



# **Grammar and Phonology Screening Test (GAPS)**

## **Technical Manual**

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# GAPS

## Technical Manual

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## **About this Manual**

The technical manual for the GAPS test does not need to be read in order to administer or score the GAPS (see: GAPS Administration and Scoring Instructions), but instead provides additional information concerning the development, rationale and structure of the test, for those who are interested.

## **Introduction**

Approximately 7% of children have language impairment and 10% suffer from reading or writing impairment, which significantly affects such children in reaching their potential. Current standardised tests require professional administration and often last more than 30 minutes, to 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 pre-school and early school years, that could be routinely administered by a concerned parent or professional alike.

The 'Grammar and Phonology Screening' (GAPS) Test is a standardised, quick screening tool for language impairment. It is a short, reliable assessment of young children's language abilities. It is individually administered and designed 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 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. It facilitates identification of language impairment or at-risk factors of reading impairment in the early years of education. Thus, this test provides a first step in a process of assessment and targeted intervention to enable children to reach their potential.

The GAPS is effective in detecting a range of children in need of further, in-depth assessment or monitoring for language difficulties. It is designed to be administered by professionals and non-professionals alike.

## **Rationale of GAPS Test**

The 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. It is a tool to identify children with or at risk for developmental language and/or literacy disorders early in their education. It provides preliminary indicators of language component impairment in both morpho-syntax and phonology and lays the foundations for appropriate full assessment and remediation.

The simplicity of the GAPS screen means that it can be routinely administered by professionals and non-professionals alike, either to large cohorts of children prior to or at school entry, or to children showing causes for 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 to look at general levels of language functioning. Thus, 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; abilities which normally developing children would have mastered with no difficulty by around 3 to 4 years of age. (Bishop, Adams, & Norbury, 2004; Bishop, 1997; Conti-Ramsden, 2003; Gathercole & Adams, 1993; Rice, 2004; H. K. J van der Lely, 1996; van der Lely, 1998; van der Lely & Battell, 2003; van der Lely & Stollwerk, 1997).

## **Development of GAPS Test**

The GAPS test is developed from theoretical framework – the Computational Grammatical Complexity (CGC) hypothesis, along with previous research findings. According to the Computational Grammatical Complexity (CGC) hypothesis, children with G-SLI (grammatical specific language impairment) are impaired when performing the mental computations which underlie hierarchical, structurally-complex syntactic, morphological or phonological forms (van der Lely, 2005). The CGC hypothesis emphasises the distinction between syntax, morphology and phonology and their independent and differential effects on sentence processing and production.

These three components of grammar display types of computational complexity not found in the processing needed in other cognitive domains (Chomsky, 1986; Hauser, Chomsky, & Fitch, 2002). Performance in syntax, morphology and phonology 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).

Over a period of more than 10 years, van der Lely and colleagues developed a number of tests and experimental procedures tapping into the three core components of grammar which appeared 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) (H K J 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 Phonological Structure (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.

## Test Construction

**Section1: Test of Grammar (morpho-syntax):** 16 sentences were presented: 2 practice items, 11 test sentences and 3 simple declarative filler sentences. These sentences assessed subject-verb agreement, tense marking (past, future), eg, '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 & 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 (eg, *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 sub-set 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 non-words vary in complexity on the following parameters: i) marked Onset, Rhyme and final nucleus (eg, dremp), ii) marked Rhyme, with an initial unstressed syllable (Iambic stress pattern, rather than a strong-weak trochaic stress pattern (eg, bademper), iii) marked Rhyme and final Nucleus with Iambic structure (eg, difimp), iv) marked Onset and Rhyme with Iambic structure (weak-strong-weak stress pattern) (eg, padrepper). Previous research revealed that a sample of 40 normally developing children between 4:6 to 6 years produced non-words with these structures correctly between 85 to 100% of the time (Gallon et al, submitted). All items were limited to 3 syllables or less in order to minimise the effect of phonological short-term memory which is critical at 4 syllables or more (Gathercole & Baddeley 1990).

## **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 sub-tests 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 Non-word Repetition' (CN-Rep) (Gathercole & Baddeley, 1996). The CN-Rep was administered to children of 4 years of age or older due to its standardisation range. It should be noted, however, that whereas sub-tests on GAPS are specifically designed to pick up children with grammatical or phonological deficits, these tests tap other components of language (eg, vocabulary) or assess a wide range of grammatical structures, some of which are different to those described by other research 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. We therefore predicted that, generally, there should be a moderate rather than high positive correlation between the GAPS and these previously standardised tests.

## **Reliability**

The internal consistency of the pilot 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,  $\alpha = .729$ . These values indicate that the test has good/very good internal consistency. Furthermore, 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**

### **Subjects**

For the standardisation sample, the test was administered to a minimum of 75 and a maximum of 150 children in each of six age bands from 3:4 to 6:6 years. The final usable sample had a total of 668 children. Subjects for the standardisation were gathered from across the UK. The sample was carefully targeted to control, as much 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 was included, but only those for whom English was the first language. Consent was obtained in several areas from whole classes or pre-school groups.

Two small groups of children either causing concern at school or already diagnosed with SLI were 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 was 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.

### **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% was Asian, and 2.6% was Black/Other. The geographic distribution of the standardisation sample is presented in

Table 2. Data for the population was 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 administrators resulted in missing information on gender.

*Table 2. The geographic 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
York & 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

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

## **Administrators**

The test was carried out by a range of health and education professionals, as well as students and carers, using only simple, written instructions. A high proportion of testing was carried out by professional and non-professional volunteers in addition to that done by the research team (who mainly carried out testing at the pilot stage).

Of the 60 administrators (see table 4), 18 were teaching assistants, nursery nurses, play group leaders and mothers. 21 administrators were speech and language therapists, 14 teachers, 7 volunteer undergraduate and post graduate students of speech/language therapy or psychology and lastly a very small group of children were tested by a member of the research team. Testing took place predominantly in schools, nurseries or the children's homes. No inter-rater reliability between professional and other administrators took place, but a feasibility assessment of a small sample of children was marked independently on the tick/cross system by a paraprofessional administrators and speech and language therapist researcher, with 95-100% agreement, at an early stage of the standardisation.

*Table 4: Adjusted mean (SD in brackets) scores on both subtests as a function of type of Administrators*

Administrators Occupation		Sentences	Non-Words
Nursery Nurse	(N = 175)	9.33 (2.43)	6.37 (1.71)
Researcher/Student	(N = 134)	9.17 (2.97)	5.40 (1.93)
Speech Therapist	(N = 180)	8.29 (2.83)	5.62 (2.44)
Teacher	(N = 179)	8.52 (2.67)	5.61 (2.00)

## **Test Considerations**

Elicited imitation procedure was chosen as the basis for the GAPS test. It 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), especially as some para-professionals and non-professionals, unused to formal test procedures, were to take part in the administration.

This methodology also allows a focus on specific aspects of grammar and phonology, which can be precisely manipulated. Since the 1950s (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).

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