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Associated reading skills in children with a history of

Specific Language Impairment (SLI)

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Abstract

A large cohort of 200 11-year-old children with Specific Language Impairment (SLI) were assessed on basic reading accuracy and on reading comprehension as well as language tasks. Reading skills were examined descriptively and in relation to early language and literacy factors. Using stepwise regression analyses in which age and nonverbal IQ were controlled for, it was found that a single word reading measure taken at 7 years was unsurprisingly a strong predictor of the two different types of reading ability. However, even with this measure included, a receptive syntax task (TROG) entered when reading accuracy score was the DV. Furthermore, a test of expressive syntax / narrative (the Bus Story; Renfrew, 1991) and a receptive syntax task (Test for Reception of Grammar: TROG; Bishop, 1982) completed at 7 years entered into the model for word reading accuracy. When early reading accuracy was excluded from the analyses, early phonological skills (Goldman Fristoe Test of Articulation, 1986) also entered as a predictor of both reading accuracy and comprehension at 11 years. The group of children with a history of SLI were then divided into those with no literacy difficulties at 11 (those scoring above 1sd from mean on accuracy *and* comprehension) and those with some persisting literacy impairment (below 1sd on *either* accuracy or comprehension tasks). Using stepwise logistic regression, and again controlling for IQ and age, 7 year receptive syntax score (but not tests of phonology, expressive vocabulary or expressive syntax/narrative) entered as a positive predictor of membership of the 'no literacy problems' group regardless of whether early reading accuracy was controlled for in step one. The findings are discussed in relation to the overlap of SLI and dyslexia and the long term sequelae of language impairment.

Introduction

Accumulating evidence suggests that the population of children with Specific Language Impairment (SLI) as a whole have other associated difficulties especially as they get older. These include social and behavioural difficulties (Conti-Ramsden & Botting, 2004: Brinton et al, 2000) as well as non-verbal cognitive impairments (Hick et al, in press; Botting , 2005). However another strongly associated difficulty is that of reading impairments (Stothard et al, 1998; Snowling et al, 2000). The ability to read is a fundamentally important skill. Since most education is largely dependent on the ability to read, a deficit in this area is likely to cause wider disruption to learning for those with SLI.

Language and reading development

Learning to read has been shown to be strongly related to early language skills in typically developing populations, particularly phonological processing abilities (e.g. Goswami & Bryant, 1990). However, it is suggested that becoming a skilled reader depends on more than just phonological ability (Nation & Snowling, 1998). Reading has been described as the product of two interrelated but relatively independent skills, decoding and linguistic comprehension (Gough & Tunmer, 1986). Gough and Tunmer suggest that comprehension skills generally develop hand in hand with decoding skills: children with normally developing reading skills have adequate comprehension and decoding skills whereas globally poor readers have difficulty with both decoding and comprehension. Despite this, Oakhill, Cain and Bryant (2003) have shown that these are dissociable to some extent even in an ‘average’ reading ability group, and clinical groups also show that this separation of skills is possible.

The relationship between reading and SLI

Although some early studies describe children with SLI who appear not to show later reading problems (e.g. Richman, Stevenson & Graham, 1982; Silva, McGee & Williams, 1985), recent evidence increasingly suggests that children with SLI are likely to experience literacy problems (e.g. Catts, 1991; Catts et al., 2002; Conti-Ramsden, Donlan & Grove, 1992; Snowling et al., 2000) and children who have reading problems i.e. dyslexia , are likely to experience difficulties with oral language skills beyond the area of phonology (Joanisse et al., 2000; McArthur et al., 2000). Some researchers have even considered that dyslexia may be a less severe form of SLI characterized by the same phonological deficit (the “severity hypothesis”, Snowling et al., 2000) or that SLI may be a type of “dyslexia-plus” with the children with SLI showing similar phonological deficits as children with dyslexia but in addition exhibiting clear language difficulties beyond the area of phonology (Bishop & Snowling, 2004).

Thus, it is not surprising that the results of a number of studies suggest an association between reading skills and the language profiles of children with SLI. Some investigators have focused on global measures such as the severity of the language impairment. Thus, children’s level of performance on standardised tests of receptive and expressive language have been found to be closely associated with reading achievement (e.g., Bishop & Adams, 1990; Tallal, Dukette & Curtiss, 1989; Wilson & Risucci, 1988). Others have focused on specific aspects of language or have examined the cumulative effects of impairments in different areas of language functioning on reading ability. Tallal, Curtiss and Kaplan (1988) found that particular deficits in spoken language comprehension predict later reading difficulties in children with SLI.

This was thought to reflect limitations in overall language knowledge. In contrast, Bishop and Adams (1990) have emphasised the importance of language production measures. These researchers found MLU to be a good predictor of reading ability in children with SLI. Bishop and Adams also found that children with problems in vocabulary and/or syntax along with phonology were more likely to experience reading problems than those with phonological problems only. Furthermore, Bishop (2001) argues that the risk of developing literacy difficulties increases with the number of impaired language domains the child experiences, i.e., receptive language, expressive language and sound articulation. In this extensive twin study involving 8 year olds, Bishop found 29% of children with SLI who were impaired in one language domain had difficulties with reading, 72% of children with SLI who were in impaired in two language domains had difficulties reading and finally 89% of children with SLI who were impaired on all three domains had reading difficulties.

Thus, there is substantial evidence that children with SLI are likely to experience reading difficulties in school age. In addition, it appears that children with SLI who have severe impairments or impairments in more than one domain of language appear to be at higher risk of developing reading difficulties.

Different types of reading outcome

As mentioned earlier, the two main aspects to reading skill, reading accuracy and reading comprehension have been shown to be dissociated in the development of some atypical populations. For example, those with dyslexia, whose decoding/accuracy skills tend to be poorer than comprehension skills, (Bishop &

Snowling 2004) and poor comprehenders who (by definition) show average reading accuracy in the context of poor text comprehension (Cain & Oakhill, 1996).

These different reading outcomes may also show different rates of impairment in children with SLI. For example, compared to typically developing peers, reading comprehension scores may show more lag over time than accuracy scores (Snowling, Bishop and Stothard, 2000). Furthermore, these two facets of reading may be associated with different predictive factors in the SLI population. Catts (1993) for example, observed that phonological awareness and rapid naming predicted printed word recognition, whereas spoken language comprehension and production best predicted reading comprehension. Farmer (1996) also examined factors associated with later basic reading and reading comprehension in a sample of children with SLI and found that children who were successful in acquiring decoding skills were characterised by good short-term memory for sentences but difficulty with story telling. For reading comprehension, sentence recall was found to act as a good predictor, indicating that verbal short-term memory is an important factor, as well as story retelling suggesting that tasks that require expressive syntax may also influence or be influenced by reading comprehension outcomes in children with SLI. However, Farmer (1996) noted that the two variables did not combine to produce a better fit together. Thus, although research has begun to examine reading outcome in SLI in terms of earlier predictive skills, no clear picture emerges in the field as to the precise pattern of abilities relating to reading skills in the SLI population.

Studies have also described cases of children for whom literacy difficulties persist beyond language impairment. Stothard et al. (1998) and Snowling et al. (2000) found that 15-16 year old children whose language problems had resolved by age 5 ½ years did not differ from controls on tests of vocabulary and language comprehension but performed significantly less well on tests of phonological processing and literacy skill. These children's profiles over time suggest an "illusory recovery" (Scarborough & Dobrich, 1990) of their language skills during middle childhood. It is likely to be the case that these children continue to have subtle language deficits and these become more apparent later in development in that they influence the ability of adolescents with a history of SLI to perform age appropriately in tasks involving reading (both decoding and comprehension). Thus, the developmental course of SLI, and particularly the apparent 'widening' of impairment, is not yet clear. It is therefore particularly interesting to examine the earlier language profiles (rather than the concurrent language) of children with a history of SLI, in relation to their literacy skills.

The Present Study

With the above in mind, the present study examines the associated literacy abilities of children with a history of SLI as they prepare to start secondary education. The study specifically aims to explore:

1) The proportion of children experiencing difficulties with reading accuracy and with reading comprehension at 11 years of age.
2) The relationship between 7 and 11 year old reading skill.
3) Which early language skills (if any) predict reading accuracy and reading comprehension outcome.
4) The number of children with no apparent literacy impairment at age 11 and the 7 year old factors which best predict membership of this group.

Method

Participants

The participants were originally part of a wider study: the Conti-Ramsden Manchester Language Study (Conti-Ramsden & Botting, 1999a, 1999b; Conti-Ramsden, Crutchley & Botting, 1997). This original cohort was recruited from 118 language units attached to English mainstream schools identified through the ICAN listing (1994); a comprehensive list of all specialist language placements in the UK. All language units in England catering for year 2 children were contacted and any centres enrolling children with global delay or hearing impairments were excluded. The remaining language units were asked to provide the number of year 2 children attending for at least 50 percent of the week. It was established that across England approximately 500 children fitted these criteria. All language units enrolling year 2 children were asked to participate and two schools declined this invitation. Subsequently, approximately half of the eligible children in each unit were sampled. A random selection procedure resulted in an initial randomised study cohort of 242 children. The age range was 7;5 years to 8;9 years and consisted of 186 males and 56 females (females forming 23.1 percent of the cohort). The age range was slightly wider than expected as it included some children who had been kept back one school year.

This initial cohort was re-assessed in the final year of primary education (year 6). Twelve children could not be traced and for thirty children parental consent was not given to take part at this stage. The remaining 200 children participated in the study. The age range at this stage was 10;1 years to 11;10 years and consisted of 150 males and 50 females (females forming 25% of the total). This sample represented 83% of the initial cohort studied by Conti-Ramsden and colleagues. Table 1 below presents the 11 year language and IQ characteristics of the children in the present study.

table 1 about here

Measures

Measures in this study were taken at 2 time points: 7 years and 11 years. Since the tests used at 11 years are not central variables in the aims of this study, brief descriptions only are included here. Scores from the 11 year stage are presented in Table 1 to illustrate the clinical nature of the group. They are also included in basic correlations with reading later in the Results section. However the main emphasis of the article focuses on the early predictors of later reading and thus the measures at 7 years are described more fully. Key reading outcome tasks from 11 years of age are described last.

7 year measures

Ravens Coloured Matrices (Raven, 1986)

This assessment presents children with a series of patterns from which a 'piece' is 'missing'. The child is instructed to look at the pattern and select (from six alternative 'pieces' printed below the pattern) the one and only piece that can complete the pattern.

Test for Reception of Grammar (TROG; Bishop, 1982)

This is a multiple-choice test designed to assess oral comprehension of syntax. The child is shown four pictures while a sentence is read aloud by the examiner. The child is then required to select the picture that is represented by the sentence. Sentences begin simply and progress to more complex grammatical structures. The items cover a range of grammatical knowledge and responses are scored as correct or incorrect. Raw scores are transformed into age-adjusted centile ranges. For ease of statistical comparison, in the present study these ranges were transformed further into centile midpoints for that range.

The Bus Story Test (Renfrew, 1991).

In this assessment, the examiner tells the child a short story about a bus while the child looks through a book of pictures illustrating the story. The child must then retell the story as accurately as possible using only the pictures as cues. Stories are audiotaped, transcribed and scored for the amount of correct information given. Two points are given for information central to the story, and one point for peripheral details. The total "information score" is then compared to age-relevant population norms and a centile range is assigned. In this study, ranges were transformed into mid-point centiles, as for the TROG assessment.

Naming vocabulary subtest of the British Ability Scales (BAS, Elliot, 1983).

In this test children are asked to name a series of pictures of everyday objects. Responses are scored as correct or incorrect, and testing is discontinued after the child has named 5 items incorrectly. The number of correct answers is summed and a centile for age recorded.

Goldman-Fristoe Test of Articulation (GFAT, Goldman and Fristoe, 1986).

Children are asked to name a series of pictures of everyday items. Children may be given clues to the name of the object, but not to pronunciation. Responses are scored as correctly or incorrectly pronounced. The number of errors is totalled, and a centile score for age and gender recorded. In this study, three allowances were made for all children to account for regional variation. These were the use of [v] in "feather"(plate 20), and of [f] in "bath" (plate 23) and in "thumb" (plate 24). This test is referred to throughout as a test of phonology because clinically it requires both phonological and articulatory skills to score and does not separate these two facets of the task. In our sample, children with pure physical articulatory difficulties were excluded.

British Ability Scales: word reading (BAS-wr: Elliot ,1983)

Children are presented with a list of single words and asked to read them aloud. This assessment measures only single word sight-reading. As with the WORD-basic reading accuracy, it is not designed to assess reading comprehension or fluency.

<u>11 year measures</u>

Past tense task (Marchman, Wulfeck and Ellis-Weismer, 1999) – An expressive task designed to measure knowledge of past tense forms, randomized for regularity and phonological similarity.

Test for Reception of Grammar (TROG; Bishop, 1982) – as above

Expressive Vocabulary Test (EVT; Williams, 1997) – An expressive vocabulary test in which children name a picture, action or quality from a picture and an oral prompt.

British Picture Vocabulary Scale-II (BPVS II; Dunn et al, 1998)- An oral receptive vocabulary test in which children indicate which picture of four given best matches an orally presented word.

Short form Wechsler Intelligence Scale for Children-III: Picture Completion subtest and Block Design subtest (PIQ, WISC-III; Wechsler, 1992). This performance 'short form' has been found to correlate well with the full IQ battery and has been used in other studies of cognitive ability and language (e.g. Sattler, 1974; Hohnen & Stevenson, 1999).

Key outcome tasks: 11 year reading

Wechsler Objective Reading Dimensions: basic reading subscale (WORD; Wechsler, 1993).

Basic reading

The child is required to read aloud a series of printed words out of context to assess word-reading ability. The test has a split-half reliability of .94 for children aged 11 years.

Reading comprehension

This is a series of printed passages and orally presented questions designed to tap skills such as recognising stated detail and making inferences. The child reads a passage and is then verbally asked a question by the tester. Performance on this task is in part linked to reading ability as there is no correction for word reading errors. The test has a split-half reliability of .90 for children aged 11 years.

For the tests of reading and IQ described above, each child gets a standard score where 100 is the population mean with a standard deviation of 15. Thus scores below 85 are considered below the normal range. For language tasks, standard scores are in the form of a centile score for age where 50 is the population mean and 15.9 is roughly equivalent to 1SD below this mean. Centiles are continuous variables.

Results

Continuous standard or centile scores have been used in all analyses in the results sections. Table 2 shows the mean standard scores for the cohort on WORD basic reading and reading comprehension subtests at age 11 years, and the number of children falling below 16th centile (<1SD on each task). As can be seen the majority of children with a history of language impairment also have reading difficulties at 11 years of age. Furthermore around a quarter have scores that fall below 2SD on reading accuracy (41/199; 21%) and reading comprehension (52/196; 27%).

Table 2 about here

Relationship between concurrent measures of reading and between reading and concurrent language / cognition scores

Unsurprisingly, reading accuracy and reading comprehension scores were found to relate highly to one another (Pearson's r= 0.78, p<0.001). They were also found to relate to concurrent language scores (see table 3) and less strongly to concurrent performance IQ (Accuracy: Pearson's r=0.30, p<0.001; Comprehension: Pearson's r=0.36, p<0.001).

Table 3 about here

Stability of reading ability over time

Single word reading accuracy assessed at 7 years of age was found to be highly correlated with both types of reading outcome at 11 (Pearson's r=0.68, p<0.001; and r=0.60, p<0.001, respectively). In total, 82% (98/119) of poor word readers at 7 years also had poor reading accuracy at 11 years compared to 45% (36/80) of normal range readers at 7 years (McNemar exact p=0.06) and 91% (108/119) had poor reading comprehension outcome compared to 60% (48/80) of normal range readers at 7 years (McNemar exact $p<0.001$). See table 3 for a full correlation matrix of language, cognition and reading scores from 7 and 11 years of age.

Predictors of reading outcome at 11 years old from 7 years of age

A series of multiple regression analyses were then undertaken to examine the relative association of various factors. As can be seen from table 3, high co-linearity (defined as correlations of >0.7, see Tabachnick and Fidell, 1996) was not evident among tests. Only reading accuracy and reading comprehension at 11 years, which act as DV's in subsequent analysis correlated to this extent. Furthermore, stepwise procedures were used to address the moderate co-linearity of between 0.6 and 0.7 seen in 3 other correlations.

Separate regressions were performed first with reading accuracy and then with reading comprehension as the DV. We wanted to perform systematic, uniform analyses across dependent variables and so used the same independent variables in all procedures, even though post-hoc the covariates were not always proven to be non-significant predictors. Note from Table 3 that all IVs used had a significant bivariate relationship with reading outcome variables. In a first block, 'age', and 'non-verbal IQ at 7' were entered as covariates along with 'reading accuracy at 7 years of age'. In the second block, 7 year language measures of phonology (GFAT), receptive syntax (TROG), expressive language (Bus Story) and expressive vocabulary (BAS-NV) were examined using a stepwise method.

For reading accuracy at 11 years, the only language measure that entered at stage 2 (the stepwise part) of the model was the TROG. For reading comprehension, both expressive and receptive syntax (Bus Story and TROG) entered (in that order) as making significant unique contributions to outcome at 11. The total models explained a substantial part of the variance in outcome (Adj. R Square = 0.54 and 0.51 respectively).

Because reading accuracy at 7 was highly correlated with the DV's and measured the same skill over time, the analyses were then also repeated without this covariate. In this analysis, when reading accuracy was the DV, both receptive syntax (TROG) and phonology (GFAT) entered into the stepwise stage of the model. When reading comprehension was the DV in this analysis, expressive and receptive syntax and phonology entered (in that order) as significant associates. These models, as expected without reading accuracy at 7, explained less (but still significant proportions) of the overall variance in reading accuracy (Adj. R Square = 0.21) and comprehension (Adj. R Square = 0.29) at 11. See tables 4 and 5 for full regression details for accuracy and comprehension respectively.

Tables 4 and 5 about here

We also performed separate logistic regression analyses to predict children who had poor comprehension (<1SD; regardless of reading accuracy) and another to examine predictors of being a child with poor reading accuracy (<1SD; regardless of reading comprehension skill). Not surprisingly, results exactly mirrored the linear regressions, with receptive syntax entering the model when reading accuracy cut-offs were used, and expressive and receptive syntax and phonology entering the model predicting those with low reading comprehension scores. See tables 6 and 7 for details.

Tables 6 and 7 about here

Competent readers

The next analysis sought to identify children from the sample who, at 11 years of age, had neither reading accuracy nor reading comprehension scores outside the normal range (1SD). These children are referred to here as ‘competent readers’ (although we acknowledge there may be other aspects of reading not measured here, such as fluency). Two logistic regressions were performed to examine whether any of the early measures could predict competent reader outcome. As with the linear regressions, the first analyses entered non-verbal IQ at 7 and 11, age and early reading accuracy in a first block, followed by 7 year language measures in a second stepwise step. The second analyses did not include early reading accuracy. In both cases, TROG at 7 was the only language measure that entered into the model after controlling for the factors in step 1. The total models both accounted for substantial amounts of variance (Nagelkerke r-square=0.61 and 0.40 respectively). See table 8 for full logistic regression details.

Table 8 about here

Discussion

This study addresses an important question: whether selective or joint impairment of language comprehension and production in SLI at an early age, is associated with outcome in literacy skills at 11 years of age. The results of the present study clearly show that even when IQ, age and early reading accuracy are controlled for, language skills at 7 have an important predictive contribution to reading skills at 11 years.

Interestingly, the present investigation shows that tests involving structural aspects of language/syntax, both expressive and receptive, are the most implicated in this association. Tests of expressive vocabulary showed little relationship with later reading of either type. A test of phonology administered at 7 years did show associations with both reading accuracy and comprehension at 7 years, but only when early reading accuracy was not included in the analysis.

At the same time, it must be noted that regardless of relative language ability, this population of children are at very great risk of reading impairment as they approach high school age: 80% of our participants showed reading comprehension difficulties. The minority of 'competent readers' in our group were therefore of particular interest. Along with early reading accuracy and non-verbal IQ, higher 7 year sentence level oral comprehension (as represented by the TROG) was again shown to be a significant predictor of this outcome.

Language skills and reading ability

A number of studies have shown an association between oral language skills and reading comprehension. Like the present study, Tallal, Curtiss and Kaplan (1988) and Wilson and Risucci (1988) found that spoken language comprehension deficits predicted later reading difficulties in children with SLI. However, although our results are in line with this conclusion, the present study indicates that early expressive language skills also show associations with later reading comprehension ability and thus also supports studies in which MLU has been found to be a predictor of reading ability in children with SLI (e.g. Bishop & Adams, 1990). Unexpectedly, in the present study early oral vocabulary score was not a predictor of reading outcome, whilst a task of phonology was predictive in this way. This may be because the naming vocabulary task used requires the production of each word, and therefore assesses cognitive accessibility to, and physical articulation of vocabulary as well as vocabulary knowledge per se – skills which may be particularly confounded in an SLI population. However, vocabulary and phonology at 7 were not strongly correlated (0.20). The predictive role of early phonological skill and reading accuracy was more expected and has been documented to be similar in individuals with SLI and dyslexia (Carroll and Snowling, 2004). It is interesting to note that here it also entered into the models for reading comprehension at 11, but this was only when early reading accuracy was not used in the analyses and thus, we suspect this may be acting as a 'proxy' for early decoding skill. However, again the bivariate correlation between early reading accuracy and phonology was moderate but not strong (0.35). In future research, early tests of receptive vocabulary which were not available here, would be an interesting potential predictor. Indeed, concurrent vocabulary knowledge (BPVS) did show a clear association with reading comprehension skill (r=0.54).

It should be noted that the reading comprehension test used in the present study also requires an expressive response from the child in the form of a verbal response to a question once the paragraph has been read by the child. This particular comprehension task therefore carried a clear expressive load. Thus, children with expressive difficulties at an earlier age may have been expected to show difficulties with this task. It would be interesting for future research to compare such responses against a comprehension task that does not require a verbal response.

Furthermore, Bishop (1997) suggests that, as comprehension is multifaceted and involves a host of subskills, it is not possible to summarise a child's 'receptive language level' in terms of a score on a single test, such as the TROG. Indeed, it is possible that impairment of comprehension may be missed due, in part, to the considerable variation in the type of receptive language difficulties. However this is less likely in children of younger ages, and in the present study the TROG was the single most powerful language predictor of reading ability when all analyses are considered.

<u>IQ and other cognitive processes</u>

It was interesting to find any group within this sample of children with severe and persistent SLI whose reading was 'competent'. Early skills in receptive language as measured by the TROG seem to go some way to predicting this outcome. But early IQ scores also showed a significant relationship with outcome. It may be important to note that although about half the cohort showed a decline from normal range IQ (>85) at 7 years to IQ below 85 at 11 years, only one child of the 33 competent readers showed this pattern. The majority of the children in this group therefore had consistently normal range PIQ's over time (although nearly all showed a decline of some degree within this range see Botting, 2005) and nearly half of the competent readers (14/33;42%) also had language profiles which suggested their language difficulties may have been resolved. In part this supports Snowling et al's (2000) finding that PIQ may act as a protective factor for later reading accuracy skill, but here also seems to apply to reading comprehension outcome.

This leads us to question which underlying or 'higher' processes might also be impacting in this way. Unfortunately, no direct measures of more specific cognitive processes such as working memory or inference were included at the 7 year stage of the study, and thus their predictive status cannot be assessed. Other studies however (e.g., Cain, Oakhill & Bryant, 2004) have shown that skills such as these do play a role in text comprehension even when verbal skills have been controlled for. It may be that in the present study, the narrative Bus Story re-telling task – an assessment that involves a number of different processes as well as language - is in part acting as a proxy for more executive cognitive skills. Notably, Farmer (1996) also found this test to be predictive of reading outcome.

<u>Pervasiveness of clinical levels of reading impairment and stability over time</u>

Reading impairment was still clearly a problem for this sample of children with a history of SLI, 83% of whom showed a depressed score (<1SD) on either reading accuracy or reading comprehension at 11 years of age. The present study also indicates that in those with SLI, reading impairment at the beginning of primary schooling is likely to be persistent at least until age 11 years. Whilst poor early reading accuracy predicted the difficulties of some of these children (73%), the level of overall accuracy was not satisfactory in clinical screening terms. It is not the case that reading skills at 7 were showing a ‘lag’ because of delayed language, that would eventually spurt and make up ground in literacy skill. To the contrary, the fact that verbal language skills showed a contribution to reading outcomes even when reading accuracy at 7 was controlled for, suggests that there is an additive effect over time of poor verbal and poor decoding skills on reading comprehension. It also implies that these two skills do not entirely overlap, at least in early literacy development.

Dyslexia and SLI: what is the nature of the overlap?

The present study was not designed to address this question directly. However, given the recent theoretical and clinical emphasis placed on this diagnosis overlap (Bishop and Snowling, 2004) it is of course of interest to note how many children in the present study show a pattern of literacy impairment that is very similar to those primarily identified as having dyslexia. Because of the nature of recruitment for the wider study (i.e., attendance in a language unit), none of the children in this sample were identified as having primary literacy difficulties before language impairment was recorded. In addition, they represent a particular SLI group (one that required special education for language) and it is therefore also unlikely that other children with such obvious language deficits would be initially described as dyslexic. However, as the language skills of the population improve, or become more hidden in the mainstream classroom, the difficulties of this group and of groups with less severe language impairment might look characteristically dyslexic in nature.

Recent research has highlighted this overlap, not only in the incidence of reading difficulties experienced by those with SLI but also in the language impairments revealed when those with dyslexia are assessed on similar measures (e.g., McArthur et al, 2000). Whilst some researchers have considered whether SLI and dyslexia might be on the same continuum and whether dyslexia may be a milder form of SLI (Bishop & Snowling, 2004; Snowling et al., 2000), it may be interesting to consider the position where the language difficulties have a central role in both SLI and dyslexia , thus, individuals with dyslexia may in fact have a form of “SLI-plus”. Despite this potential ‘continuum’, Bishop and Snowling (2004) and Snowling et al. (2000) provide substantial evidence to suggest that a uni-dimensional model is not likely to be sufficient to explain the overlap. That is, a simple severity hypothesis is not supported by the data currently available: SLI and dyslexia appear to show a different pattern of development of skills in which the former group tends to show increasing reading deficits, whereas in the latter group, some compensation is often possible and reading comprehension remains better than decoding skills. The present findings support this position in that the incidence of reading difficulty showed both an increase over time (accuracy: from 60% to 67% falling below 1sd) and also a higher incidence of reading comprehension difficulties (80% vs 67%).

Concluding remarks

Overall, the present study indicates that children with SLI at 11 years also demonstrate significant reading problems. It is of clinical and theoretical interest to identify the developmental pathway from which these difficulties stem, and the findings reported here suggest that poor structural knowledge of language (both expression as measured by retelling a narrative and comprehension as measured by sentence understanding) are important risk factors when identifying poor readers from the population of children with SLI at 11 years of age. Conversely, high PIQ and good receptive language may act as protective factors for children who at least appear to be competent readers at 11 years. It would be interesting to assess whether interventions specifically aimed at structural language skills, or indeed at higher level processes as other studies suggest are involved, also improve later reading outcome in the way vocabulary instruction has been shown to (Stahl & Fairbanks, 1986). We have suggested that whilst the pattern of literacy difficulty in SLI overlaps with that seen in dyslexia in some respects, further research is required to establish the complex co-morbidity of these two disorders. Prospective developmental studies combining language, cognition and literacy are likely to be able to further address this important question.

Table 1. Descriptive language characteristics of the participants at 11 years of age

	Mean (SD)
Age	131.3 (5.3) months
Past tense task	19.7 (27.9) Centile
TROG	28.7 (29.1) Centile
EVT	72.6 (16.2)
BPVS	83.8 (12.8)
WISC PIQ	86.3 (23.6)

Note: standard scores provided unless specified

Table 2. Reading test standard scores for age at 11 years of age

	Mean (SD) Standard score for age	Number (%) falling below 1sd from mean for age
Reading accuracy	81.4 (14.5)	134/199 (67%)
Reading comprehension	75.4 (13.8)	156/196 (80%)

Table 3: Correlations between reading outcome and concurrent language tests at 11 years of age

	GFAT 7	Bus Story	TROG 7	BAS NV 7	NVIQ 7	BAS WR	EVT 11	BPVS 11	PTT 11	TROG 11	NVIQ 11	Read acc
Bus Story	0.15											
TROG 7	0.11	0.53										
BAS NV	0.20	0.36	0.40									
NVIQ 7	0.28	0.39	0.40	0.25								
BAS WR	0.35	0.14	0.20	0.26	0.28							
EVT 11	0.27	0.45	0.48	0.42	0.37	0.35						
BPVS 11	0.26	0.43	0.51	0.46	0.31	0.42	0.63					
PTT 11	0.24	0.43	0.41	0.29	0.34	0.37	0.44	0.43				
TROG 11	0.14	0.47	0.52	0.36	0.34	0.19	0.50	0.46	0.56			
NVIQ 11	0.22	0.38	0.37	0.24	0.63	0.22	0.53	0.40	0.44	0.44		
Read. acc	0.32	0.24	0.35	0.25	0.28	0.68	0.43	0.43	0.52	0.42	0.30	
Read. cmp	0.26	0.41	0.47	0.33	0.36	0.60	0.58	0.54	0.59	0.51	0.36	0.78

N.B.: All but (TROG7 and GFAT7) and (TROG11 and GFAT7) are statistically significant at $p<0.05$

Table 4: Multiple regression tables for reading accuracy outcome

DV=Reading accuracy at 11 (Reading accuracy at 7 included)

Final model: F(4,179)= 54.6, p<0.001.

		B(SE)	Beta	Sig.
Block 1	Age	0.43 (0.14)	0.15	0.003
(Enter)	Non verbal IQ at 7	0.04 (0.06)	0.04	0.53
	Reading accuracy at 7	0.45 (0.04)	0.66	<0.001
Block 2	Entered:			
(Stepwise)	TROG at 7	0.16 (0.04)	0.22	<0.001
	Excluded:			
	Bus Story at 7			0.09
	GFAT at 7			0.22
	Naming Vocabulary at 7			0.46

DV=Reading accuracy at 11 (WITHOUT Reading accuracy at 7)

Final model: F(4,179)=12.9, p<0.001

		B(SE)	Beta	Sig.
Block 1	Age	0.14 (0.18)	0.05	0.45
(Enter)	Non verbal IQ at 7	0.11 (0.07)	0.11	0.13
Block 2	Entered:			
(Stepwise)	TROG at 7	0.20 (0.05)	0.28	<0.001
	GFAT at 7	0.11 (0.03)	0.26	<0.001
	Excluded:			
	Bus Story at 7			0.29
	Naming Vocabulary at 7			0.12

Table 5: Multiple regression tables for reading comprehension

DV=Reading comprehension at 11 (Reading accuracy at 7 included)

Final model: F(5,175)=37.8, p<0.001.

		B(SE)	Beta	Sig.
Block 1	Age	0.10 (0.15)	0.04	0.49
(Enter)	Non verbal IQ at 7	0.03 (0.06)	0.04	0.57
	Reading accuracy at 7	0.34 (0.04)	0.51	<0.001
Block 2	Entered:			
(Stepwise)	Bus Story at 7	0.17 (0.05)	0.23	0.001
	TROG at 7	0.15 (0.04)	0.23	0.001
	Excluded:			
	GFAT at 7			0.75
	Naming Vocabulary at 7			0.35

DV=Reading comprehension at 11 (WITHOUT Reading accuracy at 7)

Final model: F(5,175) =15.74, p<0.001

		B(SE)	Beta	Sig.
Block 1	Age	-0.09 (0.17)	-0.03	0.60
(Enter)	Non verbal IQ at 7	0.11 (0.07)	0.11	0.12
Block 2	Entered:			
(Stepwise)	TROG at 7	0.19 (0.05)	0.28	<0.001
	Bus Story at 7	0.17 (0.06)	0.22	0.004
	GFAT at 7	0.07 (0.03)	0.17	0.01
	Excluded:			
	Naming Vocabulary at 7			0.10

Table 6: Logistic regressions for low reading accuracy (final model)

DV= Reading accuracy <1sd at 11 (Reading accuracy at 7 included)

Final adjusted r-square (Nagelkerke) =0.48

	Variable	Beta	SE	Exp(B)	p-value
Entered as	Age	-0.14	0.05	0.87	0.002
Covariates	Nonverbal IQ at 7 years	-0.002	0.02	0.88	0.99
Block 1	Reading accuracy at 7	-0.08	0.01	0.92	<0.001
Entered stepwise Block 2	TROG at 7 years	-0.03	0.01	0.97	0.006
Not	Bus Story at 7 years				0.26
entered	BAS Naming Vocabulary at 7				0.18
	GFAT at 7 years				0.49

DV= Reading accuracy <1sd at 11 (WITHOUT Reading accuracy at 7)

Final adjusted r-square (Nagelkerke) =0.19

	Variable	Beta	SE	Exp(B)	p-value
Entered as	Age	-0.06	0.03	0.95	0.10
Covariates	Nonverbal IQ at 7 years	-0.02	0.01	0.98	0.16
Block 1					
Entered	BAS Naming Vocabulary at 7	-0.02	0.01	0.98	0.02
stepwise	TROG at 7 years	-0.02	0.01	0.98	0.02
Block 2					
Not	Bus Story at 7 years				0.82
entered	GFAT at 7 years				0.19

Table 7: Logistic regressions for low reading comprehension (final model)

DV= Reading comprehension <1sd at 11 (Reading accuracy at 7 included)

Final adjusted r-square (Nagelkerke) =0.67

	Variable	Beta	SE	Exp(B)	p-value
Entered as Covariates Block 1	Age	-0.003	0.06	0.99	0.96
	Nonverbal IQ at 7 years	-0.09	0.03	0.91	0.001
	Reading accuracy at 7	-0.09	0.02	0.92	<0.001
Entered stepwise Block 2	Bus Story at 7 years	-0.04	0.02	0.96	0.009
	TROG at 7 years	-0.03	0.01	0.97	0.04
	GFAT at 7 years	0.02	0.01	1.02	0.05
Not entered	BAS Naming Vocabulary at 7				.461

DV= Reading comprehension <1sd at 11 (WITHOUT Reading accuracy at 7)

Final adjusted r-square (Nagelkerke) =0.42

	Variable	Beta	SE	Exp(B)	p-value
Entered as Covariates Block 1	Age	0.03	0.05	1.03	0.47
	Nonverbal IQ at 7 years	-0.10	0.02	0.90	<0.001
Entered stepwise Block 2	TROG at 7 years	-0.03	0.01	0.97	0.001
Not entered	Bus Story at 7				0.07
	BAS Naming Vocabulary at 7				0.10
	GFAT at 7				0.87

Table 8: Logistic regressions for ‘competent readers’ (final model)

(Reading accuracy at 7 included)

Final adjusted r-square (Nagelkerke) =0.61

	Variable	Beta	SE	Exp(B)	p-value
Entered as Covariates Block 1	Age	0.01	0.05	1.01	0.92
	Non verbal IQ at 7	0.08	0.03	1.08	0.004
	Reading accuracy at 7	0.07	0.01	1.07	<0.001
Entered stepwise Block 2	TROG at 7 years	0.04	0.01	1.04	0.001
Not entered	Bus Story at 7 years				0.06
	GFAT at 7 years				0.07
	BAS Naming Vocabulary at 7				0.28

(WITHOUT Reading accuracy at 7)

Final adjusted r-square (Nagelkerke) =0.39

	Variable	Beta	SE	Exp(B)	p-value
Entered as Covariates Block 1	Age	-0.003	0.05	0.99	0.95
	Nonverbal IQ at 7 years	0.10	0.03	1.10	<0.001
Entered stepwise Block 2	TROG at 7 years	0.04	0.01	1.04	0.001
Not entered	BAS Naming Vocabulary at 7				0.07
	GFAT at 7 years				0.99
	Bus Story at 7 years				0.37

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