DLD (e.g., verbal memory and grammar). Unsurprisingly, this is the preferred method of researchers, as this allows for the relatively quick and more objective diagnosis. However, there is no agreement over which test to use or what level of performance should be deemed significantly below average.

There are a large variety of standardised tests of language ability available to researchers, SALTs and teachers alike. In British English, The Clinical Evaluations of Language Fundamentals 4 (CELF-4), Test of Reception of Grammar (TROG) and the British Picture Vocabulary Scale (BPVS) are some of the most commonly used tests. Nevertheless, there is no formally agreed test or procedure to use to diagnose DLD. Although it is widely accepted that individuals must score at least 1 to 1.5 standard deviations (SD) below the mean on a standardised language test (standard scores of 85 and 78, respectively) to receive a diagnosis of DLD (Bishop, 2014). Most studies tend to prefer the -1.5 SD cutoff (see Table 2), as it is believed the -1 SD cutoff could lead to over-identification of difficulties (Castilla-Earls et al., 2015). However, Reilly, Bishop and Tomblin (2014) suggested using the cutoff of -1.25 SD with children scoring < -1 SD also being monitored. Many articles debating this issue have highlighted the problems associated with the lack of straightforward diagnostic criteria for DLD, regarding cutoffs used and the test procedure to be used both in practice and research (e.g., Ebbels et al., 2014; Reilly, Bishop and Tomblin, 2014; Bishop, 2014; Rice, 2016). These differences in tests/procedures have led to high variability between studies of DLD in diagnoses of the test samples and the risk of over- and under-diagnosis (Spaulding, Plante and Farinella, 2006), making it harder to understand the precise needs and difficulties of those with DLD.

Furthermore, this also adds to the difficulty in understanding the true prevalence of DLD. For example, studies looking at the prevalence of DLD in those with literacy impairments have been found to vary from 12.5% to 85% (McArthur et al., 2000). These differences could be explained due to differences in the diagnostic criteria used.

Table 2. *Language Cutoffs and Tests used in Studies Examining DLD*

Study	Measure/s used	SD	SS
Bishop et al. (2009)	Non-empirical paper	1.33	80
Castilla-Earls et al. (2015)	CELF-4 Spanish	1.75	73
Catts et al. (2005)	TOLD-2: P	1.25	81
Critten et al. (2014)	CELF	2	70
Farquharson et al. (2014)	CELF	1	85
Fraser, Goswami and Conti-Ramsden (2010)	CELF	1	85
Gooch et al. (2014)	CELF – Preschool 2, TEGI	1	85
Hayiou-Thomas et al. (2017)	CELF, TEGI	1	85
Joanisse et al. (2000)	CELF, WISC	1	85
Kapantzoglou et al. (2015)	SPELT-3	1.25	81
Larkin, Williams and Blaggan (2013)	TROG, BPVS, CELF	1	85
Larkin and Snowling (2008)	BPVS, CELF	1	85
Lukacs and Kemeny (2014)	Hungarian standardised tests	1.5	78
Marshall et al. (2009)	TROG, BPVS, CELF, TWF	1.5	78
Marshall, Marinis and van der Lely (2007)	TROG, BPVS	1.5	78
Marshall, Ramus and van der Lely (2010)	TROG, BPVS, CELF, TWF	1.5	78
Marshall and van der Lely (2009)	TROG, BPVS, CELF, TWF	1.5	78
McCarthy, Hogan and Catts (2012)	TOLD-2: P, CELF-3, PPVT	1.25	81
Nash et al. (2013)	CELF, SS, TEGI	1.5	78
Newbury et al. (2011)	CELF	1.5	78
Nihart et al. (2009)	French standardised tests	1.5	78
Pawlowska, Robinson and Seddoh (2014)	CELF-P2, Brigance-II	1	85
Przybylski et al. (2013)	French standardised tests	2	70
Ramus et al. (2013)	TROG, BPVS, CELF, TWF	1.5	78
Rispbeens and Been (2007)	Dutch standardised tests	1.5	78
Robertson et al. (2009)	TROG, WRMT-R, PPVT	1.13	83
Tuomainen (2009)	TROG, BPVS, TWF, CELF	1.5	78
Williams, Larkin and Blaggan (2013)	TROG, BPVS, CELF	1	85
Wolter and Green (2013)	PPVT (and SLT diagnosis)	1.5	78
Wong et al. (2010)	HKCOLAS	1.25	80
van der Lely and Ullman (2001)	TROG, BPVS	1.5	78
Vandewalle et al. (2012)	Dutch standardised tests	1.75	72

Note. SD indicates Standard Deviation. SS indicates Standard Score.

Standard scores between 85 and 115 (within 1 SD of the mean) within the average range; this is because of the majority of individuals (68%) score in this range. Standard scores below or equal to 84 (-1 SD) are defined as below average and show signs of potential difficulty, with scores below or equal to 69 (-2 SD) showing signs of moderate difficulty; this distinction is part of the rationale for why most studies use 1.5 SD. Although 84 is outside the average range and does show a potential difficulty, it is still very close to the average range and does not necessarily indicate a distinct difficulty. Additionally, a score of 69 is too strict of a cut off to be applied. However, both these cutoffs involve the underlying assumption that having DLD means low scores on a standardised test of language. Although this is a rational conclusion, this has not always been found to be the case.

Spaulding, Plante and Farinella (2006) investigated the validity and reliability of commercially available tests of language that are commonly used, in research and practice, to diagnose DLD to investigate the assumption that low scores on these standardised tests indicate DLD. They found quite a complicated relationship between tests of language and their ability to accurately diagnose DLD using the arbitrary -1 to -1.5 SD cutoff. They found that on some tests, individuals with DLD would fall within 1 SD of the mean (i.e. the average range). Some tests over-identify DLD, with some typically developing individuals falling within the cutoff ranges. They suggested that this was because these tests were too general and recommended using tests that specifically measure frequently occurring areas of deficit in children with DLD (e.g., receptive language and morphosyntactic skills). They did recognise a small subset of tests that could accurately diagnose DLD, including the CELF-4 because these tests specifically address the areas in which individuals with DLD commonly have deficits.

As suggested by Spaulding, Plante and Farinella (2006) CELF-4 has been highlighted as one of the most reliable language measures, regarding its ability to accurately diagnose. Additionally, the CELF-4 is suitable for use in individuals aged five to 16 years; which makes it suitable for the current thesis, as the target sample is seven to ten years. Therefore, as the CELF-4 has been found to be a reliable measure of DLD and is suitable for the target sample, this language assessment will be used in the current thesis.

Nonverbal Intelligence Criterion

Given the notion discussed earlier that only the language domain is affected in DLD, it has been usual for many researchers to try and control for nonverbal IQ in their test sample by recruiting children who have nonverbal abilities in the normal range. However similarly to the language cutoff points, there is still a significant amount of variability in what researchers believe is the acceptable cutoff for nonverbal IQ and, in fact, whether there should be one at all. Previously, cognitive referencing was the accepted practice, with nonverbal IQ being compared against standardised scores of language and if the disparity between the two was sufficiently large (usually 1 SD or more) then a diagnosis of DLD was given. However, this approach is now discredited as it is argued that it is conceptually unsound and misinformed because intelligence has been found to be an unreliable predictor of language (Bishop, 2014; Reilly, 2014; Leonard, 2014). Similar practices were also accepted when diagnosing Dyslexia, but this is also now discredited. Now there is a consensus that, for researcher purposes, children with DLD should have a nonverbal IQ within the ‘broadly normal-range’ (Bishop, 2014, p. 393); this is open to interpretation of the reader and defines no clear cutoff. Unsurprisingly, researchers vary, choosing cutoffs between 70 to 85 but with most choosing at least 80.

Table 3. *Nonverbal IQ Cutoffs used in Studies Investigating DLD*

Study	SS	Note
Bishop et al. (2009)	80-120	
Boada and Pennington (2006)	80	
Castilla-Earls et al. (2015)	75	
Catts et al. (2005)	85	
Critten et al. (2014)	85	
Farquharson et al. (2014)	75	
Fraser, Goswami and Conti-Ramsden (2010)	85	
Gooch et al. (2014)		No cutoff
Hayiou-Thomas et al. (2017)	80	
Joanisse et al. (2000)		No cutoff
Larkin, Williams and Blaggan (2013)		T score of 40
Larkin and Snowling (2008)		No cutoff
Lukacs and Kemeny (2014)	85	
Marshall et al. (2009)	80	
Marshall, Marinis and van der Lely (2007)		“Normal range.”
Marshall, Ramus and van der Lely (2010)	80	
Marshall and van der Lely (2009)	85	
McCarthy, Hogan and Catts (2012)	85	
Nash et al. (2013)	80	
Newbury et al. (2011)	80	
Nihart et al. (2009)	85	
Ramus et al. (2013)	85	
Rispbeens and Been (2007)		“Normal range.”
Robertson et al. (2009)	85-115	
Williams, Larkin and Blaggan (2013)		T score of 40
Wong et al. (2010)	85	
van Alphen et al. (2004)		“Normal range.”
van der Lely and Ullman (2001)	85	
Vandewalle et al., 2012)	85	

There have been many arguments for and against including a cutoff for non-verbal IQ. The initial reasons for the cutoff were to control for the language problems being due to low cognitive functioning, as opposed to a specific language difficulty (Rice, 2016), as definitions of DLD typically suggest that there is no known cause of the language difficulty seen. However, definitions of DLD changed. Previously, the specific part of the DLD title suggested either a significant discrepancy between language and nonverbal intelligence or as language being the only area of difficulty. However, recently within the literature generally there has been a move away from discrepancy-based definitions (Bishop, 2014; Bishop et al., 2016).

Particularly as research has indicated that language impairment in those with low IQ is very similar to the language impairment of those with average IQ. For example, Norbury et al. (2016) found that there was no difference between children with low IQ (one to two standard deviations below the mean) and average IQ in severity of language deficit, social, emotional and behavioural problems, or educational attainment. However, the authors did note differences between those language impairments with known medical diagnosis and/or intellectual disability (more than two standard deviations below mean). Overall, they concluded that nonverbal IQ should not affect access to specialist clinical support services.

Furthermore, it has been found that language impairments can lead to lower nonverbal IQ scores over time. Botting (2005) conducted a longitudinal study where nonverbal IQ measures were delivered to children with DLD at 7, 8, 11 and 14 years old. They found that nonverbal IQ significantly decreased by over 20 IQ points in this period, with the steepest fall occurring between 8 and 11 years old. This was seen to affect children in their sample with DLD, regardless of their starting IQ (i.e. including those with above average, average and below average starting IQ); although there was a small subgroup who were found to have relatively stable IQ (moves less than one standard deviation). They concluded that there is a dynamic relationship between language and nonverbal IQ and that definitions of DLD that outlined that non-verbal abilities were 'spared' should be challenged.

Additionally, it has been well documented that DLD is very commonly comorbid with a large variety of difficulties, such as Dyslexia (McArthur et al., 2000), ADHD (Redmond, 2016), and ASD (Rice, 2016). Therefore, it was decided this would make the criteria overly narrow, mainly as in practice these types of exclusionary criteria are not applied (e.g., Belliar et al., 2014).

Although conventionally it was accepted that individuals should have a nonverbal IQ of above 85 to avoid confounds caused by low cognitive functioning (Rice, 2016), there is still marked inconsistency in the way that non-verbal IQ exclusionary criteria are applied in the literature. Gallinat and Spaulding (2014) conducted a meta-analysis of 136 studies examining nonverbal intelligence in individuals with DLD. They found that studies used a large variety of nonverbal IQ cutoffs (as summarised in Table 3). Nearly half of all the studies used 85 as their cutoff. Followed by 75 and 80, with nearly 20% of all the studies using one or the other of these. Somewhat surprisingly, the next most frequent was no cutoff, with 12.5% of studies using this. The less frequent were 70 and 90 with hardly any studies using these. Overall, this portrays the variability in cutoffs used by studies but also highlights 85 as the most common cutoff.

Although 85 is the most common nonverbal IQ cutoff used, this cutoff may be unreflective of those with DLD; this is because nonverbal intelligence and language are two skills that are highly correlated, although the relationship may be indirect (Gallinat and Spaulding, 2014). Additionally, there is a growing body of work to suggest that individuals with DLD may also have a non-verbal IQ deficit. For example, they have been found to have deficits in deductive reasoning (Newton, Roberts and Donlan, 2010), attention (Spaulding, Plante and Farinella, 2006), and working memory (Bavin et al., 2005), which are all essential parts of nonverbal cognition. Therefore, it is unsurprising that there have been arguments to suggest that this should not be included as part of the diagnostic criteria for DLD. Gallinat and Spaulding (2014) also found that individuals with DLD, on average, scored over 10 points less than their typically developing peers on a measure of nonverbal IQ. They suggested this might be because some of the cognitive processes that underlie such tasks, for example, procedural memory, long-term memory retrieval and ability to develop a narrative (Lum and Bleses, 2012; Dijk and Kintsch, 1983) may also be implicated in language ability. Individuals with DLD may have a difficulty understanding task instructions, as this is a linguistic skill, which may impede their performance even when taking part in nonverbal assessments of intelligence. Also, most intelligence tests aim to assess fluid reasoning, the ability to problem-solve in new conditions which are true of both assessments of verbal and nonverbal intelligence. Problem-solving of this kind has a very strong link with inner speech, with skills in this area found to facilitate successful problem solving (Pintner, 1913). Inner speech is also another linguistic skill, so it is clear that this is likely another area of difficulty in those with DLD. Unsurprisingly, it has been found that children with DLD have a significant delay in their ability to use inner speech to mediate cognition (Lidstone et al., 2012), placing them at a further disadvantage when completing a range of cognitive tasks.

As outlined, nonverbal deficits are an area of fierce debate within the DLD literature. Currently, it is unclear whether broader cognitive deficits should be considered as part of the DLD profile, or whether this should be controlled with exclusionary criteria. Additionally, if children with non-verbal deficits are to be excluded from DLD samples, there is no consensus for where a cutoff should be set, other than that children's non-verbal IQ should be within broadly normal limits. However, recent work by Bishop et al. (2017) suggests that for those with an IQ of less than 70, they should be considered as having DLD and additional intellectual disability.

First Language Criterion

England is a multicultural country, and it is unsurprising that the number of primary school children who speak English as an additional language (EAL) is increasing by 1% each year (SFR, 2018). Therefore, within about ten years, one-quarter of all primary school children will have English as an additional language (Babayiğit, 2014); this pattern is not uncommon globally, with many other countries including the USA and Canada being reported to be experiencing similar demographic changes (Lipka, Siegel and Vukovic, 2005). Therefore, it is vital that teachers, practitioners and researchers have a firm understanding of how individuals who are learning in a second language (L2) perform. Unfortunately, this is still an area of weakness within our knowledge, and there have been calls to develop a more nuanced understanding of language and literacy development within these groups (Babayiğit, 2014; Goldenberg et al., 2011; Bishop et al., 2012).

Within literacy research, it has been found that L2 learners outperform their peers on word recognition, with their development shown to be substantially faster than their monolingual peers following a few years of formal reading instruction in their second language (Babayiğit, 2014; Lesaux, 2006). Although L2 learners have been found to have this relative strength in comparison to their peers in printed word recognition, this has not been found to be the case for literacy as a whole. L2 learners tend to lag behind their monolingual peers in reading comprehension (Geva, 2000), this might be due to limited English oral language proficiency (e.g., poor vocabulary knowledge). However, these findings are not entirely unequivocal with mixed findings in some studies (Babayiğit, 2015). These inconsistent findings have been associated with differences in socioeconomic status (SES), sociocultural, and educational experiences in L2 learners (Lipka, Siegel and Vukovic, 2005), with studies suggesting these factors are more critical for L2 learners than L1 (Babayiğit, 2014).

With regards to language development within EAL and L2 children, the picture is less clear. Initially, Paradis (2004) found greater similarities between L2 and DLD children than between L2 and younger children in their understanding of grammatical structure. However, in a later study, Paradis (2016) highlighted that L2 individuals with DLD acquired English slower than L2 individuals who were typically developing but noted that L2 individuals follow a different developmental trajectory than those with DLD in their first language. Furthermore, Blom and Paradis (2013) found that DLD seems to present in similar ways between L1 and L2 individuals. They found that L2 children with DLD omit regular past tense inflection (*walk* instead of *walked*) more often than their L2 typically developing peers, a similar pattern to that between L1 DLD children to their typically developing L1 peers.

Additionally, typically developing L2 children often overregularise irregular verbs (*catched* instead of *caught*), whereas L2 children with DLD would often fail to use any tense markings. Again, this finding is very similar to the pattern found in L1 individuals. Furthermore, bilingual children with DLD do show similar language skills to their monolingual peers with DLD (Rice, 2016) which indicates the need for further study in this area.

Overall, these studies highlight three vital points. First, typically developing L2 individuals perform similarly to L1 learners with DLD. Furthermore, there is a subset of L2 individuals that is characterised by additional language difficulties and these children perform differently to typically developing L2 individuals. Finally, these L2 individuals with additional language difficulties perform more similarly to L1 learners with DLD than do typically developing L2 individuals, but some important differences have been observed which has implications for the diagnosis of DLD.

Bilingualism is often seen as a known cause for atypical development in the second language (Rice, 2016), and many studies choose to control this *known* cause of language difficulties when recruiting DLD samples. EAL and L2 children are often excluded from taking part to achieve this. Although some research has been conducted in this area, more work is needed to understand whether this is a justifiable exclusionary criterion. As Bellair et al. (2014) pointed out, in a clinical setting, children receive a diagnosis according to who will benefit from specific language interventions.

Therefore, SALTs will give a diagnosis of DLD even if the child is EAL, provided they meet the other criteria. Therefore, further research is needed to understand potential differences between children with DLD versus children with DLD and EAL.

Conclusions

In conclusion, this Chapter has outlined several debates from the DLD literature, including those concerning the appropriateness of different terminology, diagnostic criteria, and exclusionary criteria. As outlined above, the agreed terminology for this thesis will be Developmental Language Disorder (DLD), defined as a spoken language disorder of an idiopathic nature (Bishop, 2014). Children with language impairments have always been a somewhat heterogeneous group and therefore has been subject to all these different exclusionary criteria (as outlined above). Since the removal of SLI from the DSM-5 and the introduction of DLD arguably there is now greater heterogeneity still as cutoffs are not being applied as broadly. The current thesis seeks to explore these potential similarities and differences between groups of children with DLD by delivering a fine-grained measurement of their phonological and morphological awareness skills. This will increase our understanding of those with DLD-only, DLD and literacy difficulties, DLD and low IQ, and DLD and EAL.

The outcomes of the current Chapter lead to the development of the third research question. In addition to addressing the differences between DLD-only and those with DLD and literacy difficulties and typical controls, this thesis will also seek to explore the individual differences according to literacy-level, IQ and EAL status across all three groups. In order to examine this, a third research question was developed:

3. Whether individual differences in literacy-level, nonverbal IQ and EAL status will affect performance on implicit-to-explicit continua for phonological and morphological awareness tasks for those with DLD or DLD with literacy difficulties?

Chapter Three: CAPPT and CAMPT: Contribution and Development

The essential starting point for this thesis was an extensive literature review, drawing upon developmental trajectories, theory, and empirical research, to map a large variety of existing language measures onto newly developed implicit-to-explicit continua for phonological and morphological awareness. The current Chapter describes the theoretical and developmental process taken to build these continua. As previously outlined, not enough is known about task demands (e.g., Duncan et al., 2013), however some work has been conducted investigating implicit-to-explicit task demand differences (e.g., Roberts and McDougall, 2003) and has promising results for the development of our understanding of those with DLD and DLD with literacy difficulties (e.g., Ramus et al., 2013). This Chapter addresses aspects of research question one: specifically, whether implicit-to-explicit continua can be developed for phonological awareness and morphological awareness tasks?

The Multiple Deficit Model (Marshall, 2009) argues that Dyslexia and DLD are distinct disorders but frequently co-occur due to a shared underlying aetiology and suggest that phonological skills mediate this relationship although other constructs are involved. This model shares several similarities with previous models (as reviewed in Chapter 1). However, this is a model which is much more probabilistic, as it recognises that the relationship is not caused by a single shared deficit but by interactions between a number of different phonological and morphological difficulties.

Some research has begun to disentangle these interactions between phonological deficits. Ramus et al. (2013) found that although individuals with DLD and/or Dyslexia have difficulty with phonology, this deficit manifests itself differently. Dyslexic individuals have intact phonological representations (indicated by normal performance in phoneme/rhyme detection) but deficits in their phonological skills (e.g., phoneme segmentation/deletion), whereas individuals with DLD are more likely to have deficits in their phonological representations (Ramus et al., 2013). Marshall (2009) also outlines that individuals with DLD have additional language deficits in morphology, semantics and syntax that Dyslexic individuals do not have. However, some studies have reported contrasting findings observing that some Dyslexic individuals do have a morphological deficit (e.g., Elbro, 1989; Fowler and Liberman, 1995). Therefore, it is possible that the principles of the Multiple Deficit Model could also be applied to morphology, i.e., children with comorbid Dyslexia and DLD may have a morphological deficit that differs quantitatively or qualitatively from that observed in DLD-only children. The current thesis aims to add to the model by examining more closely the phonological and morphological awareness of DLD children with or without additional literacy difficulties.

Although some studies have sought to differentiate between the two disorders, it is hard to directly compare these studies and draw firm conclusions due to the vast variety of phonological and morphological awareness measures used. As Duncan et al. (2013) outlined, it is essential to develop our understanding of task demands as these can vary greatly and some require the use of additional skills to complete them. This leads to further difficulties in understanding whether any two tasks are equivalent and whether good performance or bad performance is due to real strengths or weakness or due to the task itself. This is particularly concerning as, for phonological awareness measures at least, the wealth of tasks available limits how comparable results from different studies using different measures can be. Furthermore, there appears to be research support for developing implicit-to-explicit continua for these tasks, at least for phonological awareness tasks (e.g., Roberts and McDougall, 2003; Ramus et al., 2013). Building upon this, the current thesis aims to delve deeper into phonological and morphological awareness tasks to understand how these tasks can vary in levels of explicit understanding required to complete them. From this, it will allow a closer examination of the phonological and morphological deficits in children with Dyslexia and children with DLD and allow some insight into where the similarities and differences lie in these.

Some researchers have begun to explore task differences, with phonological tasks being contrasted for their stimulus and response type (Cunningham et al., 2015), recruitment of additional cognitive skills (e.g., conscious access, speeded retrieval: Ramus et al., 2013; Yopp, 1988; Gombert, 1992), as well as the extent to which they require children to demonstrate explicit knowledge of phonological structure (Roberts and McDougall, 2003; Joanisse et al., 2000; Yopp, 1988; Gombert, 1992). Furthermore, some of this work within the literature that is attempting to address how differences between explicit phonological knowledge and implicit understanding of phonology can be used differentiate between DLD and Dyslexia (e.g., Joanisse et al., 2000;

Gombert, 2003; Nithart et al., 2009). Morphological tasks, on the other hand, have received much less attention within the literature, although some comparisons have been drawn on the basis of the type of stimuli used. The contrasts made here include lexicality (nonword vs. real-word items: Nithart et al., 2009), linguistic level (sub-lexical, lexical, or supra-lexical items: Bowers, Kirby and Deacon, 2010), as well derivations with transparent vs. opaque phonological changes (e.g., drive-driver vs. explode-explosion: Carlisle, 2000).

Phonological and morphological awareness are large, complex constructs that are vital for understanding the development of literacy and language (Elbro and Arnbak, 1996) and although some previous studies have investigated task differences, more work is needed in this area. For example, some of the existing studies have not used full assessment batteries with systematically sampled tasks (Joanisse et al., 2000; Marshal, Ramus and van der Lely, 2010), while others have not included groups of children with comorbid language and literacy difficulties (de Bree and Kerkhoff, 2010; Law et al., 2015). In summary, there are not yet any studies which systematically investigate the performance of children with DLD and children with DLD and additional literacy difficulties across a broad range of phonological and morphological awareness tasks which have been systematically selected on the basis of specific processing demands.

Ramus et al. (2013) delivered a complete test battery to children with Dyslexia and/or DLD; they found that phonological tasks mapped onto two different factors and that these factors were differently affected within each disorder (Dyslexia-only, DLD-only and individuals with both). They defined these factors as phonological representations and phonological skills. The current thesis argues that the different factors found in Ramus et al. (2013) study could be due to differences in tasks that require implicit-to-explicit differences in the tasks instead. Moreover, the definitions posed by the authors for the phonological representations matches neatly with the implicit understanding while the phonological skills matched explicit knowledge as outlined in Karmiloff-Smith's (1998) Representational Redescription Model. Therefore, this thesis aims to extend their work on two dimensions: first it aims to extend their study into assessing implicit understanding and explicit knowledge differences; as well as assessing morphological awareness in addition to phonological awareness.

Therefore, the current thesis aims to add to previous research literature by clarifying the confusing relationship between developmental Dyslexia and DLD. It poses to do this from an oral language perspective, focusing on both phonological and morphological awareness. First by drawing upon current phonological research that has begun to take steps in addressing differences in explicit knowledge and implicit understanding. Second, it will extend this, by addressing how these differences can mediate the relationship between DLD and Dyslexia. Finally, it will explore the implicit-to-explicit differences in morphological awareness and how this can further help mediate the relationship between these disorders.

Implicit-to-Explicit Framework

Implicit and explicit levels of knowledge and understanding have been empirically supported in domains of language (Karmiloff-Smith, 1992; Ellis, 2008), phonology (Ramus and Ahissar, 2012; Mundy and Carroll, 2012), and morphology (Dienes et al., 1991). The notion of progressing from implicit-to-explicit levels of understanding is also captured in prominent theories of cognitive development, such as Karmiloff-Smith's (1992) Representational Redescription (RR) model and children's developmental trajectories for phonological awareness (Ziegler and Goswami, 2005; Duncan et al., 2013). The RR Model provides a framework for cognitive development where learning can be understood as a process of implicit representations becoming redescribed into increasingly explicit representations (levels E1, E2 and E3). This redescription process posits how knowledge becomes more consciously accessible, easier to verbalise and more flexible to apply, across and within domains. Contrary to previous models, such as Piaget's constructivist model (1972), Karmiloff-Smith (1992) outlined that while understanding develops linearly during the process of learning, performance often does not. She noted that performance would show a decrement at the first explicit level, as children have gained enough understanding to form theories about how to do something but will often over-apply them as they do not yet recognise the exceptions. For example, when children first learn to talk they will say irregular past tense verbs correctly '*I went to the park*', however after they have been exposed to the grammatical rules of regular past tense they can make overgeneralisation errors '*I wented to the park*'. Ultimately this decrement in performance will eventually promote increased understanding, and this is depicted in the 'U' shaped curve of development (*Figure 2*). The red arrow depicts the linear development of understanding that happens simultaneously with the development of performance.

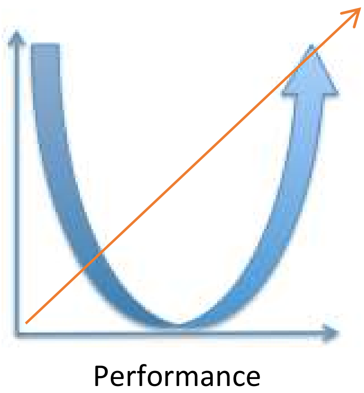

Figure 2. The ‘U’ Shaped Curve of Development (RR Model, Karmiloff-Smith, 1992).

The RR Model’s Continuum for Development

Within the RR Model, Karmiloff-Smith (1992) describes four key levels that form an overall continuum or trajectory for cognitive development. The implicit level is the first level and is the only fully implicit level involved in the RR Model. Task success characterises this level, but this is also combined with a complete inability to verbalise how this success was achieved. This is because the individual has no conscious awareness of the underlying mechanisms and cannot consciously inspect or analyse their mental representations. This level is defined as being procedural, data-driven and is thought to develop as a direct response to stimuli in the environment. Therefore, implicit representations are suitable for tasks or skills that require automaticity and speed but inappropriate for anything that requires reflection, explanation or application to new situations.

The next level outlined is the emergence of explicit understanding (E1), which is the first explicit level of three. Following the ‘U’ shaped curve of development, this is where the decrement of performance begins, following the procedurally driven task success at the implicit level. In contrast to the implicit level, where children freely adapt their responses, children become inflexible in this level and begin over-applying theories or rules they have developed about how to do something. This shows that the children are now beginning to develop explicit mental representations of rules (e.g., past tense –ed) derived from patterns/regularities they have learnt at the implicit level. Children at this level ignore external cues (e.g., children would be unlikely to have heard someone say 'wented') as representations are being built up.

Near explicit understanding (E2) is the second explicit level. A balance between performance and understanding characterises this level. On the 'U' shaped curve of development, this is where an individual's performance starts to improve and match their understanding. The overgeneralisations of the previous level are being integrated with external cues (e.g., children realise that 'went' is the appropriate form, as this is what adults say). This level marks again when the children become adaptive; they understand that in certain situations it may be necessary to change their response. This level is marked by success again, but this time with some understanding as well.

The final level is full explicit understanding (E3). This level sees another improvement in performance as well as understanding. However, in contrast to the implicit level, children can now fully verbalise their success and analyse each component of the representation. This knowledge can now be shared within the domain, as well as externally. This level marks the ability to use the knowledge with and creativity (e.g., they can apply the knowledge to novel or pseudo-words, such as tasks that involve defining unfamiliar words such as '*beastly'* or '*wugged'*).

The RR Model makes clear distinctions between performance and understanding, as the level of understanding does not always reflect in performance; for example, those with no understanding can be successful, and those with some understanding can be unsuccessful. This model goes further than other cognitive development models, such as Piaget's (1972) Constructivist Theory of Learning that depicts a strict level like process to learning, as the RR Model addresses the curvilinear development of performance as well as the linear development of understanding and how that interacts with performance. Karmiloff-Smith's (1992) approach stands out from traditional models of cognitive development as it advocates domain specific change and thus allows for individuals to have differing abilities across fields of learning. This approach would, therefore, allow for the differing levels of ability and cognitive profiles that individuals with Dyslexia and/or DLD show across phonological and morphological awareness. In contrast, constructivist approaches would predict individuals to have a limited capacity, performing at the same level across and within all domains of learning, such as Piaget (1972).

The model also advocates a multi-representational cognitive system where earlier levels of representation remain intact following redescription. This model allows individuals to access representations at each level, and to use the most appropriate route for the tasks at hand, which constructivist theories cannot account for. For example, the implicit route is much better for tasks that require automaticity and fast speed of retrieval; whereas the explicit route is more necessary when individuals need to verbalise their actions and/or generalise their knowledge to a new situation. This implication is something unique that the RR Model allows us to understand, how impairments could be restricted to some tasks but not others within a domain. For example, several studies have shown that individuals with Dyslexia do not have problems with the implicit route (Ramus and Szenkovits, 2008; Ramus et al., 2013; Mundy and Carroll, 2012; Fraser, Goswami and Conti-Ramsden, 2010). Currently, this is something the Phonological Representation Hypothesis for Dyslexia (Bishop and Snowling, 2004) cannot account for.

Furthermore, previous work examining phonological and morphological awareness appears to suggest a similar implicit-to-explicit development style. For example, Ziegler and Goswami (2005, p. 4) stated that emergence of phonological awareness could be described as “a continuum from shallow sensitivity to large phonological units, to a deep awareness of small phonological units”. The use of the words “sensitivity” and “awareness” implies a progression from an implicit level of understanding to an explicit level of understanding.

Overall, the RR Model provides an in-depth account of how individuals, particularly those with difficulties, can have differing levels of understanding to their performance and that it is possible for individuals to have intact representations and complete some tasks but not others. In summary, the RR Model and more generally the notion of a distinction between implicit and explicit knowledge provides a useful framework for refining the measurement of children’s language capabilities, developing our understanding of language and literacy disorders and interpreting the similarities and differences in the phonological and morphological profiles of these children. The work summarised in the remainder of this Chapter takes the first step towards this goal and describes the development of the Continuum of Awareness for Phonological Processing Tasks (CAPPT) and the Continuum of Awareness for Morphological Processing Tasks (CAMPT).

Continuum of Awareness for Phonological Processing Tasks

Step 1: Reviewing the literature on phonological tasks

This section will be reviewing the literature in relation to phonological awareness tasks and explaining any distinctions that have already been drawn between different task types. There have been concerns that researchers do not understand enough about what phonological awareness tasks are measuring, particularly as they can vary a lot (Protopapas, 2014; Duncan et al., 2013). Although these differences have not been systematically differentiated in order to understand precisely how they differ, some research has begun to classify differences between tasks. For example, it has been suggested that tasks may vary due to how they deal with unit size differences, need for metalinguistic skills and the need for explicit understanding.

Ziegler and Goswami (2005, p. 4) statement that emergence of phonological awareness develops from a “shallow sensitivity” to larger phonological units, to a “deep awareness” of phonemes implicates a unit size differences in understanding. Interestingly this size distinction has also been assessed within the literature, and it has been found that children master phonological skill in order from largest to smallest; starting with words, then syllables, onset-rime and finally phonemes (Anthony et al., 2003). However, this became an area of controversary and debate around the relative importance of small versus large phonological units (Hulme et al., 2002). For example, Duncan, Seymour and Hill (1997) found that letter-sound correspondences rather than onset or rime units formed the basis of children's phonological awareness. Furthermore, some more recent studies do not make unit size distinctions for differences in explicit requirement (e.g., Duncan et al., 2013; Roberts and McDougall, 2003); particularly, because it is possible for individuals to have implicit and/or explicit understanding of both small and large phonological units. Roberts and McDougall (2003) made distinctions between rhyme and phoneme-based tasks. However, they did not define one as more or less explicit than the other, instead matched the tasks for each unit size and kept them separate in the analysis. Therefore, the current thesis will not make unit size distinctions in the continuum, but the current thesis will keep phoneme-based and rime-based tasks separate in analyses (Chapter 7) in order to locate any potential differences here.

Roberts and McDougall (2003) do make implicit-to-explicit distinctions between different task types, which both use rhyme and phoneme-based stimuli. This approach strikes some similarities to the different levels of explicit knowledge proposed in the RR Model. However, there is one fewer level here. Roberts and McDougall (2003) used production–based tasks for their implicit level, with tasks such as rhyme sentence completion tasks and identification of the initial phoneme. This is very similar to how the RR Model operationalises implicit understanding. Although the implicit level of Roberts and McDougal's study is similar to the RR Model, their other two levels do not strike as many similarities.

Roberts and McDougall's (2003) near explicit level used discrimination tasks, such as oddity tasks, where individuals had to discriminate between items based on the onset and rime, as well as initial and final phoneme (e.g., which word is the odd one out: cat, bat, *man*); and rhyme and phoneme matching tasks (e.g., which words start with the same sound: cat, *mat*, *man*). However, this does not appear to equate to Karmiloff-Smith's near explicit level (E2) as these tasks do not require a specific understanding of phonology to complete them. Therefore, these tasks are more in line with the RR Model's implicit or E1 level (early explicit knowledge) and will be used to assess this part of the continuum.

Finally, for full explicit tasks, Roberts and McDougall (2013) used segmentation and blending tasks for both rhyme and phoneme stimuli. This included: segmenting words according to phonemes as well as onset and rime; blending onset and rime, and phonemes (e.g., blending and segmenting tasks such as, //d/ 1-second pause 'oll' what word am I trying to say? *doll* and what sounds make up 'cot'? */c/ /o/ /t/*). However, these explicit tasks appear to fall short of the RR Model's definition of full explicit tasks and appear to be more in line with Karmiloff-Smith's second explicit level E2; as although this involves conscious awareness and understanding it does not require the flexibility and/or creativity that are outlined in Karmiloff-Smith's most explicit level E3. Therefore, although Roberts and McDougall's (2003) study attempts to assess the full continuum of implicit-to-explicit, according to the RR Model, does not do this successfully and therefore these tasks will only be used to assess the near-explicit part of the continuum.

Joanisse et al. (2000) also outlined blending and segmenting tasks as higher level, explicit tasks but defined deletion tasks as being more explicit as these involve manipulation. Manipulation tasks, such as deletion tasks (e.g., say '*cake'* without the /c/ = *'ache')* and addition tasks (e.g., say '*rake'* with a */b/* at the front *'brake'*), involve flexibility and creativity, which Karmiloff-Smith also outlines as the most explicit. Therefore, manipulation tasks were defined in the current thesis as the most explicit E3, whereas segmenting/blending tasks were defined as the second level E2, near explicit and discrimination tasks defined as first level explicit E1.

Step 2: Developing the Continuum of Awareness for Phonological Processing Tasks (CAPPT)

Guided by existing classification systems from the literature (Yopp, 1988; Ramus et al., 2013; Joanisse et al., 2000; Roberts and McDougall, 2003) as well as the RR Model (Karmiloff-Smith, 1992), an implicit-to-explicit continuum was designed to classify commonly used phonological processing tasks (Table 4). The blue columns within Table 4 represent the different implicit-to-explicit levels within the continuum. These progress from the most implicit level, which is depicted in pale blue, up to the fully explicit level, which is depicted is the darkest blue. Within the blue levels, there are further degrees of explicitness due to stimuli or linguistic level type. Each row corresponds directly to a different task type. The ticks filling the cells of the table indicate which skills are required for successful task completion. Therefore, this gives an indication of types of implicit-to-explicit requirements needed in order to complete the tasks successfully; the further along the continuum the ticks fall more explicit task types are indicated. It is important to note, that although this is depicted as a table with distinct, blue levels, that the CAPPT is a continuum and therefore is continuous with small incremental changes. The specific levels that have been described are intended to describe approximate levels within the continuum, where differences between tasks are noted.

Table 4. *Table Depicting the CAPPT*

Task Type	Production	Discrimination	Segmentation & Blending	Manipulations
Repetition	✓			
Oddity	✓	✓		
Matching	✓	✓		
Segmenting	✓	✓	✓	
Blending	✓	✓	✓	
Addition	✓	✓	✓	✓
Deletion	✓	✓	✓	✓
Spoonerisms	✓	✓	✓	✓

Note: ✓ = Skills present within this section/band of the continuum.

The development of this continuum was influenced by Ziegler and Goswami's (2005) notion that phonological awareness is a continuum progressing from sensitivity to awareness. The four levels of explicitness within the continuum were influenced by the developmental trajectory outlined within Karmiloff-Smith's RR Model (1992) and the mapping of different skills on to these levels was further informed by existing classifications of phonological awareness tasks. Specifically, Roberts and McDougall (2003) influenced the development of the Production, Discrimination and

Segmentation & Blending categories, with Segmentation & Blending and Manipulation being further distinguished in accordance with Joanisse et al. (2000). Additionally, the levels are further sub-divided into stimuli type or linguistic level (Ziegler and Goswami, 2005; Anthony et al., 2013). Furthermore, the overall continuum was also influenced by previous research that implicated differences in the meta-linguistic levels required in order to complete tasks, with the representation and epilinguistic tasks falling lower on the continuum while the skills and metalinguistic tasks are much higher (i.e., Yopp, 1988; Gombert, 1992; Ramus et al., 2013).

Each of the four columns in Table 4 represents a different type of phonological awareness skills (Production, Discrimination, Segmentation and Blending, and Manipulation) and also a level of Karmiloff-Smith's (1992) RR Model (Implicit, E1, E2, and E3). Each row of Table 4 outlines a different task; the number of ticks a task has and how far these ticks span across the continuum outlines the requirements of the task regarding production, discrimination, segmentation/blending and manipulation and thus how explicit each task is.

Production is the first column on the phonological awareness implicit-to-explicit continuum, as it is the most implicit. This column was designed to incorporate tasks that involve the assessment of individuals' abilities to pronounce words, units of rime and phonemes correctly. Only one task involved a production-only level of understanding, and this was repetition tasks, where children are asked to repeat real and pseudowords presented to them orally.

The next column is Discrimination; this category involves slightly increased explicit understanding compared to the production tasks. This column was designed to incorporate tasks that involve the assessment of individuals' abilities to match and differentiate between words, units of rime and phonemes. Several tasks fell into this category: word discrimination (e.g., finding the correct pronunciation: aminals, animas, _animals_); rhyme discrimination (e.g., rhyme oddity tasks: which word is the odd one out: bake, _sock_ or rake?); and phoneme discrimination (e.g., pattern detection tasks 'what words start with the same sound as *cow*: girl, chest, _card_?).

The third column is Segmentation and Blending, where tasks require higher levels of explicit understanding although not quite as much as those involving flexibility and creativity. This column incorporates tasks that involve the segmentation of words into either phonemes or units of rime, as well as the blending of units of rime or phonemes into words. This category was also further sub-divided according to stimuli with tasks at the rhyme level and the phoneme level. Again, several tasks fell into this category: rhyme blending (e.g., /d/ 1-second pause 'oll', what word am I trying to say? _doll_) and segmenting; as well as phoneme blending and segmenting (what sounds make up *cot*? _/c/ /o/ /t/_).

The final column is Manipulation, which is the most explicit category for phonological awareness tasks as these tasks require individuals to apply their knowledge with flexibility and creativity. This column includes tasks that involve the addition and deletion of phonemes. Several tasks fell under this category and would include: addition tasks (e.g., say -*at* with a /*b*/ at the front: _bat_); deletion tasks (e.g., say *bat* without the /*b*/: -_at_); and spoonerisms tasks (e.g., swap the first sounds in *bat* and *man:* _mat ban_).

Step 3: Mapping the CAPPT

Finally, after reviewing the literature and developing the CAPPT, a selection of existing phonological awareness tasks needed to be selected in order to represent each level of the continuum. This battery of tasks was subsequently administered to children with DLD-only, DLD with literacy and typically developing children in order to develop our understanding of children with language impairments (Chapter 6). Due to the richness of the variety of pre-existing tasks, this was completed with relative ease. Table 5 outlines the tasks chosen to represent each level of the CAPPT in this subsequent empirical investigation.

Table 5. *Task Mappings for the CAPPT*

Level	Task	RR Model
Production	Nonword Repetition*	Implicit
Discrimination	Mispronunciation Detection***	Beginning Explicit
Segmentation	Fluency* Alliteration*	Near Explicit
Manipulations	Phoneme Deletion* Phoneme Substitution* Spoonerisms **	Full Explicit

Note. * from the Phonological Assessment Battery Two (PhAB2: Gibbs and Bodman, 2014); ** from the Phonological Assessment Battery (PhAB: Frederickson, Frith and Reason, 1997); *** from Carroll, Mundy and Cunningham (2014).

Continua of Awareness for Morphological Processing Tasks

Step 1: Reviewing the Literature on Morphological Tasks

Research into the components of morphological awareness is relatively neglected in comparison to phonological awareness. It was, therefore, unsurprising that no conceptualisations akin to Roberts and McDougall's (2003) work in phonological awareness were found to examine implicit-to-explicit differences in morphological awareness. However, there have been several distinctions made within morphological tasks that can inform a framework of how they might vary from implicit-to-explicit. For example, it has long been noted that opacity of the phonological change in derivational words can affect performance on tasks: with transparent changes (e.g., drive – driver) being easier to learn than opaque ones (e.g., explode and explosion: Carlisle, Stone and Katz, 2001). This finding would appear to follow an implicit-to-explicit divide as transparent derivations would not require any knowledge or understanding of how the words are related, as one can rely on phonological cues; whereas opaque derivation would require knowledge of both the base word and the morpheme to understand any connection, as there are no additional cues.

Additionally, it has been noted that morphological awareness tasks can vary according to the linguistic layer that they involve; with some involving the supra-lexical, lexical or sub-lexical levels. Bowers, Kirby and Deacon (2010) conducted a review of twenty-two studies, and they found that morphological awareness developed from larger to smaller units. Pawlowska, Robinson and Seddoh (2014) found that children performed better on lexical anomalies tasks than morphological (sub-lexical) tasks. Therefore, this would suggest that supra-lexical tasks are the most implicit, followed by lexical tasks and with sub-lexical tasks being most explicit. As already outlined, phonological awareness has been found to follow a very similar pattern (Anthony et al., 2003; Ziegler and Goswami, 2005), although this does not change the level of explicitness of a task.

Some similarities between morphological and phonological tasks were found. For example, morphological application tasks (e.g., defining morphemes within words: *beastly* mean *beast* and *–ly* means like) have several similarities to phonological manipulation tasks (e.g., spoonerism tasks: swap the first sounds in the words *bat* and *man: mat ban*), as both these tasks require elements of flexibility and creativity, as well as the ability to break down words. Therefore, the manipulation level from the CAMPT informed the most explicit level of the CAMPT. However, there were far fewer parallels than anticipated between phonological and morphological tasks.

Therefore, it was considered whether phonological awareness, overall, is simply far more implicit than morphological awareness. For example, in the very early levels of language development children produce vocalisations that do not carry any meaning, known as babbling although they are phonetically consistent with meaningful language (Goldstein and Schwade, 2008). It is not until children receive feedback from adults that vocalisations start to convey meaning. Therefore, this indicates that children develop implicit understanding/awareness of the phonetic structures of language before the morphemic structure (Polka et al., 2008). This could imply that phonological awareness, by nature, is more implicit and this could explain differences in CAPPT and CAMPT results.

Moreover, considering the framework of the RR Model (Karmiloff-Smith, 1998), it was noted that although the tasks may not draw direct parallels between phonology and morphology they can still draw from the same framework. For example, oddity tasks (e.g., which word is the odd one out: bat, cat, *man*) where noted to be similar to morphological judgements tasks (e.g., which word has a real connection to *create*: cream, *creative*, great), at least at face value. Both tasks do not require an understanding of the underlying phonemes or morphemes; instead they require individuals to process a whole word. Additionally, these tasks are both forced choice and therefore limits participants' responses, and they also offer the correct answer. The oddity tasks were considered to be in line with the RR Model's Implicit and E1 level but, were placed as the second level on the CAPPT (beginning explicit). This was partly because there were alternative phonological tasks that were more implicit (non-word repetition tasks) and partly because children may be able to use some phonological knowledge to complete them (whereas they could not for non-word repetition tasks). When reviewing the literature for morphological awareness, oral language tasks, no tasks were found to be more implicit. Therefore, it was considered that this might be due to phonology being an overall more implicit skill. Morphological judgement tasks were considered to fulfil the requirements for an implicit task for morphological awareness.

Step 2: Developing the CAMPT

Guided by existing classification systems from the literature as well as the RR Model (Karmiloff-Smith, 1992) an implicit-to-explicit continuum was designed to classify where different morphological tasks should be situated (Table 6). These findings have been simplified for this thesis to include the central task themes within the literature. Similar to the CAPPT, the blue columns within Table 6 represent the different implicit-to-explicit levels within the continuum. These progress from the most implicit level, which is depicted in pale blue, up to the fully explicit level, which is depicted is the darkest blue. Within the blue levels, there are further degrees of explicitness due to stimuli or linguistic level type. Each row corresponds directly to a different task type. The ticks filling the cells of the table indicate which skills are required for successful task completion. Therefore, this gives an indication of types of implicit-to-explicit requirements needed in order to complete the tasks successfully; the further along the continuum the ticks fall more explicit task types are indicated. It is important to note again though, that although this is depicted as a table with distinct, blue levels, that the CAMPT is a continuum and therefore is continuous with small incremental changes. The specific levels that have been described are intended to describe approximate levels within the continuum, where differences between tasks are noted.

Table 6. *Table Depicting the CAMPT*

Task Type	Judgement	Recognition		Completion			Application	
		Transp.	Opa.	Reg.	Non.	Irreg.	Lex.	Sub.
Word Judgement	✓							
Transparent Analogies	✓	✓						
Opaque Analogies	✓		✓					
Regular Sentence Completion	✓	✓	✓	✓				
Pseudo Sentence Completion	✓	✓	✓		✓			
Irregular Sentence Completion	✓	✓	✓			✓		
Define Words	✓	✓	✓	✓		✓	✓	
Define Morphemes	✓	✓	✓	✓		✓		✓

Note: ✓ = Skills present within this section/band of the continuum. Transp. Indicates transparent. Opa. Indicates opaque. Reg. indicates regular. Non. Indicates pseudoword. Irreg. indicates irregular. Lex. Indicates lexical. Sub. indicates sublexical.

Overall, the development of the CAMPT was based mainly on the previous development of the phonological implicit-to-explicit continuum framework; with consideration made for the differences suggested between tasks. The Application level in the CAMPT is directly inspired by the Application level of the CAPPT. However, the Discrimination, Judgement and Completion levels were added as a new category as there appears to be no direct parallel between morphological and phonological tasks. The sub-categories of Application were based on Bowers, Kirby and Deacon (2010), and the sub-categories of Completion were based on Carlisle, Stone and Katz (2001).

Each column was used to represent a type of morphological awareness task (Judgement, Recognition, Completion, and Application) and also represent a level of Karmiloff-Smith's (1992) RR Model (Implicit, E1, E2, and E3). Some of these columns were split further to incorporate other elements of explicitness, such as stimuli type and linguistic level, in order to map all tasks effectively. Each row of Table 6 outlines a different task, the number of ticks a task has and how far these ticks span across the continuum outlines the requirements of the task regarding judgement, recognition, completion and application and thus how explicit each task is.

Judgement is the first column on the morphological implicit-to-explicit continuum, as it is the most implicit. This column was designed to incorporate tasks that involve forced choice (either multiple choice or yes/no tasks) judgement of words and how morphologically related they are. This column was further divided to incorporate the effects of stimuli type, with transparent word changes (this includes both words containing inflectional and derivational morphemes) defined as more implicit than opaque word changes (words containing derivational morphemes only). Several tasks fell into this category: such as transparent morphological choice (e.g., which word has a real connection to *drive*: *driver*, dive, dry); and opaque morphological choice (e.g., which word has a real connection to *explode*: load, *explosion*, explore).

The next column is Recognition, which involves a slight increase in explicit understanding compared to the Judgement tasks. This column was designed to incorporate tasks that involve the assessment of individuals' abilities to recognise morphological connections between the definitions of words (e.g., she was a good teacher, she was very: *helpful*, helpless, unhelpful). Although these tasks also incorporate those with multiple choice options, these are slightly harder as they do not make the context as obvious as the previous Judgement tasks (where a target word is explicitly stated).

The third column is Completion, which requires a higher level of explicit understanding although not as much as those involving flexibility and creativity. This column incorporates tasks that involve the grammatical closure of sentences; this category was also further sub-divided according to stimuli with regular words classified as most implicit, then pseudowords and finally irregular words classified as the most explicit. Several tasks fell into this category: word family completion tasks (e.g., she hoped to make a good: *Impression*, Impressive, Impressionable) and word grammatical closures (e.g., here is a wug. Here are two *wugs*). Both tasks varied according to regular, pseudo and irregular stimuli. Multiple choice tasks are less explicit, as less understanding is needed when answering multiple choice questions then open-ended questions.

The final column is Application, which is the most explicit tasks. These tasks involve the application of morphemes in explaining what words mean; and have been further sub-divided into lexical and sub-lexical. This category involves: defining multimorphemic words (e.g., defining *beastly* as something that is *beast-like*); and defining morphemes within words (e.g., defining *beast* as a *monster* and *–ly* as *like*). These tasks also involve a dynamic approach, which further adds to their explicitness as individuals have to verbalise their actions and understanding.

Step 3: Mapping the CAMPT

Finally, after reviewing the literature and developing the CAMPT measures needed to be selected in order to represent each level of the continua. However, there is a lack of richness of the variety of pre-existing morphological awareness tasks; this meant the mappings of the CAMPT were not completed with the same amount of ease as for the CAPPT. Due to the lack of richness, several tasks already existing in the literature were adapted to suit the requirements of the current study (see Chapter 4). Table 7 outlines the tasks chosen to represent each level.

Table 7. *Task Mappings for the CAMPT*

Level	Task	RR Model
Judgement	Real Connection	Implicit
Recognition	Derivational Comprehension	Beginning Explicit
	Extended Word Structure	Near Explicit
Completion	Advanced Derivations Word Structure	
	Opaque Word Structure	
Application	DATMA	Full Explicit

Note. All tasks here are based on adaptations to the literature and will be outlined in Chapter 4 and Chapter 5.

<u>CAPPT and CAMPT: Conclusions</u>

Dyslexia and DLD have unusually high comorbidity (McArthur et al., 2000); and children with both disorders have difficulty with phonological awareness but that the profile of difficulty is different in each disorder (Ramus et al., 2013). Morphological awareness is a marked area of difficulty for individuals with DLD and has occasionally been noted as an area of difficulty for individuals with Dyslexia (Leonard, 1998; Casalis et al., 2000). As outlined above, Karmiloff-Smith's RR Model (1992) is a useful framework for further examining and contrasting the overlapping morphological and phonological profiles of these children. A distinction between implicit and explicit knowledge has also received support in domains of language (Karmiloff-Smith, 1992; Ellis, 2008), phonology (Ramus and Ahissar, 2012; Mundy and Carroll, 2012; Roberts and McDougall, 2003; Joanisse et al., 2000), and morphology (Dienes et al., 1991). Informed by insights from the RR Model and studies of typical phonological development (e.g., Ziegler and Goswami, 2005), the work described in this Chapter has sought to develop a novel, transparent and robust system for the classification of phonological and morphological awareness tasks in the form of implicit-to-explicit continua.

Overall, this continuum development process appeared to be far easier for phonological awareness tasks than for morphological awareness tasks, which may be due to the richness in phonological awareness research and the lack of the same for morphological awareness research. Furthermore, the most implicit task for the CAPPT appears to suit the requirements of the RR Model better than the most implicit task for the CAMPT, which again may be due the limited morphological awareness research and the vast amount of phonological awareness research. Furthermore, perhaps this offers more evidence to suggest that, simply, phonological awareness is more implicit. In the following Chapters, these continua will be used to facilitate a more fine-grained examination of differences in the oral language skills of individuals with DLD and comorbid DLD and Dyslexia. Therefore, the implication of the current Chapter offers partial resolution for research question one, as continua for implicit-to-explicit differences in phonological and morphological tasks were developed. These will now be examined in the next Chapter.

Chapter Four: Morphological Task Developments

Chapter 3 highlighted that it was more difficult to both develop and map tasks on to the CAMPT versus the CAPPT due to a smaller amount of previous research literature and the number and nature of existing tasks available for usage. Therefore in order to fully assess the CAMPT, several morphological measures had to be adapted. This Chapter seeks to outline the measure adaptations the current thesis undertook, as well as the methods and results of the pilot study. This Chapter addresses aspects of research question one: specifically, whether adaptations can be made to morphological awareness tasks in order to make them appropriate for the implicit-to-explicit framework of the CAMPT?

The implicit-to-explicit approach has been used to conceptualise types of knowledge used to complete tasks within the domain of language (Karmiloff-Smith, 1992; Ellis, 2008), including areas of phonology (Ramus and Ahissar, 2012; Mundy and Carroll, 2013; Roberts and McDougall, 2003; Joanisse et al., 2000) and morphology (Dienes et al., 1991). Additionally, the Representational Redescription Model (Karmiloff-Smith, 1992) can be used to explain the differences in performance on phonological awareness tasks noticed in Ramus et al. (2013) study. Therefore, the current thesis will examine performance on implicit and increasingly explicit phonological and morphological awareness tasks in children with DLD with and without additional literacy difficulties. Any similarities or differences in performance will enable the identification of profiles associated with DLD versus those associated with their additional literacy difficulties. As outlined in Chapter 3, several steps have been taken towards this, including the development of the CAPPT and the CAMPT.

In comparison to the field of phonology, where there is an abundance of research outlining the differences between task demands, the underpinnings of morphological awareness tasks have been neglected by comparison. Therefore, (as outlined in Chapter 3) the CAMPT was primarily informed by the development of the phonological implicit-to-explicit continuum. A simplified version of the CAMPT is outlined in Table 8.

Table 8. *Simplified CAMPT*

Task Type	Implicit	Lower Explicit	Near-Explicit	Full Explicit
Judgement	✔			
Recognition	✔	✔		
Completion	✔	✔	✔	
Application	✔	✔	✔	✔

Note: ✓ = Skills present within this section/band of the continuum

Table 8 outlines the different, anticipated levels of the CAMPT and similar to the CAPPT there is one level for implicit tasks and three increasingly explicit levels. The implicit level comprises of judgement tasks that require individuals to link words together based on morphological relatedness. These tasks are implicit as they do not require any understanding of why they match and furthermore, these often have phonological clues. Recognition tasks require individuals to spot similarities between words and morphemes and require a lower explicit level of understanding. Moreover, these tasks require individuals to recognise morphological relatedness between words, but it does not require individuals to produce their own morphologically related words. Completion tasks, on the other hand, do require individuals to produce their own morphological related words. Completion tasks include grammatical closure tasks and are therefore classified as the next (near-explicit) level. Finally, application tasks, such as defining a novel, morphologically complex words, were classified as fully explicit tasks as these require individuals to apply morphological knowledge in new and creative ways. Following the development of the continuum a variety of morphological language tasks, which are used widely in the literature, were mapped onto the different explicitness levels, as described previously in Chapter 3.

Tasks were selected from various points along the continua in order to represent different degrees of implicit and explicit processing for both the CAPPT and the CAMPT. The tasks selected for this all needed to be oral language tasks as the current study wanted to control for potential confounds due to limited literacy skills. Furthermore, the tasks needed to be suitable for children aged seven to ten years old, as this was the target sample of the current thesis. Task selection was completed successfully for the CAPPT, as this is an area that boasts extensive research within the literature. Unfortunately, this was not the case for the CAMPT, as this is a relatively underdeveloped area of the literature and the measures used are limited. However, it was noted that the several existing morphological awareness tasks could be adapted to suit the requirement of the current thesis. Two of these tasks needed to be adapted to ensure suitability for the age range of the current thesis. First, the Word Structure subtest of the Clinical Evaluation of Language Fundamentals (CELF), was initially designed for children aged five to eight years old and therefore required extending in difficulty so it could be used on children aged up to ten years old. Second, Larsen and Nippold's (2007) Dynamic Measure of Morphological Awareness was adapted to make it more appropriate for younger children. Additionally, one further task, Bowers' (2006) Real Connections task, was adapted from a written task to an oral language task. A pilot study was conducted to test the reliability and consistency of these measures and is reported in this Chapter.

Methodology

Design

The current study was designed as a pilot study to test the reliability and validity of adaptations to existing morphological awareness tasks, to both satisfy the criterion of the CAMPT and ensure their suitability for the target population. Measures were also assessed for ceiling and floor effects, as well as an assessment of the delivery of the measures themselves to ensure the clarity of instructions and to test the appropriateness of items and prompts.

Participants

Participants were recruited via two different methods. Firstly, participants were recruited from one local school after gatekeeper consent had been gained. Schools were recruited either through emailing contacts or contacting schools already familiar with Coventry Universities' Literacy Group. Data collection took place in the Spring term for all participants and participants were recruited from Years three, four and five. In addition to these children, children were also recruited from a research event (Coventry University Young Researchers: CUYR) that Coventry University hosted in the summer holidays and collected in August 2015. Overall, a total of 81 children took part in the pilot study. Their ages ranged from six years to twelve years old, with a mean age of eight years and seven months. Not all participants took part in every measure as outlined in Table 9 below.

Table 9. *Mean Age for Each Task by Participant Recruitment Group.*

Task	Local School			CUYR			Total		
	N	Age	Range	N	Age	Range	N	Age	Range
Real Connection	23	107	84 - 122	27	115	60 - 144	50	111	60 -144
DATMA	23	107	84 - 122	5	115	80 - 118	28	109	80 - 122
Extended Word Structure	23	107	84 - 122	15	102	72 - 120	38	107	72- 122
Advanced Derivations	23	107	84 - 122	2	80	78 - 82	25	101	78 - 122
Opaque Derivations	23	107	84 - 122	9	114	78 - 144	32	109	78 - 144

Materials

Background Measures

In addition to the adapted morphological awareness measures intended for the pilot study, participants completed a short series of background measures. These were delivered to screen the children's language, literacy and non-verbal intelligence levels.

Nonverbal IQ

Participants completed the Matrix Reasoning subscale of the Wechsler Abbreviated Scale of Intelligence (WASI: The Psychological Corporation, 1999). Participants were presented with an incomplete pattern and asked to complete the pattern by selecting one of five choices. Testing discontinued after four consecutive errors were made. Participants' responses were scored for accuracy, and raw scores were converted to a standardised scale with a mean of 50 and a standard deviation of ten as described in the test manual. The WASI manual reports high levels of reliability (α = .89 and r= .86 - .96, depending on age group).

Language Ability

Participants completed the Concepts and Following Directions subscales of the Clinical Evaluation of Language Fundamentals (CELF-4: Semel, Wiig and Secord, 2006). Participants were presented with a picture and then given an increasingly complicated instruction to follow (e.g., point to the black ball, then the small white shoe). Participants' responses were scored for accuracy, and raw scores were converted into scaled scores with a mean of ten and a standard deviation of three as described in the test manual. The test manual for the CELF-4 UK reports Cronbach's alpha and split-half correlations of α = .73 - 92, r = .76 - .93.

Literacy Ability

Participants were screened for their literacy ability using the Word Reading (Card B) subscale of the British Ability Scales, 2^{nd} edition (BAS-II: Elliot, Smith and McCulloch, 1996). Participants were presented with a card which contained a list of single words printed in a large font and divided into nine sections of ten, and they were then asked to attempt to read each of these words. Children were encouraged to guess or to try and 'sound out' words they were unfamiliar with aloud. Participants aged under eight years old started from item one, participants aged over eight but less than eleven started at item 21, participants aged eleven and older started on item 41. However, if participants made less than three correct attempts at their starting point, they were asked to start from the previous section. Participants were stopped once they had made more than eight errors in one section. Participants were scored for accuracy only. Raw scores were then converted into ability scores and then finally into standard scores (M = 100, SD = 15). The published split-half reliability of this test was high at r = .88.

Pilot Morphological Awareness Measures

Real Connections

Bowers' (2006) Find the Real Connection task meets the criteria for the Judgement section of the morphological awareness implicit-to-explicit continuum because this task is multiple choice and only requires individuals to link words together. This is the most implicit task. However, this task was initially a written language task, and the current thesis is assessing oral language skills. Therefore, this task needed to be adapted to become an oral task.

This task was initially delivered in a written form whereby the participant had to choose one word from six that had a real connection to the target word. In order to adapt this to an oral task, first, the number of potential answers was changed from six to three to reduce the high working memory load that would occur without the orthographic support.

Additionally, to control for individual word knowledge and to assess all types of morphological changes equally (inflectional, transparent derivational and opaque derivational; see Table 10), items where matched and balanced. This was done to ensure all morpheme types were being measured equally. Item balancing allowed for all elements to be tested while controlling for individual word knowledge, which is something the original measure did not do.

Participants were presented with the target word followed by three response options. One of these words shared a morphological link to the target word, either an inflection, transparent derivation or opaque derivation of the target word. The other two words were phonological foils that used a similar sound to the target word but without a morphological link. Example matched items and foils: target word '*real'* items: *unreal, reason, already* (inflectional); rearing, *already*, reason (transparent derivational); cereal, ideally, *reality* (opaque derivational).

The experimenter read out the stimuli, and the participant was asked to respond verbally. For example, "The target word is healthy – which of these has a real connection to healthy? ***healthier***, wealthy, help". Participants were allowed to practice with three trial items with the experimenter. Children were encouraged to explain their choices. During the practice items, the experimenter was allowed to give feedback to ensure they understood the task adequately. Feedback was not given during the main activity.

There were ten different target words, each with three different items: one item with an inflection, another with a transparent derivation and another with an opaque derivation. All items were delivered in a randomised order, totalling thirty items (see Table 11). Participants were measured on accuracy, and this was measured in four different ways, an overall score, an inflection score, a transparent and an opaque score.

Table 10. *Real Connections Items; Organised by Target with Morpheme Change Type.*

Target	Options			Type
saving	saves	raving	craves	Inflectional
	available	saveable	shave	Transparent Derivational
	bravery	average	saver	Opaque Derivational
real	cereal	ideally	reality	Opaque Derivational
	already	unreal	reason	Transparent Derivational
	really	rearing	feel	Inflectional
create	creative	cream	ate	Transparent Derivational
	mate	great	recreation	Opaque Derivational
	grated	created	creak	Inflectional
sign	singer	signal	spine	Opaque Derivational
	sight	line	assignment	Transparent Derivational
	sigh	signs	align	Inflectional
please	ease	teasing	pleasant	Opaque Derivational
	pleaser	plenty	complete	Transparent Derivational
	pleasing	increased	grease	Inflectional
using	amusing	use	confusing	Inflectional
	fusing	closing	useful	Transparent Derivational
	usual	amuse	sing	Opaque Derivational
easy	east	increase	ease	Opaque Derivational
	easily	greasy	tease	Transparent Derivational
	base	eastern	eased	Inflectional
science	scissors	unscientific	essence	Opaque Derivational
	scientist	fascinate	audience	Transparent Derivational
	sentence	sciences	discipline	Inflectional
busy	dizzy	busier	buses	Inflectional
	noisy	buster	busily	Transparent Derivational
	bus	business	cosy	Opaque Derivational
section	dissection	inspect	reject	Transparent Derivational
	intersection	secrets	secure	Opaque Derivational
	action	reject	sectioned	Inflectional

Table 11. *Real Connection Items in Order of Delivery.*

No.	Target	Options		
1	saving	saves	raving	craves
2	create	grated	created	creak
3	sign	singer	signal	spine
4	section	intersection	secrets	secure
5	please	ease	teasing	pleasant
6	easy	base	eastern	eased
7	science	scissors	unscientific	essence
8	real	already	unreal	reason
9	create	mate	great	recreation
10	sign	sight	line	assignment
11	saving	bravery	average	saver
12	real	cereal	ideally	reality
13	please	pleaser	plenty	complete
14	create	creative	cream	ate
15	using	fusing	closing	useful
16	easy	easily	greasy	tease
17	science	scientist	fascinate	audience
18	busy	noisy	buster	busily
19	sign	sigh	signs	align
20	busy	bus	business	cozy
21	section	dissection	inspect	reject
22	saving	available	saveable	shave
23	please	pleasing	increased	grease
24	using	amusing	use	confusing
25	real	really	rearing	feel
26	using	usual	amuse	sing
27	easy	east	increase	ease
28	science	sentence	sciences	discipline
29	busy	dizzy	busier	buses
30	section	action	reject	sectioned

Word Structure

The Word Structure subtest of the Clinical Evaluation of Language Fundamentals' 4th Edition (CELF: Semel, Wiig and Secord, 2006) was selected as an appropriate task to assess the Completion section of the morphological awareness continuum because it requires participants to generate morphological related responses. This task is at the near-explicit level of the CAMPT. The Word Structure task assesses both the use of pronouns and inflectional and derivational morphology within a primed sentence context. Unfortunately, this task was designed for use with children aged five to eight years, and the current thesis is working with children aged seven to ten. Therefore, the Word Structure task needed to be extended to suit the requirements of the current thesis. This was extended in three ways with lower frequency words, advanced morphemes and opaque items being added.

New items were added to this task so that it could be used with a slightly older population. Firstly, items were added to match the affixes that were used in the original measure. However, instead of using high-frequency words, like that of the original task, low-frequency words were used (the frequency of the words and morphemes was determined through the use of Children's Printed Word Database (Masterson, Dixon and Stuart, 2003) in May 2015). New items such as, "Here is one *chimpanzee*, here are two… *Chimpanzees*" were included, and new pictures were developed to accompany each item. In total 14 new items were added in this format, totalling 46 items in total. These items were delivered alongside the original items, where the items were clustered together based on affix type of those they were matched too. This task was renamed the Extended Word Structure task to reflect these additions.

Furthermore, the CELF Word Structure has been criticised for not including enough derivational morpheme items (e.g., *–er, -est, -y*) and mainly consisting of inflection morpheme items (e.g., plural *–s*, possessive *–s*, third person singular *–s, -ing, -ed*) (Larsen and Nippold, 2007). Therefore, more derivational items were added to ensure that this was tested thoroughly. They also note that there is no subtest within the CELF-4 that test knowledge of more advanced derivational morphemes (e.g., *–ness, -tion, -ism, -some*) and suggest that this would be more appropriate for older students aged 9 and above. Therefore, some items using these less frequent and more complex derivational morphemes were included. Example items: *"*the archer was very *accurate.* He had great… *accuracy"* and "the knight protected the *King's land*. He protected the whole*… kingdom"*. This task was named the Advanced Derivations Word Structure.

Additionally, Carlisle (1988) stressed the importance of assessing derivational morphology with words that had an opaque phonological change, as opaque phonological changes (e.g., *explode-explosion*) are harder for children to understand than transparent ones (e.g., *drive-driver*). This idea was also incorporated within the implicit-to-explicit continuum; therefore, this was also something that could extend the CELF Word Structure subtest, as these are not covered in this test. These items were based on Carlisle's (1988) task items, which were designed for children aged 9-14. The items were balanced so that there were a decomposition and a derivation item for each affix. Example item: “the teacher asked for an *explanation*. She started to… *explain”*. This task was named the Opaque Word Structure.

Extended Word Structure

As this task was mainly based on the CELF Word Structure, with a small selection of new items added, the original protocol from the test manual was followed. All new items added were integrated within the existing item order of the CELF version (see Table 12). In this task, children were shown pictures and then were read sentences that they had to complete by using the appropriate grammatical morpheme. In order to ensure that the participant understood the requirement of the task, three trial items and 15 example items were used before each different item type. These were all the original trial, and example items from the CELF Word Structure and corrective feedback were given for these. This task consisted of 46 items, of which only 14 new items were added to the original (see Table 12). The stimuli were presented verbally by the experimenter and required the participant to respond verbally as well. Each correct answer was awarded one point.

Table 12. *Extended Word Structure items.*

No.	Item	Target
1	Here is one book. Here are two…	books
2	Here is one horse. Here are two…	horses
3	**Here is a galaxy. Here are lots of…**	**galaxies**
4	**Here is one chimpanzee. Here are two...**	**chimpanzees**
5	Here is one mouse. Here are two…	Mice
6	Here is one child. Here are three…	children
7	**Here is a baby calf. Here are three…**	**calves**
8	**Here is a cactus. This field is full of...**	**Cacti**
9	The boy likes to read. Every day he…	Reads
10	Here the bird eats. Here the bird…	Ate
11	**Caitlyn is singing a lullaby. Every day she sings...**	**lullabies**
12	**Here the dog digs. Here the dog has…**	**Dug**
13	This is Kim, and this is Paula. This is Kim’s mitten, and this is…	Paula's
14	This is a king. Whose crown is this? It is the…	King's
15	This man sings. He is called a…	singer
16	**This man play's music. He is a…**	**musician**
17	This girl is sad. Tell me about this girl…	happy
18	This girl is…	listening
19	This boy is…	eating
20	Tell me what the rest of the children are doing…	swinging
21	Here…	skipping
22	This boy said, “This cap is mine and that one is...”	Yours
23	The man is climbing a ladder. This is the ladder that the man…	climbed
24	**Evie saw a stone shimmering in the light. When it was in the light it...**	**shimmered**
25	They have a new radio to share. The radio belongs to all of…	Them
26	The girl said “Those toys are ours. They belong to….”	Us
27	She is sliding now. Soon he…	will slide
28	These nursery school children are eating now. Next, these first years…	Eat
29	This woman is a fast runner, but this woman is even…	faster
30	And this woman is the…	fastest
31	This picture is good, but this picture is even…	better
32	And this picture is the very…	Best

33	**This room is messy, but this room is…**	**messier**
34	**And this room is the…**	**messiest**
35	**This birds nest is cosy, but this one is...**	**cosier**
36	**And this one is the…**	**cosiest**
37	Tell me who is hungry?	she is
38	Who is sleepy?	They are/he is
39	Jill said, “Al you have all the luck”. She could have said, “Al you are…”	Lucky
40	**He wants to freeze his drink. Now his drink is...**	**frozen**
41	The boy is looking in a mirror. Who is he looking at? The boy is looking at…	himself
42	The girl is looking in the mirror. Who is she looking at? She is looking at…	herself
43	The girl has a hamburger to eat. Who has a hamburger?	she does
44	The school choir has a song to sing. Who will sing a song?	they will
45	This boy is drawing a cat. This is the cat that the boy…	Drew
46	**This man is teaching. This is what he…**	**taught**

Note. **Bold font** indicates the items were added

Advanced Derivations Word Structure

This task was also primarily based on the CELF Word Structure task and was also delivered in an oral format, except this task was delivered without any pictures. Pictures were not used in this task because the language is more complex and finding or developing pictures to reflect the items and not distract from them was too complicated. The experimenter read a sentence aloud to the participant and asked that they completed the sentence using one of the words from the first sentence but changing it slightly. In order to ensure that the participant understood the requirement of the task, two example items were delivered with corrective feedback first. This task consisted of 9 items (see Table 13).

Table 13. *Advanced Derivation Word Structure items.*

No.	Item	Target
1	Martha and Jake were always quarrelling. The pair are very_?	Quarrelsome
2	The flower had great beauty. It was very_?	Beautiful
3	This kitten does not have a home. The kitten is_?	Homeless
4	Harry's pencil was not very sharp. He needs to_?	Sharpen (it)
5	Calvin asked for an apology. Greg started to _?	Apologize
6	Leo was very good at art. He wanted to become an_?	Artist
7	The archer was very accurate. He had great target_?	Accuracy
8	The knight always protected the King's land. He protected the whole_?	Kingdom
9	The little girl grew green with envy. She was very_?	Envious

Opaque Word Structure

Again, this task was based mainly on the CELF Word Structure task and was also delivered in an oral format and was delivered without any pictures. The experimenter read a sentence aloud to the participant and asked that they completed the sentence using one of the words from the first sentence but changing it slightly. This task also utilised two practice items with corrective feedback to ensure children understood the task adequately. This task consisted of 14 items (see Table 14).

Table 14. *Opaque Word Structure items.*

No.	Item	Target
1	Joe developed an original idea for his story. The teacher praises him for his…	originality
2	Julia is very popular. Her teacher said she has a lot of...	popularity
3	This man does magic shows. He is a…	magician
4	This man works with electric circuits. He is an…	electrician
5	The train conductor was waiting for a sign. He finally got the...	signal
6	Paul is a national supporter. He supports the…	nation
7	This swimming pool is very deep. It has a very large...	depth
8	This swimming pool has a very large width. It is very...	wide
9	The teacher asked for an explanation. She started to…	explain
10	Michael worked on a production line. He made lots of…	produce
11	The teacher asked the students to describe their summer holidays. Ahmed won a prize for his…	description
12	Claire nearly did not recognise her teacher. It took a while for her…	recognition
13	Ben needed to decide what food he wanted in the restaurant. Finally, he has made his…	decision
14	The teacher taught the children about division. They now know how to…	divide
15	Holly is very athletic. When she grows up, she wants to be an…	athlete
16	Evie's favourite lesson is drama. She is very...	dramatic

Dynamic Assessment Task of Morphological Awareness

Larsen and Nippold (2007) designed the Dynamic Assessment Task of Morphological Awareness (DATMA), which was based on earlier work by Anglin (1992). This task involved asking children to define derived words that would be unfamiliar to them, although they would be familiar with the base words. Instead of merely being a static measure, this was designed to be a dynamic measure, so there were several prompts developed to help the children define the words correctly. This task makes an excellent assessment of the Application section of the CAMPT because it requires participants to apply their morphological awareness in a new context. This task represents the most explicit task of the CAMPT. However, this task was used originally with a slightly older population (10-12 years). Pike (2011) conducted a study and used this as a measure, but with slightly different items, for children aged 8-9 years old. Therefore, a selection of items from both Larsen and Nippold (2007) and Pike (2011) were used, as this would make it more appropriate for our target age group. The following items were taken from Larsen and Nippold (2007): Beastly, Dramatize, Fearsome, Flowery, Oddity, Puzzlement and Secretive. The following items were taken from Pike (2011): Wishful, Oceanaut, Yellowing, Craziness, Guesser and Ageist.

As the DATMA is a dynamic task, there are a variety of prompts that are used if an individual is unable to answer in the first instance. However, Larsen and Nippold's (2007) prompts were insufficient for the requirements of the Application section of the CAMPT. Hasson et al. (2014) also used the DATMA but with some modification to the prompts, which were more appropriate but not entirely appropriate. Therefore, the prompts used in the current study were developed considering both approaches but with some modifications.

First, it was noted that Larsen and Nippold's (2007) prompts only assessed ability to define one morpheme within a word, whereas Hasson et al. (2014) assessed individuals understanding of both morphemes. As assessment of knowledge of both morphemes is more in line with the Application section of the CAMPT, it was decided that Hasson et al. (2014) procedure would be followed. Secondly, it was noted that Hasson et al. (2014) included orthographic cues as well as reading in their prompt structure. As previously mentioned the current thesis is only looking at oral language skills, so this prompt was excluded. Additionally, as the DATMA was selected to assess the Application level of the CAMPT and this includes the ability to apply rules with creativity and flexibility, it was decided to add a sentence formation task, similar to that of the Formulated Sentences from the CELF-4 but without pictures. Therefore, this was added for those who correctly answered before the sentence prompt.

The first prompt asked participants if they could define the what (e.g., what does Beastly mean?). If they correctly defined the word immediately, questions were asked (e.g., how did you know that?) to see whether they used morphological cues to obtain their answer. If participants correctly defined the word and showed understanding of both morphemes (e.g., participant response *beastly* – "because *beast* means scary and *–ly* means like"), they were awarded 7 points (max score). If participants only showed awareness of one (e.g., participant response *oddity* – "because *odd* means strange"), they were awarded 6 points. If the participant was unable to define the word, prompts were presented until the correct answer was given or the scaffolds were exhausted. All answers were scored according to the assessment flowchart outlined in *Figure 3*.

Additionally, if participants were able to define the word before prompt 3 (where the word is provided in a sentence for them), they were also asked if they could use the word in a sentence. Participants were awarded a maximum of two additional points. They were awarded two points for a fully appropriate answer (e.g., "my brother is very beastly") or one point for answers that were not completely correct (e.g., "I am good at keeping secretive"). Scoring of the definitions and sentences were marked separately.

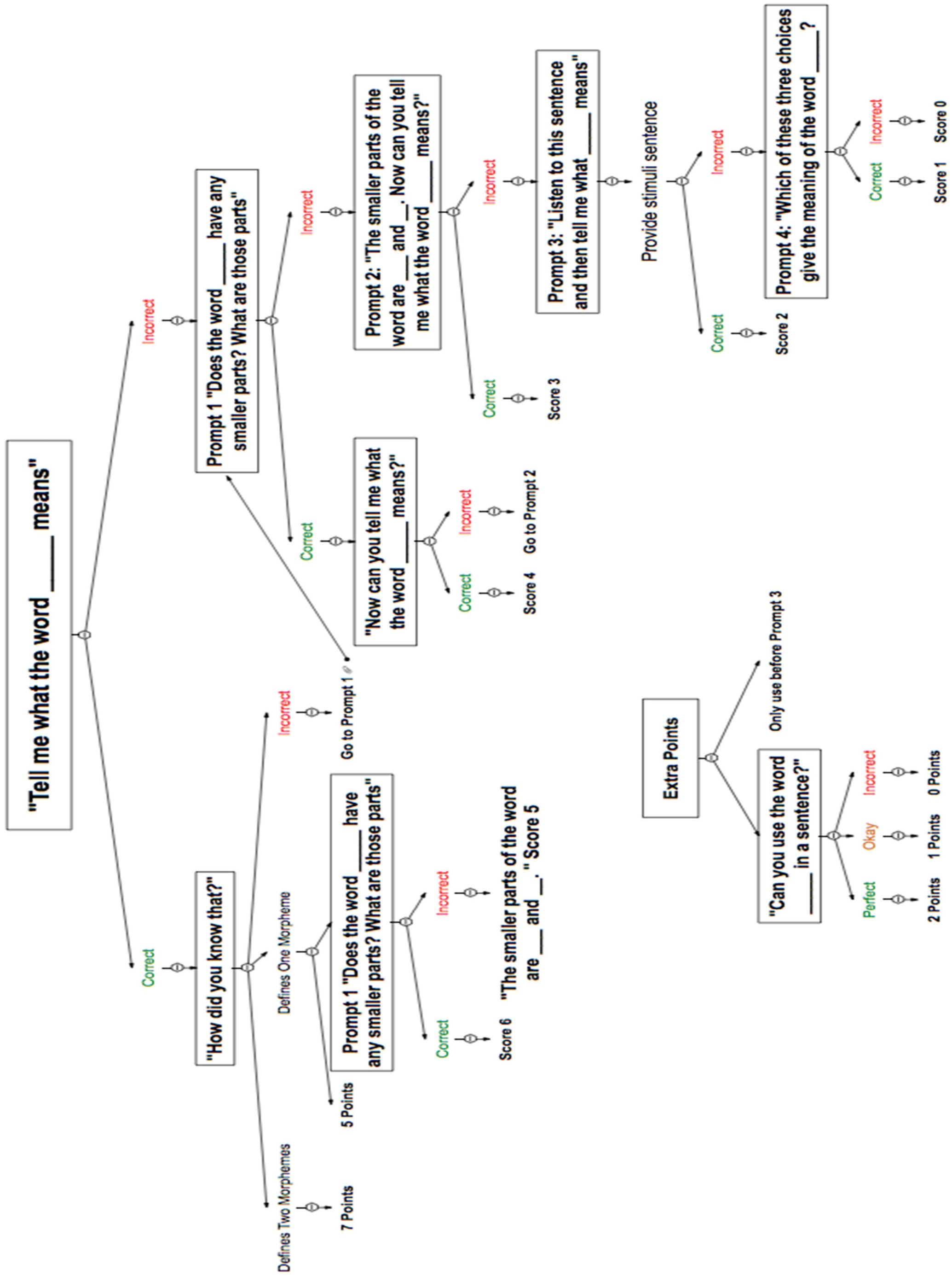

Figure 3. Scaffolds used in the DATMA task.

Procedure

Although the overall procedure was the same for the different participant recruitment groups, there were some minor differences. Therefore, outlined below are the procedures for each participant recruitment group.

Schools

Ethical consent was gained from Coventry University's Ethics Committee (Appendix A) before gatekeeper consent was sought, and data collection took place. Informed parental consent was gained, as well as informed consent for each participant. Parents and participants were informed of their right to withdraw before, during and for up to two weeks after the data was collected. Each child completed a series of tasks that were conducted over two sessions of 45 minutes. In the first session, participants completed the background measures to ensure the tasks were piloted on a normally distributed population (word reading, language and non-verbal IQ). In the second session, participants then completed the experimental tasks. All Word Structure subtasks were delivered together with the extended items first, followed by the advanced and opaque items. The tasks were delivered in a counterbalanced order, with six different possible orders. After completion of all tasks, children were debriefed, and parental debrief letters were sent home.

CUYR

Ethical consent was gained from Coventry University's Ethics Committee (Appendix A) before data collection took place in the current study. Furthermore, ethical consent was also gained from Coventry University's Ethics Committee for the

CUYR event. Before the event took place, informed, parental consent was gained for the CUYR event. During the event, parents were approached and asked if they would consent to their child taking part in the current thesis. Depending on time available, children were able to take part in any of the three tasks. The Word Structure and its subscales task took around 15 minutes to administer, the DATMA task took around 20 minutes, and the Real Connection tasks took around 5-10 minutes to administer. No background measures were taken for the participants recruited in the CUYR. After completion of the task/s, children were debriefed, and parental debrief letters were sent home.

Results and Discussion

Real Connections

Unfortunately, the real connections task was not found to be normally distributed, as indicated by the $p < .001$ on the Sharpio-Wilks test. Further inspection of the histograms suggested that this task was positively skewed. The participants scored a mean of 25.61 with a standard deviation of 3.83, as this measure has a maximum score of 30, this suggests good performance.

Furthermore, as all participants scored near the top end and with a relatively low amount of variability, this indicates that participants hit ‘ceiling’ on this task. Cronbach alpha reliability coefficient of internal consistency for the real connections task was .791, which is an acceptable level of reliability. The data was also screened for outliers, and none were found.

Extended Word Structure

This task was found to be normally distributed, as p = .091 on the Sharpio-Wilks test. The participants scored a mean of 32.72 with a standard deviation of 4.46 on the overall task and a mean of 8.97 with a standard deviation of 2.01 on the additional 14 items. The max score here was 46, so therefore this shows relatively high performance on this task. Cronbach alpha reliability coefficient of internal consistency was found to be acceptable (.764). The original items of the CELF Word Structure had a Cronbach alpha coefficient of .710, and the added items had a coefficient of .521. As the CELF is a standardised measure, the current thesis did not want to remove any of the items from this measure therefore only weak items from the additional items were removed. Six of the additional fourteen items were removed (items 3, 7, 8, 24, 33 and 34), this increased the overall coefficient to .781. These items have been omitted from the main study (Chapter 5, Chapter 6 and Chapter 7). The mean on the items that remained was 5.21 with a standard deviation of 1.61. The data was also screened for outliers, and none were found.

Opaque Derivation Word Structure and Advanced Derivation Word Structure

As there were so few items for each of these tests, these tasks were analysed together. The combined task was found to be normally distributed, as p = .783 on the Sharpio-Wilks test. The participants scored a mean of 11.28 with a standard deviation of 4.58. The max score on this task was 23, and therefore this shows relatively low performance overall on this task. These tasks had a combined Cronbach's alpha of .831, and with the removal of item five, ten and eleven from the opaque items and item one from the advance items, this increased to .850. These items have been omitted from the main study (Chapter 5, Chapter 6 and Chapter 7). The mean on the items that remained was 9.8 with a standard deviation of 3.78. The data was also screened for outliers, and none were found.

DATMA

This task was found to be normally distributed, as p = .478 on the Sharpio-Wilks test. The participants scored a mean of 61.36 with a standard deviation of 10.75. This task has a max score of 90, which shows a relatively high overall performance. Cronbach alpha reliability coefficient of internal consistency was found to be acceptable .681, which increased further to .746 with the removal of three items: beastly, fearsome and secretive. These items have been omitted from the main study (Chapter 5, Chapter 6 and Chapter 7). Internal consistency of the DATMA has been previously assessed with split-half reliability; which was found to be acceptable (t=–.40, p= .6938) (Larsen and Nippold, 2007). The data was also screened for outliers, and none were found.

Conclusion

After completion of data analyses, the usefulness of each measure and their items were considered. All measures aside from the real connections task were normally distributed. Children appeared to be reaching 'ceiling' on the real connections task, and thus it was considered for removal. However, as the intended participants for this study are those with DLD and they are likely to have a morphological awareness difficulty, this task was kept as it may highlight key differences between typically developing and those with language impairments. Therefore, this task was kept for the main study.

The next task to be considered was the dynamic assessment of morphological assessment; the task was found to have a reasonable level of reliability, which increased with the removal of several items (*beastly*, *fearsome* and *secretive)*. This task was considered to be a successful adaptation from the original as it had a normal distribution and acceptable reliability. Therefore, this task will be used in the main study but with the reduced items.

The extended word structure task was most reliable with the removal of six of the additional items, making the overall total now 40 items. This task was also considered a successful adaptation as this task now suited an older population without children being affected by ceiling effects. Therefore, the current thesis will use this measure with the reduced items.

The opaque and advanced derivation word structure tasks were most reliable when these items were combined, also with the removal of three items. Again, this was considered a successful adaptation, as it was found to be suitable for older children without causing flooring effects for younger children in the population. Therefore, the current thesis will combine these measures and remove these items.

To conclude, all tasks apart from the real connections task were considered as successful adaptations. They were all found to have acceptable levels of reliability and only with real connections being not normally distributed. Therefore, these tasks will be used in the main study to examine the differences between children with DLD and Dyslexia systematically. The real connections task although not so successful will also be used as the ceiling effects gained with typically developing children could prove a useful contrast to performance on the task by children with DLD.

Chapter Five: Evaluating the CAMPT and CAPPT

Chapter 3 outlines the reviewing, development and mapping processes followed in order to create the CAPPT and CAMPT. As outlined previously, this was far easier for the CAPPT due to the wealth of the research literature available. Therefore, in order to map tasks appropriately, several task adaptations were completed and tested for their reliability (Chapter 4). The final step in the development of the CAPPT and CAMPT is to evaluate what has been developed through a Factor Analysis. Therefore, the current Chapter describes an empirical study in which tasks drawn from different sections of these continua were administered to a diverse sample of typically developing children and children with language and/or literacy impairments. The results of this Chapter will address research question one: specifically whether implicit-to-explicit continua be evaluated for phonological awareness and morphological awareness tasks?

As noted in earlier Chapters, the main theoretical underpinnings for this thesis were taken from Karmiloff-Smith's (1992) Representational Redescription Model. Within this model, Karmiloff-Smith provides a framework for cognitive development where learning is described as a process of implicit representations becoming redescribed into increasingly explicit representations. Within the RR Model, Karmiloff-Smith (1992) describes four critical phases of development that form an overall continuum. The implicit level is the first level and is the only fully implicit level involved in the RR Model. The RR Model then outlines three levels of explicit understanding.

This model starts with E1, which is the least explicit level and is often characterised by decrements in performance. Next is the E2 level, which is the near-explicit level, and the final level is E3 which marks attainment of fully explicit understanding.

Continuum of Awareness for Phonological Processing Tasks (CAPPT)

The phonological implicit-to-explicit continuum was influenced by Ziegler and Goswami's (2005) notion that phonological awareness progresses from an initial implicit sensitivity to large units, such as syllables, to an explicit awareness of smaller units, such as phonemes. The categories within the CAPPT were influenced by this framework as well as the developmental trajectory outlined within Karmiloff-Smith's RR Model (1992). A simplified version of this continuum is outlined in Table 15.

Table 15. *Simplified CAPPT*

Task Type	Implicit	Lower Explicit	Near-Explicit	Full Explicit
Production	✔			
Discrimination	✔	✔		
Segmentation	✔	✔	✔	
Manipulations	✔	✔	✔	✔

Note: ✓ = Skills present within this section/band of the continuum

Table 15 outlines the levels of the CAPPT and where different types of tasks would correspond. Production based tasks, such as non-word repetition tasks, were classified as implicit tasks; this is because they only require individuals to produce and replicate phonemes which do not require any explicit understanding. Discrimination tasks, such as rhythm oddity tasks, were classified as beginning-explicit tasks. These tasks require individuals to hold a phonological unit in their memory and reference other units against it until they find a match. Although this does require an understanding of the underlying phonemes, it does not require the ability to deconstruct words into their constituent phonemes. However, this is a requirement for segmentation and blending tasks, and therefore these tasks are classified as near-explicit. Manipulation tasks, such as spoonerisms, are the next and final level and require fully explicit understanding, as in addition to deconstructing they also require the manipulation of phonemes, for example transposing phonemes. Following the development of the continuum a variety of phonological awareness language tasks, which are used widely in the literature, were mapped onto the different explicitness levels.

Continuum of Awareness for Morphological Processing Tasks (CAMPT)

In comparison to the field of phonology, where there is an abundance of research outlining the differences between task demands, the underpinnings of morphological awareness tasks have been neglected by comparison. Therefore, the CAMPT was primarily informed by the development of the phonological implicit-to-explicit continuum. A simplified version of the CAMPT is outlined in Table 8 in Chapter 4.

Table 8 outlined the levels of the CAMPT and similar to the CAPPT there is one level for implicit tasks and three increasingly explicit levels. The implicit level comprises of judgement tasks that require individuals to link words together based on morphological relatedness. These tasks are implicit as they do not require any understanding of why they match and furthermore, these often have phonological clues. Recognition tasks require individuals to spot similarities between words and morphemes; these tasks require a lower explicit level of understanding. These tasks require individuals to recognise morphological relatedness between words, but it does not require individuals to produce their own morphologically related words. However, this is a task requirement in the completion tasks, such as grammatical closure tasks and are therefore classified as the next (near-explicit) level. Finally, application tasks, such as defining a novel, morphologically complex words, were classified as fully explicit tasks as these require individuals to apply morphological knowledge in new and creative ways. The development of the CAMPT was more complex than that for the CAPPT, and therefore instead of merely mapping pre-existing tasks to the CAMPT, several tasks had to be adapted first (Chapter 4). These adapted tasks were mapped onto the different explicitness levels, as described previously in Chapter 3.

Summary and Research Aims

The work summarised thus far has culminated in the development of implicit-to-explicit continua for existing measures of phonological and morphological processing. The empirical research described in the remainder of this Chapter evaluates the CAPPT and CAMPT continua. The language tasks previously mapped to the continua were administered to a diverse sample of typically developing children, as well as children with language and literacy impairments, and the children's pattern of performance across tasks was investigated using Exploratory Factor Analysis (EFA). The primary aim was to explore the extent to which factors emerging from the analysis would correspond with the distinctions made between different degrees of implicit and explicit awareness specified on the continua. A secondary aim was to produce composite dependent variables for between-group comparisons (reported in Chapter 6).

Method

Design and Participants

The current study utilised a cross-sectional, correlational design in which a diverse sample of typically developing children, children meeting the classic diagnostic criteria for DLD (as outlined in Chapter 2), and children with DLD and additional literacy difficulties (hereafter identified as DLD+), completed a battery of 21 language tasks that had previously been mapped to the CAPPT and CAMPT continua.

Participants were recruited via two different methods. Firstly, participants were recruited from a range of five Primary State Schools situated in the West Midlands after gatekeeper consent had been gained. Schools were recruited by the following methods; emailing existing contacts, contacting schools already familiar with Coventry Universities' Literacy Group, developing new contacts through networking at Coventry Universities' Literacy Groups' outreach events. From the five schools recruited this way, two of the schools had specialist language hubs attached to them, and the remaining schools were Mixed Primary State schools. Data collection started in the spring term of 2015 and ran until the end of the summer term in 2017. Participants were recruited from the year groups three, four, five and six. Teachers were asked to refer children with language or literacy difficulties, as well as some of their typically developing peers. A total of 57 participants (26 males) were recruited in this manner, ten of these children (eight males) w~~h~~ere from specialist language hubs.

Secondly, a recruitment email was sent to parents in the local area who had signed-up previously to receive the ‘Young Researchers’ newsletter produced by the Literacy Research Group at Coventry University. Data collection took place in the autumn term of 2016, mainly during the October half-term break. Participants were recruited from the year groups two, three, four, five and six. A total of 13 participants (eight males) were recruited this way; this gave a total of 70 participants (34 males).

For this analysis, children with no difficulties were placed in the typically developing (TD) group. Children with language scores less than or equal to 78 (1.5 SD below Mean) and a reading score greater than or equal to 85 were placed into the DLD-only group. Finally, children with language difficulties and a reading score less than or equal to 85 (1 SD below the Mean) were placed in the DLD+ group. Seventy children (38 girls) were included in this sample; 37 TD (23 girls), 18 DLD-only (7 girls) and 15 DLD+ (8 girls). The children’s ages ranged from six years and four months to eleven years and seven months, with a mean age of eight years and ten months.

On average, the children from the specialist language hubs tended to have lower standard scores for language (mean = 65.9) and IQ (mean = 75.8) than their Mixed Primary State School peers (mean = 75.0 and 94.1, respectively). Furthermore, the language difficulties appeared to be more severe in the DLD+ group (mean = 65.1) than the DLD-only group (mean = 78.1). One of the participants from the specialist language hub had an additional speech impairment. It was decided that she would be included in the study, as although this affected their speech production the participant was still understandable.

A-priori power analysis was not conducted due to the niche samples required for the research. The recruitment approach was to recruit the maximum number of children within the time available using sample sizes from past research (e.g., Ramus et al., 2013) as a guide. The total sample size here is in line with previous research reporting similar group comparisons, such as Ramus et al. (2013). Observed power is reported for group difference analyses in the relevant results chapters.

Measures

Background Measures

In addition to the CAPPT and CAMPT test batteries, a series of background measures were also delivered. These were delivered to screen children's language and literacy skills and assign them to a typically developing control group, DLD-only group, or DLD with additional literacy difficulties group (DLD+). The analysis of between-group differences is presented in Chapter 6. Nonverbal IQ (as measured by the Matrix Reasoning, WASI) and literacy ability (as measured by Word Reading, BAS-II) were administered and scored as described in Chapter 4.

Language Ability

All participants completed the Recalling Sentences (α=.86-.93, r=.86-.96), Formulated Sentences (α=.75 – 86, r= .75-.8) and Concepts and Following Directions (α=. 73 – 92, r= .76-.9) subscales of the Clinical Evaluation of Language Fundamentals (CELF-4: Semel, Wiig and Secord, 2006). For the recalling sentences subscale, participants are asked to imitate orally presented sentences. For formulated sentences, children are shown a picture of a scene and provided with a target word, and they are then asked to create a sentence that both describes the picture and includes the target word. For concepts and following directions, children are shown pictures and asked to identify items and/or point to them in a prescribed order according to a verbal instruction. Participants aged under eight years also completed the Word Structure subscale (α=.78 - .84, r=. 80-.89). For word structure, children are shown pictures and asked to describe them using a verbal prompt designed to elucidate understanding of word class and morphology. Participants' responses were scored for accuracy, and raw scores were converted into scaled scores with a mean of ten and a standard deviation of three as described in the test manual. These scaled scores were then combined to derive the Core Language Score and Expressive Language Index (M = 100, SD = 15). CELF-4 has been noted too as a superior measure for accurately diagnosing DLD (Spaulding, Plante and Farinella, 2006). The CELF has a Cronbach's alpha range from .87 to .95 for the composite scores, as outlined in the test manual.

CAPPT and CAMPT Measures

Phonological Awareness

A selection of tasks was taken to represent the CAPPT, with care taken to ensure each level of the continuum was represented. Several tasks were taken from the Phonological Assessment Battery, 2nd Edition (PhAB2: Gibbs and Bodman, 2014), including Nonword Repetition, Alliteration, Fluency, Phoneme Deletion, Phoneme

Substitution, Picture Naming and Digit Naming. The Spoonerisms task from the Phonological Assessment Battery, 1st Edition (PhAB: Frederickson, Frith and Reason, 1997). A further task, Mispronunciation Detection, was taken from Carroll, Mundy and Cunningham (2014).

Nonword Repetition: Participants were instructed to listen carefully and repeat the 'alien names' as best as they could (e.g., can you say: *Gerrit*? *Narraf*?"). Participants completed two trial items where feedback was given before moving onto the fourteen test items. No feedback was given for the test items. This task was scored for accuracy where responses were marked as correct or incorrect. The test manual for the Phonological Assessment Battery outlined that internal reliability ranged from α= .89 - .95.

Alliteration: Participants were instructed to listen carefully and choose the 'odd one out' from a set of four words. Participants were informed that the odd word would start with a different sound. Example item: "Which is the odd one out: Now, Not, Nose, *Big*?". Participants completed three trial items where feedback was given before advancing onto the 12 test items. There was no feedback given on the test items. This task was scored for accuracy where responses were marked as correct or incorrect. The test manual for the Phonological Assessment Battery outlined that internal reliability range from α= .89 - .95.

Fluency: This task consisted of two sections. In the first section, participants were required to generate as many words as they could that would rhyme with the target word. Participants were given one trial item before taking the two test items. The items were scored for the number of correct rhymes supplied in thirty seconds.

In the second section, participants were required to list as many words as they could that started with a particular phoneme. The two test items were scored for the number of correct words supplied in thirty seconds. Scores each section was totalled to give an overall fluency score for each section. The test manual for the Phonological Assessment Battery outlined that internal reliability range from α= .89 - .95.

Phoneme Deletion: Participants listened to a spoken monosyllabic word and were then asked to pronounce the word with one phoneme removed. This task was divided into three sections. In the first section, participants were required to remove the final phoneme (e.g., team without the /m/ gives…? *Tea*). Participants completed two trial items with feedback before six test items. No feedback was provided on test items. If participants scored four or more out of six, they progressed to the next section where they were required to remove the initial phoneme (e.g., plot without the /p/ gives…? *Lot*). Participants again completed two trial items with feedback before six test items. If participants scored four or more correct answers, they passed onto the final section where they were required to remove a medial phoneme (e.g., smoke without the /m/ gives…? *Soak*). Participants were again given two trial items with feedback before the six test items. Participants' scores were summed across sections, giving a total maximum score of 18. The test manual for the Phonological Assessment Battery outlined that internal reliability range from α= .89 - .95.

Phoneme Substitution: participants listened to a monosyllabic word and were asked to substitute the initial phoneme with a new one (e.g., what would cat sound like with a /f/ at the front instead? *Fat*). Participants completed two trial items with feedback before completing ten test items without feedback. This task was scored for accuracy where correct answers were awarded one point. The test manual for the Phonological Assessment Battery outlined that internal reliability range from α= .89 - .95.

Spoonerisms: participants heard two monosyllabic words and were then asked to swap their initial phonemes to create two new words (e.g., what do we get when we swap the first sound in the words, King and John? *Jing Kon*). Participants completed three trial items with feedback before completing ten test items without any feedback. This task was scored for accuracy and participants were awarded one point for each word correct within an item, giving a maximum score of 20. The test manual for the Phonological Assessment Battery outlined that internal reliability range from α= .89 - .95.

Picture Naming: participants were required to name each item in a sequence of pictures as quickly as possible. Participants were given a trial card with five different pictures (box, table, ball, hat, door). The researcher named all of the items and then asked the participant to name them as quickly as they could. The participants were then asked to do the same with a longer list of items and advised to name the pictures on the test card as quickly as possible without making mistakes. Participants completed two test cards. Their response times were recorded in seconds, and the number of errors was also noted. The time taken for each card was then combined to get a total score. The test manual for the Phonological Assessment Battery outlined that internal reliability ranged from α= .89 - .95.

Digit Naming: participants were required to name each item in a sequence of digits as quickly as possible. Participants were given a trial card with a list of numbers printed on it. The researcher named all of the numbers and then asked the participant to name them as quickly as they could. The participants were then asked to do the same with a longer list and advised to name the digits on the test card as quickly as possible without making mistakes. Participants completed two test cards. Their response times were recorded in seconds, and the number of errors was also noted. The time taken for each card was then combined to get a total score. The test manual for the Phonological Assessment Battery outlined that internal reliability ranged from α= .89 - .95.

Mispronunciation Detection: Participants completed the Mispronunciation Detection task. This assessed participants' sensitivity to mispronounced words. The task was presented on a laptop computer using DirectRT (Jarvis, 2006). Within this task, children were presented with a picture while simultaneously hearing its name, either pronounced correctly or incorrectly. Children were required to decide whether this was pronounced correctly or not and respond using keys on the keyboard. Stickers were placed on the keyboard to ensure children remembered which keys to press to indicate correct and incorrect pronunciations. A thumbs-up sticker was placed on the correct key, and a thumbs-down sticker was on the incorrect key. Children were provided with headphones for this task to control for background noise. First, the children would complete a practice trial to ensure they understood the requirements of the task. Feedback was provided for every trial item; there were eight trial items in total. The children were encouraged to complete this task as quickly as possible. Participants' responses were graded for accuracy and reaction time. Reaction time was only scored on correct answers only. This task had a Cronbach's alpha of .85, as described by Carroll, Mundy and Cunningham (2014).

Morphological Awareness

A selection of tasks was drawn from existing tasks in the CAMPT, however many of these had to be adapted to suit the requirements for the current study, as outlined in Chapter 4. The Real Connection tasks were initially adapted from Bowers (2006). The Word Structure task from the CELF-4 (Semel, Wiig and Secord, 2006) was extended into three different subtasks. The DATMA was adapted from Larsen and Nippold (2007), Pike (2011), and Hasson et al. (2015). These tasks were administered and scored as outlined in Chapter 4. In addition to these measures, a new measure was added The Derivation Comprehension task, which was based on Siegel's (2008) morphological comprehension task.

Derivational Comprehension: Participants heard a sentence read aloud by the researcher and then had to complete the sentence by choosing one of three possible response options. This task consisted of ten real-word (e.g., she is a good teacher, she is always: ***helpful***, helpless, unhelpful) and ten pseudo-word items (e.g., she is a good teacher, she is always: ***deelpful***, undeelpful, deelpless). The pseudo-word version was completed to control for language familiarity. Responses were scored for accuracy and children received separate scores out of ten for real-word and pseudo-word items. This task had a Cronbach's alpha of .791.

Procedure

Ethical approval was gained from Coventry University's Ethics Committee (Appendix B) and Gatekeeper permission obtained from the local schools before data collection commenced. Informed parental consent was gained for each child, as well as assent from the children themselves. Each child completed six background tasks, 11 tasks drawn from the CAPPT and ten tasks drawn from the CAMPT. These tasks were conducted over three testing sessions of approximately 45 minutes each. The order of the sessions was counterbalanced, and the ordering of the tasks within sessions was randomised. One of the sessions consisted of background measures only, another consisted of the phonological awareness measures, and another consisted of the morphological awareness measures. The researcher collected the data in a one-to-one session. Sessions either took place in a quiet place away from the child's classroom or in a quiet room at Coventry University. After completion of all tasks, children were debriefed, and parental debrief letters were sent home.

Results and Discussion

CAPPT

The means and standard deviations are outlined in Table 16 below. The dataset for the Factor Analysis included ten phonological awareness measures and 70 participants. Therefore, the participant-to-variable ratio is 7, which is above the minimum ratio of 5 recommended by Bryant and Yarnold (1995). Initially, the factorability of the ten phonological awareness measures was examined. Several well-recognised criteria for factorability of a correlation matrix were used. Firstly, it was observed that all ten of the tasks correlated with at least one of the other variables with an *r* value > .3 (Brace, Kemp and Snelgar, 2016), suggesting reasonable factorability (See Table 17 below). The strongest relationships were observed between Phoneme Deletion and Substitutions (*r* = .606) and Spoonerisms and Phoneme Substitutions (*r* = .591). Secondly, the Kaiser-Meyer-Olkin measure of sampling adequacy was .791, which is above the minimum value of .6 recommended by Brace, Kemp and Snelgar (2016).

Table 16. *Means and Standard Deviations of CAPPT*

Task	Mean	Standard Deviation
Mispronunciation Detection Accuracy	45.83	2.06
Mispronunciation Detection RT (Milliseconds)	775.89	461.86
Fluency	19.93	7.60
Nonword Repetition	9.96	2.51
Alliteration	8.37	3.18
Phoneme Deletion	13.07	4.70
Phoneme Substitution	7.50	2.41
Spoonerisms	10.01	6.02
RAN Digits (Seconds)	56.34	19.92
RAN Pictures (Seconds)	104.94	26.33

Furthermore, Bartlett's test of sphericity indicated that the variables in the correlation matrix are related and therefore the null hypothesis was rejected, $p < .001$. The diagonals of the anti-image correlation matrix were over .5 for all tasks which are another indicator of sampling adequacy. Finally, the communalities were all above .6, confirming that each task shared some common variance with the others. All of these indicators, when taken together, strongly suggest that that factor analysis was suitable for the battery of phonological awareness tasks and that the sample size was adequate for the analysis to be conducted.

Table 17. *Correlational Matrix for CAPPT*

	1	2	3	4	5	6	7	8	9	10
1	-	-.392	-.060	.094	.054	-.021	.079	.085	-.046	.036
2	-	-	-.134	-.176	-.260	-.112	-.195	-.181	-.024	.008
3	-	-	-	-.051	.337	.494	.424	.338	-.335	-.426
4	-	-	-	-	.211	.285	.262	.252	-.198	-.215
5	-	-	-	-	-	.421	.526	.471	-.352	-.197
6	-	-	-	-	-	-	.606	.547	-.472	-.405
7	-	-	-	-	-	-	-	.591	-.521	-.458
8	-	-	-	-	-	-	-	-	-.421	-.355
9	-	-	-	-	-	-	-	-	-	.636
10	-	-	-	-	-	-	-	-	-	-

Note. 1 = Mispronunciation detection accuracy; 2 = Mispronunciation detection rate; 3 = Fluency; 4 = Nonword Repetition; 5 = Alliteration; 6 = Phoneme Deletion; 7 = Phoneme Substitution; 8 = Spoonerisms; 9 = Digits RAN; 10 = Pictures RAN.

Principal Component Analysis (PCA) was used because the primary purpose was to identify and compute composite scores for the factors underlying the phonological awareness measures (Neill, 2008). The analysis was conducted in SPSS utilising the Oblimin rotation method (an oblique rotation which allows the resulting factors to correlate). Examination of the Eigenvalues indicated three factors with Eigenvalues greater than 1, explaining 38.44%, 14.94% and 10.15% of the variance respectively. Examination of the Scree plot indicated an additional factor which explained a further 9.01% of the variance (Eigenvalue = .901). The four-factor solution, which explained 72.54% of the variance in the correlation matrix, was preferred because of its previous theoretical support and the point of inflection in the scree plot. The factor-loading matrix from the Pattern Matrix for this solution is presented in Table 18.

Table 18. *Factor Loadings and Communalities Based on PCA with Oblimin Rotation for the CAPPT (N = 70).*

	Factor 1 (High Explicit)	Factor 2 (Low Explicit)	Factor 3 (Implicit)	Factor 4 (RAN)	Com.
Alliteration	.857				.658
Spoonerisms	.690				.695
Phoneme Deletion	.681				.655
Phoneme Substitution	.662				.633
Mispronunciation Detection (Accuracy)		.910			.815
Mispronunciation Detection (RT)	-.342	-.727			.715
Nonword Repetition			-.851		.842
Fluency	.506		.554		
RAN (Digits)				.806	.752
RAN (Pictures)				.892	.797

Note. Factor loadings of less than .3 were suppressed. Com. indicates Communalities.

There were some clear correspondences between the extracted variables and the implicit-to-explicit levels of development suggested by Karmiloff-Smith (1992) in the RR Model and applied in the CAPPT continuum. Tasks that were chosen to represent levels E2 and E3 of the RR Model (corresponding to the Near-Explicit and Full Explicit bands of the CAPPT), all loaded on factor one; this indicated that factor one measured High Explicit phonological awareness. Furthermore, the task that was chosen to represent level E1 of the RR Model (corresponding to the Low Explicit band of the CAPPT) all loaded on factor two; this indicated that factor two was measuring Low Explicit phonological awareness. Furthermore, the task that was chosen to represent the implicit level of the RR Model, and CAPPT loaded on factor three; this indicated that factor three was measuring Implicit phonological awareness. In addition to these factors, a fourth factor was found which comprised of the two RAN tasks. It has been long documented that although naming and RAN tasks have a strong relationship with phonological awareness tasks they do not measure phonological awareness directly. It is understood that naming and RAN tasks reflect other factors, such as the ability to integrate information, speed-of-processing, attention and memory (Georgiou and Parrila, 2013, 172). Furthermore, Georgiou et al. (2008) outline that RAN is part of the phonological processing construct, as it assesses the phonological retrieval units. However, they also differentiate RAN tasks from phonological awareness tasks.

It was noted that the fluency task loaded quite highly on two factors, both the High Explicit and the Implicit phonological awareness factors. The fluency task could be showing that individuals can complete tasks via two routes: perhaps, some individuals completed this task implicitly whereas others did not. For example, some individuals could explicitly break down the target words into onset and rime and then match the rime to words in their lexicon or perhaps use explicit knowledge of spelling; whereas others could rely on implicit rhyming skills and not be able to explain why or how the words rhyme. However, it was decided that fluency would be incorporated in the High Explicit phonological awareness factor, as participants could complete to the task using either explicit or implicit routes.

Overall, the preferred factor solution indicates that there were four distinct factors, which were underlying the CAPPT. All ten of the original tasks were included. The four-factor solution was the preferred to the three-factor solution as this was consistent with previous research in a variety of ways. For example, both RAN measures were found to load separately from the remaining PA measures (Georgiou and Parrila, 2013). Additionally, only one Implicit factor was found indicating a single level Implicit task as argued in the RR Model (Karmiloff-Smith, 1992). Finally, this model appeared to detect differences between discrimination and manipulation tasks (Joanisse et al., 2000). Although Karmiloff-Smith’s (1992) RR Model outlined two distinct levels level comprising Near and Full Explicit awareness; in the current solution, there is no distinction. However, previous research within the field of phonological awareness has grouped these tasks, for example, Ramus et al. (2013), Roberts and McDougal (2003) and Joanisse et al. (2000). After the factor analysis was completed, composite scores were created for each of the four factors, based on the saved factor scores totals of the tasks that had their primary loadings on each factor.

CAMPT

The means and standard deviations are outlined in Table 19 below.

Table 19. *Means and Standard Deviations of CAMPT*

Task	Mean	Standard Deviation
Extended Word Structure	26.67	6.11
Advanced Derivations Word Structure	3.99	1.85
Opaque Word Structure	3.91	2.99
Derivational Comprehension	7.10	2.03
Pseudo-word Derivational Comprehension	6.16	2.23
DATMA	44.80	13.70
DATMA Sentences	8.27	4.83
Real Connections - Inflectional	8.01	2.03
Real Connections -Transparent	7.37	2.25
Real Connections - Opaque	7.66	2.042

The data set for Factor Analysis comprised ten measures of morphological awareness and a sample of 70 participants; this increased the participant-to-variable ratio to 7. All ten of the tasks correlated with at least .5 with at least one other item, again suggesting reasonable factorability (Brace, Kemp and Snelgar, 2016) (See Table 20 below). The correlation matrix found the strongest relationships between Advanced Derivations Word Structure and Opaque Word Structure (.800) and DATMA and DATMA Sentences (.752). The weakest correlations were found between Mispronunciation (RT) and Digit Naming and Picture Naming (-.024 and .008, respectively). The Kaiser-Meyer-Olkin measure indicated sampling adequacy of .877. Bartlett's test of sphericity indicated homogeneity of variances, p <.001. The diagonals of the anti-image correlation matrix were over .8 for all tasks which are another indicator of sampling adequacy. All communalities were above .6; this further confirmed that each item had shared some common variance with other tasks. In the sum of these indicators, it was deemed that factor analysis was suitable for all ten of the morphological awareness tasks.

Table 20. *Correlation Matrix for CAMPT*

	1	2	3	4	5	6	7	8	9	10
1	-	.676	.656	.532	.568	.436	.547	.633	.527	.522
2	-	-	.800	.517	.527	.416	.487	.606	.625	.618
3	-	-	-	.503	.501	.489	.522	.613	.553	.541
4	-	-	-	-	.671	.537	.535	.435	.352	.494
5	-	-	-	-	-	.524	.523	.489	.557	.520
6	-	-	-	-	-	-	.350	.383	.351	.324
7	-	-	-	-	-	-	-	.752	.424	.573
8	-	-	-	-	-	-	-	-	.495	.561
9	-	-	-	-	-	-	-	-	-	.714
10	-	-	-	-	-	-	-	-	-	-

Note. 1 = Extended Word Structure; 2 = Advanced Derivations Word Structure; 3 = Opaque Word Structure; 4 = Real Connections Inflectional; 5 = Real Connections Opaque Derivational; 6 = Real Connections Opaque Derivational; 7 = DATMA; 8 = DATMA Sentences; 9 = Derivational Comprehension; 10 = Pseudoword Derivational Comprehension.

Principal component analysis (PCA) was used because the primary purpose was to identify and compute composite scores for the factors underlying the morphological awareness continuum (Neill, 2008). Examination of the eigenvalues indicated one factor with an eigenvalue of greater than 1, explaining 58.26% of the variance. However, examination of the Scree plot indicated an additional variable which explained a further 9.47% of the variance (Eigenvalue = .954). Solutions to the one and two factors were examined using the Oblimin rotations of the factor loading matrix. The two-factor solution, which explained 67.74% of the variance, was preferred because of its previous theoretical support and the point of inflection on the scree plot after two variables. The Oblimin rotation found that all tasks had initial loadings of over .6. The factor-loading matrix from the Pattern Matrix as for this final solution is presented in Table 21.

Table 21. *Factor Loadings and Communalities Based on PCA with Oblimin Rotation for the CAMPT (N = 70).*

	Factor 1 (Explicit)	Factor 2 (Implicit)	Com.
Morphological Completion	.896		.676
Pseudo Morphological Completion	.864		.725
Complex Affix Word Structure	.807		.651
DATMA Sentences	.764		.749
Opaque Word Structure	.691		.691
Word Structure Plus	.628		.714
DATMA	.602		.571
Real Connection - Transparent Derivational		.876	.665
Real Connection - Inflectional		.811	.646
Real Connection - Opaque Derivational		.637	.686

Note. Factor loadings of less than .3 were suppressed. Com. Indicates communalities.

There were some clear correspondences between the extracted variables and the implicit-to-explicit levels of development suggested by Karmiloff-Smith (1992) in the RR Model and applied in the CAMPT continuum. Tasks that were chosen to represent the Near-Explicit and Full Explicit bands of the CAMPT all loaded on the same factor, factor one; this indicated that factor one measured Explicit morphological awareness. Furthermore, all tasks that were chosen to represent the Implicit band of the CAMPT all loaded on factor two; this indicated that factor two was measuring Implicit morphological awareness.

Overall, the preferred factor solution indicates that there were two distinct factors, which were underlying the CAMPT. All ten of the original tasks were included. The original theoretical underpinnings of CAMPT were retained. The two-factor solution was the preferred to the one-factor solution, as previous research has indicated that implicit tasks only assessed word-level understanding of morphemes, whereas more explicit tasks assessed direct knowledge of morphemes (e.g., Bowers, Kirby and Deacon, 2010; Pawlowska, Robinson and Seddoh, 2014). Furthermore, the results also support the finding that judgement tasks are implicit (Mahony, Singson and Mann, 2000; Duncan et al., 2009), whereas analogy and production tasks use explicit skills (Kirby et al., 2012; Diamanti et al., 2017). After the factor analysis was completed, composite scores were created for each of the two factors, based on the saved factor scores totals of the tasks that had their primary loadings on each factor.

Conclusion

In summary, these findings indicate that the phonological awareness continuum is constructed of four different levels whereas the morphological awareness continuum is only constructed of two. The results from the phonological awareness measures supported the CAPPT and found a High Explicit, a Low Explicit, an Implicit and a RAN factor. Furthermore, the results from the morphological awareness measures partially supported the CAMPT and found an Implicit and an Explicit factor.

In the Continuum Development Chapter (Chapter 3), it was theorised that both continua would load in an almost identical fashion with both continua having four key levels corresponding broadly to the levels of knowledge outlined in the RR Model. However, it was found that only the phonological continuum had four levels, whereas the morphological continuum only had two. Although there is a definite difference in the number of factors, the results did not find much difference in the total amount of variance explained. Furthermore, both continua were found to reflect differences between explicit and implicit tasks, justifying the broad approach taken to classifying the tasks and the notion of implicit versus explicit levels of knowledge. However, unlike with phonological tasks, a further distinction between degrees of explicit knowledge was not supported for morphological awareness. There are two possibilities that could explain this difference between phonological and morphological tasks. First, this could be a function of the narrower selection of morphological awareness tasks available in the literature and sampled in this study. As already outlined, there has been considerably more research conducted on phonology than morphology and, there is a substantial difference in the amount of available tasks between phonology and morphology. The lack of choice in morphological awareness tasks for the CAMPT may have prevented the fine-grained sensitivity the CAPPT was able to find. An additional factor to consider is whether there are fewer parallels between the task types than anticipated. Perhaps morphological awareness covers a narrower range of skills and subdivision into more than two levels of explicitness may not be theoretically appropriate.

Furthermore, it could be argued that there was not such a fine-grained result of Low Explicit versus High Explicit tasks for morphological awareness as more generally they may require higher levels of explicit understanding to complete them compared to many of the phonological awareness tasks. For example, in the very early levels of language development children produce vocalisations that do not carry any meaning, known as babbling although they are phonetically consistent with meaningful language (Goldstein and Schwade, 2008). It is not until the children receive feedback from adults that vocalisations start to convey meaning. Therefore, this indicates that children develop implicit understanding/awareness of the phonetic structures of language before the morphemic structure (Polka et al., 2008). This could imply that phonological awareness, by nature, is more implicit and this could explain the differences in CAPPT and CAMPT results.

Overall, the findings of this Chapter aimed to address research question one. This Chapter succeeded in that, as it evaluated the theoretical distinctions between phonological and morphological awareness tasks with an empirical study. However, it is noted that a longitudinal study is needed in order to evaluate these continua fully, as the RR Model is fundamental developmental.

Chapter Six: Group Difference on the CAPPT and CAMPT

In the previous Chapter, several factors were found to make up the CAPPT (High Explicit, Low Explicit, Implicit, and Naming) and CAMPT (Explicit and Implicit). For each factor from the CAPPT and CAMPT, composite language variables (Z-scores) were created. The current Chapter will compare the performance of those with DLD-only, DLD+ and TD children on the CAPPT and the CAMPT. Furthermore, this Chapter will also investigate the impact of nonverbal IQ and EAL status affect the performance of those with DLD and DLD+ on the CAPPT and CAMPT. Moreover, in addition to these group-based analyses, this Chapter investigates the relationship between the factors of the CAPPT and CAMPT and language and reading ability using hierarchical regression. The results of this Chapter will address the second and third research questions; specifically, as the profile of those with DLD-only, DLD+ and TD are examined on the CAPPT, and the CAMPT and the impact of nonverbal IQ and EAL status on this is also examined.

DLD and Literacy Impairment

Initially, the Severity Model suggested that DLD and Dyslexia are so frequently comorbid because they may, in fact, be versions of the same disorder. Kamhi and Catts (1986) proposed that the same underlying deficit causes both literacy and language disorders, however, individuals with Dyslexia were just less severely impaired than those with DLD. Over time, this view has been superseded by the Multiple Deficits Model which views DLD and Dyslexia as two distinct disorders that share a partial overlap of risk factors (Pennington, 2006; Marshall, 2009). As described previously in

Chapter 1 individuals with DLD and/or Dyslexia have difficulties in the same broad areas, but they are not necessarily impaired in the same way. *Figure 1* in Chapter 1 depicts this pattern by showing that although both separate disorders experience deficits in phonological and morphological awareness, having deficits in the same aspects but also with each disorder having unique areas of difficulty. Although this model outlines key differences in phonological and morphological deficits faced by those with DLD and/or Dyslexia, this model does not outline precisely where these differences lie. Therefore, the current thesis sought to investigate this comorbidity to develop our understanding of DLD further by locating where these differences lie. This was achieved by recruiting participants with DLD-only as well as a group of children with DLD plus additional reading difficulties.

Classical versus Liberal Definitions of DLD

As previously outlined, there is currently a debate within the literature over precisely what DLD is; in that, it has been argued the parameters of DLD are still unclear. The lack of clear parameters is problematic, as practitioners working in a clinical setting may apply very different definitions of DLD in comparison to those that are used within research (Bellair et al., 2014). The 'classic' definition of DLD referred to an unexpected difficulty in expressive or receptive language; where 'unexpected' meant there was no known cause for the difficulty. Within scientific research, below average IQ and having English as an additional language (EAL) were seen as known causes for the language impairment, and thus these children were not considered to have DLD. However, more recent research has indicated that nonverbal IQ is an unreliable known cause for DLD, as low IQ does not always lead to language difficulties

(Bishop et al., 2016; Spaulding and Gallinat, 2014); similar results have been indicated for EAL children too (Blom and Paradis, 2013; Paradis, 2016; Rice, 2016).

Furthermore, as Bellair et al. (2014) pointed out, in a clinical setting, children receive a diagnosis of DLD if it is felt they will benefit from specific language interventions, regardless of their IQ level and EAL status. The more liberal, clinical definition is partly why the 'classic' definition of DLD has been criticised because research is intended to inform practice, but the characteristics of DLD samples that are being recruited in research studies are sometimes very different to the children who receive a diagnosis of DLD in the real world. Therefore, research-informed recommendations may be based on the needs of children with less severe and/or more restricted language impairments than many of those encountered in practice.

The current Chapter will examine the difference between the 'classic' definition of DLD, and the more liberal, practice-based definitions by contrasting the language profiles of DLD groups when different diagnostic cutoffs are applied. For each analysis, children with a standardised expressive and/or receptive language score of less than 78 (1.5 Standard Deviations below the Mean) and a standardised reading score of above 85 will be classified as having DLD (DLD-only). Children who obtain language scores of less than 78 and a standardised reading score below 85 (1 Standard Deviation below the Mean) will be classified as having DLD with additional literacy difficulties (DLD+). However, the additional exclusionary criteria will vary across four different analyses: Liberal, Liberal IQ, Liberal EAL and Classical. The Liberal analysis will include children in the DLD groups regardless of their IQ level or their EAL status. The Liberal IQ analysis will include children regardless of their IQ but exclude children with EAL. The Liberal EAL analysis will include EAL children but exclude those with low IQ (i.e., standardised IQ score of less than 85). Finally, the Classical analysis will exclude children with IQ scores less than 85 and those with EAL status.

Summary and Research Aims

The work summarised thus far has culminated in the development and evaluation of implicit-to-explicit continua for existing measures of morphological and phonological processing. The empirical research described in the remainder of this Chapter initially aims to explore the performance of typically developing (TD), DLD-only and DLD+ children using various composite language variables derived from the CAPPT and the CAMPT. The primary aim of this Chapter will examine whether TD, DLD-only or DLD+ children perform differently from each other and explore the precise areas of strength and difficulty in each of the DLD groups with reference to the CAPPT and CAMPT. The secondary aim of this Chapter will be to add to the DLD debate and explore the impact of different diagnostic criteria on the profiles of language impairment that are observed. A further aim of the Chapter is to explore the relationship between the factors underlying the CAPPT and CAMPT, and measures of language and literacy abilities.

Method

Design and Participants

The current study utilised a quasi-experimental design in which a diverse sample of typically developing children, children with DLD and children with DLD and additional literacy difficulties were compared on six composite language variables drawn from the CAPPT and CAMPT (Chapter 5). Methods for the recruitment of participants are outlined in full in Chapter 5. In summary, a total of 57 children aged 6-11 years were recruited from a range of five primary schools (two with specialist language hubs) in the Midlands and a further 13 children were recruited via email sent to parents on Coventry University's Literacy Group's mailing list. Children were then screened and assigned to DLD-only, DLD+ or TD groups accordingly. To investigate differences between the different diagnostic criteria used several different analyses were completed, with the inclusion criteria for DLD varying systematically on each occasion. Table 22 outlines the different diagnostic criteria used for these analyses.

Table 22. *DLD Diagnostic Criteria and Labels for the Different Analyses.*

		Language	Reading	IQ	EAL
Liberal	DLD-only	≤78	≥85	No criterion	Included
	DLD+		≤85		
	TD	≥78	≥85		
Liberal IQ	DLD-only	≤78	≥85	No criterion	Excluded
	DLD+		≤85		
	TD	≥78	≥85		
Liberal EAL	DLD-only	≤78	≥85	≥85	Included
	DLD+		≤85		
	TD	≥78	≥85		
Classical	DLD-only	≤78	≥85	≥85	Excluded
	DLD+		≤85		
	TD	≥78	≥85		

The first analysis reported in this Chapter is the Liberal analysis. The Liberal analysis included children with low IQ and those with EAL status. Children with no difficulties were placed in the TD group. Children with language scores less than or equal to 78 (1.5 SD below Mean) and a reading score greater than or equal to 85 were placed into the DLD-only group. Finally, children with language difficulties and a reading score less than or equal to 85 (1 SD below the Mean) were placed in the DLD+ group. Seventy children (38 girls) were included in this sample; 37 TD (23 girls), 18 DLD-only (7 girls) and 15 DLD+ (8 girls).

The second analysis reported in this Chapter is the Liberal IQ analysis. The Liberal IQ analysis included children with low IQ (below 85) but excluded those with EAL status from all groups. This is in line with the practice of other studies (e.g., Bisop et al., 2009) which exclude EAL children from their typically developing control groups as well as the DLD groups. Children with no difficulties were again placed in the TD group. Children with language scores less than or equal to 78 and a reading score greater than or equal to 85 were placed into the DLD-only group. Finally, children with language difficulties and a reading score less than or equal to 85 were placed in a DLD+ group. From the original groups representing the most Liberal diagnostic criteria, ten EAL children were excluded from the TD group; one was excluded from the DLD-only group, and five were excluded from the DLD+ group. This left a total of 54 children (24 girls) in this sample; 27 TD (14 girls), 17 DLD-only (6 girls) and 10 DLD+ (4 girls). The purpose of this analysis was to explore the consequences of excluding EAL children from a DLD diagnosis.

The third analysis reported in this Chapter is the Liberal EAL analysis. The Liberal EAL analysis excluded children with low IQ (standard scores less than or equal to 85) but included those with EAL status. Children with no difficulties were placed in the TD group. Children with language scores less than or equal to 78 and a reading score greater than or equal to 85 were placed into the DLD-only group. Finally, children with language difficulties and a reading score less than or equal to 85 were placed in a DLD+ group. From the original groups representing the most Liberal diagnostic criteria, eight low IQ children were excluded from the TD group, eleven were excluded from the DLD-only group, and seven were excluded from the DLD+ group. In total, 44 children (25 girls) were included in this sample; 29 TD (18 girls), 7 DLD-only (2 girls) and 8 DLD+ (5 girls). The purpose of this analysis was to explore the consequences of excluding low IQ children from a DLD diagnosis.

The final analysis reported in this Chapter is the Classical analysis. The Classical analysis excluded children with low IQ (below 85) and those with EAL status as well. Children with no difficulties were placed in the TD group. Children with language scores less than or equal to 78 and a reading score greater than or equal to 85 were placed into the DLD-only group. Whereas, children with language difficulties and a reading score less than or equal to 85 were placed in a DLD+ group. From the original groups representing the most Liberal diagnostic criteria, fifteen children were excluded from the TD group, eleven was excluded from the DLD-only group, and eleven were excluded from the DLD+ group. Thirty-three children (16 girls) were included in this sample; 22 TD (12 girls), 7 DLD-only (2 girls) and 4 DLD+ (2 girls). The decline in the sample sizes indicates that a large proportion of those with DLD-only and DLD+ have low IQ or EAL status. The purpose of this analysis was to explore the consequences of excluding low IQ children as well as children with EAL from a DLD diagnosis.

Measures and Procedure

The experimental measures from the CAPPT and CAMPT and the data collection procedures used in this study are outlined in Chapters four and five. However, the current study also used a series of background measures to assign participants to TD, DLD-only and DLD+ groups. These are described in turn below. The between-group analyses were completed using composite language variables (factor scores) derived from the Factor Analyses conducted on the CAPPT and the CAMPT (Chapter 5) as dependent variables. There were four phonological processing variables (High Explicit, Low Explicit, Implicit and Naming) and two morphological processing variables (Explicit and Implicit). In creating the composite variables, participants' scores on the original measures were converted to z-scores, weighted according to the loading of the task on the factor in question and then summed (Ramus et al., 2013).

Background Measures

In addition to the CAPPT and CAMPT test batteries, a series of background measures were also delivered. Participants completed several subscales of the CELF-4 (Semel, Wiig and Secord, 2006) in order to gain a Core Language Scale and Expressive Language Index. The Word Reading subscale of the BAS-II (Elliot, Smith and McCulloch, 1996) was also completed in order to measure literacy abilities. Furthermore, the Matrix Reasoning Subscale of the WASI (The Psychological Corporation, 1999) was completed in order to gauge nonverbal abilities. These were delivered to screen children's language and literacy skills and assign them to a typically developing control group, DLD-only group, or DLD with additional literacy difficulties group (DLD+). These tasks were administered and scored as described in Chapter 4 and Chapter 5.

Results and Discussion

Data Screening

Before analysis began, all of the dependent variables were screened for Skewness and Kurtosis. As displayed in Table 23, several of the measures were not normally distributed, however when working with groups with specific learning difficulties this is to be expected (Allen and Bennet, 2008). Therefore it was decided that parametric analyses would be conducted in the first instance, in order to maximise power, but where necessary analyses have been repeated using non-parametric tests and confirmed the same pattern of results. Multiple ANOVAs were required in each analysis (one for each of the composite variables) and therefore a Bonferroni correction was applied to the significance threshold, adjusting the alpha criterion to .0125. This alpha level will be used throughout for omnibus tests, however, where appropriate, results which meet the standard alpha level of .05 will also be discussed. Post-hoc analyses contrasting the three groups of children were also conducted with a Bonferroni correction applied (alpha = .016). Bonferroni corrected p-values are reported for these tests. An alpha criterion of .001 was adopted for Levene's test as recommended by Allen and Bennet (2008) when working with non-typical participant groups. As with the normality assumption (above), where data violated the homogeneity of variance assumption non-parametric tests were also conducted in order to confirm the findings.

Table 23. *Skewness and Kurtosis Statistics for the Dataset and Distribution Analysis.*

	Phonology				Morphology	
	High Explicit	Low Explicit	Implicit	Naming	Explicit	Implicit
Skewness z-score	-1.125	-7.804*	2.797*	3.010*	-2.223*	-2.976*
Kurtosis z-score	-1.460	16.309*	1.588	1.118	-0.065	-.539
Shapiro-Wilks	.965*	.838*	.953*	.937*	.947*	.910*

Note. *p < .05

Liberal Analysis

First, an analysis was conducted with the most liberal exclusionary criteria for DLD applied. Participants with low IQ and EAL status were included in this analysis. These criteria are the most reflective of DLD in a clinical setting. The Means and Standard Deviations of the background measures for the participants in this analysis are outlined in Table 24.

Table 24. *Mean (Standard Deviation) scores for Background Variables by Participant Group (N = 70).*

Group	N	CLS	ELI	IQ	Reading	Age
TD	37	93.84 (9.83)	92.08 (8.45)	99.62 (17.31)	106.92 (12.16)	105.32 (15.23)
DLD-only	18	73.81 (7.46)	74.56 (8.50)	89.25 (20.98)	100.94 (12.59)	100.50 (11.29)
DLD+	15	65.12 (10.88)	65.12 (9.47)	87.18 (19.15)	78.82 (6.04)	114.35 (18.02)

Note. Standard scores (M = 100, SD = 15) reported for the following measures: CLS = Core Language Scale of the CELF; ELI = Expressive Language Index from the CELF; IQ = WASI Matrices; Reading = BAS Word Reading Card B. Ages are reported in months.

The Mean IQ scores of both impaired groups are below the TD group but fall within the average range. The mean age of the TD group is eight years and ten months. The mean age of the DLD group is eight years and four months. The mean age of the DLD+ group is slightly older at nine years and four months. The age of the participants was found to be significantly different; F (2, 51) = 5.053, p = .009. Therefore, age was controlled for in the following analyses. Table 25 outlines the descriptive statistics for each composite factor score.

Table 25. *Means (SD) Factor Scores for Liberal Analysis.*

Group	CAPPT			CAMPT		
	High Explicit	Low Explicit	Implicit	Naming	Explicit	Implicit
TD	.497 (.69)	.109 (.81)	-.178 (.88)	-.345 (.73)	.462 (.87)	.456 (.67)
DLD-only	-.338 (1.19)	.081 (.79)	.241 (1.22)	.354 (1.17)	-.546 (.88)	-.481 (1.25)
DLD+	-.819 (.67)	-.367 (1.51)	.151 (.99)	.427 (1.11)	-.483 (.92)	-.549 (.84)

Note. Scores on the Implicit CAPPT and Naming factors are reaction times, and therefore negative scores indicate superior performance.

Overall, it was expected that the TD group would perform the best and the DLD+ would perform the worst. The Means indicate that the TD group outperformed both impaired groups on all factors. The Means also indicated that the DLD-only group outperformed the DLD+ on all factors except the Implicit CAPPT and the Explicit CAMPT. Table 26 outlines the Cohen's *d* effect sizes between groups.

Table 26. *Cohen's d Effect Sizes Between Groups in Liberal Analysis.*

Group	CAPPT			CAMPT		
	High Explicit	Low Explicit	Implicit	Naming	Explicit	Implicit
TD x DLD-only	1.929**	.035	.393	.717*	1.150**	.933**
TD x DLD+	.857**	.392	.351	.822**	1.057**	1.328**
DLD-only x DLD+	.498	.397	.081	.064	.069	.064

Note. Scores on the Implicit CAPPT and Naming factors are reaction times, and therefore negative scores indicate superior performance. ** indicates a strong effect size; * indicates a moderate effect size.

CAPPT

A series of One-Way ANCOVAs were conducted with group (TD, DLD-only and DLD+) as the independent variable, age as a covariate and children's scores on each of the four factors as the dependent variables. The covariate was significantly related to overall performances on the High Explicit CAPPT, F (1, 67) = 11.243, p = .001, η^2 = .146. The first ANCOVA revealed a significant difference between groups on the High Explicit CAPPT factor, F (2, 67) = 20.487, p < .001, η^2 = .383. Bonferroni post-hoc analysis indicated significant differences between the TD children and those with DLD+ (p < .001, d = .857) and DLD-only (p < .001, d = 1.929), with the DLD groups both performing significantly below the level of the TD controls. A further significant difference was found between the DLD-only group and the DLD+ group (p = .018, d = .498). Due to violations of the normality assumption the analysis was repeated using the non-parametric Kruskal-Wallis test and the same pattern of results was obtained (χ^2 (2) = 19.55, p < .001). Levene's test indicated that the homogeneity of variance assumption was met (p = .035).

Furthermore, a significant difference between groups on Naming factor was also obtained, F (2, 67) = 6.782, p = .002, η^2 = .170. The covariate was significantly related to overall performances on the Naming CAPPT, F (1, 67) = 6.525, p = .013, η^2 = .090, however this was not strong enough to meet the correction for multiple analyses. Post-hoc analysis with Bonferroni corrections indicated significant differences between the TD children and those with DLD+ (p = .004, d = .822). A further significant difference between the TD group and the DLD-only group was found (p = .036, d = .717). Inspection of the descriptive statistics indicates that individuals with

DLD-only and DLD+ had significantly slower response times than those in the TD group. Due to violations of the normality assumption the analysis was repeated using the non-parametric Kruskal-Wallis test and the same pattern of results was obtained, (χ^2 (2) = 6.825, p = .033).

The covariate was not found to be significantly related to overall performances on the Low Explicit and Implicit CAPPT (F (1, 67) = .001, p = .973, η^2 = .001 and F (1, 67) = .010, p = .921, η^2 = .001, respectively); furthermore, no significant group differences were found for these factors either (F (2, 67) = 1.134, p = .328 and F (2, 67) = 1.277, p = .286, respectively).

CAMPT

Two more One-Way ANCOVAs were conducted to explore group differences on the CAMPT. The covariate (age) was significantly related to overall performances on the Explicit CAMPT, F (1, 67) = 49.615, p < .001, η^2 = .429. The first ANCOVA revealed a significant difference between groups on the Explicit Morphological Awareness factor, F (2, 67) = 23.553, p < .001, η^2 = .416. Bonferroni post-hoc analysis indicated significant differences between the TD children and those with DLD+ (p < .001, d = 1.057), as well as those with DLD-only (p < .001, d = 1.150). Inspection of the descriptive statistics indicates that individuals with DLD-only and DLD+ scored significantly below the TD children. However, no significant differences were found for between the DLD-only group and the DLD+ group (p = .080), with Means indicating that individuals with comorbid difficulties are impaired similarly to those with DLD-only for Explicit morphology. Levene's tests indicated that the data met the assumption of normality (p = .567).

Furthermore, significant differences between groups on the Implicit Morphological Awareness factor were also found, F (2, 67) = 13.154, p < .001, η^2 = .285. The covariate was significantly related to overall performances on the Implicit CAMPT, F (1, 67) = 8.632, p = .005, η^2 = .116. Post-hoc analysis with Bonferroni corrections indicated significant differences between the TD children and those with DLD+ (p < .001, d = 1.328), as well as those with DLD-only (p = .004, d =.933). Inspection of the descriptive statistics indicates that individuals in the DLD-only and DLD+ groups scored significantly below the TD controls. No significant differences were found for between the DLD-only group and the DLD+ group (p = .631), indicating that individuals with comorbid difficulties are impaired similarly to those with DLD-only for Implicit morphology. Levene's test indicated that the data did not meet the assumption of homogeneity of variance (p < .001). Therefore, this analysis was repeated using the non-parametric Kruskal-Wallis test and the same pattern of results was obtained (χ^2 (2) = 15.808, p < .001).

Summary

In summary, those with DLD-only were significantly impaired in relation to their typically developing peers, on several tasks from the CAPPT, but not all, and both aspects of the CAMPT. The DLD-only participants performed significantly worse on the High Explicit and Naming factors of the CAPPT. However, for the Lower Explicit and Implicit CAPPT they did not perform significantly differently. This suggests that individuals with DLD-only have a profile of strengths and weakness about their phonological awareness, however, are impaired more wholly in their morphological awareness. This finding challenges Ramus et al. (2013) as they found individuals with DLD to be impaired on both lower and higher level phonological tasks. This may suggest subtle differences due to samples, as the Ramus et al. (2013) paper used very strict criteria when selecting participants. Perhaps those with language-only or language and literacy impairment (who have average IQ and have English as a first language) are more impaired in phonology than those with low IQ and EAL.

In addition to differences being found between the DLD-only and TD groups, significant differences were found between the DLD+ and the TD group. The DLD+ group were also significantly impaired in comparison to their typically developing peers on the High Explicit and Naming factors of the CAPPT and both aspects of the CAMPT. This suggests a similar profile of strengths and weaknesses for those with DLD-only and DLD+. Again, this finding further challenges Ramus et al. (2013) as they found their DLD+ group was impaired on both lower and higher level phonological tasks too.

Furthermore, despite a trend for DLD+ children to perform below the level of their DLD-only peers for the majority of factors, only a significant difference was found for the High Explicit CAPPT. The results indicate that in the main participants with DLD-only and DLD+ do not perform distinctly differently on aspects of the CAMPT and CAPPT, however, do perform differently for High Explicit CAPPT tasks. This finding partially supports previous research, as although the DLD+ group were found to score lower than the DLD-only, they were not found to perform significantly differently (Ramus et al., 2013; Marshall and van der Lely, 2009). However, the current study did manage to find a significant difference between these groups and as such suggest further support for considering fine-grained implicit-to-explicit differences in tasks.

Liberal IQ Analysis

The next analysis is slightly less liberal than the previous, as now participants with EAL status were excluded. Participants with low IQ were still included. This section will outline the One-Way ANCOVAs for these DLD inclusion criteria. The Means and Standard Deviations of the background measures for the participants in this analysis are outlined in Table 27.

Table 27. *Mean (Standard Deviation) Scores for Background Variables by Participant Group (N = 70).*

Group	N	CLS	ELI	IQ	Reading	Age
TD	27	96.26 (10.10)	93.89 (8.99)	100.52 (17.68)	106.78 (13.04)	104.00 (16.70)
DLD-only	17	73.12 (7.24)	73.82 (8.18)	88.47 (20.07)	98.47 (12.94)	99.59 (11.56)
DLD+	10	67.70 (9.79)	67.70 (8.69)	77.00 (14.37)	78.60 (5.25)	122.00 (14.87)

Note. Standard scores (M = 100, SD = 15) reported for the following measures: CLS = Core Language Scale of the CELF; ELI = Expressive Language Index from the CELF; IQ = WASI Matrices; Reading = BAS Word Reading Card B. Ages are reported in months.

Overall the descriptive statistics show a similar pattern to the Liberal analysis; however, although the TD group scored highest in all background measures and the DLD+ scored the lowest on all measures. In the Liberal analysis, both of the impaired groups mean IQ scores fell in the average range, here only the DLD-only group do. This indicates that some of the DLD+ participants with EAL had higher IQ than those without EAL. The mean age of the TD group is eight years and eight months. The mean age of the DLD group is eight years and four months. The mean age of the DLD+ group score is slightly older at ten years and two months, slightly higher than the Liberal analysis. The age of the participants was found to be significantly different; F (2, 51) = 7.457, p = .001. Therefore, age was controlled for in the following analyses. With the removal of EAL participants, the overall participant numbers fell by 16 participants overall (23%). The DLD+ group had the highest prevalence of those with EAL (10 participants, 33%), then the TD group (5 participants, 27%) and the DLD-only group (1 participant, 6%). Table 28 outlines the descriptive statistics for each composite factor score as well as the effect sizes between groups.

Table 28. *Means (SD) Factor Scores for Liberal IQ Analysis.*

Group	CAPPT				CAMPT	
	High Explicit	Low Explicit	Implicit	Naming	Explicit	Implicit
TD	.498 (.73)	.115 (.77)	-.150 (.88)	-.132 (.65)	.392 (.98)	.418 (.73)
DLD-only	-.333 (1.23)	.123 (.79)	.071 (1.01)	.412 (1.18)	-.527 (.91)	-.552 (1.25)
DLD+	-1.052 (.54)	-.776 (1.66)	.243 (.97)	.177 (.70)	-.205 (.72)	-.488 (.95)

Note. Scores on the Implicit CAPPT and Naming factors are reaction times, and therefore negative scores indicate superior performance.

The overall results here are similar to the Liberal analyses. The Means indicate that the TD group outperformed both impaired groups on most of the factors, however the TD group scored slightly less than the DLD-only on the Low Explicit CAPPT. The Means all indicated that the DLD-only group outperformed the DLD+ on all factors except the Naming CAPPT and the Explicit and Implicit CAMPT. Table 8 outlines the Cohen's *d* effect sizes between groups.

Table 29. *Cohen's d Effect Sizes Between Groups for Liberal IQ Analysis*

Group	CAPPT				CAMPT	
	High Explicit	Low Explicit	Implicit	Naming	Explicit	Implicit
TD x DLD-only	.822**	.010	.233	.577*	.971**	.944**
TD x DLD+	2.414**	.905**	.173	.467	.694*	1.064**
DLD-only x DLD+	.759**	.906**	.449	.242	.392	.057

Note. ** indicates a strong effect size; * indicates a moderate effect size.

On the previous Liberal analysis, no strong or moderate effect sizes were found between these groups. In fact, most of the effect sizes there were very weak. The results here appear to indicate that the impaired groups performed more distinctly when participants with EAL are excluded. Furthermore, when comparing these results to the Liberal analysis, several of the Means change quite substantially particularly for the DLD+ group and the Naming CAPPT factor.

CAPPT

A series of One-Way ANCOVA were conducted and highlighted several significant differences between groups on the factors of the CAPPT and CAMPT. The covariate (age) was significantly related to overall performances on the High Explicit CAPPT: F (1, 51) = 11.094, p = .002, η^2 = .182. The first significant difference noted was between groups on the High Explicit Phonological Awareness factors, F (2, 51) = 19.339, p < .001, η^2 = .436. Bonferroni post-hoc analysis indicated significant differences between the TD and those with DLD+ (p < .001, d = 2.410) as well as between the TD and those with DLD-only (p =.021, d = .822). Inspection of the descriptive statistics indicates that individuals with DLD+ and DLD-only scored significantly less than TD. A further significant difference was found between the impaired groups (p = .003, d = .759). Levene's test indicated that the assumption of normality was met (p = .034).

Secondly, significant differences were found between groups on the Low Explicit Phonological Awareness factor. However, this was not strong enough to meet the correction for multiple analyses, F (2, 51) = 4.386, p = .018, η^2 = .149. The covariate (age) was not found to significantly relate to overall performances on the Low Explicit CAPPT: F (1, 51) = 2.063, p = .157, η^2 = .040. Post-hoc analysis with Bonferroni corrections indicated some significant differences between the DLD+ and the TD (p = .021, d = .905) and DLD-only groups (p = .029, d = .906). Inspection of the descriptive statistics indicates that individuals DLD+ and DLD-only scored below the TD group, with a big mean difference between groups. Overall this suggests that the analyses are underpowered therefore although we cannot say confidently there is a difference here, there is at least some evidence that the groups are performing differently on this factor. However, this result will be interpreted with caution.

Further analyses were conducted on Implicit and Naming factors, but these did not find any significant results (F (2, 51) = .538, p =.553 and F (2, 51) = 1.757, p =.093, respectively). Theses analyses did not find significance for the covariates either (F (1, 51) = .039, p =.844 and F (1, 51) = 3.462, p =.069, respectively). However, a moderate effect size was found between the TD and DLD-only group for the Naming CAPPT, indicating the DLD-only may be impaired here.

CAMPT

A series of One-Way ANCOVAs were conducted and indicated a strong significant difference between groups on Explicit and Implicit Morphological Awareness factors. The covariate (age) was significantly related to overall performances on the Explicit CAMPT, F (1, 51) = 37.579, p < .001, η^2 = .429. Results from the Explicit Morphological Awareness Factor indicated a significant difference between groups, F (2, 51) = 13.535, p < .001, η^2 = .351. Bonferroni post-hoc analysis indicated that DLD-only participants were significantly different from the TD participants, p = .004, d = .971; the descriptive statistics indicated that those with DLD-only scored significantly less than those the TD group. A further significant difference was found size between the DLD+ and TD group (p < .001, d = .692). However, no significant differences were found between the impaired groups. Levene's test indicated this factor was normally distributed, p = .827.

In addition, results from the Implicit Morphological Awareness factors indicated significant differences. The covariate (age) was significantly related to overall performances on the Implicit CAMPT, F (1, 51) = 5.915, p = .019, η^2 = .182, however this was not strong enough to meet the correction for multiple analyses. Furthermore, significant group difference were found, F (2, 51) = 7.244, p = .001, η^2 = .255. The post-hoc analysis with Bonferroni corrections also indicated strong significant differences between TD group participants and DLD-only participants, p = .011, d = .944; with DLD-only participants scoring significantly less than the TD. Further significant differences were found between TD and DLD+, p = .004, d = 1.064, with those with DLD+ scoring lower than those in the TD group. Furthermore, Levene's test indicated that the data was not normally distributed (*p* = .001), however as the current study is examining groups with specific learning difficulties this is to be expected. Therefore, the non-parametric equivalent test was run and confirmed this finding, Kruskal-Wallis $\chi^2(2) = 10.461$, *p* = .005.

Summary

In summary, the DLD-only group were significantly outperformed by their typically developing peers on only the Higher Explicit CAPPT factor and both factors of the CAMPT. No differences were found between the DLD-only group and the TD group on the Lower Explicit and Implicit tasks of the CAPPT. Furthermore, although no statistical significance was found between the DLD-only and TD group for the Naming CAPPT, although a moderate effect size was found. This may indicate subtle differences between these groups here. Similar to the results of the Liberal analysis, these results suggest that those with language difficulties have a complex profile of phonological strengths and weaknesses but are impaired more wholly on morphological awareness. Again, these results challenge Ramus et al. (2013).

In addition to the differences between the DLD-only and TD group, significant differences were also found between the DLD+ and TD group. The TD group outperformed the DLD+ group on the High Explicit CAPPT and the Implicit CAMPT. Furthermore, although no statistical significance was found between the DLD+ and TD group for the Low Explicit CAPPT and Explicit CAMPT, large and moderate (respectively) effect sizes were found. This may indicate less severe difficulties here. No differences were found between the DLD+ and TD group for Implicit or Naming CAPPT though. Overall, these results suggest that those with DLD+ have a profile of strengths and weaknesses for phonological and morphological awareness. Individuals with DLD+ are the most impaired in their High Explicit CAPPT, and then their Low Explicit CAPPT with relative strengths in their Implicit and Naming CAPPT. Furthermore, individuals with DLD+ are most impaired in their Implicit CAMPT with relative strengths in their Explicit CAMPT.

Furthermore, significant differences were found between the DLD+ and DLD-only group for the High Explicit and Low Explicit CAPPT. Participants with language-only impairments were less impaired than their peers who had an additional literacy impairment. This finding may suggest differences between those with literacy difficulties in addition to their language difficulties, for their higher explicit phonological awareness. This finding supports Ramus et al. (2013) as they found that those with literacy difficulties were particularly impaired in their higher level phonological awareness skills.

In comparison to the Liberal analysis, the Liberal IQ analysis confirms some findings, challenges other and finds some new ones (see Table 30 for a summary). For example, the previous findings on the High Explicit CAPPT were now supported with strong effect sizes. Additionally, a new difference was found on the Low Explicit CAPPT (one supported with significance) and may indicate that for individuals with EAL and DLD+ are compensated in these skills which makes them perform more like their DLD-only peers. However, this finding may suggest differences between DLD individuals with and without EAL as the language difficulties they face could be due to familiarity issues instead of deficits in core language skills which enables them to overcome these difficulties (e.g. Low Explicit CAPPT).

Table 30. *Comparison Table for Findings.*

	CAPPT												CAMPT					
	High Explicit			Low Explicit			Implicit			Naming			Explicit			Implicit		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Liberal	✓	✓	✓							✓	✓		✓	✓		✓	✓	
	**	**								*	**		**	**		**	**	
Liberal IQ	✓	✓	✓			✓							✓	✓		✓	✓	
	**	**	**		**	**				*			**	*		**	**	

Note. 1 indicates TD vs DLD-only; 2 indicates TD vs DLD+; 3 indicates DLD-only vs DLD+; ** indicates a large effect size (Cohens *d* > .8); * indicates a moderate effect size (Cohen's *d* > .5). ✓ indicates significant post-hoc results.

Furthermore, the Liberal analysis reported previously found strong differences between the impaired groups and the TD group for Naming CAPPT. However, when excluding EAL children, these differences were only found between the TD and DLD-only group and were weaker. This may suggest that those with DLD+ and EAL have additional difficulties in Naming CAPPT than those non-EAL DLD+ do not have. This finding is interesting as previous research has found that those with EAL were faster than their first language peers for number naming tasks (e.g. Hutchinson et al., 2005). A similar pattern was found with Explicit CAMPT and therefore suggests that those with EAL and DLD+ have additional difficulties or larger impairments in these skills. Again, it is possible that this could relate to language familiarity, with those with EAL only experiencing difficulties with language due to familiarity as they still have the underlying skills intact. Therefore, overall these results indicate that by removing those with EAL from that new difficulties appear, and other difficulties disappear.

Liberal EAL Analysis

Under the Liberal EAL diagnostic criteria, all low IQ children were excluded from the analysis, but children with EAL were included. The Means and Standard Deviations of the background measures for the participants in this analysis are outlined in Table 31. With this analysis, the issues with group sizes start to become more pronounced here. Therefore, due to these small and unequal group sizes, p-values, effect sizes and descriptive statistics will be used to make conclusions from the data.

Table 31. *Mean (Standard Deviation) Scores for Background Variables by Participant Group (N = 44).*

Group	N	CLS	ELI	IQ	Reading	Age
TD	29	94.24 (10.80)	91.86 (8.61)	108.00 (10.58)	108.34 (10.54)	106.38 (15.89)
DLD-only	7	74.43 (8.54)	72.71 (6.26)	109.43 (12.63)	96.86 (9.23)	106.86 (11.01)
DLD+	8	68.25 (11.45)	67.38 (11.24)	99.50 (11.75)	81.13 (4.19)	109.88 (20.68)

Note. Standard scores (M = 100, SD = 15) reported for the following measures: CLS = Core Language Scale of the CELF; ELI = Expressive Language Index from the CELF; IQ = WASI Matrices; Reading = BAS Word Reading Card B. Ages are reported in months.

Overall the descriptive statistics show a similar pattern as the Liberal analysis; however, although the TD group scored highest in the language measures they did not score highest in the IQ measure, the DLD-only group did. The mean age of the TD group is eight years and ten months. The mean age of the DLD group is eight years and eleven months. The mean age of the DLD+ score is nine years and two months. With the removal of low IQ participants, the overall participant numbers fell by twenty-six participants (38%). The DLD-only group had the highest prevalence of those with low IQ (eleven participants, 52%), then the DLD+ group (seven participants, 47%)

and the TD group (eight participants, 22%). Table 32 outlines the descriptive statistics for each composite factor score as well as the effect sizes between groups.

Table 32. *Means (SD) Factor Scores for Liberal EAL Analysis.*

Group	CAPPT				CAMPT	
	High Explicit	Low Explicit	Implicit	Naming	Explicit	Implicit
TD	.547 (.72)	.080 (.82)	-.300 (.79)	-.477 (.65)	.530 (.96)	.489 (.69)
DLD-only	.363 (1.25)	-.075 (.61)	.021 (1.30)	-.155 (1.08)	-.181 (.73)	-.088 (1.17)
DLD+	-.683 (.76)	-.009 (.97)	.154 (1.28)	.229 (1.17)	-.572 (1.10)	-.500 (.80)

The overall results here are similar to the Liberal analyses and Liberal IQ analysis. The Means indicate that the TD group outperformed both impaired groups on all factors. The Means all indicated that the DLD-only group outperformed the DLD+ on all factors except the Low Explicit CAPPT. Table 33 outlines the Cohen's *d* effect sizes between groups.

Table 33. *Cohen's d Effect Sizes Between Groups for Liberal EAL Analysis.*

Group	CAPPT				CAMPT	
	High Explicit	Low Explicit	Implicit	Naming	Explicit	Implicit
TD x DLD-only	.180	.214	.298	.361	.834**	.836**
TD x DLD+	1.661**	.099	.426	.745*	1.321**	1.065**
DLD-only x DLD+	1.013**	.081	.103	.341	.419	.411

Note. ** indicates a strong effect size; * indicates a moderate effect size.

A strong effect size was found between the impaired groups on the High Explicit CAMPT. On the previous Liberal analysis, no strong or moderate effect sizes were found between these groups. In fact, most of the effect sizes there were very weak. The results here appear to indicate that the DLD-only are not impaired on phonological awareness tasks when those with low IQ are excluded. However, the difficulties remain for those with DLD+ in phonological awareness tasks and both impaired groups on the morphological awareness tasks. Furthermore, when comparing these results to the Liberal analysis, several of the Means improved quite substantially, particularly for the DLD-only group and the Naming CAPPT factor.

CAPPT

A series of One-Way Between-Participants ANOVA were conducted and highlighted a significant difference between groups on the factors of the CAPPT and CAMPT. The first significant differences noted was between groups on the High Explicit factor, F (2, 41) = 7.010, p = .002, η^2 = .255. Post-hoc analysis with Bonferroni correction indicated significant differences between the TD and those with DLD+, p = .002, d = 1.661. Inspection of the descriptive statistics indicates that individuals with DLD+ scored significantly less than TD. The group difference between the DLD+ group and DLD-only group neared significance, p = .055, d = 1.013. Furthermore, inspection of the descriptive statistics indicates the DLD-only group outperformed the DLD+ group. Although no statistically significant difference was found between the two DLD groups, the sizeable Mean difference and large Cohen's d effect size may indicate some meaningful differences in performance here. Levene's test indicated that the data met the assumption of homogeneity of variance, p = .121. Further analysis was conducted on Low Explicit, Implicit and Naming factors but these did not find any significant results (p = .890, p = .443 and p = .107, respectively). However, a moderate effect size was found between the TD and DLD+ group for the Naming CAPPT, indicating the DLD+ were impaired here.

CAMPT

A series of One-Way Between-Participants ANOVA were conducted and indicated a significant difference between groups. The first significant difference noted was between groups on the Explicit factor, F (2, 41) = 4.891, p = .012, η^2 = .193. Post-hoc analysis with Bonferroni corrections indicated significant differences between the TD and those with DLD+, p = .018, d = 1.065; with individuals with DLD+ scoring significantly less than those in the TD group. Mean scores also indicate the TD group performed better than the DLD-only group. This finding was not significant but yielded a strong effect size, p = .254, d = .836, suggesting that a genuine group difference may exist but fail to reach significance due to a lack of power in the more restricted analyses. Levene's test indicated that this factor met the assumption of homogeneity, p = .557. Further significant differences were found between groups on the Implicit factor, F (2, 41) = 5.418, p = .008, η^2 = .209. Bonferroni post-hoc analysis indicated significant differences between the TD and those with DLD+, p = .010, d = 1.321. The descriptive statistics indicated that those with DLD+ scored significantly less than the TD participants. Levene's test indicated that the data met the assumption of homogeneity of variance, p = .109.

Summary

In summary, the DLD-only group did not perform significantly differently from their typically developing peers on any measure of the CAPPT or CAMPT. However, substantial Mean differences and moderate effect sizes were found between the DLD-only and TD group for both factors of the CAMPT. This may indicate meaningful differences here. However, the current study was too underpowered to address this adequately. Overall these results suggest that those with language-only impairments and normal IQ may not face any impairments, relative to their typically developing peers on phonological awareness measures. However, they do face impairments in their morphological awareness. These results challenge Ramus et al. (2013) as they found participants with language-only impairments to be impaired on both higher and lower level phonological awareness tasks.

Although no statistically significant differences were found between the DLD-only and TD group, they were found between the DLD+ and TD group. The TD group outperformed the DLD+ group on the High Explicit CAPPT and the Implicit and Explicit CAMPT. Furthermore, although no statistical significance was found between the DLD+ and TD group for the Low Naming CAPPT, a moderate effect size was found. This may indicate less severe difficulties here. No differences were found between the DLD+ and TD group for Low Explicit or Implicit CAPPT though. Overall, these results suggest that those with DLD+ have profiles of strengths and weakness for phonological and morphological awareness. For their phonological profile, individuals with DLD+ are the most impaired in their High Explicit awareness, and then their Naming speed with relative strengths in their Low Explicit and Implicit phonological awareness.

Whereas in their morphological profile, individuals with DLD+ are equally impaired in their Explicit and Implicit morphological awareness.

Furthermore, a trend for strong, but not statistically significant, differences were found between the DLD+ and DLD-only group. Participants with language-only impairments were less impaired than their peers who had an additional literacy impairment. This trend yielded strong effect sizes between the DLD groups for the High Explicit CAPPT. However, the DLD groups were not found to perform any differently in any of the other aspects. This finding may suggest subtle differences between those with literacy difficulties in addition to their language difficulties, for their higher explicit phonological awareness only. This finding supports Ramus et al. (2013) as they found that those with literacy difficulties were particularly impaired in their higher level phonological awareness skills.

In comparison to the Liberal analysis, the Liberal EAL analysis confirms some findings, challenges other and finds some new ones (see Table 34 for a summary). The findings here indicate differences between those with language difficulties and those with low IQ and language difficulties. For example, in the Liberal EAL analysis, the DLD-only group were not found to be impaired on any aspect of the CAPPT, they were only found to perform worse than the TD group for both factors of the CAMPT. However, previous analyses found differences between the DLD-only and TD group for High Explicit and Naming factors of the CAPPT. This suggests that only those with DLD-only and EAL have difficulties in these areas. Overall, these results indicate that by removing those with low IQ that individuals with DLD-only no longer experience difficulties in High Explicit or Naming CAPPT. These results also further show that there are fewer differences when removing participants with low IQ than when removing those with EAL and suggests that EAL status may have a substantial impact on the profile of difficulty an individual with DLD experiences.

Table 34. *Comparison Table for Findings.*

	CAPPT												CAMPT					
	High Explicit			Low Explicit			Implicit			Naming			Explicit			Implicit		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Liberal	✓	✓	✓							✓	✓		✓	✓		✓	✓	
	**	**								*	**		**	**		**	**	
Liberal IQ	✓	✓	✓			✓							✓	✓		✓	✓	
	**	**	**		**	**				*			**	*		**	**	
Liberal EAL		✓												✓			✓	
		**	**								*		**	**		**	**	

Note. 1 indicates TD vs DLD-only; 2 indicates TD vs DLD+; 3 indicates DLD-only vs DLD+; ** indicates a large effect size (Cohens *d* > .8); * indicates a moderate effect size (Cohen's *d* > .5). ✓ indicates significant post-hoc results.

Additionally, the High Explicit CAPPT found the same difference between the TD group and DLD+ group and also found additional differences between the DLD-only and DLD+ groups which are consistent through each of the analysis, so far. However, the current analysis did not find significant differences between the DLD-only and TD group. This may suggest that those with DLD-only and low IQ struggle more in comparison to their typically developing peers, however that those with average IQ and DLD-only perform more in line with their typically developing peers.

Further differences between analyses were noted on the Naming CAPPT. In the Liberal analysis, differences were found between both impaired groups and the

TD group and the Liberal IQ, and Liberal EAL only found differences for between the TD and one of the impaired groups. Furthermore, it is interesting that these analyses found these differences between opposing groups. This finding suggests that for individuals with DLD-only and low IQ are slower at Naming CAPPT than their typically developing peers, however, that those with DLD-only and EAL do not have this difficulty. The opposite pattern is found for the DLD+ group. These findings suggest critical differences between those with low IQ or EAL and how this relates to the naming speed of those with language difficulties.

Classical Analysis

The Classical diagnostic criteria are the strictest and excluded participants with low IQ and those with EAL. As the current analysis was very underpowered, ANOVAs were not conducted as comparisons were unlikely to reach significance even when substantial Mean differences and effect sizes were present. Instead, a discussion of the descriptive statistics and effects sizes will be used to explore group differences. The Means and Standard Deviations of the background measures for the participants in this analysis are outlined in Table 35.

Table 35. *Mean (Standard Deviation) Scores for Background Variables by Participant Group (N = 33).*

Group	N	CLS	ELI	IQ	Reading	Age
TD	22	97.81 (10.25)	94.33 (8.81)	108.00 (11.05)	107.95 (11.55)	104.76 (17.53)
DLD-only	7	74.43 (8.54)	72.71 (6.26)	109.43 (12.63)	96.86 (9.23)	106.86 (11.01)
DLD+	4	75.50 (2.08)	75.75 (8.91)	91.00 (14.67)	82.75 (1.71)	119.50 (21.44)

Note. Standard scores (M = 100, SD = 15) reported for the following measures: CLS = Core Language Scale of the CELF; ELI = Expressive Language Index from the CELF; IQ = WASI Matrices; Reading = BAS Word Reading Card B. Ages are reported in months.

The mean age of the TD group is eight years and five months. The mean age of the DLD group is eight years and seven months. The mean age of the DLD+ score is nine years and eleven months. With the removal of low IQ and EAL participants, the overall participant numbers fell by 38 participants (53%). The DLD+ group had the highest prevalence of those with EAL and low IQ (eleven participants, 74%), then the DLD-only group (eleven participants, 52%) and the TD group (sixteen participants, 44%). Table 36 outlines the descriptive statistics for each participant group.

Table 36. *Means (SD) Factor Scores for Classical Analysis*

Group	CAPPT				CAMPT	
	High Explicit	Low Explicit	Implicit	Naming	Explicit	Implicit
TD	.557 (.78)	.107 (.80)	-.258 (.82)	-.278 (.61)	.460 (1.09)	.460 (.77)
DLD-only	.364 (1.25)	-.074 (.61)	.021 (1.30)	-.155 (1.08)	-.181 (.73)	-.088 (1.17)
DLD+	-.916 (.77)	-.541 (.85)	.453 (1.43)	-.110 (.33)	.111 (.58)	-.360 (.99)

Similarly, to the Liberal analyses, the descriptive statistics generally show that typically developing individuals score higher (or faster for Naming) on the measures of the CAPPT and the CAMPT than the impaired individuals. Table 37 outlines the Cohen's *d* effect sizes between groups.

Table 37. *Cohen's d Effect Sizes Between Groups for Classical Analysis.*

Group	CAPPT				CAMPT	
	High Explicit	Low Explicit	Implicit	Naming	Explicit	Implicit
TD x DLD-only	.185	.254	.256	.140	.691*	.553*
TD x DLD+	1.232**	.631*	.609*	.056	.399	.954**
DLD-only x DLD+	1.901**	.785**	.316	.345	.442	.251

Note. ** indicates a strong effect size; * indicates a moderate effect size.

Cohen's *d* only highlights strong effect sizes between the TD and DLD+ group for High Explicit factors from the CAPPT. It also shows moderate effect sizes between the TD group and DLD-only on both CAMPT factors and the Low Explicit factor of the CAPPT between the TD group and DLD+. This indicates that although overall the TD group appear to perform better than the other groups, that this is only a strong finding for High Explicit phonological factor when comparing them to the DLD+ group. The comparison between DLD-only group and the DLD+ group yielded more strong effect sizes. These strong effect sizes were found for the High Explicit and Low Explicit factors from the CAPPT and the Implicit factors from the CAMPT between the impaired groups. An additional moderate effect size was found between the TD and DLD+ groups on the Implicit factors from the CAPPT.

Furthermore, when comparing these Means to the Liberal analyses, quite a few substantial differences are noted. With the DLD-only group improving on all measures, however, this only yielded a moderate effect size for the High Explicit CAPPT. The DLD+ group performed worse on the High Explicit, Low Explicit and Implicit CAPPT but improved on the Naming CAPPT and Implicit and Explicit CAMPT.

Summary

In summary, those with DLD-only did not perform differently to their typically developing peers on any factor of the CAPPT. However, on the CAMPT, moderate effect sizes suggested a trend towards those with DLD-only being impaired relative to their typically developing peers. Overall this suggests, that when using the classic diagnostic criteria, those with DLD-only perform similarly to their typically developing peers on measures of phonological awareness and morphological awareness, but they might have mild deficits in their morphological awareness. This result challenges previous research as strong differences were found between those with language-only difficulties in phonological and morphological awareness tasks (i.e., Ramus et al., 2013; de Bree and Kerkhoff, 2010) although as already noted the study is underpowered by comparison.

Although the profile of difficulty for those with DLD-only was narrow, the profile for those with DLD+ was broader. A trend was found for those with DLD+ to perform worse than their typically developing peers on High Explicit and Low Explicit CAPPT as well as Implicit CAMPT. The DLD+ did not perform differently than their typically developing peers on Implicit and Naming CAPPT or Explicit CAMPT. Relative to their typically developing peers, this shows a specific profile of strengths and weaknesses for phonological and morphological awareness tasks. Furthermore, there was also a trend in the data which suggests that DLD+ performed worse than their DLD-only peers on High Explicit, Low Explicit and Implicit CAPPT. This suggests distinct differences between the language impaired groups and suggests that those with additional literacy difficulties are more impaired in their phonological awareness. This finding supports previous research as phonological deficits have been strongly associated with literacy difficulties (Ramus and Szenkovits, 2008; Bishop and Snowling, 2004). However, no differences were found for Naming CAPPT or either factor of the CAMPT. This may suggest that those with language difficulties experience similar levels of difficulty in morphological awareness tasks, which possibly contributes to their language impairments.

In comparison to the Liberal analysis, the Classical analysis found quite a different pattern but reflects some similar elements (see Table 38 for a summary). Furthermore, the Classical analysis reflects different aspects of the Liberal IQ and Liberal EAL analyses. Throughout each of the analyses, only five key findings were found to be consistent between the DLD groups and the TD group. The first is that those with DLD-only are impaired relative to their typically developing peers on both the Implicit and Explicit factors of the CAMPT. Furthermore, those with DLD+ are impaired on High Explicit CAPPT and the Implicit CAMPT relative to their TD peers. An important finding to note here is that both DLD groups were found to consistently perform in line with their typically developing peers for the Implicit CAPPT. Again, this finding challenges Ramus et al. (2013) as they found individuals DLD-only and DLD+ to be impaired on lower and higher level phonological awareness tasks.

Additionally, differences between the DLD-only and DLD+ groups appear to be consistent for the High Explicit CAPPT only. This may suggest that due to the additional literacy difficulty, that those with DLD+ have an impaired High Explicit phonological awareness. This finding is in line with research that suggests individuals with reading difficulties have deficits in higher level phonological awareness tasks but not lower level tasks (Ramus and Ahissar, 2012; Mundy and Carroll, 2012). Therefore, this suggests that a similar pattern may be true of those who have language and literacy difficulties.

However, in addition to finding several consistencies, the results of the multiple analyses also find several inconsistencies. The findings here indicate differences in the profile of difficulty when examining groups with language difficulties and low IQ and/or EAL. For example, only two out of four analysis found significant differences between the DLD-only and TD group on the High Explicit CAPPT. Both these results were found when participants with low IQ were included. Therefore, this might suggest that those with DLD and low IQ are hindered in this area, but those with average IQ are not. A similar finding was also found for Low Explicit CAPPT. However, this was only found for removing participants with EAL. Therefore, this may show a similar relationship between EAL status and those with language and literacy difficulties for lower explicit tasks.

Table 38. *Comparison Table for Findings.*

	CAPPT												CAMPT					
	High Explicit			Low Explicit			Implicit			Naming			Explicit			Implicit		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Liberal	✓	✓	✓							✓	✓		✓	✓		✓	✓	
	**	**								*	**		**	**		**	**	
Liberal IQ	✓	✓	✓			✓							✓	✓		✓	✓	
	**	**	**		**	**				*			**	*		**	**	
Liberal EAL		✓												✓			✓	
		**	**								*		**	**		**	**	
Classical		**	**		*	**			*				*			*	**	

Note. 1 indicates TD vs DLD-only; 2 indicates TD vs DLD+; 3 indicates DLD-only vs DLD+; ** indicates a large effect size (Cohens *d* > .8); * indicates a moderate effect size (Cohen's *d* > .5). ✓ indicates significant post-hoc results.

Furthermore, the differences between the impaired groups and the TD groups on the Naming CAPPT were found to have an unusual pattern in each of the analysis; with both groups having strong differences to the TD group in the Liberal analysis, but then only the DLD-only for the Liberal IQ and only the DLD+ for the Liberal EAL and finally with no differences in the classical analysis. Looking at the descriptive statistics, both Means for each impaired group improved considerably. The lack of impairment here in the stricter analysis suggests that impaired naming speed is only present in those with language impairments and EAL and those with language and literacy impairments who also have low IQ.

Further differences were found in the analysis for the factors of the CAMPT. For example, there was a fairly consistent finding that those with DLD groups perform worse than their TD peers on Explicit CAMPT. However, this was minimalised in the classical analysis. This finding suggests that IQ and EAL status may also play an important role in the Explicit morphological awareness of those with language impairments; with difficulties being more likely if in addition to language difficulties one has low IQ or EAL status. This finding is similar to that of the High Explicit CAPPT, so may suggest that IQ and EAL status is implicated in explicit awareness tasks. A similar pattern was found for the DLD-only participants in the Implicit CAMPT. However, the DLD+ was found to have consistent deficits, regardless of IQ level and EAL status. Overall, these findings have important implications for the new DLD definition, and it is liberal diagnostic criteria; potentially suggesting different subgroups of DLD that should be treated differently as they have difficulties in different areas.

Moreover, these findings suggest that morphological awareness profile plays a vital role in the difficulties those with language impairments face, regardless of their IQ level or EAL status and it also plays a more a critical role than phonological awareness. Whereas, phonological awareness profile plays a vital role for those with comorbid literacy and language difficulties but plays a slightly less important role for those with language-only difficulties. In order to investigate the relationship between language and literacy abilities and phonological and morphological awareness profiles, a hierarchical regression analysis was also conducted. This was done in response to the issues with statistical power mentioned earlier.

Hierarchical Multiple Regression

Hierarchical multiple regression was performed to investigate the ability of the CAPPT (High Explicit, Low Explicit, Implicit and Naming) and CAMPT (Explicit and Implicit) factors to predict children's core language (CLS), expressive language (ELI) and reading ability, after controlling for IQ and age. This was conducted with the full sample collapsed across language groups. Preliminary analyses were conducted to ensure no violation of the assumptions of linearity, and homoscedasticity. However, as outlined earlier, the factors were not normally distributed, but this could be attributed to the use of non-typically developing populations, and therefore the analysis was conducted. Additionally, the correlations amongst the predictor variables included in the study were examined, and these are presented in Table 39. All correlations were weak to moderate, ranging between $r = -.183$, $p = .065$ and $r = .658$, $p < .001$. This indicates that multicollinearity was unlikely to be a problem (Tabachnick and Fidell, 2007). The High Explicit and Naming factors from the CAPPT and both factors from the CAMPT were significantly correlated with the CLS and ELI, and the Low Explicit factor from the CAPPT was significantly correlated with reading. The correlations between the predictor variables and the CLS were all weak to moderately strong, ranging from $r = .099$, $p = .208$ to $r = .484$, $p < .001$. A similar pattern was found for the correlations between the predictor variables and the ELI, ranging from $r = -.068$, $p = .287$ to $r = .469$, $p < .001$. Again, a similar pattern was found for reading, with correlations ranging from $r = -.123$, $p = .155$ to $r = .488$, $p < .001$.

Table 39. *Correlations for all Continuous Variables (N = 70).*

							CAPPT			CAMPT	
	Variables	CLS	ELI	Reading	IQ	Age	High Explicit	Low Explicit	Implicit	Naming	Explicit	Implicit
	IQ	.345**	.275*	.320**	1							
	Age	-.252*	-.241*	-.203*	-.007	1						
CAPPT	High Explicit	.484***	.469***	.488***	.547***	.204	1					
	Low Explicit	.099	.078	.224*	.093	-.066	.139	1				
	Implicit	-.166	-.068	-.123	-.221*	.012	-.037	-.090	1			
	Naming	-.309**	-.296**	-.389***	-.262*	-.228*	-.397***	.040	.013	1		
CAMPT	Explicit	.437***	.406***	.451***	.336**	.509***	.658***	.147	-.183	-.396***	1	
	Implicit	.406***	.456***	.459***	.290**	.239*	.646***	.191	.049	-.413***	.584***	1

Note. Statistical significance: *p < .05; **p < .01; ***p < .001

Core Language

In the first step of hierarchical multiple regression, two predictors were entered: nonverbal IQ and age (in months). This model was statistically significant F (2, 67) = 7.399, p = .001 and explained 18.1 % of variance in CLS. Both nonverbal IQ and age factors made a significant unique contribution to the model (see Table 40). After entry of the CAPPT and CAMPT factors at Step 2, the total variance explained by the model as a whole was 54.7% (F (8, 61) = 9.205, p < .001). The introduction of the CAPPT and CAMPT explained additional 36.6% of variance in CLS, after controlling for nonverbal IQ and age (R^2 change = .366; F (6, 61) = 8.214, p < .001). In the final adjusted model, two out of eight predictor variables were statistically significant, with age recording a higher Beta value (β = -.613, p < .001) than the High Explicit factor from the CAMPT (β = .541, p < .001). However, age is negative, which may be due to sampling issues as in the previous ANOVA analysis participants in the DLD+ group were found to be significantly older than the other groups.

Table 40. *Hierarchical Regression Model of Core Language*

		B	*SE*	*Β*	*t*	*P*
Step 1						
	IQ	.282	.091	.343	3.101	.003
	Age	-.251	.111	-.249	-2.255	.027
Step 2						
	IQ	.011	.089	.013	.124	.902
	Age	-.616	.106	-.613	-5.810	< .001
CAPPT	High Explicit	2.056	2.294	.130	.896	.374
	Low Explicit	-.974	1.427	-.062	-.683	.497
	Implicit	-.978	1.474	-.062	-.663	.510
	Naming	-2.071	1.569	-.131	-1.320	.192
CAMPT	Explicit	8.864	2.284	.541	3.750	< .001
	Implicit	1.735	1.945	.110	.892	.376

A hierarchical multiple regression was also run for Expressive Language, however the findings of this very much replicated the findings for Core Language. This is due to CLS and ELI being so highly correlated. Therefore, the findings of this hierarchical multiple regression are presented in Appendix C.

Reading

In the first step of hierarchical multiple regression, two predictors were entered: nonverbal IQ and age (in months). This model was statistically significant F (2, 67) = 5.572, p = .006 and explained 14.3 % of variance in reading ability. Only the nonverbal IQ factor made a significant unique contribution to the model (Table 41). After entry of the CAPPT and CAMPT factors at Step 2, the total variance explained by the model as a whole was 54.7% (F (8, 61) = 9.223, p < .001). The introduction of the CAPPT and CAMPT explained additional 40.5% of variance in reading ability, after controlling for nonverbal IQ and age (R^2 Change = .405; F (6, 61) = 9.093, p < .001). In the final adjusted model three out of eight predictor variables were statistically significant, with age recording a higher Beta value (β = -.548, p < .001) than the High Explicit factor from the CAMPT (β = .480, p = .001) and Naming factor from the CAPPT (β = -.236, p = .020).

Table 41. *Hierarchical Regression Model of Reading*

		B	*SE*	*β*	*t*	*P*
Step 1						
	IQ	.264	.094	.319	2.817	.006
	Age	-.203	.115	-.200	-1.772	.081
Step 2						
	IQ	-.010	.089	-.012	-.112	.911
	Age	-.555	.107	-.548	-5.194	< .001
CAPPT	High Explicit	1.489	2.311	.093	.644	.522
	Low Explicit	1.368	1.437	.086	.952	.345
	Implicit	-.368	1.485	-.024	-.260	.796
	Naming	-3.763	1.580	-.236	-2.381	.020
CAMPT	Explicit	7.666	2.301	.480	3.332	.001
	Implicit	2.233	1.959	.140	1.140	.259

Discussion

Overall, all models were significant, and Step 1 (nonverbal IQ and age) explained the most amount of variance in CLS and explained similar amounts of variance in ELI and reading. After the entry of the CAPPT and the CAMPT, CLS and reading achieved the highest amount of variance explained (54.7%). The CAPPT and CAMPT explained the highest change in variance for reading and the lowest in CLS. This finding suggests that reading performance is more related to performance in the CAPPT and the CAMPT than performance on either language measure. Furthermore, this also suggests that expressive language is more related to the CAPPT and CAMPT than core language (which was also found to be more related to age and nonverbal IQ than other measures).

In both language measures, age and Explicit CAMPT scores were the only significant predictors of language. This finding is interesting as the results from the ANOVAs highlighted that the High Explicit CAPPT and the Explicit and Implicit CAMPT appeared to be more critical for those with language impairments, as these were the only areas with consistent findings for both the impaired group. Mainly as the findings with High Explicit CAPPT and Implicit CAMPT were much stronger, keeping significance and strong effect sizes throughout. However, this finding may be because in the regression analyses IQ and age were controlled for, and therefore may subtly suggest that High Explicit CAPPT and Implicit CAMPT have a stronger relationship with those factors instead of language.

Morphological awareness is one of the critical underlying skills for language, so much, so it is seen as an essential area of assessment for those diagnosing DLD (Spaulding, Plante and Farinella, 2006). Therefore it is unsurprising that this is a significant predictor of either language measure. However, this was only found to be the case for Explicit morphological awareness measures, as no significance was found for the Implicit measures. This may suggest that Explicit morphological awareness is more related to language than Implicit morphological awareness. However, it should be noted that one of the tasks used in the Explicit CAMPT (Word Structure) was used as a language measure for those aged less than eight (37 participants). Although the Word Structure was adapted for its use in the CAMPT and furthermore, this was accessed in relation to the composite factor score for Explicit CAMPT and not just this task alone. However, in the reading results, a similar strong finding was found which may suggest that this is a genuine finding.

For reading, in addition to age and Explicit CAMPT, Naming CAPPT was also a significant predictor. Therefore, it is interesting that only relatively weak group differences were found for Naming CAPPT in the ANOVA analysis, but that Naming CAPPT was a significant predictor here. This may indicate that the addition of language difficulties may confuse the picture in the ANOVAs slightly. Previous research has found that explicit morphological awareness measures can predict reading, even after controlling for other factors, such as IQ and phonological awareness (Bowers et al., 2014). For example, Kirby et al. (2012) found that IQ and phonological awareness accounted for 51% of performance on a word identification task and that morphological awareness measures accounted for an additional 13% of the variance. Previous research has also found a similar pattern for naming tasks, again even when controlling for IQ and phonological awareness naming tasks accounted for 5% of the variance in word identification (Georgiou et al., 2008). Therefore, the current study partially supports these finding, as both morphological awareness and rapid naming was found to be a significant predictor of reading, but the current study did not find phonological awareness to be a significant predictor. Furthermore, phonological awareness begins to lose its predictive power for reading ability for children around age five, whereas morphological awareness has increased longevity and has been found to keep its predictive power for reading in children up to age 14 (Kuo and Anderson, 2006; Nagy, Berninger and Abbott, 2006). As the current study used slightly older children, this may explain this finding.

In addition to this, a large proportion of the participants in the current study had additional language or literacy difficulties, and perhaps this could be impacting the results. For example, individuals with DLD have been found to have a distinct difficulty in morphological awareness, and therefore, this difficulty could be so marked that it is impacting the remainder of the results (e.g. de Bree and Kerkhoff, 2010). This implication is also reflected in the ANCOVA and ANOVA results presented above, as DLD-only and DLD+ participants were impaired all aspects of the CAMPT but only the High Explicit aspects of the CAPPT.

Conclusion

In summary, the performance of TD, DLD-only and DLD+ children were compared and explored through the composite language scores derived from the CAPPT and the CAMPT. Overall the results of the ANCOVA and ANOVA analyses indicate that participants with DLD-only, DLD+ and TD perform distinctly differently on some aspects of the CAPPT and CAMPT; however, this depends on the exclusionary criteria used for identifying DLD. Those with DLD-only were more impaired than their typically developing peers on High Explicit and Naming CAPPT and Explicit and Implicit CAMPT. However, these findings depended on the exclusionary criteria applied. For example, difficulties with High Explicit and Naming CAPPT disappeared when participants with low IQ were removed. This suggests a unique profile of difficulty for those with low IQ but an area of relative strength for those with IQ in the average range or above. In addition to these areas of difficulty, individuals with DLD-only were found to have areas of relative strength. Participants with DLD-only did not perform differently to their typically developing peers on Low Explicit and Implicit CAPPT. This suggests that although individuals with DLD-only may have difficulties with their more explicit phonological awareness skills, that not all of their phonological awareness abilities are impaired. This finding challenges Ramus et al. (2013) who found that those with DLD-only were impaired on both higher and lower level phonological tasks.

Furthermore, those with DLD+ were also found to be impaired relative to their typically developing peers on High Explicit, Low Explicit and Naming CAPPT and Explicit and Implicit CAMPT. However, similar to the case with DLD-only participants, their pattern of difficulty also seemed to relate to the diagnostic criteria used. Difficulties with Low Explicit CAPPT only appeared when participants with EAL were removed whereas difficulties with Naming CAPPT only appeared when participants with EAL were included. Therefore, this suggests a unique relationship between EAL status and the phonological profile of those with DLD and literacy difficulties. Furthermore, with the removal of those with EAL status and low IQ, difficulties on the Explicit CAMPT disappeared and therefore might suggest a relationship between EAL status and morphological abilities too. In addition to areas of difficulties, those with DLD+ were also found to have an area of relative strength in Implicit CAPPT. Therefore, this also suggests that those with DLD and literacy impairments are not impaired in phonology as a whole. This finding challenges previous research (Ramus et al., 2013). However, as both groups were found to perform in line with their typically developing peers, this may be due to the increased attention teachers now pay for phonics instruction. This instruction may have decreased the gap between these groups. Morphological instruction, in comparison, receives far less attention. Perhaps this is why the DLD groups have a particular difficulty here.

Moreover, results were found to change quite substantially when participants with low IQ and/or EAL were included or excluded from the analyses. Excluding participants with EAL in the analyses caused the most differences and may suggest that EAL status impacts the experience of DLD the most, particularly for Low Explicit and Naming CAPPT. On the other hand, excluding participants with low IQ appeared to affect the overall results less but affected the results of the DLD-only group the most, with their performance improving. Overall, these findings imply that children who fit the 'classical' definition of DLD present a very different profile of difficulty to those who fit the broader 'liberal' diagnostic criteria that are used in clinical practice. Research is intended to inform practice, and as this is the case, classical research may struggle to inform liberal practice on DLD accurately; especially because only a small amount of findings were found to be consistent through each of the analyses. These implications highlight a significant disparity between the types of difficulties children with DLD face and therefore outline the need for more research in this area to ensure that informative research is conducted, so clinicians best understand how to diagnose and support all types of children with DLD.

ANCOVA and ANOVA was preferred to MANCOVA and MANOVA due to the nature of the theoretical background and the research aims. A key argument of the current thesis is that although these tasks are drawn from the same fields, they are not measuring the same thing. Each factor is a different type of phonological or morphological awareness task that relates to language and literacy in different ways. Therefore, the research aims were to investigate the impact of each different type of phonological and morphological awareness alone. A multivariate analysis of variances would require these separate factors to be summed together into a composite DV and therefore would not support this research aim or the theoretical background.

Reviewing the Observed Power analysis indicated that some of the analyses reported in this chapter were underpowered. The mean observed power for the Liberal Analysis is 73.5%, for the Liberal IQ Analysis it is 71.7% and the Liberal EAL is 53.4%. This suggests that Liberal and Liberal IQ Analysis where slightly underpowered, however the Liberal EAL was moderately underpowered. On average, low power affected the Low Explicit, Implicit and Naming factors of the CAPPT the most (Mean = 34.7%, 19.8% and 61.2%, respectively), with the High Explicit CAPPT and the Implicit and Explicit CAMPT all having acceptable power (Mean = 96.8%, 92.4% and 92.4%, respectively). These findings emphasise the need for taking a cautious, holistic approach when interpreting the findings, as some of the analyses are clearly underpowered. Furthermore, these findings further highlight the importance of taking the hierarchical multiple regression in to consideration when analysing the results of this chapter.

The results of the hierarchical multiple regression indicated that the factors of the CAMPT and CAPPT when combined with age and IQ, are very strong predictors of language and reading, explaining just over 50% of the variance in each. Quite surprisingly, the only factors from the CAMPT and CAPPT that were significant predictors of language were Explicit CAMPT. Naming CAPPT and Explicit CAMPT were significant predictors of reading though. These findings were surprising as it was anticipated that factors from the CAPPT would play a stronger role in both language and literacy.

As outlined previously, the prevalence of Dyslexia in DLD has been found to vary considerably from 12.5% to 85% (McArthur et al., 2000). In the current study, the prevalence of additional literacy difficulties was found to vary too from 32.1% - 53.3% (Liberal 51.5%; Liberal IQ 32.1%; Liberal EAL 53.3%; and Classical 36.4%). Although the current study is not based on a representative population sample, it shows how this can vary according to the different diagnostic criteria applied in research. It appears that the inclusion of those with EAL status may lead to an overestimation of the overlap; which could indicate a key difference for those with a language impairment in their second language. This could also be due to the individual being less familiar with the language, especially as there were far fewer children with EAL status that were found to have DLD-only. However, several EAL children did not have literacy or language problems which indicates that there is a unique population of those with EAL who also experience language difficulties. Nevertheless, this is an important implication for clinicians to keep in mind, although further research is needed in this area.

Furthermore, the findings of this study can add to the models of the DLD and Dyslexia. Kamhi and Catts (1986) Severity Model outlines that DLD is just a more severe version of Dyslexia and outlines that individuals with DLD always have Dyslexia as well. Therefore, these findings form more evidence against Kamhi and Catts (1986) as the current study found several instances of DLD-only. Furthermore, these results can add to the Multiple Deficit Model (Pennington, 2006; Marshall, 2009) proposed earlier in this thesis, as this shows that individuals with DLD-only and DLD+ perform distinctly different on aspects of phonology and morphology but not on all aspects.

However, this needs further investigation to examine whether there are any item-type differences.

Within the CAPPT and CAMPT, alongside the suggestion that there would be several distinct levels between tasks the continua also suggested further differences with these levels at an item-type level. For example, within CAMPT it was predicted that individuals would struggle more with task items that use opaque morphological changes than transparent (Carlisle, 2000). Furthermore, within the CAPPT it was predicted that individuals would struggle more with task items that required individuals to use individual phonemes than other items where they could use onset and/or rime (Ziegler and Goswami, 2005). Therefore, this will be addressed in the next Chapter with further item-type analysis, investigating the micro differences outlined in the CAPPT and CAMPT. This analysis will allow for a more in-depth investigation of the proposed model.

Previous research has indicated that IQ (Bishop et al., 2016; Spaulding and Gallinat, 2014) and EAL status (Blom and Paradis, 2013; Paradis, 2016; Rice, 2016) are not causal factors for DLD and should, therefore, be removed from their diagnostic criteria. The results here can add further to this debate. The results here indicate that these are, in fact, essential factors to keep in mind although also stress the importance of using broader diagnostic criteria so as these individuals can receive support as well. As when removed from the analysis the profile of difficulty was narrower and distinctly different than when these children are included. This, therefore, shows distinct differences between the types of problems these individuals face. However, as the definition for DLD in a clinical setting is more focused on those who will benefit from intervention (Bellair et al., 2014), it highly crucial that more research be conducted on these children that are often excluded from research for research to inform practice much better.

Chapter Seven: Item-Type Differences on the CAPPT and CAMPT

Past research has demonstrated the effects of item-type on performance for both morphological tasks (e.g., opaque derivations vs transparent derivations) and phonological tasks (e.g., phoneme production vs onsets/rimes production). However, this research has primarily focused on typically developing individuals (e.g., Roberts and McDougall, 2000) and less is known about item-type effects in those with DLD-only and DLD+. Several measures used in the CAPPT and CAMPT included manipulations of item-type. Items within the CAPPT varied including differences in syllable number (nonword repetition), unit size (fluency), unit location (phoneme deletion) and orthographic structure (phoneme substitution). Items within the CAMPT varied including differences in morpheme type (real connection), novelty (word structure and derivational comprehension) and lexical level (DATMA). Therefore, the current Chapter examines these item-type effects within individuals with DLD-only and DLD+ compared to typical controls through mixed factorial ANOVA. The findings of this Chapter further address research question two: specifically, whether individuals with DLD-only, DLD+ or TD individuals perform differently on item-type tasks within phonological and morphological awareness tasks.

Phonological Item-Type Differences

Item-type differences are common within phonological language tasks and can include variations in syllable number, unit size and orthographic structure. These variations are often deliberately manipulated by the researcher, for example, nonword repetition items can vary according to how many syllables they contain. The Phonological Assessment Battery II Nonword Repetition task (PhAB2: Gibbs and

Bodman, 2014) has items which have two-syllables (e.g., Ger-rit) and three-syllables (e.g., Nan-nen-colt). Other tasks, such as the Children's Test of Nonword Repetition (Gathercole et al., 1994), include items with as many as five syllables. These item-level manipulations can have substantial impacts on performance. For example, typically developing children perform significantly better on two-syllable items than three-syllable or four-syllable items in nonword repetition tasks (Tamburelli et al., 2012). Children with specific learning difficulties have also been found to struggle more on items with high syllable counts in comparison to typically developing children. For example, Ramus and Szenkovits (2008) outlined that it is long understood that most individuals with Dyslexia can repeat one-syllable and two-syllable items with relative ease. However, they tend to struggle with items containing three or more syllables (Marshall and van der Lely, 2009; Szenkovits and Ramus, 2005). Interpreting these item-level effects on performance is vital for our understanding of language and literacy difficulties as they help establish the nature of children's difficulties more precisely and indicate the potential locus of impairment. For example, following the observation of length effects in nonword repetition, Ramus and Ahissar (2012) suggested that impairments on this task may be due to an underlying verbal short-term memory deficit that individuals with Dyslexia face rather than indicating a difficulty representing phonological units as has often been assumed (e.g. Snowling, 2000). Similar difficulties that mainly affect the processing of items with higher syllable counts have also been found in children with DLD (Burke and Coady, 2015). Furthermore, a verbal short-term memory deficit has been suggested as an explanation of these findings in individuals with DLD (Marshall et al., 2009). These findings underline the importance of investigating effects of syllable number within nonword repetition tasks and the influence of item-type differences on the performance of children with DLD and/or reading difficulties more generally.

Similarly, phonological production tasks can vary according to the size of the unit they require an individual to produce. For example, the Fluency task from the PhAB2 (Gibbs and Bodman, 2014) contains rhyme and alliteration subscales. Rhyme items require an individual to produce answers based on the rime, whereas alliteration items require participants to generate items that share an initial phoneme instead of items that rhyme. Ziegler and Goswami (2005: 4) describe phonological awareness as “a continuum from shallow sensitivity to large phonological units, to a deep awareness of small phonological units”. A syllable is the largest unit of phonology, followed by rime, and then by phonemes (which are the smallest).

Furthermore, children have been found to master phonological skills from the largest to the smallest (Anthony et al., 2003). This suggests that children may find rime-based items easier to process than phoneme-based items. However, more recently it has been found that meta-phonological development starts independently for each unit of sound, implying a more complicated pattern than the one found by Anthony et al. (2003).

Duncan et al. (2013) conducted a literature review on this matter and found evidence for a small-to-large and a large-to-small developmental trajectory for phonological awareness. They concluded that this depended upon the specific tasks and the different task demands this placed on an individual when combined with these item-type differences. Therefore, this finding emphasises item-type differences within tasks but suggests that they can occur in different patterns for different tasks, leading to unclear predictions regarding the effects of unit size on performance. Roberts and McDougall (2003) delivered participants a series of tasks and matched them to ensure they had rhyme and phoneme-based items for each task. However, the item-type differences between tasks were not explored because they combined multiple tasks for their study. In summary, the effects of unit size on the performance of DLD children is under-researched, and the complex literature regarding the developmental trajectories for different phonological units underlines the importance of understanding item-level effects within phonological tasks.

Although units of rime are consistently represented by multiple graphemes, phonemes can be presented by singular and multiple graphemes. Digraphs are two-letter graphemes that are used to denote a single phoneme, for example, the six letter word ‘wreath’ contains only three phonemes WR + EA + TH whereas the six letter word ‘strict’ contains six S + T + R + I + C + T (Rapp and Fischer-Baum, 2014). These orthographic differences between words have also been found to influence performance. The orthographic processing of digraphs when reading words have been shown to be particularly challenging for young readers and children with Dyslexia. Marinus and de Jong (2010) suggested that this may be because these individuals are trying to decode these words letter-by-letter, instead of phoneme-by-phoneme. Decoding words in this way also increases the likelihood of errors as digraphs often change the sound of the letters they contain, for example, the letter p in ‘pig’ also appears in ‘phone’, but they sound very different from each other. Importantly for the current context, these digraph processing errors are also seen in oral language tasks, such as phoneme counting and phoneme segmentation. For example, Tunmer and Nesdale (1982) found that typically developing preschool children made consistent errors counting phonemes in words with digraphs; they would often “overshoot” on familiar words (e.g., counting four phonemes in *book* instead of three). However, they found this was only the case for familiar words, as when presented with pseudowords, they made significantly fewer errors.

Furthermore, Bruck (1992) investigated the link between orthographic representations and phonological awareness in Dyslexic individuals. She found that individuals with Dyslexia were less affected by the presences of digraphs in both phoneme counting and phoneme deletion tasks. For example, on the phoneme deletion tasks, typically developing individuals were more likely to delete only one letter instead of the whole digraph (e.g., *them* became -*hem* instead of -*em*). Therefore, this not only shows that digraphs influence performance in phoneme deletion tasks but also that individuals with specific learning difficulties are affected differently by this item-level characteristic than those who are typically developing. Perin (1983) also reported similar findings in the context of spoonerism tasks; with normal readers being more influenced by the presence of digraphs (e.g., Chuck Berry became Bhuck Cerry instead of Buck Cherry). Despite this, most studies investigating phonological processing in typically developing and Dyslexic children have not controlled for the presence of digraphs (Marinus and de Jong, 2010); this is also true of DLD studies (e.g., Marshall and Harcourt-Brown, 2009). Therefore, the current study will look to examine these item-level differences in typically developing, DLD-only and DLD+ children in order to develop a more fine-grained understanding of the phonological language profiles of the DLD children.

Morphological Item-Type Differences

Item-type differences within morphological measures include morpheme type (e.g., inflectional vs derivational), novelty (e.g., pseudo- vs real-words), and lexical level (e.g., sub-lexical vs lexical). Derivational morphological changes vary in degrees of phonological opacity; with transparent phonological derivations sounding very similar to their root morpheme and opaque phonological derivations potentially sounding entirely different to their root morpheme. For example, the difference between *drive* and *driver* (a transparent derivation) is minimal, with merely the addition of the *-er* sound to the root. In contrast, the morphological shift between *explode* and *explosion* (an opaque derivation) removes the final phoneme from the root word and adds the suffix *-sion* to the end. The opacity of the phonological change in derived words affects performance of morphological processing tasks. For example, children have been found to perform better on transparent items than on opaque items (Carlisle, Stone and Katz, 2001). Similar findings have been found in those with language impairments (e.g., Critten et al., 2014; Silliman and Bahr, 2006). Although many studies intentionally include both opaque and transparent phonological changes in their morphological tasks, not all of them explicitly contrast children's performance for the different types of item (e.g., Apel, Diehm and Apel, 2013; Levesque, Kieffer and Deacon, 2017; Tong, Deacon and Cain, 2014). Therefore, the research in this area is limited, particularly in relation to children with language or literacy impairments. Consequently, the current study will examine these item-type differences systematically in the context of sentence completion and morpheme matching tasks in typically developing individuals and those with language and literacy impairments.

Morphological task items can also vary regarding novelty. Specifically, items can include base words or affixes that are familiar/high-frequency, unfamiliar/low-frequency, or entirely novel (i.e., pseudowords). The Children's Printed Word Database (Masterson, Dixon and Stuart, 2003) is a database of printed word frequencies for words read by children aged between five and nine years old. Certain base words and affixes are far more common than others. For example, the affix *-er* returns 337 different words that end in this morpheme; whereas the affix *-ful* only returns 33 different words. Therefore, high-frequency words and affixes are those that frequently appear in children's literature and that they are familiar with. Whereas low-frequency words do not often appear in children's literature and children are therefore less familiar with them (Levesque, Kieffer and Deacon, 2017). The use of low-frequency task items within experimental language tasks is designed to control for the effects of rote learning and over-familiarisation, and researchers often use low-frequency items to investigate morphological awareness in particular. However, it is less common for researchers to compare performance between low-frequency, high-frequency, and novel items directly (e.g., Levesque, Kieffer and Deacon, 2017; Larsen and Nippold, 2007; Fraser, Goswami and Conti-Ramsden, 2010; Apel, Diehm and Apel, 2013). When this issue has been explored, typically developing children have been shown to perform better with higher frequency morphologically complex words in a single-word reading task (Lazaro, Camacho and Burani, 2013).

Furthermore, Law et al. (2015) suggested that this effect of base frequency demonstrates how print exposure and vocabulary knowledge are explicitly linked to one's morphological ability. If this interpretation is correct, we may expect that those with language impairments will be less susceptible to the benefits of high-frequency items as they are likely to have a weaker vocabulary. Van der Lely and Ullman (2001) investigated performance on sentence completion tasks with high-frequency, low-frequency, and novel (pseudoword) word items in children with and without DLD. They found that CA and LA control groups showed significant effects of base frequency, performing significantly better with high- compared to low-frequency items.

In contrast, the performance of individuals with DLD did not differ between the high- and low-frequency items. Van der Lely and Ullman (2001) also found that individuals with DLD were significantly worse at regular pseudoword items than irregular pseudoword items. This demonstrates that individuals with DLD are less aware of the regular language rules but appear to be spared in their irregular word knowledge, in comparison. However, it has been suggested that further research is needed here to investigate the impact of word frequency on these groups and to understand how these compare on different morphological awareness tasks. Therefore, the current study will investigate the effects of word frequency on the performance of TD, DLD-only and DLD+ children in two different morphological tasks: sentence completion and morpheme matching.

Finally, it has been noted that morphological awareness tasks can vary according to the linguistic level that they involve. Supra-lexical tasks require individuals to show an understanding of the morphological structure within a sentence; such as, defining morphologically complex words when they are given in a sentence context (e.g., “the *beastly* man scared the children”) or accurately following instructions. Lexical tasks require individuals to show an understanding of the morphological structure within a word; such as defining words presented out of context (e.g., “define *beastly*”). Finally, sub-lexical tasks require individuals to define the morphemes within words (e.g., “*beastly* can be broken into the little parts *beast* and *-ly*, what does the *-ly* part mean?”). Bowers, Kirby and Deacon (2010) outlined that morphological instruction is focused at the sub-lexical level, with the intention of facilitating children’s reading, spelling and vocabulary, and the supra-lexical level, with the goal of enhancing reading comprehension. Bowers et al. also concluded that morphological awareness developed from larger to smaller units, first developing an understanding of morphology at the sentence level which then progresses to the word level and finally the morpheme level. These findings suggest that children should find defining words at a sentence level much more accessible than defining them out of context at a word level (Pawlowska, Robinson and Seddoh, 2014). The current study systematically explores the effects of linguistic level on TD, DLD-only and DLD+ children in the context of a definitions task.

Summary and Research Aims

Several researchers have outlined the importance of developing our understanding of item-type effects within phonological awareness tasks (e.g., Duncan et al., 2013). Phonological tasks have been found to vary regarding phonological unit size, syllable number and orthographic influences. Furthermore, research has suggested the need for more detailed investigation of item-level effects on morphological processing measures (Critten et al., 2014; Carroll and Breadmore, 2017; Apel, Diehm and Apel, 2013; Mahony, Singson and Mann, 2000), especially in children with literacy or language difficulties. Morphological tasks and the items within them have been found to vary regarding opacity, frequency and linguistic level. Therefore, the research aim of the current Chapter is to systematically explore a variety of item-type effects in typically developing children (TD), children with DLD (DLD-only) and children with DLD and additional language difficulties (DLD+). No specific hypotheses were formulated for analyses reported in this section, due to the exploratory nature of these analyses and the lack of a strong consensus in the literature as to the likely direction of outcomes. Overall, this chapter helps enhance our understanding of the phonological and morphological profiles associated with language and literacy impairments.

Method

Design and participants

The current study utilised a quasi-experimental design in which TD, DLD, and DLD+ children completed a series of tasks drawn from the CAPPT and the CAMPT containing systematic item-type manipulations. Methods for the recruitment and screening of participants have been outlined previously (see Chapter 5). In summary, a total of 57 children aged 6-11 years were recruited from a range of five primary schools (two with specialist language hubs) in the Midlands and a further 13 children were recruited via email sent to parents on Coventry University's Literacy Group's mailing list. The most liberal inclusion criteria for DLD, including children with EAL and low IQ scores, was used for this analysis in order to maximise power and best represent the clinical picture of DLD. To recap, 70 children aged 6-11 years old participated in this study. Of this sample, 37 were typically developing, 16 were DLD-only, and 17 had language and literacy difficulties (DLD+).

Measures and Procedure

The original measures and data collection procedures used in this study are outlined in Chapters 4 and 5. Analysis for the current Chapter was completed using the raw scores from several language measures drawn from the CAPPT and the CAMPT. The CAPPT had five tasks containing item-type manipulations; these were Nonword Repetition, Fluency, Phoneme Substitution, Phoneme Deletion and Spoonerisms. The CAMPT had four tasks where further item-type analyses could be conducted; these were Word Structure, Real Connection, DATMA and Derivational Comprehension.

Table 42 outlines the item-type manipulations present within tasks drawn from the CAPPT. The nonword repetition task included items of two different lengths (two vs three syllables) and was therefore used to explore the effects of syllable number. The fluency task consisted of two different unit sizes, with phonemes and rime item-types. Therefore, this task will be used to explore the effects of unit size. The phoneme deletion task manipulated the location of the target phoneme (initial, medial or final). Both the phoneme substitution and spoonerism tasks contained orthographic structure manipulations (single letters vs digraphs).

Table 42. *Item-type Manipulations: CAPPT.*

Measure	Manipulation	Item-types	Number of items
Nonword Repetition	Syllable number	Two-Syllable	8
		Three-Syllable	6
Fluency	Unit size	Rhyme (rime)	2
		Alliteration (phoneme)	2
Phoneme Deletion	Phoneme location	Initial Phoneme	6
		Medial Phoneme	6
		Final Phoneme	6
Phoneme Substitution	Orthographic structure	Single-Letter	6
		Digraph	4
Spoonerisms	Orthographic structure	Single-Letter	10
		Digraph	10

Table 43 outlines the item-type manipulations present within tasks drawn from the CAMPT. The real connections task contained a morpheme-type manipulation. The word structure and morpheme completion tasks manipulated the novelty of the items using word frequency and lexicality (real-word vs pseudo-word) respectively. The DATMA task manipulated the linguistic level of the items (sentence vs word).

Table 43. *Item-type Manipulations: CAMPT.*

Measure	Manipulation	Item Types	Number of Items
Real Connections	Morpheme-type	Inflection	10
		Transparent Derivation	10
		Opaque Derivation	10
Word Structure	Novelty	High-Frequency	40
		Low-Frequency	8
		Opaque	12
Morpheme Completion	Novelty	Real-word	9
		Pseudoword	9
DATMA	Linguistic level	Word	70
		Sentence	20

Results and Discussion

Data Screening and Preparations

Before analysis began, all the individual tasks were screened for Skewness, Kurtosis and Normal Distribution. As displayed in the Table 44 which indicated that several of the measures were not normally distributed, however when working with groups with specific learning difficulties this is to be expected (Allen and Bennet, 2008). Therefore it was decided that further analysis will continue. Post-hoc analyses contrasting the three groups of children were also conducted with a Bonferroni correction applied (alpha = .016). Bonferroni corrected p-values are reported for these tests. An alpha criterion of .001 was adopted for Levene's test as recommended by Allen and Bennet (2008) when working with non-typical participant groups. As with the normality assumption (above), where data violated the homogeneity of variance assumption non-parametric tests were also conducted in order to confirm the findings. Before data analysis started, all raw scores were converted to proportion of correct responses to the overcome the unequal number of items within some tasks (raw score/items).

Table 44. *Skewness and Kurtosis Statistics for the Dataset and Distribution Analysis.*

	CAPPT					CAMPT			
	Fluency	Nonword Repetition	Phoneme Deletion	Phoneme Substitution	Spoonerism	Word Structure	Real Connection	Derivational Comprehension	DATMA
Skewness z-score	2.55*	-2.98*	-3.53*	-3.11*	-0.89	-1.65	-2.67*	-2.50*	-3.34*
Kurtosis z-score	1.60	1.05	0.52	0.01	-1.90	-0.55	-0.75	0.39	0.88
Sharpiro-Wilks	.055*	.001*	.000*	.000*	.004*	.062*	.000*	.011*	.000*

Note. *$p < .05$

Nonword Repetition

A 2 (item type: two-syllable, three-syllable) by 3 (Group: TD, DLD-only, DLD+) mixed factorial ANOVA was conducted with nonword repetition accuracy (proportion of correct responses) as the dependent variable. Table 45 outlines the Means and Standard Deviations for each participant group and each item type. Mean scores indicate that the three groups scored similarly on the two-syllable items. However, for the three-syllable items, group differences begin to become more apparent, with the TD children outperforming the DLD groups. There is an 8% drop in accuracy of the TD group, compared to a 24% drop in the DLD group and a 21% drop in the DLD+ group. Overall, individuals score higher on the two-syllable task items than on the three-syllable task items and individuals in the DLD groups are more affected by the presence of an additional syllable.

Table 45. *Means and Standard Deviations for Nonword Repetition.*

Group	Two-Syllable	Three-Syllable
TD	.82 (.20)	.74 (.25)
DLD-only	.85 (.18)	.61 (.23)
DLD+	.76 (.27)	.55 (.30)

Levene's test indicated homogeneity of variance, p = .353 and p = .579 respectively. There was a significant main effect of item type, with participants scoring higher in the two-syllable item-types: F (1, 67) = 20.61, p < .001, η^2 = .235. There was a non-significant main effect of group: F (2, 67) = 2.69, p = .075, η^2 = .074. Despite the trend towards more pronounced group differences for the three-syllable items, the interaction effect did not reach significance: F (2, 67) = 1.88, p = .160, η^2 = .053.

Summary

Overall, the finding here indicates that there is a significant item-type difference present on the Nonword Repetition task; individuals in the current thesis performed significantly worse on the three-syllable items. This finding improves our understanding of item-types differences, as it highlights the importance of considering syllable amount for non-word repetition tasks. Although this finding supports the general finding of individuals struggling more on higher syllable amount item-types (i.e., Tamburelli et al., 2012), this does not support all previous research.

This analysis did not, however, find any significant group differences or interaction effects which challenges previous research. For example, individuals with DLD and Dyslexia had been found to be more impaired on items with higher amounts of syllables relative to their typically developing peers (i.e., Marshall and van der Lely, 2009; Burke and Coady, 2015). Previous research had suggested that this may be due to the short-term memory difficulty that is associated with each disorder. This finding might imply that, although there are significant differences for all groups between two- and three-syllable item-types, they are no more affected than typically developing individuals for three-syllable items-types. Perhaps the short-term memory difficulty is more impactful at a higher level. Alternatively, perhaps this could be due to the previously mentioned studies using strict, classical definitions of impairment. More research is needed here, however, including manipulations with items with higher syllable counts.

Fluency

A 2 (item type: rhyme, alliteration) by 3 (Group: TD, DLD-only, DLD+) mixed factorial ANOVA was conducted with raw fluency scores (number of correct items generated) as the dependent variable. Table 46 outlines the Means and Standard Deviations for each participant group and each item type. Mean scores indicate that typically developing individuals score higher on both rhyme and alliteration items of the Fluency task than either of the language impaired groups. Furthermore, all groups score higher on the alliteration task than the rhyme task. Although children with DLD+ appear to gain higher scores on alliteration tasks, this increase is not as steep as other groups; for example, the TD group increased by nearly two extra words (1.7) whereas for the DLD+ children this was closer to just one extra word.

Table 46. *Means and Standard Deviations for Fluency.*

Group	Rhyme	Alliteration
TD	4.80 (1.96)	6.55 (2.71)
DLD-only	3.59 (1.50)	5.09 (2.63)
DLD+	3.56 (1.84)	4.64 (1.51)

Levene's test indicated homogeneity of variance, p = .476 and p = .116 respectively. There was a significant main effect of item type, with individuals scoring higher in the alliteration task, F (1, 67) = 20.32, p < .001, η^2 = .864. There was also a significant main effect of group: F (2, 67) = 6.02, p < .004, η^2 = .152. Bonferroni corrected post-hoc analysis revealed that the DLD-only and the DLD+ groups scored significantly below the TD group (p = .010, d = .716 and p = .044, d = .954, respectively).

Again, despite the trend towards less pronounced group differences for alliteration items, the interaction effect did not reach significance: F (2, 67) = .46, p = .634, η^2 = .014.

Summary

Overall, the finding here indicates that there is a significant item-type difference present on the Fluency task; individuals in the current thesis performed significantly worse on the rhyme items. This finding appears to support the small-to-large trajectory of phonological development in this task context (Duncan et al., 2013). Furthermore, overall differences were found to occur between groups as well. The analysis found significant group differences between those within the TD group and those with DLD+ and those with DLD-only.

Conversely, this finding only partially supports the previous High Explicit level finding (outlined in Chapter 6). As this task formed part of the High Explicit factor for the CAPPT and it was found that both DLD-only and the DLD+ were found to differ from their typically developing peers significantly. This suggests that although individuals with DLD-only differ on some tasks that form the High Explicit level of the CAPPT, that they do not on all the tasks or perhaps they only differ when tasks are combined.

Phoneme Deletion

A 3 (item type: initial, final, medial) by 3 (Group: TD, DLD-only, DLD+) mixed factorial ANOVA was conducted with phoneme deletion accuracy (proportion of correct responses) as the dependent variable. Table 47 outlines the Means and

Standard Deviations for each participant group on each item type. Mean scores indicate that typically developing individuals score the highest and individuals in the DLD+ group score the lowest. All groups score higher on the initial phoneme items than on the medial items. The DLD+ appear most affected by the medial phoneme, as their Mean score decreased by 55% for this item-type. Whereas, the DLD-only group decreased by 35% and the TD group by only 25%.

Table 47. *Means and Standard Deviations for Phoneme Deletion*

Group	Initial	Medial	Final
TD	.95 (.13)	.71 (.34)	.83 (.20)
DLD-only	.89 (.14)	.57 (.43)	.71 (.31)
DLD+	.78 (.28)	.35 (.42)	.53 (.39)

Levene's test indicated homogeneity of variance, $p = .002$, $p = .004$ and $p = .059$ respectively. The assumptions of sphericity were violated ($p < .001$), therefore the Greenhouse-Geisser correction was used. There was a significant main effect of task type: F (1.51, 101.00) = 30.86, $p < .001$, $\eta^2 = .315$. Bonferroni post-hoc analysis found that individuals scored significantly higher on the initial phoneme items than on the final or the medial phoneme items ($p < .001$, $d = .637$ and $p < .001$, $d = .958$ respectively). Participants also scored higher on the final phoneme items than the medial ($p < .001$, $d = .395$). The main effect of group found a significant difference: F (2, 67) = 8.74, $p < .001$, $\eta^2 = .207$. Bonferroni post-hoc analysis indicated significant differences between the TD group and the DLD+ group ($p <.001$, $d = 1.12$). Again, although there was a trend towards more pronounced group differences for the medial items, the interaction effect did not reach significance, F (3.02, 101.00) = 1.07, p = .366, η^2 = .031.

Summary

Overall, the finding here indicates that there is a significant item-type difference present on the Phoneme Deletion task. Individuals in the current thesis performed significantly worse on the medial or final phoneme items than the initial phoneme items. Participants were also found to score higher on the final than the medial item-types. However, this finding only had a small effect size. This analysis only found significant group differences between those within the TD group and those with DLD+; those with DLD-only were not found to differ, on overall task performance from each group significantly. This finding suggests that individuals with DLD-only are less impaired than their language and literacy impaired peers for this task as well.

Conversely, this finding only partially supports the previous High Explicit level finding (outlined in Chapter 6); as previously both DLD-only and the DLD+ were found to differ from their typically developing peers significantly. This further suggests that although individuals with DLD-only differ on some tasks that form the High Explicit level of the CAPPT, that they do not on all the tasks or perhaps they only differ when tasks are combined.

Phoneme Substitution

A 2 (item type: single-letter, digraph) by 3 (Group: TD, DLD-only, DLD+) mixed factorial ANOVA was conducted with phoneme substitution accuracy (proportion of correct responses) as the dependent variable. Table 48 outlines the Means and

Standard Deviations for each participant group on each item type. The Means indicate that overall the TD group scored the highest and participants performed worse on the digraph items. Although participants experience a similar decline between item-type differences (a decrease of around .2), proportionately, this affected the impaired groups the most. The DLD+ and DLD-only scores decreased by around 35% and 30%, whereas those in the TD group decreased by just 20%.

Table 48. *Means and Standard Deviations for Phoneme Substitution*

Group	Single-Letter	Digraph
TD	.97 (.15)	.77 (.24)
DLD-only	.71 (.30)	.50 (.29)
DLD+	.67 (.28)	.43 (.34)

Levene's test indicated homogeneity of variance, p = .002 and p = .135 respectively. There was a significant main effect of task type, with participants scoring higher in the single-letter items: F (1, 67) = 29.44, p < .001, η^2 = .305. There was also a significant main effect of group: F (2, 67) = 19.34, p < .001, η^2 = .372. Bonferroni post-hoc analysis indicated significant group differences between the TD group and those in the DLD-only and DLD+ groups (p < .001, d = 1.250 and p < .001, d = 1.629 respectively); however, no significant differences were found between those with DLD-only and DLD+. Again, although there was a trend towards more pronounced group differences for the digraph items, the interaction effect did not reach significance, F (2, 67) = .106, p = .900, η^2 = .003.

Summary

Overall, the finding here indicates that there is a significant item-type difference present on the Phoneme Substitution task; individuals in the current thesis performed significantly worse on the digraph items. This analysis found significant group differences between those within the TD group and those with DLD+ and those with DLD-only. Furthermore, no significant differences were found between those with DLD-only and those with DLD+, which supports the main analysis (Chapter 6) on the High Explicit level tasks. However, the previous tasks from the High Explicit level of the CAPPT did not support this finding for DLD-only participants. Therefore, this task must impact the overall finding for DLD-only participants more so than the phoneme deletion and fluency task.

Spoonerisms

A 2 (item type: single-letter, digraph) by 3 (Group: TD, DLD-only, DLD+) mixed factorial ANOVA was conducted with spoonerism accuracy (proportion of correct responses) as the dependent variable. Table 49 outlines the Means and Standard Deviations for each participant group on each item type. The Means indicate that individuals score higher on the single-letter task items than the digraph items and the TD group scored the highest on both item-types. Individuals in the DLD+ group scored the worst on both item-types and scored very similarly on each task item type (27% decrease). The DLD-only and TD group experienced the steeper decline between item-types, with 42% and 39% decrease.

Table 49. *Means and Standard Deviations for Spoonerism*

Group	Single-Letter	Digraph
TD	.74 (.26)	.45 (.27)
DLD-only	.53 (.32)	.31 (.27)
DLD+	.33 (.30)	.24 (.24)

Levene's test indicated homogeneity of variance, p = .557 and p = .570 respectively. There was a significant main effect of task type, with participants scoring higher in the single-letter items: F (1, 67) = 38.25, p < .001, η^2 = .363. There was a significant main effect of group: F (2, 67) = 10.05, p < .001, η^2 = .231. Bonferroni post-hoc analysis indicated significant group differences only between the TD group and those in the DLD+ group (p = <.001, d = 1.291). The interaction effect was significant: F (2, 67) = 3.97, p = .023, η^2 = .106. Bonferroni post-hoc analysis indicated significant differences for the TD and DLD-only groups between the single-letter and digraph items, p <.001, d = 1.09 and p = .001, d = .743 respectively. However, the DLD+ did not perform significantly differently between these item-types, p = .156, d = .331.

Summary

Overall, the finding here indicates that there is a significant item-type difference present on the Spoonerisms task; individuals in the current thesis performed significantly worse on the digraph items. This analysis only found significant group differences between those within the TD group and those with DLD+. However, the DLD-only were not found to perform significantly differently from the TD group. Therefore, this indicates that only those with language and literacy difficulties are impaired, relative to their typically developing peers, in spoonerism tasks. This is reasonably unsurprising as the spoonerism tasks is a task that is highly associated with reading and literacy skills, instead of language skills (Ramus et al., 2013). However, this finding has to be interpreted with caution as there were some moderate-to-large effect sizes despite non-significant p-values, which may indicate this analysis is underpowered. Therefore, there could be significant differences for the DLD-only group that were not picked up in this analysis.

The DLD+ were the only group which did not score significantly differently between item-types. Suggesting that individuals in the DLD+ group are better at minimising the effects of orthographic influences than the impaired groups. This finding supports previous research; as individuals with reading impairments were found to be less affected by the presence of digraphs (Perin, 1983; Bruck, 1992), mainly as this effect was not found in those with DLD-only. Overall, this suggests that although the presence of digraphs has been found to affect performance in oral language tasks that this is more related to reading ability than language ability.

In summary, this finding partially supports the previous finding in the Group Differences Chapter (Chapter 6), as the impaired groups were found to perform significantly different from the TD group. However, this is another measure from the CAPPT that did not find the same differences between DLD-only and TD participants. Therefore, this difference must only present when all tasks are combined.

CAMPT

Real Connection

A 3 (item type: inflection, transparent derivation and opaque derivation) by 3 (Group: TD, DLD-only, DLD+) mixed factorial ANOVA was conducted with real connection accuracy (proportion of correct responses) as the dependent variable. Table 50 outlines the Means and Standard Deviations for each participant group on each item type. The Means indicate that individuals in the TD group scored the highest. The TD and DLD-only groups score consistently through the different item types. Individuals in the DLD+ group score the worst overall and score inconsistently between item types; scoring 19% lower on the opaque derivation items than the inflectional. The TD and DLD+ groups score highest in the inflection items and lowest in the opaque derivations items. However, the DLD-only had the different pattern, scoring 3% higher in the opaque items than the inflection items and 3% lower in the transparent items.

Table 50. *Means and Standard Deviations for Real Connection*

Group	Inflection	Transparent Derivation	Opaque Derivation
TD	.88 (.18)	.84 (.15)	.81 (.19)
DLD-only	.71 (.28)	.69 (.27)	.73 (.22)
DLD+	.72 (.18)	.66 (.18)	.58 (.23)

Levene's test indicated homogeneity of variance for low-frequency and opaque items, p = .157 and p = .030 respectively, but not for high-frequency items p = .007. Therefore, as equal variances could not be assumed, so Games-Howell post-hoc analysis was used in this instance. The Mauchly's test indicated that assumption of sphericity was not violated (p = .165). The main effect of task type was significant: F (2, 134) = 3.48, p = .034, η^2 = .049. The Bonferroni post-hoc analysis found that individuals scored higher in the inflection items (p = .012, d = .278) than opaque items. However, there was not a significant difference between opaque derivation and transparent derivation or inflection and transparent derivation items. The main effect of group was significant: F (2, 67) = 9.71, p <.001, η^2 = .225, d = .331. Games-Howell post-hoc analysis indicated significant group differences only between the TD group and those in the DLD+ groups (p <.001, d = 1.346). The interaction effect was non-significant: F (2, 134) = 1.914, p = .112, η^2 = .054.

Summary

Overall, the finding here indicates that there is a weak significant, item-type difference present in the Real Connection task; individuals in the current thesis performed significantly worse on the opaque items and the best on the inflectional items. This supports previous research (i.e., Carlisle, Stone and Katz, 2001). However, although this finding was significant, it only yielded a small effect size. Therefore, this finding is interpreted with caution.

Furthermore, no significant differences were found for transparent items. This analysis only found significant group differences between those within the TD group and those with DLD+; those with DLD-only were not found to differ, on overall task performance from each group significantly. This could suggest that individuals with DLD-only are less impaired than their peers with DLD and additional literacy difficulties. Particularly because those with literacy difficulties have been found to have additional deficits in phonological processing (for review see Ramus and Szenkovits, 2008). Therefore, perhaps those with additional literacy and phonological difficulties may not be benefiting from the phonological cue that is present in the transparent items, but the TD and DLD-only group are.

Word Structure

A 3 (item type: high-frequency, low-frequency, opaque) by 3 (Group: TD, DLD-only, DLD+) mixed factorial ANOVA was conducted with word structure accuracy (proportion of correct responses) as the dependent variable. Table 51 outlines the Means and Standard Deviations for each participant group on each item type. The Means indicate that overall the TD group scored the highest on all item types. Children from the impaired groups scored similarly across item types, and all groups scored highest on the high-frequency item-types and lowest on the opaque item-types. Overall the DLD-only and DLD+ group perform similarly across all item-types, decreasing by 35-61% and 34-69% respectively. Although the TD group follows the same pattern, this appears to be less steep, decreasing by 18-42%.

Table 51. *Means and Standard Deviations for Word Structure*

Group	High-Frequency	Low-Frequency	Opaque
TD	.74 (.10)	.61 (.22)	.43 (.26)
DLD-only	.60 (.12)	.39 (.20)	.23 (.23)
DLD+	.56 (.19)	.37 (.17)	.19 (.14)

Levene's test indicated homogeneity of variance for all items-types, p = .002, p = .225 and p = .017 respectively. The Mauchly's test indicated that assumption of sphericity was not violated (p = .204). There was a significant main effect of task type F (2, 134) = 127.79, p < .001, η^2 = .656. Bonferroni post-hoc analysis found that most of the item-type significantly differed from each other; with individuals scoring higher in the high-frequency items than low-frequency (p < .001, d = .845) and opaque (p < .001, d = 1.647). There was also a significant difference between opaque and low-frequency items, p <.001, d = .727. The main effect of group was significant: F (2, 67) = 21.30, p < .001, η^2 = .430. Bonferroni post-hoc analysis indicated significant group differences only between the TD group and those in the DLD-only and DLD+ groups (p < .001, d = 1.131 and p < .001, d = 1.346 respectively). Again, despite the trend towards less pronounced group differences for opaque items, the interaction effect did not reach significance: F (2, 134) = .78, p = .541, η^2 = .023.

Summary

Overall, the finding here indicates that there is a significant item-type difference present on all item-types in the Word Structure task; individuals in the current thesis performed significantly worse on the opaque items and the best on the high-frequency items. This supports previous research (van der Lely and Ullman, 2001; Carlisle, Stone and Katz, 2001). However, participants did not perform significantly differently on opaque and low-frequency items. This analysis only found significant group differences between those within the TD group and those with DLD-only and DLD+ groups; participants in the TD outperformed those in the impaired groups.

Derivational Comprehension

A 2 (item type: real word, pseudoword) by 3 (Group: TD, DLD-only, DLD+) mixed factorial ANOVA was conducted with derivational comprehension accuracy (proportion of correct responses) as the dependent variable. Table 52 outlines the Means and Standard Deviations for each participant group on each item type. The Means indicate that the TD group score the highest overall and groups scored the highest on the real word item-types. The DLD-only appeared to struggle the most with the pseudoword items, decreasing by 22% for these items. The DLD+ decreased by 16% and the TD decreased by 10% for the pseudoword items.

Table 52. *Means and Standard Deviations for Derivational Comprehension*

Group	Real Word	Pseudoword
TD	.82 (.27)	.74 (.27)
DLD-only	.76 (.19)	.59 (.26)
DLD+	.74 (.27)	.62 (.22)

Levene's test indicated homogeneity of variance for all items-types, $p = .681$ and $p = .673$ respectively. There was a significant main effect of task type, with individuals scoring higher in the real word items: $F\ (1, 67) = 23.22$, $p < .001$, $\eta^2 = .257$.

There was a non-significant main effect of group: F (2, 67) = 2.44, p = .095, η^2 = .068. Again, despite the trend towards less pronounced group differences for pseudoword items, the interaction effect did not reach significance: F (2, 67) = 1.35, p = .267, η^2 = .039.

Summary

Overall, the finding here indicates that there is a significant item-type difference present on the derivational comprehension tasks; individuals in the current thesis performed significantly worse on the pseudoword items. This finding supports previous research (i.e., van der Lely and Ullman, 2001). However, although all participants performed differently between item-types, no group differences were found. This could imply that although TD participants could be expected to receive a benefit for real word items (as they have sufficient vocabularies) that this is not the case. This finding challenges previous research (Law et al., 2017).

Overall, this finding challenges the previous CAMPT Explicit level finding (outlined in Chapter 6). The real connection tasks formed part of the Explicit CAMPT factor which did find group differences. However, no group differences were found for this task on its own. This could imply, similarly to the High Explicit CAPPT results, that although individuals with DLD-only differ on some tasks that form the Explicit level of the CAMPT, that they do not on all the tasks or perhaps they only differ when tasks are combined.

DATMA

A 2 (item type: lexical, supra-lexical) by 3 (Group: TD, DLD-only, DLD+) mixed factorial ANOVA was conducted with phoneme deletion accuracy (proportion of correct responses) as the dependent variable. Table 53 outlines the Means and Standard Deviations for each participant group on each item type. The Means indicate that overall the TD group scored the highest and all participants scored higher on the lexical item-types. The DLD-only and DLD+ group score very similarly across item-types and both appear to have a steeper decrease than the TD group, as these groups decrease by 43% and 46% respectively. Whereas the TD group only decreased by 28%.

Table 53. *Means and Standard Deviations for DATMA*

Group	Lexical	Supra-lexical
TD	.68 (.16)	.49 (.22)
DLD-only	.60 (.24)	.34 (.25)
DLD+	.59 (.29)	.32 (.25)

Levene's test indicated homogeneity of variance for all items-types, $p = .224$ and $p = .575$ respectively. There was a significant main effect of task type¸ with individuals scoring higher in the lexical items: F (1, 67) = 142.36, $p < .001$, $\eta^2 = .680$. There was a significant main effect of group: F (2, 67) = 3.31, $p = .042$, $\eta^2 = .090$. However, Bonferroni post-hoc analysis did not indicate any significant group differences between the groups. Again, despite the trend towards less pronounced group differences for supra-lexical items, the interaction effect did not reach significance: F (2, 67) = 2.16, $p = .123$, $\eta^2 = .061$.

Summary

Overall, the finding here indicates that there is a significant item-type difference present on the DATMA task; individuals in the current thesis performed significantly better on the lexical item-types. This finding challenges previous research, which suggested it is more accessible to define words in a supra-lexical context (i.e., Pawlowska, Robinson and Seddoh, 2014). This analysis did not find any significant group or interaction differences. Overall, this finding challenges the previous CAMPT Explicit level finding (outlined in Chapter 6); as both of the impaired groups were found to differ from the TD group significantly. This could further imply, similarly to the High Explicit CAPPT results, that although individuals with DLD-only differ on some tasks that form the Explicit level of the CAMPT, that they do not on all the tasks or perhaps they only differ when tasks are combined.

Conclusion

The research aim of the current Chapter was to explore item-type effects on the phonological and morphological processing of typically developing individuals (TD), DLD-only individuals and those with DLD and additional language difficulties (DLD+). Table 54 outlines the results from the current Chapter. The table indicates if any differences were found between item-types, the different language groups or whether any interaction between the two was found. In summary, each task was found to have significant item-type differences. This finding suggests the importance of taking these differences into account when designing, implementing and analysing tasks. This finding supports the calls from previous research to investigate within tasks differences more (i.e., Duncan et al., 2013; Critten et al., 2014).

Table 54. *Summary Table of Item-Type Results for CAPPT and CAMPT*

	CAPPT					CAMPT			
	NR	F	PD	PS	S	RC	WS	DC	DD
Item-type effect	✓	✓	✓	✓	✓	✓	✓	✓	✓
Group effect	TD >DLD TD > DLD+		TD >DLD+	TD > DLD TD > DLD+	TD > DLD+	TD > DLD TD > DLD+	TD > DLD TD > DLD+		
Interaction effect					✓				

Note: ✓ = p< .05; NR = nonword repetition; F = fluency; PD = phoneme deletion; S = spoonerism; RC = real connection; WS = word structure; DC = derivational comprehension; DD = DATMA.

Furthermore, the results here indicate that there are some group differences between these tasks but not for all of them. The fluency task for the CAPPT and the DATMA and derivational comprehension tasks from the CAMPT did not find any between-group differences. This suggests that individuals with DLD-only and DLD+

may be compensated in these areas. Whereas, on the phoneme deletion and spoonerisms tasks those with DLD-only were spared with both DLD groups being more impaired on the nonword repetition, phoneme substitution, real connection and word structure tasks than their TD controls.

Interestingly, no group differences were found directly between those with DLD-only and DLD+. This suggests that further research is needed here. Overall, these results suggest that those with language impairments perform differently to their typically developing peers on Implicit phonological and morphological awareness tasks. This also suggests that those with language impairments are more impaired than their typically developing peers on some, but not all, aspects of explicit phonological and morphological awareness tasks. This further suggests the importance of taking item-types explicitly into consideration as this could be a factor affecting performance. Overall this has enhanced our understanding of the phonological and morphological profile of those with DLD and DLD with additional literacy difficulties. However, it is important to note that at several occasions moderate effect sizes were yielded where no significant differences were found (e.g., group differences in nonword repetition, derivational comprehension and DATMA tasks). This may indicate that the findings here were unpowered.

Although there were item-type differences on all measures and group differences on most measures, significant interaction effects were only found for the spoonerisms tasks. This implies something unique about this task as well as something unique about those with DLD+, as they were the only group not to score significantly differently between task items. This appears to relate to the reading difficulty they experience which minimises the orthographic influences the other groups benefitted from. Furthermore, as interaction differences were only found on the spoonerisms task, this suggests that although there are item-type on all tasks and group differences on most tasks that overall most groups performed similarly within the item-type differences. To conclude, these findings suggest the importance of considering item-type differences, primarily when choosing measures from research or clinical purpose as different tasks could highlight or minimise difficulties on a task type.

Chapter Eight: General Discussion

In this Chapter, the three research questions of the thesis will be discussed in relation to the findings. Following this, implications and limitations of the current thesis and directions for future research are also discussed. Finally, the conclusion outlines implications for our understanding of the measurement of phonological and morphological awareness tasks and raises issues relevant to research methods used in the study of phonological and morphological awareness as well as raising implication for theory. Furthermore, the conclusion also outlines implications for our understanding of DLD and raises issues relevant to the research methods used in the study of DLD and also to clinical practices.

Research Questions

1. Can implicit-to-explicit continua be developed and evaluated for phonological awareness and morphological awareness tasks?

Previous research has indicated that phonological and morphological awareness tasks can vary in a multitude of ways, and this has led to concerns within research that we do not know enough about what, precisely, these tasks are measuring (Duncan et al., 2013; Critten, Pine and Messer, 2013; Carroll and Breadmore, 2017). Implicit and explicit levels of knowledge and understanding have been empirically supported in domains of language (Karmiloff-Smith, 1992; Ellis, 2008) and literacy (spelling: Critten, Pine and Messer, 2013; Critten, Pine and Steffler, 2007; Critten, Sheriston and Mann, 2016). Furthermore, some research had indicated that applying the framework of the RR Model may be instrumental in developing our understanding of task differences for phonological (Ramus and Ahissar, 2012; Mundy and Carroll, 2013) and morphological awareness (Dienes et al., 1991). The current thesis has built upon these previous works by applying the RR Models framework to these key underlying language skills in a fine-grained manner to precisely map out task differences.

CAPPT and CAMPT

Via use of the conceptual framework provided by the RR model (Karmiloff-Smith, 1992) and a thorough and in-depth review of the literature on phonological and morphological awareness, the CAPPT and the CAMPT were developed, and tasks were mapped onto them (Chapter 3). In the case of the CAMPT tasks had to be adapted and pilot tested to ensure they were fit for purpose (Chapter 4). These findings, therefore, shows that implicit-to-explicit continua could be developed for both phonological and morphological awareness tasks. After the development of both continua, these were then tested empirically in order to evaluate them.

The results from the factor analysis for the CAPPT (Chapter 5) indicated four factors; RAN; Implicit; Lower Explicit and Higher Explicit. Table 55 outlines the results from the factor analysis and compares it against the mapped continua. Overall the results from the factor analysis supported the fine-grained implicit-explicit trajectory of the CAPPT, however, instead of three, only two explicit levels were found. This may be because the differences between the tasks were too subtle to be picked up in the current study (potentially due to lack of power). However, as they were both proposed as higher explicit tasks, this was considered to support the CAPPT. Furthermore, the beginning explicit stage of the RR Model was defined by a decrement in performance (although an increase in understanding) and therefore could be more complex to capture empirically in a cross-sectional study.

Table 55. *Task Mappings and Factor Loadings for the CAPPT*

Task	Proposed Level	FA Level	Evaluated
RAN	-	RAN	-
Nonword Repetition	Implicit	Implicit	Yes
Mispronunciation Detection	Beginning Explicit	Low Explicit	Yes
Fluency Alliteration	Near Explicit	High Explicit	Partly
Phoneme Deletion	Full Explicit		
Phoneme Substitution			
Spoonerisms			

Note. FA indicates Factor Analysis.

The results from the factor analysis for the CAMPT indicated two factors; Implicit and Explicit. Table 56 outlines the results from the factor analysis and compares it against the mapped continua. Overall the results from the factor analysis provide some support for the CAMPT, as distinctions were found between implicit and explicit tasks. However, unlike the CAPPT no distinctions were found between explicit tasks themselves. Although the CAPPT findings evidenced fewer explicit factors than expected; this result from the CAMPT could suggest that most explicit morphological awareness tasks cannot be differentiated, i.e. they all require the same level of explicit knowledge to complete.

Table 56. *Task Mappings and Factor Loadings for the CAMPT*

Task	Proposed Level	FA Level	Evaluated
Real Connection	Implicit	Implicit	Yes
Derivational Comprehension	Beginning Explicit		
Extended Word Structure	Near Explicit		
Advanced Derivations Word Structure		Explicit	Partly
Opaque Word Structure			
DATMA	Full Explicit		
Real Connection	Implicit		

Alternatively, the finding might suggest that the RR model is more suited to mapping the implicit-to-explicit differences in phonological awareness than it is to mapping those same differences in morphological awareness tasks. This may be due to the interrelated nature of phonology and morphology, as linguistically speaking, phonology is the starting point in which morphology develops (Carstairs-McCarthy, 2014); therefore perhaps the most implicit forms of morphology are, in fact, phonological. This implication would allow for beginning or lower explicit levels within the CAMPT.

Moreover, it was expected that the CAMPT would be far more similar to the CAPPT than it was found. Both were expected to find four levels, but only the CAPPT found that many. Therefore, this may suggest critical differences between phonological and morphological awareness tasks. This might be due to phonological awareness, overall, being a more implicit skill as children from a very young age begin to develop skills here. For example, phonological awareness has been argued to start developing around six months old, when infants begin modelling their babbling on adult speech via a feedback loop (Fry, 1966). Therefore, it may be a more implicit skill overall or, at least, we may have more ways of measuring implicit ability. For example, nonword repetition tasks are implicit and are similar to the process a baby undertakes when babbling; listening to adult speech and replicating it (Fry, 1966).

Morphological awareness, on the other hand, appears to be tied to words in a way that phonology is not, and this may mean that, overall, phonological awareness is a more implicit skill to acquire. Phonological awareness, in its purest form, relates to the speech sound whereas morphological awareness relates to word meaning. Moreover, morphological awareness appears to depend on other factors as this develops much later than phonological awareness (Nagy and Anderson, 1984; Casalis, Cole and Sopo, 2004); and it appears to be more dependent on the development of other skills, including semantics, phonology and reading (Law et al., 2015; de Bree and Kerkhoff, 2010; Carstairs-McCarthy, 2014). Furthermore, morphological awareness develops in a non-linear fashion (Casalis, Cole and Sopo, 2004); this is because levels of morphological complexity are not mastered simultaneously but according to their frequency and their utility in new tasks. Therefore, the apparent usefulness of phonological awareness (in comparison to the limited usefulness of morphological awareness) may be due to the implicit nature of phonological awareness which has enabled it to be a more productive skill in language and literacy development.

Furthermore, phonological awareness has been found to be the most reliable predictor of early reading development, whereas morphological awareness has been found to be more important for later reading development (Casalis, Cole and Sopo, 2004). Morphological awareness has also been found to be a stronger predictor of comprehension, whereas phonological awareness has been found to be a stronger predictor of word analysis (Carlisle, 1995). This implication may further suggest the more explicit nature of morphological awareness in comparison to phonological awareness. Phonological awareness appears to be a highly productive, base skill that enables individuals to further develop other skills, for example, improved phonological awareness allows for improved decoding and fluency which then enables the improvement of morphological awareness through reading (Law et al., 2015).

Item-type Differences

It was proposed and found that there would be several distinct levels within phonological and morphological awareness tasks that increase incrementally in requirements for explicit awareness. Furthermore, it was also theorised that there would be several item-type differences within these levels. Item-type differences were investigated in Chapter 7. It was found that all task item-types on the CAPPT were significantly different from each other (Table 57). Item-type differences were found between syllable number, unit size and orthographic structure for phonological tasks.

Table 57. *Item-type Difference in the CAPPT*

Measure	Level	Item-types
Nonword Repetition	Implicit	Two-Syllable
		Three-Syllable
Fluency	High	Rhyme (rime)
	Explicit	Alliteration (phoneme)
Phoneme Deletion	High	Initial Phoneme
	Explicit	Medial Phoneme
		Final Phoneme
Phoneme Substitution	High	Single-Letter
	Explicit	Digraph
Spoonerisms	High	Single-Letter
	Explicit	Digraph

Furthermore, in addition to phonological item-type differences, morphological item-type differences were found (Table 58). Item-type differences within morphological measures included morpheme type (e.g., inflectional vs derivational), novelty (e.g., pseudo- vs real-words), and lexical level (e.g., sub-lexical vs lexical). Overall the item-type analysis indicated the importance of also considering the item-types that are being used within phonological and morphological awareness tasks, as well as differences in implicit-to-explicit requirements.

Table 58. *Item-type Difference in the CAMPT*

Measure	Level	Item Types
Real Connections	Implicit	Inflection
		Transparent Derivation
		Opaque Derivation
Word Structure	Explicit	High-Frequency
		Low-Frequency
		Opaque
Morpheme Completion	Explicit	Real-word
		Pseudoword
DATMA	Explicit	Word
		Sentence

Moreover, these findings that show item-type differences have important implications, particularly for task selection and item development. This finding supported previous research that suggests there might be item-type differences between tasks (Tamburelli et al., 2012; Duncan et al., 2013; Marshall and Harcourt-Brown, 2009; Carlisle, Stone and Katz, 2001; Levesque, Kieffer and Deacon, 2017; and Pawlowska, Robinson and Seddoh, 2014).

To summarise, phonological and morphological awareness tasks were for the first time mapped onto continua that explain the difference in implicit-to-explicit understanding in order to complete them. This thesis successfully developed implicit-to-explicit continua for the phonological and morphological awareness tasks, and then evaluated these. Although, the factor analysis of the CAPPT and to a lesser extent the CAMPT has supported the idea of implicit and different levels of explicit tasks of phonological and morphological awareness essentially the trajectory Karmiloff-Smith (1992) presents is developmental in nature. Therefore, further evaluation should be attempted, through a longitudinal study where children's progression and performance could be mapped on to or compared against the continua in order for this theoretical framework to receive additional validation.

2. How will children with DLD-only, DLD/Dyslexia and typical controls compare on an extensive range of tasks that assess the implicit-to-explicit continua for phonological and morphological awareness?

Children with language only impairments often have a wide variety of other comorbid disorders, the most prominent is literacy difficulties with estimates varying from 12.5% to 85% for comorbidity (McArthur et al., 2000; Vandewalle et al., 2012). Chapter 6 outlined the between-group analysis that the current thesis undertook in order to begin to address the relationship between these disorders. The findings indicate that those with DLD-only have some areas of strength and some of weakness in their phonological awareness while being more wholly impaired in their morphological awareness. The results highlighted that for their phonological awareness the DLD-only group only had difficulties with their High Explicit phonological awareness and their rapid naming but performed in line with their typically developing peers for Low Explicit and Implicit phonological awareness tasks. This finding supported previous research that found that those with DLD-only were impaired on higher level phonological awareness tasks (Ramus et al., 2013; Messaoud-Galusi and Marshall, 2010; Nithart et al., 2009). However, it contradicts previous research suggesting that individuals with DLD only had good RAN skills (Bishop et al., 2009). Furthermore, those with DLD-only were also found to have impairments in their Explicit and Implicit CAMPT. This finding is unsurprising as morphological difficulties are the most pervasive area of difficulty for those with language impairments (Gardner et al. 2006; Krok and Leonard, 2015; Larsen and Nippold, 2007).

Indeed, those with DLD and literacy difficulties had a similar profile to those with language only difficulties, mainly being wholly impaired on morphological awareness tasks while only being impaired in some areas of phonological awareness tasks. Those with DLD and literacy difficulties had difficulties with High Explicit, Low Explicit and Naming CAPPT but did not have difficulties with Implicit CAPPT. Furthermore, individuals with DLD and literacy difficulties had difficulties with both Explicit and Implicit CAMPT. This finding supports previous research which indicates that those with language and literacy impairments are impaired in phonological awareness tasks (Joanisse et al., 2000; Vandewalle et al., 2013; de Groot, 2015). Furthermore, the Implicit CAMPT deficit found in the current thesis add further support to the implicit, procedural memory deficit that is suggested to be associated with the grammar deficits in individuals with DLD (Ullman, 2015; Hedenius et al., 2011), but this appears to be limited to their morphological awareness. Moreover, the findings of the current theory challenge the previous finding individuals with DLD may have enhanced explicit, declarative memory (Lukacs et al., 2017), as individuals with DLD were found to have impaired High Explicit phonological awareness and impaired Explicit morphological awareness.

Individuals with DLD-only and DLD and literacy difficulties only performed differently on measures of High Explicit and Low Explicit CAPPT; with the DLD-only group performing better than those with DLD and literacy difficulties. These results indicate that higher level phonological awareness difficulties could be what is contributing to the literacy difficulty in the comorbid group and highlight that strengths here allow individuals to avoid these additional literacy difficulties. Overall the findings of Chapter 6 indicate that those with DLD and literacy difficulties are more impaired than those with language only difficulties. Moreover, these results suggest that those with language difficulties are more impaired in their morphological than their phonological awareness and those with language and literacy impairments have greater difficulty with phonological awareness tasks. This finding supports previous research which indicates that those with language and literacy impairments are more impaired in their phonological awareness than their DLD-only peers (Nithart et al., 2009; Messaoud-Galusi and Marshall, 2010; and Ramus et al., 2013).

Chapter 7 also investigated between-group differences on item-type differences within tasks (Table 59). Although all tasks were found to have item-type differences, the groups did not perform differently on all tasks. Those with DLD-only performed in line with their typically developing peers for several High Explicit phonological awareness tasks: the fluency, phoneme deletion and spoonerism tasks.

This finding shows further areas of strength within the phonological profile of those with DLD-only.

Table 59. *Summary Table of Item-Type Results for CAPPT and CAMPT*

	CAPPT					CAMPT			
	NR	F	PD	PS	S	RC	WS	DC	DD
Item-type effect	√	√	√	√	√	√	√	√	√
Group effect	TD >DLD TD > DLD+		TD >DLD+	TD > DLD TD > DLD+	TD > DLD+	TD > DLD TD > DLD+	TD > DLD TD > DLD+		
Interaction effect					√				

Note: √ = p< .05; NR = nonword repetition; F = fluency; PD = phoneme deletion; S = spoonerism; RC = real connection; WS = word structure; DC = derivational comprehension; DD = DATMA.

For example, the result suggested that the DLD-only group were most impaired on the phoneme substitution tasks. This finding could suggest that the majority of their difficulty is here instead of the other aspects of the High Explicit factor. Moreover, the DLD-only group also performed in line with their typically developing peers for several morphological awareness tasks; the derivational comprehension and DATMA tasks. This finding shows areas of strength within the morphological profile of those with DLD-only; which is something the previous group-based analysis did not find.

Several new areas of strength were also found for those with DLD and literacy impairments. For phonological awareness tasks, a new strength was found in the fluency task whereas, for the morphological awareness tasks, new strengths were found for the derivational comprehension and DATMA tasks. The overall findings here mirror those outlined above; those with DLD and additional language impairments were more impaired, especially for phonological awareness tasks. This finding is supported by previous research which also found a similar pattern (Messaoud-Galusi and Marshall, 2010; Catts et al., 2005; Gardner et al., 2006; de Bree and Kerkhoff, 2010).

In order to address this research question further, hierarchical multiple regression was conducted (Chapter 6). For measures of language, only Explicit CAMPT was found to be a significant predictor. Morphological awareness is one of the critical underlying skills for language, so much, so it is seen as an essential area of assessment for those diagnosing DLD (Spaulding, Plante and Farinella, 2006). Therefore it is unsurprising that this is a significant predictor of either language measure. However, this was only found to be the case for Explicit CAMPT, as no significance was found for the Implicit measures; which suggests that Explicit CAMPT is more related to language than Implicit CAMPT. Although see earlier discussion in this Chapter, as by its nature morphological awareness may be more explicit as it develops later than phonological awareness and is intertwined not only with phonological awareness but also semantics and syntax. This could perhaps explain its emergence here as the significant predictor. Furthermore, it is possible that there was no single significant phonology predictor because there is significant common variance predicted by each of the phonology factor scores.

For reading only Explicit CAMPT and Naming CAPPT were the significant predictors. In typically developing populations, measures of phonological awareness usually are among the strongest predictors of reading (e.g. Kirby et al., 2012) and although morphological awareness has been found to predict reading (e.g. Bowers et al., 2014; Law et al., 2015) this is not usually as strong a predictor as phonological awareness. Therefore, this finding may indicate something unique about the sample, especially as just under 50% of the population had language difficulties and those with language difficulties have primary deficits in their morphological awareness (de Bree and Kerkhoff, 2010). This finding implies that for those with language impairments, their reading and language abilities are more reliant on their morphological awareness than their phonological awareness. There are however two alternative interpretations. First, this finding could be due to the increased predictive power morphological awareness gains as children get older (Kuo and Anderson, 2006; Nagy, Berninger and Abbott, 2006). Second, this finding may be again be due to significant common variance predicted by each of the phonology factor scores when summed together, but not when taken singularly.

In summary, research question two was addressed in Chapter 6 and Chapter 7, through group-based and item-type analysis. Those with DLD-only were found to have a profile of strengths and weaknesses in relation to their phonological awareness, sometimes struggling with higher level phonological awareness tasks. They were also found to be more wholly impaired in their morphological awareness. Those with DLD and literacy impairments had a similar profile as those with DLD-only have they experienced broader difficulties in the phonological awareness tasks. These results have implications for research and clinical practice, which are discussed in more detail later on in the Chapter.

3. Whether individual differences in literacy-level, nonverbal IQ and EAL status will affect performance on implicit-to-explicit continua for phonological and morphological awareness tasks for those with DLD or DLD with literacy difficulties?

In addition to comorbid literacy difficulties, individuals with language impairments often have low IQ and have English as an additional language (EAL) (Bishop et al., 2017). These overlaps make it harder for SLTs, teachers, parents and researchers to understand the precise area of difficulty an individual is having and furthermore decide the best intervention for these children. Furthermore, the recent replacement of SLI from the DSM-5 with the more general specifier of Language Disorder due to the controversies relating to these overlapping disorders and conditions has further added to the confusion. However, more recently a new term has evolved for children with unexplained language difficulties; Developmental Language Disorder (DLD). This term came to place after the work of RALLI (now

RADLD) which was led by Bishop et al. (2012) with the aim of raising awareness and clarity over language impairments.

In addition to the new term, this also led to new diagnostic criteria which are far more inclusive than those used for SLI. The diagnostic criteria now encompass those with literacy difficulties, low IQ and EAL, alongside other things. This is partly because it is now understood that those with pure, language-only impairments are the exception and not the rule (Bishop, 2014; Bishop et al., 2016). However, although these differences are now accepted as part of DLD, not much research has (yet) been conducted in order to explore low IQ and EAL and how this relates to the difficulties these individuals face. Therefore, little is known for how best to support those with non-pure language-only difficulties. In comparison to low IQ and EAL research, there is an abundance of research investigating literacy impairments in those with language difficulties. After the development and validation of the CAPPT and CAMPT, the next stage of the thesis was the use the newly developed and fine-grained assessment batteries in order to examine the profiles of children with or without language difficulties.

Chapter 6 outlined the between-group analysis that the current thesis undertook to address this research question (Table 60). The findings indicated that nonverbal IQ did impact the performance of those with DLD-only. It was found that when participants with low IQ were excluded the difficulties with High Explicit, and Naming CAPPT disappeared. Similarly, Ramus et al. (2013) found that five out of 13 of their DLD-only participants did not have a phonological deficit at all. They concluded that there might be a unique subtype of DLD without phonological impairments. The results of the current thesis also suggest this too; more precisely that those with low IQ and DLD experiencing greater difficulty with phonology. Furthermore, these results may show that those with DLD and average IQ may have enhanced explicit, declarative memory as suggested by Lukacs et al. (2017) however that this is limited to phonology. Although IQ impacted the profile of difficulty of those with DLD, EAL status did not affect the performance of those in the DLD-only group.

Table 60. *Comparison Table for Findings*

	CAPPT												CAMPT					
	High Explicit			Low Explicit			Implicit			Naming			Explicit			Implicit		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Liberal	✓	✓	✓							✓	✓		✓	✓		✓	✓	
	**	**								*	**		**	**		**	**	
Liberal IQ	✓	✓	✓			✓							✓	✓		✓	✓	
	**	**	**		**	**				*			**	*		**	**	
Liberal EAL		✓												✓			✓	
		**	**								*		**	**		**	**	
Classical		**	**		*	**			*				*			*	**	

Note. 1 indicates TD vs DLD-only; 2 indicates TD vs DLD+; 3 indicates DLD-only vs DLD+; ** indicates a large effect size (Cohens *d* > .8); * indicates a moderate effect size (Cohen's *d* > .5). ✓ indicates significant post-hoc results.

Moreover, the findings indicated that diagnostic criteria impacted the performance of those with DLD and literacy difficulties. It was found that when participants with EAL were excluded difficulties in rapid naming disappeared. This finding support Bishop et al. (2009) who also found that those with DLD-only did not have rapid naming difficulties. Additionally, when participants with low IQ were excluded difficulties in Low Explicit phonology disappeared.

In summary, research question three was addressed in Chapter 6 through group-based analysis. The profile of those with DLD-only appeared to change the most with the inclusion or exclusion of those with low IQ. Whereas, the profile of difficulty of those with DLD and literacy impairments appeared to change the most with the inclusion or exclusion of those with EAL. These results appear to explain potential differences and sub-groups of DLD that have been found in previous research (e.g., Ramus et al., 2013; Gardner et al., 2006). The findings of these results have implications for research and clinical practice.

Implications

Overall, there are three key findings from the current thesis; the CAPPT and CAMPT; DLD and literacy comorbidity; and DLD definitions. The implication of each of these different findings will be outlined and addressed here.

The Measurement of Phonological and Morphological Awareness

Phonological and morphological awareness are large, complex constructs that are vital for understanding the development of literacy and language (Elbro and Arnbak, 1996) and although some previous studies have investigated task differences, more recent research has suggested the need for further research here (i.e., Duncan et al., 2013; Critten et al., 2014). Therefore, the development and evaluation of the CAPPT and CAMPT, as outlined in Chapters 3-5, can partly fulfil this gap in the literature. Indeed, the results of the implicit-to-explicit continua have implications for researchers. The findings from this can be used to inform other studies and allow them to choose tasks with a more fine-grained understanding of what exactly it is they are measuring. This is equally true for those interested in typical development although in this thesis it has been applied to atypical development. In connection to the latter CAPPT and CAMPT can be used to make a comparison with the previous literature, particularly around instances of mixed findings where some studies found that individuals with DLD and/or literacy difficulties had difficulties with phonological (e.g. Nithart et al., 2012; Ramus et al., 2013; Bishop et al., 2009), however, others did not. The CAPPT and CAMPT will allow for exact comparisons to be made between studies, in terms of task requirements and therefore conclusions can be drawn over which tasks children may be struggling with more specifically and why.

In addition to these implications in research, the CAPPT and CAMPT also have implications in practice. For example, the fine-grained understanding of the differences in task requirements can be applied to allow clinicians and schools to have an increased understanding of the precise area of difficulty an individual is struggling with or locate any areas of strength. This will allow clinicians and schools to use more appropriate and precise interventions, perhaps with those that allow individuals to use the strengths they have to overcome their weaknesses. Not only will this be beneficial for the children themselves but could allow greater efficiency and better use of resources when selecting interventions to implement.

Moreover, implications can be drawn from the CAPPT and CAMPT for psychological theory. For example, although the findings from this thesis support the RR Model for implicit-to-explicit differences between phonological and morphological awareness tasks; they also outline key differences between implicit-to-explicit processing and awareness in these fields. Within phonological awareness measures, there was found to be two explicit levels of awareness, whereas within morphological measures only one was found. Furthermore, phonological awareness tasks were found to be, overall, more implicit perhaps because morphological awareness depends on phonological awareness, to a degree (Carstairs-McCarthy, 2014; de Bree and Kerkhoff, 2010). This may suggest that conceptualisation of phonological awareness is more suited to the framework of the RR Model than morphological awareness tasks. Furthermore, the most Implicit task of the CAPPT appeared to suit the requirements of the RR Model far better than the Implicit task of the CAMPT, which further suggests this point.

Furthermore, it should be acknowledged that we already know much more about phonological awareness than morphological awareness due to the greater wealth of research regarding the former. Indeed, some research on phonological awareness has already attempted to differentiate implicit-to-explicit phonological awareness differences (e.g. Gombert, 1992; Yopp, 1998; Roberts and McDougall, 2003; Ramus et al., 2013) and was used to inform the development of CAPPT. In contrast, CAMPT was much more difficult to develop as the morphological awareness had not yet been considered in this manner in the literature. This point further outlines the need for more research into morphological awareness, particularly that which attempts to differentiate the differing levels of cognitive requirements needed in order to complete the morphological awareness tasks.

A final point to make here echoes that from earlier in this Chapter that continued validation of the use of the RR framework in CAPPT and CAMPT is needed via longitudinal data.

DLD and Literacy Impairments

The findings of the current thesis have many research implications surrounding our understanding of DLD, DLD with additional literacy problems and DLD with low IQ or EAL status. Firstly, theoretical implications can be drawn from the contrasts between those with DLD-only and DLD with literacy difficulties. As outlined earlier in the thesis, the Multiple Deficits Model (Pennington, 2006; Marshall, 2009) outlines a multifactorial approach to the relationship between DLD and Dyslexia. *Figure 4* depicts the previously proposed model of the DLD and Dyslexia overlap. Overall, this model is trying to suggest that those with DLD and Dyslexia (literacy difficulties) have some crossover in their areas of difficulty within phonology and morphology. However, they also have some unique deficits.

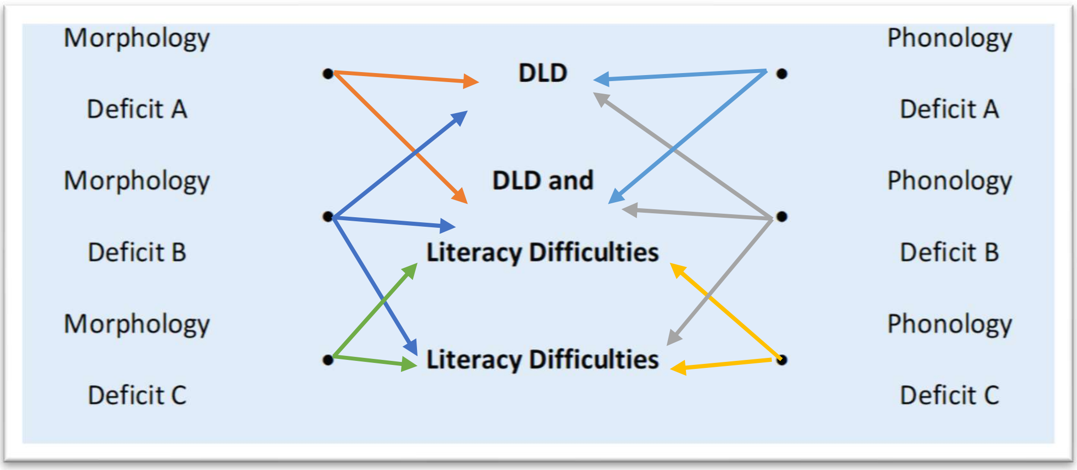

Figure 4. Proposed Model for DLD and Dyslexia's Overlap (revised from Marshal, 2009).

Figure 5 outlines the revised model of the DLD and literacy difficulties overlap, which also considers IQ and EAL status. The revised model now considers the findings of the current thesis. The figure shows that those with any iteration of DLD had the same morphological profile but had a different phonological profile. Those with DLD-only do not have any phonological deficits whereas the other iterations of DLD do have phonological deficits. Those with DLD and low IQ have High Explicit, Low Explicit and Naming CAPPT deficits. Those with DLD and EAL only had Naming CAPPT deficits. Finally, those with DLD and literacy difficulties have High Explicit and Low Explicit phonological deficits.

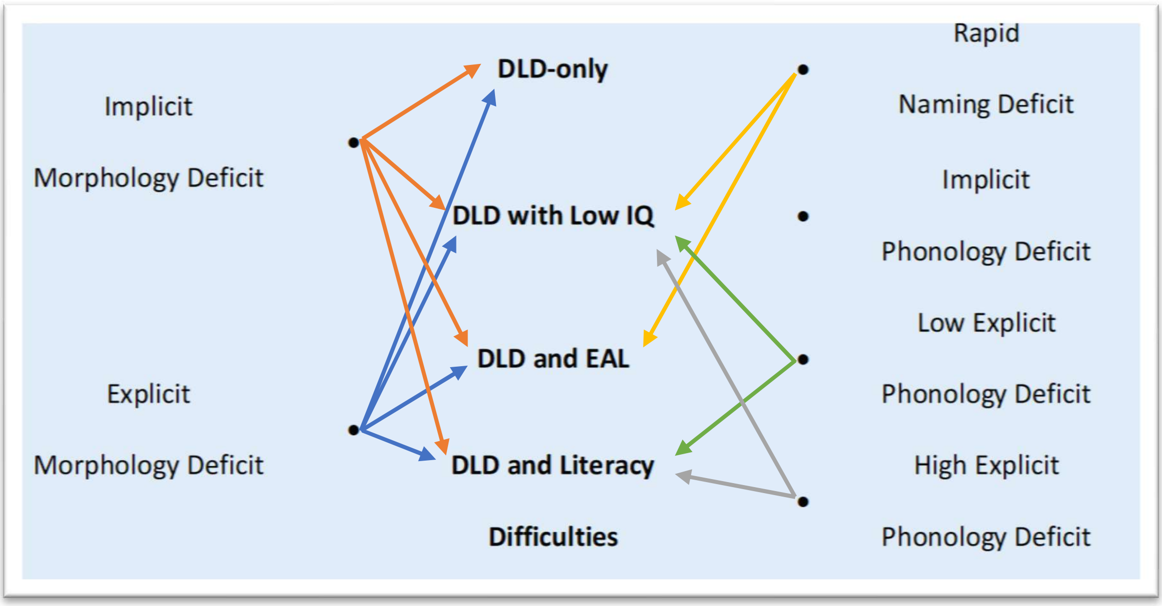

Figure 5. Revised Model Outlining DLD and Low IQ, EAL and Literacy Difficulties Overlap.

Furthermore, the results of the current thesis add to the recent debate surrounding the diagnostic criteria that should be used for DLD. Although previous definitions excluded those with potential ‘known’ causes for their language difficulties (i.e., EAL and low IQ) as having language difficulties, the new definition no longer excludes them (Bishop et al., 2016; Bishop et al., 2017). However, since this is a relatively new movement, a very limited amount of research has been conducted to examine any differences in the profile of strengths and difficulties the individuals may have. Therefore, the findings of the current thesis can add to this, suggesting that there are differences between the different subgroups of individuals who met this broad set of criteria.

The new definition of DLD is heterogeneous and broad and therefore when looked at as a whole, the types of difficulties these individuals face are also broad. The research undertaken as part of the current thesis suggests that the profile of those with DLD face depends somewhat on the diagnostic criteria applied; which, in turn, makes those broad deficits far narrower. Although the current thesis seeks to support the new definition, as language impairments are clearly pervasive regardless the background of the individual (IQ level, EAL status, literacy level) and therefore is only appropriate that those individuals receive support, it is clear that there are differences between these groups. Therefore, it is essential that those supporting individuals with DLD be aware of these potential differences, so that they can support them efficiently.

Limitations and Suggestions for Future

The Measurement of Phonological and Morphological Awareness

One potential limitation of the CAPPT and CAMPT is that these were only evaluated with a cross-section design; however the framework of the RR Model is fundamentally developmental. Therefore, in order to truly and completely assess the framework of the CAPPT and CAMPT a longitudinal study would need to be conducted. This study could be conducted with pre-school children following them until they were in their teenage years, particularly as there is evidence to suggest that both phonology and morphology are preliterate skills that develop in infancy (e.g. Anthony et al., 2003; Berko, 1958) and have continued importance throughout schooling (e.g. Berninger et al., 2009).

Further to this, another potential limitation is that these continua were developed only for oral language tasks. Therefore, although one would theorise that the framework of the continuum would still be valid in written language or reading-based tasks, this has not been empirically investigated. Furthermore, the continua were developed specifically for children in key stage two (aged six to eleven years old) and were only evaluated with this age range. Although it could be assumed that implicit-to-explicit development in phonology and morphology would be the same for children, teenagers or adults this has not been evaluated this way. Therefore, further research should investigate the continua in written language or reading based-tasks and with different age populations.

Furthermore, the analyses of the continua were based on a sample with nearly 50% of the participant having language impairments, and potentially this could have skewed the results of the factor analysis. For example, within the morphological awareness measures, only two factors were found, however for the phonological awareness measures four factors were found. This finding could have been impacted by the high proportion of those with language impairments in the sample, as their primary area of difficulty is morphological awareness and therefore their performance on morphological awareness tasks may have been more similar than those in typically developing populations. Particularly so, as those with language impairments were found to have similar impairments in both their Explicit and Implicit morphological awareness. Whereas participants with language impairments were found to perform more distinctively between phonological awareness tasks, and therefore this may have aided the finding of more factors in the CAPPT than the CAMPT. Furthermore, research should be conducted here, using a broad range of individuals to assess the continua.

Moreover, due to the limited availability of pre-existing, and standardised, oral, morphological awareness tasks the current study had to adapt several of its measures. Although this had several benefits, such as heightened control over the item-types, structure and content as well as between task item-balancing, this has some drawbacks. For example, no standardisation information was available for these tasks. Although the pilot study found these adaptations to have suitable internal reliability, far less is known about the reliability and validity of the adapted items.

Additionally, future research should be conducted using similar but different tasks to the current study in order to further validate the continuum. A task manipulation of this sort would genuinely assess whether the implicit-to-explicit framework is the correct explanation for the results of the factor analysis (Chapter 5). Furthermore, the implicit-to-explicit framework should be applied to other skills, such as semantics or syntax as these are the other vital areas of difficulties those with language impairments face and will, therefore, provide a more complete picture of the profile of those with DLD.

DLD and Literacy Impairments

The current study also attempted to recruit those with literacy-only difficulties but did not do so successfully. This is quite surprising given the relatively high population estimates for Dyslexia in school-age children (around 10%, Snowling and Bishop, 2004); especially as many of the students referred to the study were referred as having suspected Dyslexia. However, after working with over 70 children, none of them was found to have literacy-only difficulties (standard score of less than 85 on a single-word reading test). Indeed, many children were found to have literacy difficulties, but these were always found to be comorbid with language difficulties.

Furthermore, a large percentage of those referred to the thesis as 'Dyslexic' individuals were found to have normal reading ability but impaired language ability. Therefore, this finding may show that teachers and parents are perhaps less aware or less well equipped for diagnosis or to support language difficulties. This could also show that schools and parents are very well equipped at spotting and supporting literacy difficulties perhaps explaining why the children suspected of literacy difficulties (but without language difficulties) were able to achieve a standard score of at least 85 on the reading measure. Moreover, future research should look to investigate the profile of those with language-only, literacy-only and comorbid difficulties together in order to fully develop our understanding of the unusual comorbidity between those with language and literacy difficulties.

Furthermore, in order to thoroughly investigate the differences between those with language-only and language with low IQ or EAL studies should look to recruit a representative sample. This will enable us to get an accurate understanding of the prevalence percentages of those with other difficulties alongside their language difficulties. Moreover, this would give studies enough power to assess the profiles of those with language difficulties adequately. Moreover, although the current thesis attempted to explore English language deficits in those with English as an additional language, more research is needed to address this further. For example, the current study was not able to assess the individual's language ability in their first language or assess the amount of English that was used in the home to understand about familiarity in English. It would be useful if future studies could investigate both English and the first language of these individuals in order to understand if their difficulties are because of a genuine language processing deficit or more simply because of an insufficient language familiarity.

Summary and Conclusions

To summarise, in this thesis, there are several unique contributions to knowledge. The first contribution is the development and evaluation of the CAPPT and the CAMPT. This contribution has enhanced our understanding of how tasks vary, and the potential impact of these differences could. Furthermore, the contribution here enhances psychological theory, as an understanding of how the RR Model can be applied to phonological and morphological awareness tasks has been developed. The next contribution to knowledge is an enhanced understanding of the profile of strength and difficulty in relation to phonological and morphological awareness those with DLD and those with DLD and literacy difficulties have. This contribution was derived from the application of the CAPPT and the CAMPT. The final contribution of the current thesis is the impact of nonverbal IQ and EAL status on the profile of those with DLD and DLD with literacy difficulties. This contribution developed our understanding of the implications of the new, more inclusive definition of DLD.

Alongside these contributions, there are also two highly important implications. Firstly, the overall findings of this thesis outline that researchers need to consider more about the nature of the phonological and morphological awareness tasks they are using. Particularly, as differences in task demands can contribute to an individual's success or failure on a task. The CAPPT and the CAMPT have provided a framework for this. Secondly, the new inclusive definition of DLD should be welcomed as children irrespective of literacy level, IQ and EAL need to be supported when they have language difficulties. However, the challenge now for researchers and clinicians is to resist treating them as a homogenised whole as clearly the finding of this thesis would contradict this. There are different profiles and therefore need for different interventions. This thesis signifies the need for thorough assessment and measurement of skills to develop individually tailored interventions as clearly one size will not fit all.

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Appendices

Appendix A: Ethical Approval Certificate for Morphological Task Development Study

Certificate of Ethical Approval

Applicant:

Hannah-Leigh Nicholls

Project Title:

Language Development in Relation to Morphology and Phonology

This is to certify that the above named applicant has completed the Coventry University Ethical Approval process and their project has been confirmed and approved as Medium Risk

Date of approval:

18 May 2015

Project Reference Number:

P33374

Appendix B: Ethical Approval Certificate for DLD Study

Certificate of Ethical Approval

Applicant:

Hannah-Leigh Nicholls

Project Title:

Oral language profiles of individuals with SLI and/or dyslexia

This is to certify that the above named applicant has completed the Coventry University Ethical Approval process and their project has been confirmed and approved as Medium Risk

Date of approval:

02 June 2016

Project Reference Number:

P38580

Appendix C: Hierarchical Multiple Regression Results for Expressive Language

In the first step of hierarchical multiple regression, two predictors were entered: nonverbal IQ and age (in months). This model was statistically significant *F* (2, 67) = 5.129, *p* = .008 and explained 13.3 % of variance in ELI. Both nonverbal IQ and age factors made a significant unique contribution to the model (see Table 61). After entry of the CAPPT and CAMPT factors at Step 2, the total variance explained by the model as a whole was 51.1% (F (8, 61) = 7.976, p < .001). The introduction of the CAPPT and CAMPT explained additional 37.8% of variance in ELI, after controlling for nonverbal IQ and age (R^2 Change = .378; F (6, 61) = 7.873, p < .001). In the final adjusted model, two out of eight predictor variables were statistically significant, with age recording a higher Beta value (β = -.596, p < .001) than the High Explicit factor from the CAMPT (β = .487, p = .002).

Table 61. *Hierarchical Regression Model of Expressive Language*

		B	*SE*	*β*	*t*	*P*
Step 1						
	IQ	.206	.086	.273	2.402	.019
	Age	-.220	.105	-.239	-2.102	.039
Step 2						
	IQ	-.032	.085	-.042	-.375	.709
	Age	-.550	.101	-.596	-5.443	< .001
CAPPT	High Explicit	1.757	2.186	.121	.121	.425
	Low Explicit	-1.193	1.359	-.082	-.082	.383
	Implicit	.087	1.405	.006	.062	.951
	Naming	-1.586	1.495	-.109	-1.061	.293
CAMPT	Explicit	7.071	2.176	.487	3.249	.002
	Implicit	3.167	1.853	.218	1.709	.093