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# The development of the Grammar and Phonology Screening (GAPS) test to assess key markers of specific language and literacy difficulties in young children

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**Abstract**

*Background:* Despite a large body of evidence regarding reliable indicators of language deficits in young children, there has not been a standardised, quick screen for language impairment. The 'Grammar and Phonology Screening (GAPS) Test was therefore designed as a short, reliable assessment of young children's language abilities.

*Aims:* GAPS was designed to provide a quick screening test to assess whether pre-school and early school entry children have the necessary grammar and pre-reading phonological skills needed for education and social development. This paper reports the theoretical background to the test, the pilot study and reliability and the standardization.

*Methods*: This 7-10 minute test comprises 11 test sentences and 8 test nonsense words for direct imitation and is designed to highlight significant markers of language impairment and reading difficulties. To standardise the GAPS, we tested 668 children aged 3.6-6.6 across the U.K, taking into account population distribution and social economic status. The test was carried out by a range of health and education professionals as well as students and carers, using only simple, written instructions,.

*Results*: The results reveal that the GAPS is effective in detecting a range of children in need of further, in depth assessment or monitoring for language difficulties. The results concur with those from much larger epidemiological studies using lengthy testing procedures.

*Conclusions:* The GAPS test i) provides a successful screening tool; ii) is designed to be administered by professionals and non-professionals alike; ii) facilitates identification of language impairment or at-risk factors of reading impairment in the early educational years.

Thus, this test affords a first step in a process of assessment and targeted intervention to enable children to reach their potential.

**Introduction**

Language and communication are universally recognized as some of the essential building blocks for children's educational, social, and vocational development. Recent Government policies in the UK ('The National Literacy Strategy, Department of Education and Skills, 2001, Speaking and Listening Curriculum', Quality Curriculum Authority QCA, 2003) and internationally have therefore stressed the importance of oral language for children's eventual achievement. Various strategies for the monitoring and enhancement of language skills from an early age have been put in place. Health, education, and social services have recognized that developmental language deficits significantly affect children's potential, but there has not been a simple, effective measure of children's language abilities that could identify at risk children. The simplicity of the GAPS screen means it could be routinely administered by professionals and non-professionals alike, either to large cohorts of children prior to or at school entry, or to children causing concern in their early school years. Whilst no quick screen could hope to identify all the subtly different forms of SLI, GAPS goes beyond screening for general levels of language functioning as it is designed to target core grammatical and phonological abilities which are known to be impaired in the majority of children with specific language impairment and/or specific reading difficulties (Bishop, Adams, & Norbury, 2004; Bishop, 1997; Conti-Ramsden, 2003; Gathercole & Adams, 1993; Rice, 2004; van der Lely, 1996; van der Lely, 1998; van der Lely & Battell, 2003; van der Lely & Stollwerk, 1997). Only a small proportion of children with language impairments in areas of social interaction or forms of lexical-SLI have little or no deficits in syntactic and phonological functioning (van der Lely 2005, Nation et al 2004).

In this paper we report on the development and standardization of the GAPS test, firstly giving details of the theoretical background to the test design, including choice of stimuli. Next, the pilot study involving 148 children is described with resultant modifications. The results of its standardization on 668 children across the UK are then given in full followed by a small separate set of results on two groups of children with special needs. One group were children already identified as having SLI whilst the others were referred for a variety of reasons including poor educational progress, behaviour difficulties or other reasons.

*The background to the test*

Communication through language is important in almost every aspect of modern life. Yet, approximately 7% of children who are otherwise apparently developing normally have an impairment in language acquisition, termed "Specific Language Impairment", SLI (Leonard, 1998). There is increasing evidence that language development depends on multiple underlying faculties that are genetically distinctly specified (Bishop, Adams and Norbury 2005) and the majority of these SLI children have variable deficits in components of grammar (syntax, morphology and phonology) as well as other aspects of language such as vocabulary (van der Lely, 2005). In addition, such language deficits can co-occur with low IQ or other cognitive impairments such as Down's syndrome (Laws & Bishop, 2003; Norbury, Bishop, & Briscoe, 2002). The language impairment often persists into adulthood (Leonard, 1998) and impacts on various aspects of life, including social and emotional wellbeing.

Many children with SLI also have specific reading difficulties, sometimes in the form of very slow literacy development where syntactic and morphological problems are associated. However many children have specific reading difficulties (dyslexia) where phonological

impairment is considered to be core to their deficit (Ramus, 2003; Snowling, 2000) and these children may or may not have associated language impairment per se.

Based on the numbers of children in the UK between 3-6 years (3.015 million, in 2000) the 7% prevalence of SLI represents over 211,000 children (Statistics, 2005). Snowling (2000) states that 4% of all school age children suffer from severe dyslexia and a further 6% from mild-moderate dyslexia. Thus, these two disorders make up, by far, the most prevalent disorders in childhood. A screening test identifying such prevalent language difficulties or the antecedents to literacy difficulties, prior to the child's entrance into formal education would therefore provide a valuable tool. The GAPS test is designed to provide just such a tool to identify children with or at risk for developmental language and/or literacy disorders early in their educational career. It provides a check that children are "school ready" in key language areas, namely grammar (morpho-syntax) and phonology, specific aspects of language often left untapped by standardized tests for young children. Identifying children who might have an undetected grammatical deficit or have poor pre-reading skills is clearly advantageous, as it will facilitate appropriate referral for detailed assessment, early diagnosis and intervention, for instance by a Speech and Language Therapist, thereby helping to limit the impact of associated learning problems. As effective intervention relies on etiological insight it is also important that possible indicators of reading difficulties are identified and distinguished, both those that might arise as part of SLI and those flagging up predisposition to phonological developmental dyslexia. It is only with insight into initial language function that progress made by typically developing children in language and literacy skills can be effectively screened, allowing realistic evaluation of the efficacy of relevant educational and other intervention methods.

Grammatical deficits in children have been shown to be resistant to treatment, either through an enriched environment (Newman, 1996) or more specific therapy (Fey, Cleave, & Long, 1997; Nelson, Camarata, Welsh, Butkovsky, & Camarata, 1996), Law, Garrett, & Nye, 2003). Other areas of language (social interaction, vocabulary development) typically show greater positive effects (Haynes & Naidoo, 1991; Law, Garrett, & Nye, 2003). However there is growing evidence that specialised intervention programmes, targeted with knowledge of children's underlying deficits, such as that reported by Ebbels (Ebbels, 2005; Ebbels & van der Lely, 2001), can be effective. The evaluation of the type of intervention required is directly relevant to the aspect of language being measured and the nature of the deficit. A screening test that targets specific, structural aspects of language functioning is vital as part of the process of identifying subgroups of children who may require such targeted language interventions, as well as those established reading interventions targeting phonological awareness.

## The Development of the GAPS test

*Critical markers of specific language impairment and specific reading difficulties*

SLI is a heterogeneous disorder that variably affects the different components of language. There is a large body of research showing that children with SLI inconsistently manipulate core aspects of syntax, including tense marking, assigning thematic roles in passive sentences and embedded phrases and clauses, assigning reference with reflexives and forming questions (see (van der Lely, 2004)5, for a review). The problems with syntactic and morphological aspects of tense marking and other inflectional forms are a well-established phenotypic characteristic of SLI (Clahsen, Bartke, & Goellner, 1997; Conti-Ramsden & Hesketh, 2003; Leonard, 1998; Norbury, Bishop, & Briscoe, 2001; Rice & Wexler, 1996; van der Lely, 2005; van der Lely & Battell, 2003). Further, Rice and colleagues (Rice & Wexler, 1996) argue that tense marking provides a

good clinical marker of SLI. However, recent research highlights the breadth of the impairment within the grammatical system in not only the Grammatical, G-SLI subgroup (van der Lely, 2005) but in many forms of SLI in children as evinced by replications of the findings summarised above, in different research groups, in both English speaking children with SLI (Bishop, Bright, James, Bishop, & van der Lely, 2000; O'Hara & Johnston, 1997; Precious & Conti-Ramsden, 1988) and in other languages such as German, Greek and Hebrew (Friedmann & Novogrodsky, 2004; Hamann, Penner, & Lindner, 1998; Stavrakaki, 2001, 2002).

According to the Computational Grammatical Complexity (CGC) hypothesis, children with G-SLI are impaired in the computations underlying hierarchical, structurally-complex forms in one or more component of grammar (van der Lely, 2005). The CGC hypothesis emphasises the distinction between syntactic, morphological and phonological complexity and their independent and differential effects on sentence processing and production. These components show computational complexity not found in other cognitive domains (Chomsky, 1986; Hauser, Chomsky, & Fitch, 2002) and have also been found to dissociate from other cognitive functions in developmental disorders (Clahsen & Almazan, 1998; Pinker, 1994; Ramus, 2003; van der Lely, 2005; van der Lely, Rosen, & McClelland, 1998).

Thus not only the marking of tense but many other structures involving syntactic dependencies are predicted to be problematic for children with language impairments. Such structures are reflected in the choice of test items given below. They include passive sentences (*The dog is licked by the cat),* and pronominal reference (*The cat is washing herself)* (For a full explanation of these 'syntactic dependencies' and the CGC --a development of Representational Deficit for Dependent Relations (RDDR) hypothesis-- see van der Lely 1998, 2005, van der Lely and Battell 2003). Morphological complexity can be understood with respect to Pinker's Words

and Rules model (Pinker, 1999) whereby normal developers store irregular forms whole but compute morphologically regular forms using a symbolic rule (*roll + ed).* The CGC and other theories predict that for children with a morphological (rule) deficit, regularly inflected verbs might be particularly problematic as they are stored in the same way as irregulars and are therefore subject to the same word effects (Marshall & van der Lely, in press). Thus past tense forms are included in the test items.

However, tests of phonological abilities are crucial in differentiating children with language impairment with and without phonological deficit and from those children with only phonological deficit who are likely at risk for more specific reading difficulties: Whereas many, but not all, children with SLI fail on both tests of morpho-syntax and phonology (Conti-Ramsden, 2003; Gallon, Harris, & van der Lely, submitted; Marshall, Harris, & van der Lely, 2003), children and adults with a phonological form of dyslexia arguably only fail on tests of phonology (Ramus, 2003; Snowling, 2000). Thus, tests of both morpho-syntax and phonology are needed to provide preliminary indicators of language component impairment and to lay the foundations for appropriate full assessment and remediation.

Nonword repetition forms the second subtest of the GAPS. Here, the test items were designed to reflect increasing phonological complexity that can be found in English words. SLI children's problems with repetition of non-words are well known. One explanation for this problem is that it reflects a deficit in phonological short term memory (P-STM) (Conti-Ramsden, 2003; Gathercole & Baddeley, 1990). However, both processing and memory are significantly affected by underlying linguistic (phonological) representations (Morgan & Demuth, 1996; Näätänen et al., 1997). Thus, more recently, it has been recognised that nonword repetition also reflects phonological abilities, and, moreover, is a good marker of SLI and dyslexia (Bishop,

North, & Donlan, 1996; Conti-Ramsden & Hesketh, 2003; Gallon et al., submitted; Marshall et al., 2003). Furthermore, Roy and Chiat (2004) showed that nonword repetition tasks can be effectively used with children as young as 2 years of age to discriminate patterns of performance and map change over time.

The hierarchical structural organisation of sounds into words is common to all languages (Harris, 1994). So-called "parameters" regulate segmental syllable structure (Onset, Rhyme, Nucleus) and the prosodic - "metrical" word/foot structure, which affects the stress pattern of syllables in words; see (Marshall et al., 2003; van der Lely, 2005). These syllable and metrical structures can be either "marked" or "unmarked"; see (Gallon et al., submitted; van der Lely, 2005). Marked structures are not attested in all languages, and occur later in language acquisition and are therefore deemed to be more complex. Furthermore, marked structures can occur in combination; with the greater the number of marked structures the more complex the word or non-word. Many SLI children show increasing errors in non-word word repetition as the number of marked parameters increases (van der Lely, 2004; van der Lely, Rosen, & Adlard, 2004). Previous research shows that even short but phonologically complex non-words can cause difficulties (Marshall, Ebbels, Harris, & van der Lely, 2002; Roy & Chiat, 2004; van der Lely et al., 2004). Thus non-words such as *ba**drep*** are predicted to be harder than ***dre**pa,* as phonologically in *ba**drep*** the initial weak syllable makes it structurally more complex. We exploit this finding in selecting the test items for the GAPS phonology subtest.

Over the past 10 years or more van der Lely and colleagues have developed a number of tests and experimental procedures tapping the three core components of grammar that appear to be core deficits in SLI children (van der Lely, 2005). These tests, such as the "Verb Agreement and Tense Test (VATT) (van der Lely 2000) the Test of Active and Passive Sentences (TAPS)

(van der Lely, 1996), and the Advanced Syntactic test of Pronominal reference (A-STOP) which assesses pronominal and anaphoric reference in sentences, and the Test of Phonologial Structructure (TOPhS) ((van der Lely & Harris, 1999) provide a basis for the choice of sentence and non-word stimuli selected for this screening test—the GAPS test. The original, lengthy tests and procedures have been shown to target exactly those aspects of language that children with language impairment or children at risk for phonological developmental dyslexia fail (Ebbels, 2005; van der Lely, 2005; van der Lely et al., 2004)). They have proved to be highly sensitive for detecting language impairment in children when it occurs in isolation (H. K. J van der Lely, 1996; van der Lely & Battell, 2003; van der Lely & Stollwerk, 1997), when it co-occurs with low non-verbal IQ (Bishop et al 2000, Norbury et al 2001, 2002), and in distinguishing impaired vs normal grammatical abilities in children with other developmental disorders such as Down syndrome or William's syndrome respectively (Clahsen & Almazan, 1998; Ring & Clahsen, 2003).

In summary, our theoretical framework, alongside previous research findings, provide the background to us targeting pertinent linguistic aspects to be used in the screening test. It should be noted that many available standardised tests do not aim to assess specific aspects of grammar or phonological development. For example, in the Reynell Developmental Language Scales (Edwards et al., 1997), a thorough test of general language function, it is possible with single word vocabulary, auditory memory and general world knowledge to achieve correct scores without using grammatical knowledge. In contrast, in the GAPS test, the focus is on arguably the "core" deficits found in key morpho-syntactic and phonological structures which normally developing children master with no difficulty by around 3 to 4 years of age but which cause

particular difficulties for children with language impairment and those at risk for specific reading difficulties.

*Aims*

Detailed grammatical assessments of children traditionally require professionally trained people to administer them and interpret the results. Widely available standardised language tests are lengthy procedures, when most clinicians, psychologists, and educationalists are under severe time constraints. This results in only those children who are already exhibiting problems (often severe) being assessed. Alternatively, "parental concern" has been used as a criterion for referral for further assessment and has been shown be a more reliable predictor for later language impairment than some standardised tests (Dale, Price, Bishop, & Plomin, 2003). However, evaluation of this method reveals over-referral of children without language problems and under-referral of those with deficits (Laing, Law, Levin, & Logan, 2002). Heath and Hogben (2004) advocate cost effective screening for early literacy difficulties including oral language and phonological skills, but as yet there has not been an available screening test, standardised in the UK, that is easy to administer, therefore unlikely to require significant professional training and that, crucially, is sensitive to identifying language disorders and children at risk for phonological developmental dyslexia. The 'GAPS' test aims to fill this health and educational need. Other research, such as that by (Pickstone, Hannon, & Fox, 2002), clearly suggests a role for paraprofessionals in the screening of language development in the preschool population, especially as they could achieve high levels of coverage in a given community. In addition, school teaching assistants are being encouraged to assume more responsibility for collaborative

work with Speech and Language Therapists and other outside agencies (Law et al., 2003). Thus the GAPS test aims to provide a useful tool for such paraprofessionals and professionals alike and also takes a step towards including non-professionals in this process.

## Methods and procedures

### *The testers*

A high proportion of volunteers administered the test, some at the pilot but predominantly at standardisation stage. For the standardisation a call for volunteers was made via a professional website covering those working with children in education and health, as well as contact being made through heads of service and professional contacts. The response was overwhelmingly positive. In line with the aims of this screening test, at the standardisation stage a high proportion of the testing was carried out by staff and carers not traditionally trained in language assessment. Of the 62 testers, 18 were teaching assistants, nursery nurses, play-group leaders and mothers who tested 220/720 children. Most were recruited through a lead clinician or educationalist with whom the research team first made contact. 21 testers were speech and language therapists who tested 154 subjects, 14 teachers tested 223 children and finally, 7 undergraduate and post graduate students of Speech/language therapy or psychology tested 123 subjects. Testing took place predominantly in schools, nurseries or the children's homes. The testers were given a manual which contained clear instructions and examples of child responses. Some support was offered through phone and e-mail when required at the beginning of testing but in no instance was further help requested. No inter-rater reliability between professional and other testers took place but a feasibility assessment of a small sample of children were double marked on the

tick/cross system by a paraprofessional tester and speech and language therapist researcher, with 95-100% agreement, at an early stage of the standardisation.

*Subjects*

The pilot subjects were gathered in 3 stages as development of the test progressed. Initially 54 typically developing (TD) children were recruited between the ages 4.10-8.11 years. These children all came from Central London. The second stage involved more typically developing subjects and 17 language impaired children (analysed separately) from Speech and Language Therapists in London and Leeds. The age range here was 3.01-8.01 years but this age range was reduced once the pattern of response had been analysed and a ceiling effect identified in the typically developing children. The third stage involved additional TD children from Greater London, Leeds and Arbroath in Scotland where the main testers were based. The final usable cohort totaled 148. The schools who volunteered subjects received a small sum towards their school fund or a charity of their choice. Although there was no intention to collect a balanced sample at this stage socioeconomic status information by occupation was collected on 68 of the subjects to ensure all levels were at least represented. (The data was not requested on the subjects at the first stage). An abbreviated version of the then new Standard Occupational Classification (Office-of-National-Statistics, 2000a, 2000b) with nine major classifications (see Table 3) reduced to four. There was a greater representation of children from parents with professional, managerial and technical occupations than unskilled, the numbers being as follows. Of 68 children, 22 fell in the managerial and professional classes, 17 were in higher technical, 16 were in skilled manual and non-manual occupations, 7 in elementary occupations and 'other'.

Subjects for the standardisation were gathered from across the UK and Ireland. Full details of the cohort are given in the results section. Every effort was made to gather a cohort balanced for socio-economic status and rural/urban populations as far as this was possible, given the restrictions of access to volunteer testers and parental consent for testing. Consent was obtained in several areas from whole classes or preschool groups.

Two small groups of children either causing concern at school or already diagnosed with SLI are reported separately. The former (32 children) were those who were being seen or were about to be assessed by specialist external school support teaching teams, having been referred by their schools because of a variety of concerns. Further details were not always stated explicitly but they included poor behaviour, specific or general poor attainment in school and so forth. There was no immediate implication that these children had either SLI or reading difficulties but the school support team were keen to try the test out on a population already showing reason for concern. The other small group of 17 children diagnosed as SLI were all from language resourced based schools or units where teachers or SLTs had volunteered to assess them on GAPS.

*Test procedures: Elicited imitation*

An elicited imitation procedure is simple to administer and yet allows more control over administration and analysis than other procedures (Crain & Thornton, 1998; Lust, Flynn, & Foley, 1998; McDaniel, McKee, & Smith Cairns, 1996). It was therefore chosen as the basis for the GAPS test, especially as some paraprofessionals and non-professionals, unused to formal test procedures were to take part in the administration. The test comprises two elicited imitation tasks: one to test morpho-syntax, involving repetition of sentences, and one to test phonology

involving repetition of non-words. Children are shown a picture book and asked to repeat a story to an alien figure called "*Bik",* who only understands when children speak to him. The story is told to them by the tester, one sentence at a time for the children to repeat to Bik. The child is then asked to repeat the small set of non-words which are deemed to be in the alien's language.

This methodology allows a focus on specific aspects of grammar and phonology, which can be precisely manipulated. Since the 1950's (Brown, 1957), elicited imitation has proved to be a highly reliable, powerful and valid method for assessing core grammatical knowledge (syntax, morphology, phonology) (Crain & Thornton, 1998; Lust et al., 1998; Thornton, 1995). Further, it reveals the child's own grammatical ability rather than assuming that of the adult and minimises confounds with other non-linguistic cognitive factors (Lust et al., 1998). Conti-Ramsden and colleagues found elicited sentences to be the most reliable psycholinguistic marker of language impairment, with high levels of sensitivity and specificity. Furthermore, this procedure correctly identified the majority of children whose current language status fell into the normal range, despite a history of SLI (Conti-Ramsden, Botting, & Faragher, 2001).

*Test stimuli*

*Section 1: Test of Grammar (morpho-syntax)* 16 sentences were presented: 2 practice items, 11 test sentences, and 3 simple declarative filler sentences. These assessed subject-verb agreement, tense marking (past, future) e.g. 'The cat wanted some milk', phrasal embedding eg 'the cat with the bell is happy', dative construction eg 'The dog gives the cat the milk', object question formation, reversible passive construction and anaphoric and pronominal reference. The choice of the sentences was based on our previously developed tests and procedures as reported above.

Finally, careful control of all vocabulary items was employed: all words have an early age of acquisition (e.g., *cat, dog*) and are familiar to children regardless of socio-economic or cultural variation. In addition, only words with a simple phonological structure are included. Thus the test minimises the likelihood of failure due to the subjects not knowing the words or being able to pronounce them.

*Section 2: Test of phonology* 10 non-words (2 practice non-words and 8 test non-words) were a selected subset of items from the non-word repetition test of phonological structure (TOPhS) (Gallon et al., submitted; van der Lely & Harris, 1999), where prosodic structure is carefully manipulated. Specifically, the selected nonwords vary in complexity on the following parameters: i) marked Onset, Rhyme and final nucleus (e.g., dremp), ii) marked Rhyme, with an initial unstressed syllable, rather than a strong-weak stress pattern (e.g. ba**demp**er), iii) marked Rhyme and final Nucleus with Iambic structure (e.g. di**fimp**), iv) marked Onset and Rhyme with Iambic structure (weak-strong-weak stress pattern) (e.g. pa**drep**per). Previous research revealed that a sample of 40 normally developing children between 4:6 to 6 years produced nonwords with these structures correctly between 85 to 100% of the time (Gallon et al., submitted). All items were kept at 3 syllables or less in order to minimise the effect of phonological short term memory which is critical at 4 syllables or more (Gathercole and Baddeley 1990).

*Modifications to the test following the Pilot Study.*

At the pilot stage the GAPS test was administered to 148 children, as described above. Minor modifications to the test procedure were consequently made after the 3rd stage of the pilot was complete. First, practice items were added with an additional 'filler' sentence at the outset. Second, a lead-in sentence was added to the items where children were required to repeat a

question, in order to avoid very young children simply answering the question. Third, modifications were made to the test administration manual and examples of potential difficult situations that could occur were added. No actual test items were changed between the pilot and final versions of the test. However, because of these slight modifications, the results from the pilot study were not included in the larger standardisation. As mentioned before, the lower age limit of the test was raised from 3.0 to 3.6 years as many younger children were found to be unable to proceed, and secondly the upper limit was reduced from 8 to 6.5 years due to a clear ceiling effect.

*Administration*

The test comprises a short picture story-book about a cat and a dog, which serves as prompts for the child to repeat the short sentences (section 1) and made-up words (section 2). The test takes on average 7 minutes (range 5-10 mins) to administer. Little or no training was offered to testers but a simple manual with clear instructions and examples of scoring was provided. The testers were asked for comments about the test and its ease of administration at each stage of development. Following the pilot study, examples of most types of error or eventuality were included in the manual for reference, for example dealing with issues of accent to ensure children are not penalised and ensuring only key structures are marked as correct or incorrect.

*Presentation:*

*Section 1:* The administrator shows the child the picture booklet and tells the child that he is going to tell a little story. Then the administrator opens the booklet to the first page and introduces the stand-up alien "Bik".

*Administrator: "This is Bik. He only understands when children speak to him, and he would like to hear the story too. So, when I say something, you say it to Bik. Listen really carefully and make sure you say everything to Bik just the same as I say to you. Okay? Let's Practice. Hello Bik. Here is the story.*

The administrator waits for the child to repeat the practice sentence. If the child fails to repeat the sentence the administrator says:

*Administrator: "Go on. You say the same thing to Bik"*

If the child repeats the two practice sentences satisfactorily the administrator starts to present the test sentences. Where a child failed to repeat the practice items then they were not included in the standardization cohort. If they ceased attempting to repeat the test items further into the test then their score was counted, even if the result was zero.

*Section 2*: For the non-word repetition task, the administrator explains that it is the child's turn to repeat some of Bik's words. Two simple practice items are spoken by the administrator prior to the 8 test items. Note, regional vowel variation is not targeted, so does not comprise a problem. (This is mentioned in the manual) If the child attempted the practice items then their score was recorded from then on, as above.

*Scoring*: Details were kept as simple as possible. The test form utilises a simple tick/cross response. Words or parts of words that are to be scored as correct/incorrect within the test sentence are highlighted in bold on the administration-response form. In this way, exactly those pertinent aspects of morpho-syntactic abilities are assessed, relatively independently of memory failure, vocabulary knowledge etc. For section 2, the test of phonology, accurate repetition of the non-word is marked as correct and any mistakes are marked as incorrect. No transcription was required. The procedure for non-responses is as outlined above with any initial attempt at an

actual test item scored even if the child subsequently failed to complete the test. Any child who did not get past the practice items was removed from the cohort.

A table, resulting from the standardisation of the test provides conversion of raw scores into percentile scores relative to the child's age. Children falling below the 5th, 10th or 15th percentile are identified. We recommend that any child falling below the 10th percentile is referred for further assessment, and those falling between the 10-15th percentile are re-tested after 6 months. However, prior to the full standardisation of this test a pilot study was conducted, which we briefly report below, which assessed the reliability and validity of the GAPS

## Results and outcomes

### *Validity*

To assess the validity of the GAPS in correctly identifying those children with language or pre-reading phonological deficits, three standardised tests of language functioning were administered by researchers and SLTs to the same 148 children who were assessed during the pilot study. These tests were the British Picture Vocabulary Scale-Revised (BPVS) (Dunn, Dunn, Whetton, & Burley, 1997) which assesses comprehension of single word vocabulary; two subtests from the 'Clinical Evaluation of Language Fundamentals-Pre-School', (CELF) sentence structure and word structure sub-tests, which assess sentence understanding and expressive morpho-syntactic abilities respectively (Wiig, Secord, & Semel, 2000); and 'The Children's test of Nonword Repetition (CN-Rep) (Gathercole & Baddeley, 1996). This latter test was administered to children of 4 years upwards due to its standardisation range. It should be noted, however, that whereas subtests on GAPS are specifically designed to pick up children with grammatical or phonological deficits, these tests tap other components of language (e.g., vocabulary) or assess a

wide range of grammatical structures—some of which are different to those described in the research literature as significant clinical markers of SLI. The exception is the CN-Rep, which although designed to primarily tap phonological-short-term memory, also taps phonological knowledge. Therefore, we predicted that generally there should be a moderate rather than high positive correlation between the GAPS and these previously standardized tests.

Partial correlations, controlling for age were carried out to assess the relations between the two GAPS sub-tests and the above standardized language measures. The GAPS grammar test (sentence repetition) section showed highly significant correlations at the $p < .001$ level with all four tests (BPVS r(142) = .440; CELF Sentence Structure r(142) = .524; CELF Word-Structure r(142) = .427; CN-Rep r(112) = .579). Thus, these correlations showed that between 18 to 34% of the variance was being accounted for. The correlations were lower, but nonetheless significant between the GAPS phonology test (non-word repetition) and the BPVS r(140) = .257, p = .002; CELF sentence structure r(140) = .334, p = .001; and the CELF-word structure r(140) = .221, p = .008, and accounted for between 5 to 11% of the variance. This is clearly expected due to the very different language components that are being tapped by the GAPS and BPVS and CELF tests. In contrast, a highly and very strong correlation was found between the GAPS phonology (non-word repetition) test and the CN-Rep (r(107) = .671 , p < .001). Thus, the GAPS test shows the strongest correlations with those standardized language tests that are more likely to be tapping similar language components with respect to grammar or phonology, but generally shows significant correlations with these longer tests of language, even when age is partialled out.

*Reliability*

The internal consistency of the test was measured by computing Cronbach's alpha for each component of the test and for the test overall. For the sentence repetition component $\alpha = .858$,

and for the non-word repetition component, α = .729. These values indicate that the test has good/very good internal consistency. Further, for both components all items were positively correlated with a scale composed of the remaining items and the removal of a particular item led to a reduction in the value of Cronbach's alpha in 36 out of 38 cases (the alpha was unchanged in the remaining two cases).

*Standardisation*

For the standardisation sample the test was administered to a minimum of 75 and a maximum of 150 children in each 6 month age band from 3;6 to 6.6 years. The final usable sample had a total of 668 children. The sample was carefully targeted to control, as far as possible, for regional location (both rural and urban areas were included) and socio-economic status. The latter was determined using the full classification of parental occupation according to the Office of National Statistics coding index for the UK (Office-of-National-Statistics, 2000a, 2000b). A proportion of children from ethnic minorities were included but only those where English was the first language.

*Characteristics of the standardisation sample*

The age and gender distribution of the standardisation sample are presented in Table 1. Gender information was available for 94% (N = 628) of the total sample (N = 668). Ethnicity information was available for 96% (N = 643) of the sample. Using a broad classification criterion, 94.3% of the sample was White, 3.1% Asian, and 2.6% Black/Other. The geographical distribution of the standardisation sample is presented in Table 2. Data for the population were obtained from the Office of National Statistics (Statistics, 2005).

**Table 1. The distribution of the standardisation sample broken down by age and gender.**

| Age Range | Female | Male | Missing | Total |
|---|---|---|---|---|
| 3;4 to 3;11 | 31 | 32 | 23 | 86 |
| 4;0 to 4;5 | 40 | 61 | 7 | 108 |
| 4;6 to 4;11 | 68 | 82 | 0 | 150 |
| 5;0 to 5;5 | 65 | 81 | 0 | 146 |
| 5;6 to 5;11 | 53 | 49 | 0 | 102 |
| 6;0 to 6;8 | 29 | 37 | 10 | 76 |
| Total | 286 | 342 | 40 | 668 |

Anonymous marking of score sheets by some testers resulted in missing information on gender.

**Table 2. The geographical distribution of the standardisation sample**

| Location | % in Population | % in Sample | Expected N in Sample | Observed N in Sample |
|---|---|---|---|---|
| North | 15.6 | 10.2 | 104 | 68 |
| Yorks & Humber | 8.5 | 21.6 | 57 | 144 |
| East Midlands | 7.0 | 2.7 | 47 | 18 |
| West Midlands | 9.1 | 3.1 | 61 | 21 |
| East | 9.2 | 15.4 | 61 | 103 |
| London | 12.9 | 11.1 | 86 | 74 |
| South East | 13.6 | 13.3 | 91 | 89 |
| South West | 7.8 | 2.4 | 52 | 16 |
| Scotland | 8.1 | 14.7 | 54 | 98 |
| Wales | 4.9 | 5.4 | 33 | 36 |
| Northern Island | 3.3 | 0.1 | 22 | 1 |
| | 100.0 | 100.0 | 668 | 668 |

There was a statistically significant difference between the expected and observed frequencies ($\chi^2(10) = 299.3$, $p < .001$). Inspection of Table 2 reveals that certain areas of the country were over-represented (e.g., Yorks & Humber, the East and Scotland) and other areas under-represented (e.g., the North, the Midlands, the South West and Northern Ireland). There was a small but significant effect of geographical location on test performance (after controlling for age): Sentence repetition, $F(10, 656) = 5.05$, $p < .001$, $\eta_p^2 = .071$; non-word repetition, $F(10,$

656) = 2.17, $p < .05$, $\eta_p^2 = .032$. Thus 7.1% of the variability in sentence repetition scores was attributable to geographical location, and 3.2% of the variability in non-word repetition scores. Thus, geographical location accounts for only a small amount of the variability in our sample. Information regarding parental occupation was available for 73.1% of the standardisation sample (N = 448). For 120 of the subjects the parental occupation was unavailable due to personal information being withheld or omitted. Occupational category was determined using the Standard Occupational Classification (Office-of-National-Statistics, 2000a, 2000b) which has nine major classifications (see Table 3).

Table 3. The distribution of occupational groups for the standardisation sample

| Occupational Category | % in Population | % in Sample | Expected N in Sample | Observed N in Sample |
|---|---|---|---|---|
| Managers and Senior Officials | 14.9 | 12.5 | 67 | 56 |
| Professional Occupations | 11.2 | 12.7 | 50 | 57 |
| Associate Professional and Technical | 13.9 | 13.8 | 62 | 62 |
| Administrative and Secretarial | 13.4 | 4.0 | 60 | 18 |
| Skilled Trades | 11.2 | 12.7 | 50 | 57 |
| Personal Service | 7.0 | 4.9 | 31 | 22 |
| Sales and Customer Service | 7.7 | 3.6 | 34 | 16 |
| Process, Plant and Machine Operatives | 8.7 | 9.8 | 39 | 44 |
| Elementary Occupations | 11.9 | 34.8 | 55 | 156 |
| | 100.0 | 100.0 | 448 | 448 |

Again, there was a statistically significant difference between the expected and observed frequencies ($\chi^2(8) = 231.4$, $p < .001$). In particular, administrative and secretarial, and sales and customer services were under-represented, and most notably elementary occupations were over-represented. However, unlike geographical location, test performance was unrelated to the

occupational background of the parents (with age of child controlled): Sentence repetition, $F < 1$, $\eta_p^2 = .008$; non-word repetition, $F(9, 477) = 1.22$, $p = .282$, $\eta_p^2 = .022$.

**Table 4: Mean performance (SD in brackets) on the sentence repetition task, the non-word repetition task as a function of age.**

| | Repetition Task | |
|---|---|---|
| Age Group | Sentences | Non-Words |
| 3;4 to 3;11 | 5.7 (3.0) | 4.6 (2.3) |
| 4;0 to 4;5 | 7.7 (3.0) | 5.2 (2.3) |
| 4;6 to 5;5 | 9.1 (2.5) | 5.8 (2.1) |
| 5;6 to 5;11 | 10.1 (1.4) | 6.6 (1.6) |
| 6;0 to 6;8 | 10.5 (0.8) | 6.8 (1.4) |

There was a significant effect of age group for both tasks (Sentences: $F(4, 618) = 47.53$, $p < .001$; Non-words: $F(4, 618) = 15.5.6$, $p < .001$) but no significant effect of gender (Sentences: $F(1, 618) = 3.02$, p = .08; Non-words: $F < 1$). There was no interaction between age group and gender (Sentences: $F < 1$; Non-words: $F(1, 618) = 1.43$, $p = .224$). Planned comparisons between the five age groups revealed that all differences were significant with the exception of 5;6 to 5;11 vs. 6;0 to 6;8 (Sentences: M = 10.12 vs. 10.47, $t(618) = 0.93$, $p = 0.18$ and Non-words: M = 6.55 vs. 6.75, $t(618) = 0.62$, $p = .27$). Although the test means do not distinguish clearly between children in the two upper age groups, the cumulative scores differentiate the groups. Thus we considered that this warranted maintaining these two separate age groups, between 5.6 and 6.8 yrs.

*Possible Effect of Type of tester on scores*

**Table 5: Mean (SD in brackets) scores as a function of type of tester**

| Tester Occupation | | Sentences | Non-Words |
|---|---|---|---|
| Nursery Nurse Teacher assistants/Other | (N = 175) | 9.41 (2.43) | 6.40 (1.71) |
| Researcher/Student | (N = 134) | 8.78 (2.67) | 5.42 (1.93) |
| S&L Therapist | (N = 180) | 8.43 (2.99) | 5.47 (2.44) |
| Teacher | (N = 179) | 8.60 (2.83) | 5.67 (2.00) |

There was a small but significant effect of tester occupation on test performance (after controlling for age): Sentence repetition, $F(3, 663) = 7.19$, $p < .001$, $\eta_p^2 = .032$; non-word repetition, $F(3, 663) = 8.15$, $p < .001$, $\eta_p^2 = .036$, overall, $F(3, 633) = 8.75$, $\eta_p^2 = .038$. Thus 3.2% of the variability in sentence repetition scores, 3.6% of the variability in non-word repetition scores, and 3.8% of the variability in overall performance was attributable to the tester's occupation. Thus, tester occupation accounts for only a small amount of the variability in the data. It is noteworthy that the nursery nurses/teaching assistants and other testers with little or no experience in language assessments gave the highest scores on both the sentence repetition and non-word repetition tasks but it is also interesting to note that the least variability is found in this group. The greatest variability in the scores is found in the group of speech/language therapists. This will be discussed further in the discussion section.

*Derivation of the norms*

Norms were derived separately for the two sections of the test (sentence repetition and non-word repetition). Age bands were constructed to achieve a reasonably linear increase in performance on both components with increasing age. The mean number of correct repetitions for the sentence task and the non-word task are presented in Figures 1 and Figure 2 respectively.

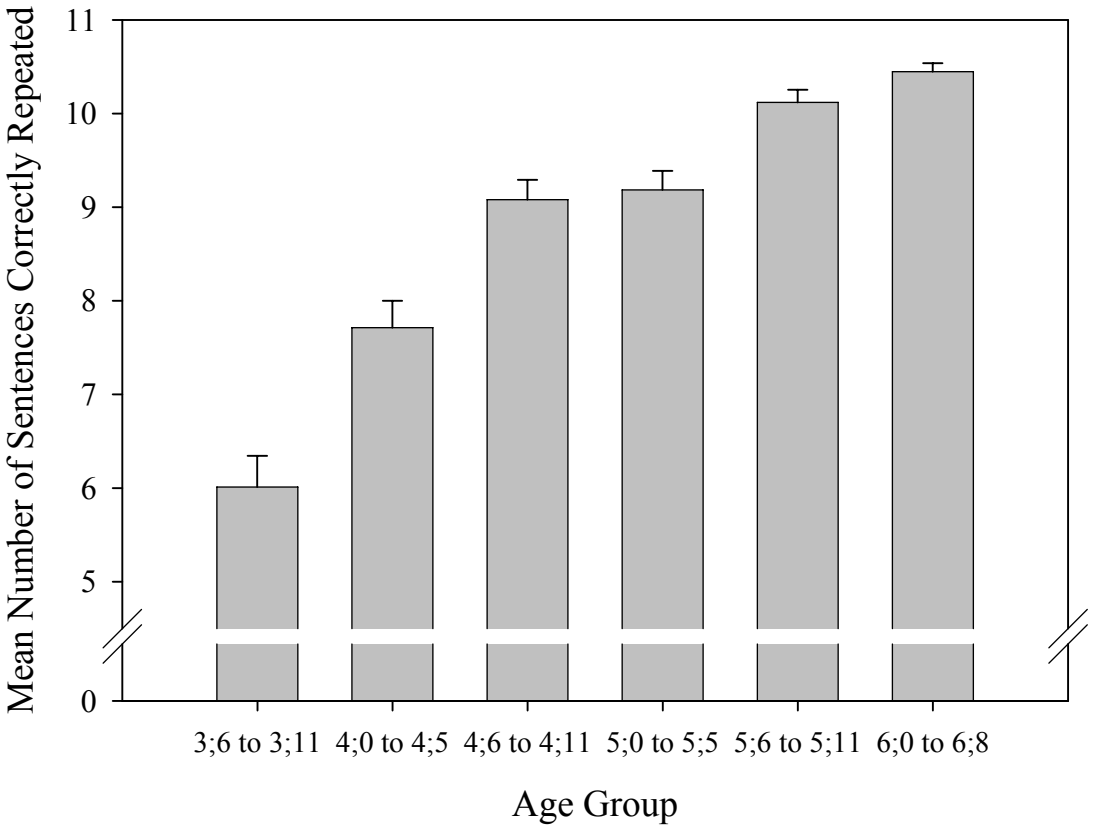


**Figure 1. The mean number of sentences correct as a function of age group.**

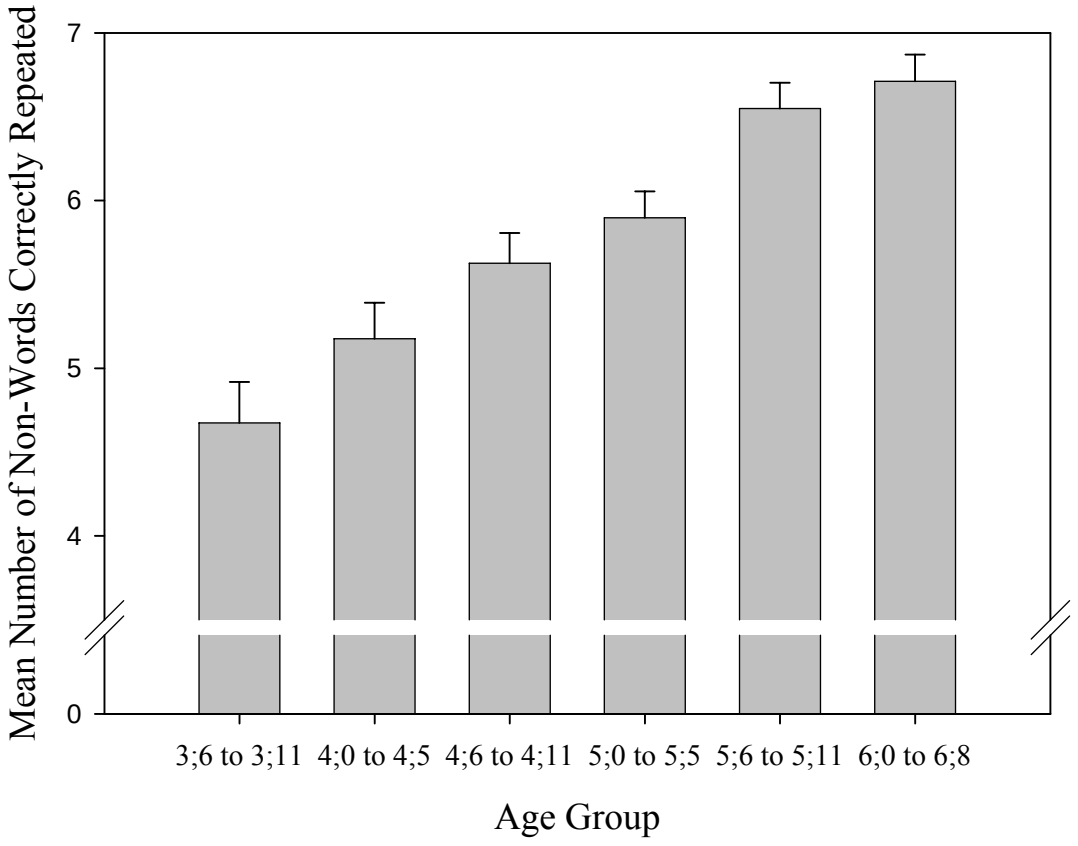


**Figure 2. Mean number of Non-Words correct as a function of age group.**

On the basis of these age groupings, cumulative percentage distributions for the number of sentences, non-words and items correctly repeated were generated for each age band. Figure 3 presents the cumulative percentage of children who correctly repeated a given number of sentences within each age band.

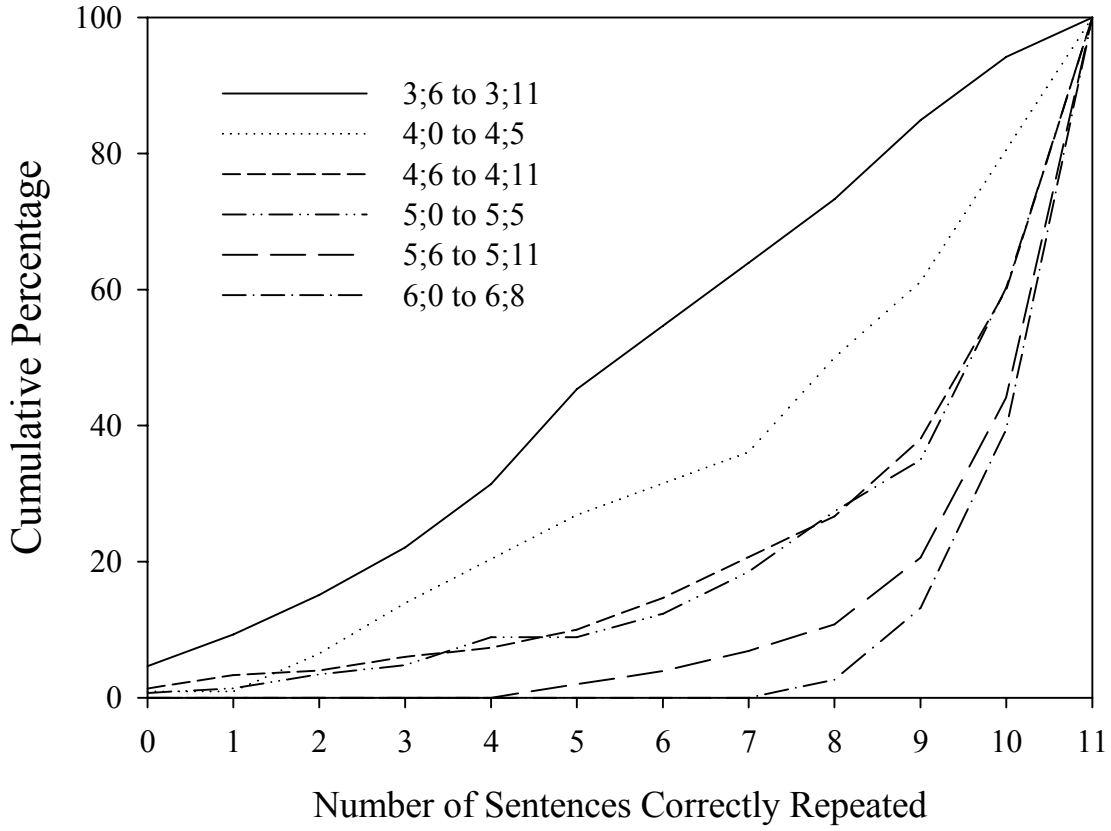


**Figure 3. The cumulative percentage of children correctly repeating a given number of sentences within each age band.**

Figure 4 presents the cumulative percentage of children who correctly repeated a given number of non-words within each age band.

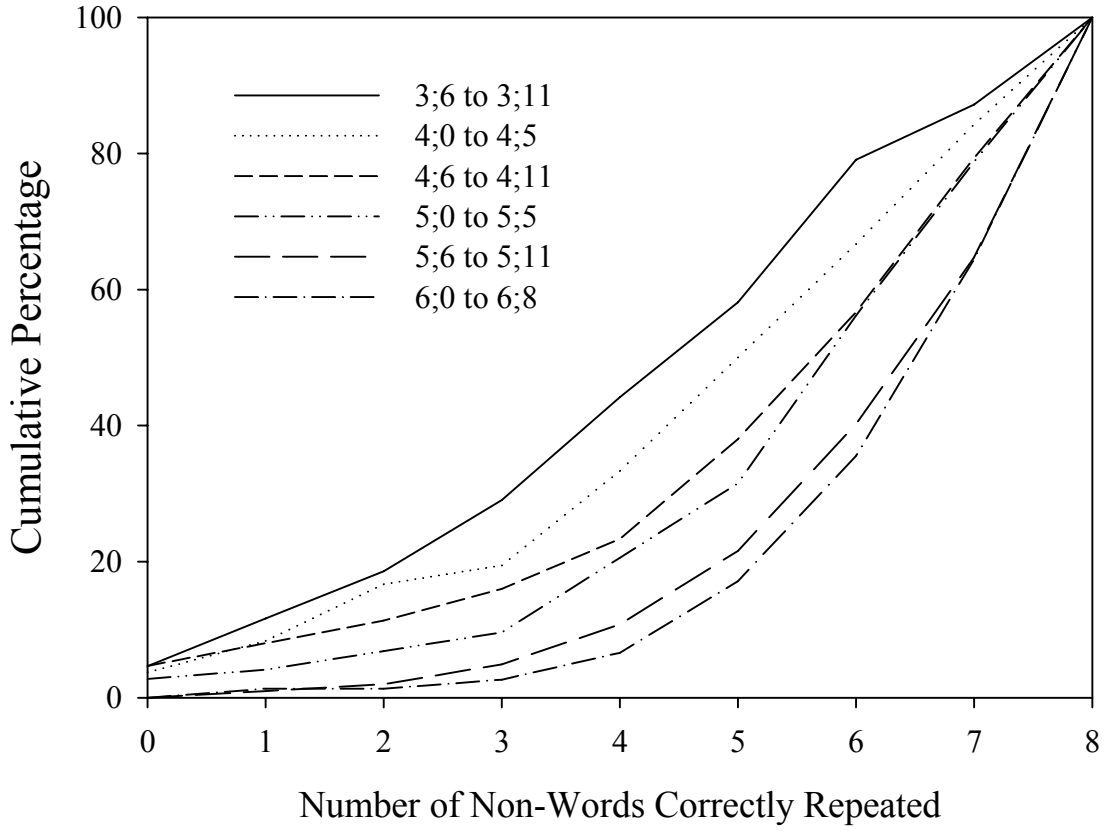


**Figure 4. The cumulative percentage of children correctly repeating a given number of non-words within each age band.**

It is evident from inspection of the bar-charts presented in Figures, 1 and 2 and the cumulative percentage plots presented in Figures 3 and 4 that the age groups 4;6 to 4;11 and 5;0 to 5;5 are not well differentiated on either of the test components (particularly sentence repetition). Statistical analysis confirmed this observation. There was no significant difference in mean performance between these two groups on any of the measures (sentences; $t(294) = .36$, $p = .721$:

non-words; $t(294) = 1.13$, $p = .260$: overall; $t(294) = .79$, $p = .431$). As a consequence of these findings it was decided to combine these two age groups to form a single group (4;6 to 5:5).

Figure 5 presents the cumulative percentage of children who correctly repeated a given number of sentences with the middle two age groups combined.

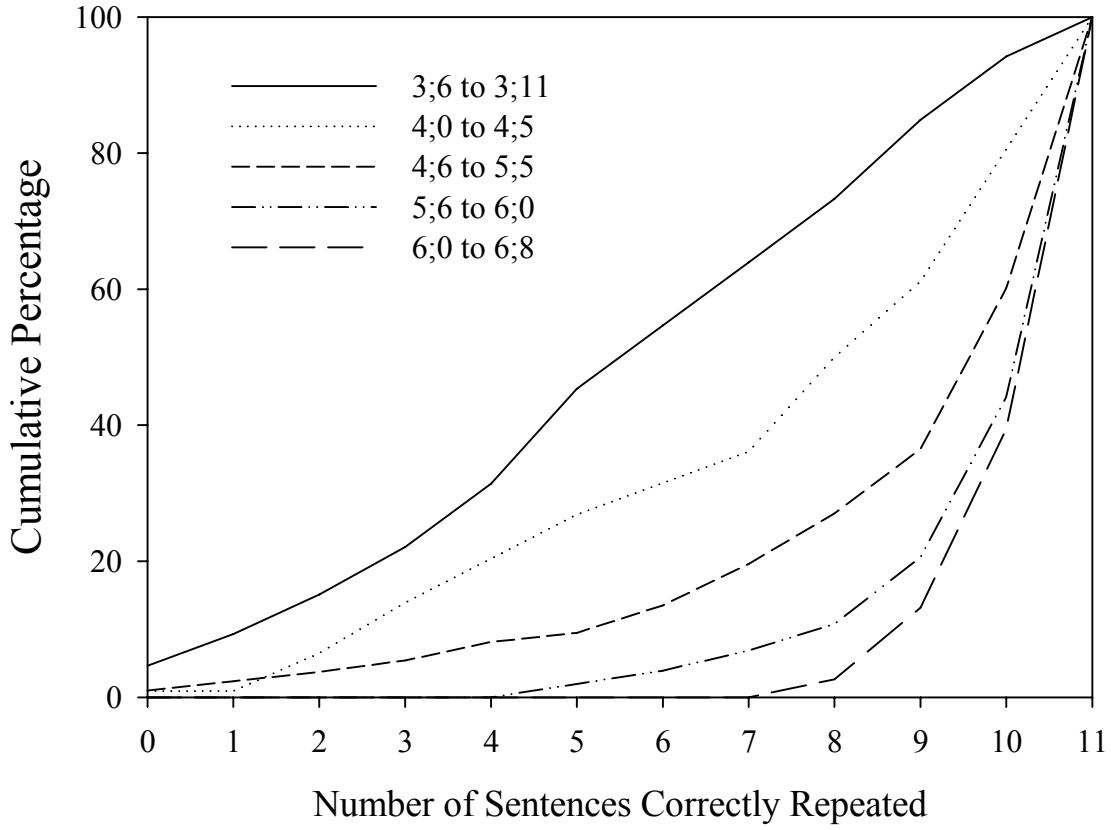


**Figure 5. The cumulative percentage of children correctly repeating a given number of sentences within each age band (new groupings).**

Figure 6 presents the cumulative percentage of children who correctly repeated a given number non-words with the middle two age groups combined.

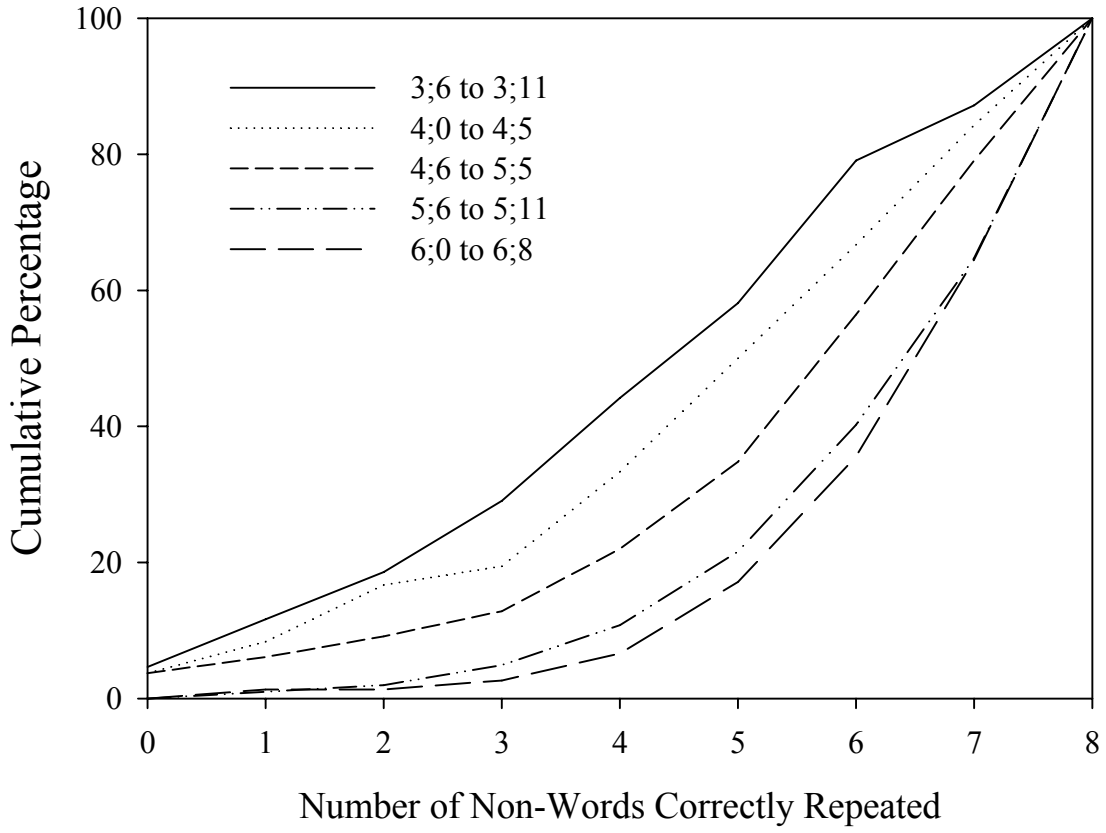


**Figure 6. The cumulative percentage of children correctly repeating a given number of non-words within each age band (new groupings**).

*Correlation between performance on two subtests.*

The correlations between performance on the sentence repetition and non-word repetition components of the test as a function of age group was significant at $p < .01$, with the correlations

varying between .68 and .41 for the majority of age groups, with the lower correlations at the older ages. The correlation was lower ($r = .28$, $p < .01$) for the 5:6 to 5:11 age group. One possible reason for this could be the impact of learning to read at this age and starting formal education. In addition, at the upper age range, scores were approaching ceiling, so the relations between sentence repetition and non-word repetition reduces in the older age groups. Note, however, the raw scores continue to differentiate the groups and provide the means of screening children's performance.

On the basis of the revised cumulative distributions, Tables 6 and 7 were constructed. Each table gives the percentage of children within each age group who obtained a particular score or lower on each component of the test. An individual child's score can be located in the left hand column, and by entering the appropriate age group, the child's performance relative to the standardisation sample can be ascertained in terms of a percentile score.

**Table 6. Raw score to percentile score conversion table for sentence component of the test.**

| Raw Score | Age Group 3:4 – 3:11 | 4:0 – 4:5 | 4:6 – 5:5 | 5:6 – 5:11 | 6:0 – 6:8 |
|---|---|---|---|---|---|
| 0 | **5** | **1** | **1** | **0** | **0** |
| 1 | *9* | **1** | **2** | **0** | **0** |
| 2 | 15 | *7* | **4** | **0** | **0** |
| 3 | 22 | 14 | **5** | **0** | **0** |
| 4 | 31 | 20 | *8* | **0** | **0** |
| 5 | 45 | 27 | *10* | **2** | **0** |
| 6 | 55 | 32 | 14 | **4** | **0** |
| 7 | 64 | 36 | 20 | *7* | **0** |
| 8 | 73 | 50 | 27 | 11 | **3** |
| 9 | 85 | 61 | 37 | 21 | 13 |
| 10 | 94 | 81 | 60 | 44 | 40 |
| 11 | 100 | 100 | 100 | 100 | 100 |

**Bold** = lower 5%. *Italics* = lower 10%. Underline = lower 15%

**Table 7. Raw score to percentile score conversion table for non-word component of the test.**

| Raw Score | Age Group 3:4 – 3:11 | 4:0 – 4:5 | 4:6 – 5:5 | 5:6 – 5:11 | 6:0 – 6:8 |
|---|---|---|---|---|---|
| 0 | **5** | **4** | **4** | **0** | **0** |
| 1 | 12 | *8* | *6* | **1** | **1** |
| 2 | 19 | 17 | *9* | **2** | **1** |
| 3 | 29 | 19 | 13 | **5** | **3** |
| 4 | 44 | 33 | 22 | 11 | *7* |
| 5 | 58 | 50 | 35 | 22 | 17 |
| 6 | 79 | 67 | 66 | 40 | 36 |
| 7 | 87 | 84 | 79 | 65 | 65 |
| 8 | 100 | 100 | 100 | 100 | 100 |

**Bold** = lower 5%. *Italics* = lower 10%. Underline = lower 15%

*Children passing and/or failing the grammar and/or phonology subtests*

A final set of analyses was carried out on three different groups of children: those who were in our standardization sample; those who had been referred to the educational support services whose development in some aspects (language, cognitive, behaviour) was giving concern, and those who had already been identified as having SLI by SLTs and teachers in language resourced mainstream schools.

Table 6 presents those children from the standardization sample passing or failing either the grammar or the phonology subtests or both subtests, using the three criteria; i.e., those children falling into the lowest 5%, 10% (to refer) or 15% (for retest).

Tables 8, 9, 10 show the numbers (and percentages) of children in the standardization sample who passed or failed either or both subtests of the GAPS at each age group and as a proportion of the whole sample at 5%, 10% and 15% criterion.

**Table 8: children who pass/failed either or both subtests at 5% cut off.**

| Age Group | | | Non-Words | | |
|---|---|---|---|---|---|
| 3;4 to 3;11 | | | Fail | Pass | Total |
| | | Fail | 2 (2.3%) | 2 (2.3%) | 4 (4.6%) |
| | Sentences | Pass | 2 (2.3%) | 80 (93.1%) | 82 (95.4%) |
| | | Total | 4 (4.6%) | 82 (95.4%) | 86 (100.0%) |
| 4;0 to 4;5 | | | Fail | Pass | Total |
| | | Fail | 1 (0.9%) | 0 (0.0%) | 1 (0.9%) |
| | Sentences | Pass | 3 (2.8%) | 104 (96.3%) | 107 (99.1%) |
| | | Total | 4 (3.7%) | 104 (96.3%) | 108 (100.0%) |
| 4;6 to 5;5 | | | Fail | Pass | Total |
| | | Fail | 5 (1.7%) | 11 (3.7%) | 16 (5.4%) |
| | Sentences | Pass | 6 (2.0%) | 274 (92.6%) | 280 (94.6%) |
| | | Total | 11 (3.7%) | 285 (96.3%) | 296 (100.0%) |
| 5:6 to 5;11 | | | Fail | Pass | Total |
| | | Fail | 0 (0.0%) | 4 (3.9%) | 4 (3.9%) |
| | Sentences | Pass | 5 (4.9%) | 93 (91.2%) | 98 (96.1%) |
| | | Total | 5 (4.9%) | 97 (95.1%) | 102 (100.0%) |
| 6;0 to 6;8 | | | Fail | Pass | Total |
| | | Fail | 1 (1.3%) | 1 (1.3%) | 2 (2.6%) |
| | Sentences | Pass | 1 (1.3%) | 73 (96.1%) | 74 (97.4%) |
| | | Total | 2 (2.6%) | 74 (97.4%) | 76 (100.0%) |
| Overall | | | Fail | Pass | Overall |
| | | Fail | 9 (1.3%) | 18 (2.7%) | 27 (4.0%) |
| | Sentences | Pass | 17 (2.6%) | 624 (93.4%) | 641 (96.0%) |
| | | Total | 26 (3.9%) | 642 (96.1%) | 668 (100.0%) |

**Table 9: children who pass/failed either or both subtests at 10% cut off.**

| Age Group | | | Non-Words | | |
|---|---|---|---|---|---|
| 3;4 to 3;11 | | | Fail | Pass | Total |
| | | Fail | 5 (5.8%) | 3 (3.5%) | 8 (9.3%) |
| | Sentences | Pass | 2 (2.3%) | 76 (88.4%) | 78 (90.7%) |
| | | Total | 7 (8.1%) | 79 (91.9%) | 86 (100.0%) |
| 4;0 to 4;5 | | | | | |
| | | Fail | 5 (4.6%) | 2 (1.9%) | 7 (6.5%) |
| | Sentences | Pass | 4 (3.7%) | 97 (89.8%) | 101 (93.5%) |
| | | Total | 9 (8.3%) | 99 (91.7%) | 108 (100.0%) |
| 4;6 to 5;5 | | | | | |
| | | Fail | 14 (4.7%) | 14 (4.7%) | 28 (9.4%) |
| | Sentences | Pass | 13 (4.4%) | 255 (86.2%) | 268 (90.6%) |
| | | Total | 27 (9.1%) | 269 (90.9%) | 296 (100.0%) |
| 5:6 to 5;11 | | | | | |
| | | Fail | 2 (2.0%) | 5 (4.9%) | 7 (6.9%) |
| | Sentences | Pass | 6 (5.9%) | 89 (87.2%) | 95 (93.1%) |
| | | Total | 8 (7.9%) | 94 (92.1%) | 102 (100.0%) |
| 6;0 to 6;8 | | | | | |
| | | Fail | 3 (4.0%) | 4 (5.2%) | 7 (9.2%) |
| | Sentences | Pass | 2 (2.6%) | 67 (88.2%) | 69 (90.8%) |
| | | Total | 5 (6.6%) | 71 (93.4%) | 76 (100.0%) |
| Overall | | | | | |
| | | Fail | 29 (4.4%) | 28 (4.1%) | 57 (8.5%) |
| | Sentences | Pass | 27 (4.0%) | 584 (87.5%) | 611 (91.5%) |
| | | Total | 56 (8.4%) | 612 (91.6%) | 668 (100.0%) |

**Table 10: children who pass/failed either or both subtests at 15% cut off.**

| Age Group | | | Non-Words | | |
|---|---|---|---|---|---|
| 3;4 to 3;11 | | | Fail | Pass | Total |
| | | Fail | 7 (8.1%) | 6 (7.0%) | 13 (15.1%) |
| | Sentences | Pass | 3 (3.5%) | 70 (81.4%) | 73 (84.9%) |
| | | Total | 10 (11.6%) | 76 (88.4%) | 86 (100.0%) |
| 4;0 to 4;5 | | | | | |
| | | Fail | 8 (7.4%) | 7 (6.5%) | 15 (13.9%) |
| | Sentences | Pass | 6 (5.6%) | 87 (80.5%) | 93 (86.1%) |
| | | Total | 14 (13.0%) | 94 (87.0%) | 108 (100.0%) |
| 4;6 to 5;5 | | | | | |
| | | Fail | 22 (7.4%) | 18 (6.1%) | 40 (13.5%) |
| | Sentences | Pass | 16 (5.4%) | 240 (81.1%) | 256 (86.5%) |
| | | Total | 38 (12.8%) | 258 (87.2%) | 296 (100.0%) |
| 5:6 to 5;11 | | | | | |
| | | Fail | 3 (2.9%) | 8 (7.9%) | 11 (10.8%) |
| | Sentences | Pass | 8 (7.9%) | 83 (81.3%) | 91 (89.2%) |
| | | Total | 11 (10.8%) | 91 (89.2%) | 102 (100.0%) |
| 6;0 to 6;8 | | | | | |
| | | Fail | 4 (5.3%) | 6 (7.9%) | 10 (13.2%) |
| | Sentences | Pass | 6 (7.9%) | 60 (78.9%) | 66 (86.8%) |
| | | Total | 10 (13.2%) | 66 (86.8%) | 76 (100.0%) |
| Overall | | | | | |
| | | Fail | 44 (6.6%) | 45 (6.7%) | 89 (13.3%) |
| | Sentences | Pass | 39 (5.8%) | 540 (80.8%) | 579 (86.6%) |
| | | Total | 83 (12.4%) | 585 (87.6%) | 668 (100.0%) |

Tables 8, 9, and 10 reveal that impairments in grammar and phonology for many children do not go hand in hand. For children falling into the lowest 10% or 15% on the GAPS subtests, the chances of having a phonological deficit, if you have a syntactic deficit, or vice versa is only around .5. Thus, of those children in the normal population who have some sort of language deficit, only half have both a phonological and a grammatical deficit. Surprisingly, the likelihood of having both a grammar and phonological deficit in the most severely impaired group (the lowest 5%) reduces to around .33. This lack of concordance between grammar and phonological

deficits accounts for why there are 6.5%, 13.6% and 20% of the children in the sample at the 5%, 10%, and 15% criterion respectively, where a level of concern over their language development is raised on this screening test.

Tables 12 and 13 present the pass-fail results at 10% criterion (recommended level for specialist referral) for the children referred to school support services for a variety of reasons and those already identified as having some form of SLI.

**Table 11 Children referred to school support services who passed/failed one subtest or both.**

| Criterion | | | Non-Words | | |
|---|---|---|---|---|---|
| 5% | | | Fail | Pass | Total |
| | | Fail | 6 (18.8%) | 5 (15.6%) | 11 (34.4%) |
| | Sentences | Pass | 3 (9.3%) | 18 (56.3%) | 21 (65.6%) |
| | | Total | 9 (28.1%) | 23 (71.9%) | 32 (100.0%) |
| 10% | | | Fail | Pass | Total |
| | | Fail | 10 (31.2%) | 7 (21.9%) | 17 (53.1%) |
| | Sentences | Pass | 1 (3.1%) | 14 (43.8%) | 15 (46.9%) |
| | | Total | 11 (34.3%) | 21 (65.7%) | 32 (100.0%) |
| 15% | | | Fail | Pass | Total |
| | | Fail | 10 (31.2%) | 9 (28.2%) | 19 (59.4%) |
| | Sentences | Pass | 1 (3.1%) | 12 (37.5%) | 13 (40.6%) |
| | | Total | 11 (34.3%) | 21 (65.7%) | 32 (100.0%) |

Of these children (27 male and 5 female), who were referred to school, support services as causing concern for a wide variety of reasons, around 60% failed the GAPS test at 15% criterion. All age groups are represented in this sample in low numbers. At 10% criterion, where referral to SLT services would be suggested, there was still over 50% failure rate suggesting a substantial proportion of this population with poor attainment have some form of language and /or literacy difficulty as part of their problem which requires further diagnostic assessment. Of these children

31% failed both subtests, whereas 22% failed only the grammatical subtest (at 10% cut off). Only one child failed the nonword and passed the grammatical subtest.

**Table 12. Children with diagnosis of SLI who passed/failed one subtest or both.**

| Criterion | | | Non-Words | | |
|---|---|---|---|---|---|
| 5% | | | Fail | Pass | Total |
| | | Fail | 7 (41.2%) | 3 (17.6%) | 10 (58.8%) |
| | Sentences | Pass | 0 (0.0%) | 7 (41.2%) | 7 (41.2%) |
| | | Total | 7 (41.2%) | 10 (58.8%) | 17 (100.0%) |
| 10% | | | Fail | Pass | Total |
| | | Fail | 7 (41.2%) | 4 (23.5%) | 11 (64.7%) |
| | Sentences | Pass | 1 (5.9%) | 5 (29.4%) | 6 (35.3%) |
| | | Total | 8 (47.1%) | 9 (52.9%) | 17 (100.0%) |
| 15% | | | Fail | Pass | Total |
| | | Fail | 9 (52.9%) | 3 (17.7%) | 12 (70.6%) |
| | Sentences | Pass | 0 (0.0%) | 5 (29.4%) | 5 (29.4%) |
| | | Total | 9 (52.9%) | 8 (47.1%) | 17 (100.0%) |

From these children diagnosed as SLI by SLTs and other professionals, if they failed any test then they failed the grammar test and some children failed the phonology test too. One child failed only the phonology test and passed the sentences. The group comprised 12 males and 5 females with a predominantly even spread across the age groups. The 5 children with some form of diagnosed SLI who passed both subtests at this criterion level were aged between 4.0-5.11 years. Had those passing been in the older age range we might have thought that the test is less sensitive at the older age group, but this does not appear to be so. These results have not been statistically analysed further due to the small numbers. However we discuss this small sample below.

## Discussion

The Grammar and Phonological Screening (GAPS) test has been designed to be a quick , simple screen of young children's language status. The screen aims to identify children in need of further assessment rather than to be definitive or diagnostic. Thus, for those children whose scores fall in the lowest 10 percent when compared to their peers further, more detailed assessment by professionals is recommended. Retesting those children who scored at a borderline 15% cut off should allow for any false negative that might arise because of narrow scoring differentials. Indeed with the older age group the precise 10-15 cut off did not fall neatly within the scores and the level had to be set somewhere between the two. We considered that the problems with small score differences were outweighed by the benefits of keeping the test short and easy to administer. In the older age range (6 years and over) typically developing children are predominantly grammatically competent on the test items and any error becomes significant. The repetition of nonwords however shows a gradual development across the full age range of the test.

The results of the standardisation seemed to suggest that the rate of development between the ages 4.6 years to 5.5 years was less marked than at the other ages, especially for grammatical markers that are strongly associated with specific language impairment. One possible explanation is that this is due to other social and cognitive developments coming to the fore in this period of early educational experience, once complex grammar is in place. However, the interpretation requires further investigation to substantiate such a claim. An alternative explanation is that the items do not discriminate very precisely between these ages and that more items would help differentiate subtle changes occurring at these ages. Indeed morpho-syntactic development, even after 6;6 years continues with respect to complexity, such as embedding and

in more subtle and stylistic forms, after the initial core grammar is in place (van der Lely, 2005). This possible weakness is balanced against our ethos of achieving a short and quick test.

The results of the pass-fail data reveal that the prevalence of grammatical and/or phonological deficits (i.e., those children in the lowest 5%) in the general population of children between 3:6 and 6:6 years is 6.5%. Tomblin and colleagues' large epidemiological study (> 7000 children) in the US revealed a similar level of 7.4% prevalence of actual SLI in monolingual English-speaking kindergarten children (Tomblin et al., 1997), using a wider range of standardized, diagnostic tests. If we take the 10% criterion (the criterion we are recommending that children are referred for further assessment) then overall approximately 14% of children are identified as in need of further assessment. 8.9% of these children were identified as having grammatical deficits with or without phonological deficits and 9.3% phonological deficits. The prevalence of overall phonological deficits found in this standardisation sample concurs with the expected 10% incidence of dyslexia in the population (Snowling, 2000). We cannot conclude that the children who fail on the GAPS phonological subtest are definitely those that go on to present with phonological developmental dyslexia. However, given our knowledge about dyslexia (Ramus, 2001; Snowling, 2000), such problems with phonological development is likely to put a child at risk for dyslexia. A similar pattern of prevalence of low performance in grammar and phonology but with raised incidence (20% overall) is found using the 15% criterion.

Although the test does not claim to be diagnostic it does highlight children who are weaker in either morpho-syntax (grammar) or phonological processing or indeed both areas. These findings provide further evidence for dissociation of language component impairment as discussed by van der Lely (2005) and Bishop et al (2005). Such dissociations within language

are important as each component deficit is likely to differentially impact on a child's education and would require qualitatively different remedial help. For example, a deficit in morpho-syntactic requires tailored intervention and could impact on understanding classroom instructions as well as reading comprehension, whereas an isolated phonological difficulty might impact more on decoding skills for reading and writing. Thus, it is noteworthy that there is generally a low level of co-morbidity between grammar and phonological deficits as revealed by our sentence and non-word subtests. This study revealed a co-morbidity at the 5% criterion of only 1.4% in the general population. This finding strongly concur with Tomblin and colleagues large epidemiological study (Shriberg, Tomblin, & McSweeny, 1999) that revealed a similar low co-morbidity of 1.3% (Shriberg et al., 1999). The percentages of children in the general population identified with co-morbid weakness in grammar and phonology rises to 4.6% at the 10% criterion and 6.6% at the 15% criterion. In other words, only 33% (5% criterion) to 50% (10% & 15% criterion) of children identified with either a grammar or phonological deficit also had a phonological or grammar deficit respectively. This finding is clearly surprising if auditory-phonological deficits are causing the grammatical deficits in young children from 3:6 years old as claimed by some theories of SLI (Chiat, 2001; Joanisse & Seidenberg, 2003; Tallal & Piercy, 1973) (see (van der Lely, 2005)). However, the results are consistent with recent genetic evidence showing dissociation between geno-phenotypes for phonological and morphosyntactic deficit (Bishop, Adams, & Norbury, in press).

In the small sample of referred children who were exhibiting difficulties in the early school years (table 12), 50% were identified as having phonological and/or grammatical deficits at a level requiring referral. Therefore there were proportionally more children in this group who

were likely to be identified as having language/literacy difficulties than in the standardization sample (table 11). They did not have the same pattern of performance as the diagnosed SLI population where 40% of children failed both subtests at the most stringent 5% cut off as compared to 19% of children the referred children. In the referred sample (table 12), only one child (3% of the small sample; approximately 5% of the standardization sample) failed just the nonword repetition test, whereas one might expect a higher number if their attainment was causing concern. These findings must be treated with caution due to the very small numbers, but suggest that only those children with the most severe and major deficits across a number of areas are those that are referred to outside agencies. Children who are at significant risk of specific reading difficulty due to phonological disability, in isolation from other language difficulties, might not cause too much concern at an early stage of literacy development where other reading strategies can compensate for poor phonological awareness. Such children might be supported sufficiently by schools through a differentiated literacy curriculum at this stage.

In the small sample of children identified as having SLI, at the 10% cut off (where referral would be made); 71% failed the phonological and/or grammatical subtests with 41% of these children failing both subtests, and 23.5% failing the grammatical subtest alone. Once again, there was only one child with an isolated phonological deficit who passed the grammatical items. Thus, the majority of children identified by SLTs as SLI appear to have both morpho-syntactic and phonological deficits. However, 5 (30%) of the 17 SLI children passed both subtests and therefore were not identified by the GAPS as being impaired on core grammatical or phonological abilities. This can be accounted for by different forms of SLI, including those children with primarily lexical or pragmatic deficits. Our percentages of children with

phonological and/or grammatical deficits from this small sample concur with that found in previous research of SLI populations (Conti-Ramsden, Crutchlet, & Botting, 1997; Dockrell, Messer, & George, 2001; Norbury & Bishop, 2002). The children were also likely to have been recipients of good quality intervention in that they attended mainstream schools with specialist language resource provision. This may have accelerated progress in areas tapped by this simple screen.

Finally, these findings emphasise the value of our test in that it provides a first a step in the process of identifying children with specific language difficulties and indeed those who might benefit from a differentiated literacy programme, much earlier than is now routine. Such early identification will mean additional, targeted support can be given at a younger age, thereby hopefully helping prevent the development of wider educational problems.

This standardisation report suggests that such a test can be successfully utilised by a wide range of people working with or caring for young children, not only those with professional training in language tests. Although the untrained testers such as nursery nurses and teaching assistants were slightly more lenient in their marking, they were the most consistent of the testers. Reports from the voluntary testers were predominantly positive and they commented that the test was easy to use and they found the process a valuable exercise. A follow up study will assess the accuracy of non -professionally trained testers through inter-rater reliability.

A follow up of approximately 150 of those children involved in the original standardisation testing is now underway. The children are being assessed on a variety of standardised language and simple reading tests as well as being retested on the GAPS. This study will therefore track the development of children who both passed and failed the GAPS and

confirm whether the former group are continuing to progress well and whether the group that failed continue to have language or literacy difficulties.

## Conclusions and implications

The elicited imitation of sentences that contain grammatical markers of SLI and non-words that vary in phonological complexity provides the basis for this standardised GAPS test. The simple tick/cross scoring method has been combined with a reliable standardisation. The prevalence of grammatical and phonological problems in the general population identified by this quick screening test concurs closely with previous large epidemiological studies based on a lengthy battery of language tests. Thus, the GAPS should form a valuable addition to the battery of full language tests available, for the most part because it is short, simple and does not necessarily require specialist training to administer although this could be provided to many support workers within the prevailing system with little added cost. The focus within education and health is towards more collaborative practice and sharing of expertise; this screen therefore fits well with this ethos.

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## What this paper adds.

**What is already known about this subject**:

Approximately 7% of children have language impairment, and 10% suffer from reading or writing impairment which significantly affects such children reaching their potential. Current standardized tests, requiring professional administration, often lasting more than 30 minutes can identify such children. However there is no short, (quick) standardised screening assessment, utilising key grammatical markers of language impairment and phonological markers for children at risk for dyslexia in the preschool and early school years that could be routinely administered by a concerned parent or professional alike.

**What this study adds:**

We provide details of a new standardised, quick to administer test for professionals and non-professionals: the Grammar and Phonology Screening (GAPS) Test identifies children at risk of language and literacy deficits in similar proportions to those found using much lengthier procedures.