# Phonological Processing Screening Test 6-8 (PPST 6-8)

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***Abstract*— Considerable evidence suggests that phonological awareness is associated with the development of skilled reading and spelling. Consequently, it is recommended that beginning readers must be assessed to ensure adequate development of phonemic awareness skills. When choosing an assessment method, reliability, validity, ease of administration, scoring and cost-effectiveness should be considered. To meet these standards, a new phonological awareness assessment measure for Greek children aged 6-8, the Phonological Processing Screening Test (PPST) was developed. The present study investigates its reliability and validity. It is recommended that the PPST must be used to idetify students who need explicit phonological awareness instruction or those who require more extensive individualized assessment.**

***Keywords—reading, spelling difficulties, screening, phonological processing***

## I. INTRODUCTION

Because of the increasing interest concerning the difficulties in the recent years (Adams, 1990; Ball, 1991; Vellutino & Scanlon, 1987). This research has yielded one consistent and clear conclusion: Phonemic awereness is strongly associated with the development of skilled reading. That is, children who understand that spoken words are composed of a series of discrete sounds that can be manipulated are more likely to become skilled readers than are children who are unable to hear and manipulate the individual sounds within words.

Phonemic awareness gradually emerges during the preschool years. By kindergarten, evidence for its causal relationship with later reading success is overwhelming (Adams, 1990; Bryant, 1989, Scarborough, 1990; Stanovich, 1997, 1988, Zorman, 1999, Stavrou, 2002). Given this relationship, inclusion of phonemic awareness activities in kindergarten and first grade is frequently suggested (Mann, 1986; Vellutino & Scanlon, 1995, Stavrou, Gibello & Sarris, 1997). However, not all children develop strong phonemic awareness skills.

Lundberg et al. (1980) reported that approximately 20% of children are affected by weak phonemic awareness skills that put them at increased risk for reading problems. Consequently, it has been recommended that teachers assess beginning readers to ensure proper development of phonemic awareness skills.

Assessment of phonemic awareness has, however, been marked by wide variability. There has been little agreement on the operationalisation of the concept of phonemic awareness which has been measured by many different tasks that tap diverse aspects and levels of linguistic complexity (Stavrou, 1968, Adams, 1990).

Nevertheless, phonemic awareness tasks are generally found to be highly intercorrelated (Mann, 1986) and are thought to be described by only one or two factors (Wagner & Torgesen 1987, 1988). Because phonemic awareness tasks are strongly related, it is important that a reliable and valid assessment method must be selected among the many possible operationalisations. Additionally, it is vital that phonemic awareness assessments designed for classroom use must be easy to administer and score. Finally, any classroom assessment must be cost effective.

Given these criteria, a promising phonemic awareness assessment method is the sound categorization tasks developed by Bradley & Bryant (1985). In these tasks, children were presented with four pictures of objects, three of which rhymed and one that was the odd one out. After naming each of the pictures, children had to select the picture that did not fit with the others (did not rhyme). Ball (1993) pointed out that soun categorization tasks can be altered so that children categorise pictures by initial sounds or judge whether words share the same initial phoneme. Mann (1986) demonstrated that a group testing format is feasible and that the memory load can be reduced by accompanying the spoken words with pictures. Adams (1990) concluded that this type of phonological tests, which they labeled an oddity taks, are the simplest phonemic awareness measure that retains substantial predictive validity for later reading achievement.

Most longitudinal studies based on assumptions derived from the information-processing paradigm and have described four skills that underlie spelling and reading: phonological processing, rapid automatised naming, memory and attention. The term phonological processing refers to the use of phonological information in processing written and oral language (Wagner and Torgesen, 1987). Rapid automatised naming is how quickly the student is able to identify simple visual stimuli (Denckla, & Rudel, 1974). Other researchers have identified memory and attention as predictors for later reading performance (Bowers, Steffy, & Tate, 1988).

Phonological awareness refers to the understanding of the rules about how words are divided into their component sounds and how these sounds are subsequently blended together. Phonological recoding implies the retrieval of phonological codes associated with an object from long-term memory (Wagner, 1988). Phonetic recoding is, recoding information into a sound-based representational system that enables them to be maintained in working memory during ongoing processing (Baddeley 1974; Wagner and Torgesen, 1987).

## II. METHOD

### *A. Participants*

The Phonological Processing Screening Test (PPSΔ) is an individual test which takes about 30 minutes to administer. The sample of the study consisted of 477 first and second-grade school children from 25 primary school in Athens which were tested with PPST four times over a three year period from fisrt through fourth grade. A group of 75 children of this sample were selected for the longitudinal study. All students were of Greek ethnic origin. Boys and girls were equally represented (48% versus 52%, respectively).

Table 1
*Time-Schedule of Assessments*

| Event | N | Measurement | Month | Year | Assessment |
|---|---|---|---|---|---|
| 8 months of next grade | 477 | T1 | Jan. | 2003 | Phonological Processing Screening Test (PPST) |
| 5 months of next grade | 75 | T2 | April | 2003 | (PPS)Retest Intelligence Teachers Ratin ? |
| 2d & 3d grade | 75 | T3 | May | 2004 | Spelling Reading |
| 3d & 4d grade | 68 | T4 | May | 2005 | Spelling Reading |

### *B. Instruments*

The Phonological Processing Screening Test (PPST) is a screening test designed to asess young readers' phonemic awareness, rapid automatized naming (RAN) and attention. The test consists of ten 10 sub-tests. The administration of the PPST typically takes 25 to 30 minutes. All components are preceded with practice items to ensure that children understand the task. The classification of children at risk was done as follows: For each predictor task was set the cut-off for a risk score, which was based on empirical distributions (lowest 15%) of each task. Children who ranged at or below the 15th percentile of the total distribution of scores were classified as children at risk.

To test for differential validity of the PPST, general intelligence was also measured by the Greek adaptation of RAVEN test. Children scoring equal to or below 85 were classified as IQ at risk. Achievement in reading, spelling and math was assessed at the end of second, third and fourth grade. Spelling skills were examined by a specially developed group spelling test (26 words from second grade vocabulary). Reading skills were examined by a standardized reading test. Finally, the children from the longitudinal sample were given a math test, assessing basic math skills.

The tasks that comprised the screening battery and the reading-related processes that each task was thought to assess are described below:

*a. Measures of Phonological Processing:*

i. Blending phonemes to form a word and then selecting from two choices either the picture named by the blend or the picture having the same rime but a different onset.

ii. Judging whether three words rhyme

iii. Deletion test (deleting first phonemes in words)

iv. Segmenting words into phonemes

*b. Measures of Phonetic Recoding in Working Memory:* Repeating multisyllabic (four or five syllables) pseudowords.

*c. Measures of Rapid Automatized Naming (RAN):*

i. Rapidly identifying and orally naming the colours of objects unaided by uncoloured line drawings (Lexical access/Recoding Speed).

*d. Attention: Susceptibility to Distraction:*

i. Rapidly identifying and orally naming the colours of objects depicted in conflicting colours (type of Stroop task); the measure was the time difference between Tasks c and d.

*e. Attention to Visual Letter Sequences: Picking from four spellings pseudowords the one that matches a visible target pseudoword spelling: both accuracy and literacy were measured (type of Marx task).*

*f. Reading pseudowords*

*g. Spelling pseudowords*

Kaplan and Saccuzzo (2001) suggested that when test results may affect an individual's future, one should use a test with a reliability of at least .95. The internal consistency reliability of the PPSΔ has been assessed in two previous studies. First, 70 students from central Athens were tested with the PPS at the end of first an second grade by a coefficient alpha of .90. Second, a representative sample of 120 Athens students was tested nine and five months before they entered

*A. Prediction based on PPS*

The prediction of criterion and control performances by the composite score from the PPST is shown in Tables 3 and 4. Math at T4 is predicted by the composite score from the screening test at a total correct rate of 79,6% which is close to the random correct rate of 65,2%. The RIOC (Relative Improvement Over Chance) is correspondingly low (22,7%). Coming to prediction of specific criteria, spelling is predicted at a total correct rate of 90.7 % which yields a RIOC of

second grade by a coefficient alpha of .92. Both Athens samples were exclusively of Greek ethnic origin and the primary language of these students was Greek)

To test the predictive validity of PPST, the final measurements at the end of the third and fourth grade are presented in this paper. A selection of results restricted to data from measurements at T1 and T2 (predictors) and T4 (criteria) are reported in the results section.

## III. RESULTS

Table 2 presents the correlational results for the total test scores of the PPST battery. Total PPST scores from T1 and T2 correlate at r =.90 (p <.001). The correlation of screening and intelligence is r =.33 at T1 and r =.36 at T2 (p <.001). Total screening score at T1 correlates at r =.82 (p<.001) with total literacy score at T4; the corresponding coefficient for screening at T2 is r =.85 (p <.001).

Table 2

*Correlational Results 2nd & 3d Grade*

| Assessment | PPS T2 | Intelligence | Total literacy score T4 | Maths |
|---|---|---|---|---|
| PPST T1 | .90** | .33** | .82** | .22 |
| PPST T2 | - | .36** | .85** | .27* |
| Intelligence | - | - | .40** | 23 |

**p<.001 *p<.05

The correlations between preschool intelligence, on the one hand, total literacy score, and math achievement are r=.27 (p<.05), and r=.23 (p<.05) respectively.

72.4%. The result for reading is even better: total correct rate is 90.7 % with a correspondingly high RIOC of 77.6%. Combined literacy achievement is predicted best, at a total correct rate of 93,3%, high above random rate by a RIOC of 91.7 %.

Summing up, the results for these controls predictions are clearly exceeded by the rates of correct prediction for spelling, reading, and the composite literacy score.

Table 3

*Results of the classificatory prediction of reading, spelling, and control variables at T4 (end of 2nd & 3d grade) on the basis of the PPS composite score of T1/T2*

### *B. Prediction based on intelligence*

Performance in spelling and reading is predicted by general intelligence at the total correct rate of 78,5% and 76,6 %, respectively, as is shown in Table 4. Literacy is correctly predicted at 63,2%. However, these rates practically do not differ from chance rates when children are divided randomly into «IQ at risk» and «IQ non risk» groups. Rates of random corrects for spelling and literacy are 75% and 56.7% respectively. The best prediction by means of the intelligence classification is that for spelling, although not significantly differing from chance.

Prediction of problem vs. normal children in math achievement is not better: The RIOC (Relative Improvement Over Chance) is correspondingly low (38%).

| Variables at T4 | Sel. Rate (SR) % | Base Rate (BR) % | Max Corr. (MC) % | Val Pos a | Fal Pos b | Fal Neg c | Val Neg d | Total Corr. (TC) % | Rand. Corr. (RC)% | RIOC |
|---|---|---|---|---|---|---|---|---|---|---|
| CONTROL MATHS | 22,7 | 14,7 | 95,3 | | | | | | | 22,7 |
| | | | | 5 | 17 | 6 | 47 | 79,4 | 65.2 | |
| CRITERION | | | | | | | | | | |
| SPELLING | 22,7 | 30,9 | 100 | 17 | 4 | 4 | 43 | 90,7 | 61.3 | 72.4 |
| READING | 22,7 | 27,9 | 98.5 | 16 | 4 | 3 | 45 | 90,7 | 61.3 | 77.6 |
| LITERACY | 22,7 | 25,0 | 96,0 | 16 | 4 | 1 | 47 | 93,3 | 60.1 | 91.7 |

a=valid positives; b= false positives; c=false negatives; d=valid negatives

SR=Selection Rate= (a + b) / N; BR=Base Rate = (a + c) / N; MC= Maximum Correct = 1-(¦SR - BR¦) ;

TC= Total Correct = (a + d) / N ; RC= Random Correct = [(α+b) ¥ (α+c) / N + (c + d) ¥ (b + d) / N] / N * 100

RIOC= Relative Improvement Over Chance = (TC – RC) / (MC – RC) * 100

Table 4

*Results of the classificatory prediction of reading, spelling, and control variables at T4 (end of 3d & 4d grade) on the basis of the of the RAVEN Intelligence Test*

| Variables at T4 | Sel. Rate (SR) % | Base Rate (BR) % | Max Corr. (MC) % | Val Pos a | Fal Pos b | Fal Neg c | Val Neg d | Total Corr. (TC) % | Rand. Corr. (RC)% | RIOC |
|---|---|---|---|---|---|---|---|---|---|---|
| CONTROL MATHS | 28 | 14.7 | 86.7 | 10 | 11 | 1 | 53 | 65.5 | 84 | 38 |
| CRITERION SPELLING | 28 | 25.3 | 98.5 | 12 | 9 | 8 | 39 | 78.5 | 75 | 42.1 |
| READING | 14,1 | 32.4 | 98.5 | 10 | 11 | 12 | 35 | 76,6 | 70,2 | 22.6 |
| LITERACY | 14,1 | 32.4 | 98.5 | 9 | 12 | 13 | 34 | 63.2 | 56.7 | 19.8 |

a=valid positives; b= false positives; c=false negatives; d=valid negatives

SR=Selection Rate= (a + b) / N; BR=Base Rate = (a + c) / N; MC= Maximum Correct = 1-(¦SR - BR¦) ;

TC= Total Correct = (a + d) / N; RC= Random Correct = [(α+b) ¥ (α+c) / N + (c + d) ¥ (b + d) / N] / N * 100

RIOC= Relative Improvement Over Chance = (TC – RC) / (MC – RC) * 100

## IV. DISCUSSION

It has been reported in the literature that 20% to 25% of students do not acquire proficient phonemic awareness skills without direct instruction (reference). Fortunately, phonemic awareness can be developed through instruction and doing so enhances childern`s subsequent skills (Ehri, 1986). It is vital, however, to identify those students who do not spontaneously acquire phonemic awareness skills and provide them with excplicit istruction.

This study was designed to identify whether PPST, intelligence, or other ratings were the best predictors of literacy acquisition. Prior research has suggested that phonological processing and rapid automatized naming (Wolf,1990a,b), were the best predictors of reading and spelling (Wagner, 1987, 1988; Schneider & Näslund, 1992; Marx, Jansen, Mannhaupt, & Skowronek, 1993; Wolf & Bowers, 1999, 2000).

The validity of the PPST is demonstrated by RIOCs of 91,7% for prediction of literacy versus about 22,7% for math and just some 38% for

According to the correlational analyses reported here, the PPST proves to be an instrument that specifically predicts the development of literacy acquisition in Greek students. Even though all correlations of predictors and criteria are highly significant, the correlations representing the specific relation, i.e. between screening composite scores and literacy show the highest values, which means that the differences are highly significant. Combined literacy achievement measured at the end of second grade was best predicted by the phonological awareness variable, followed by the phonological recoding in lexical access and working memory constructs. Obviously, preschool nonverbal intelligence is not a specific and satisfactory predictor for any school achievement, neither for spelling, reading, literacy nor for math achievement at the end of second grade. As can be seen from Table 2, zero-order correlations among most predictors and the two criterion variables were moderately high ranging between .82 and .85.

intelligence at the end of second grade. Our findings of the classificatory prediction seem to support the existing literature in several regards. First, they demonstrate that reading and spelling difficulties will most probably occur at best when more specific indicators of phonological processing skills are not met in first grade. Secondly, the strong impact of working memory and rapid automatized naming (RAN) on the acquisition of literacy emphasised in many recent publications (Compton, DeFries, and Olson, 2001; Cohn, 1992) was also confirmed in this study.

Bruck (1992) suggested that children who scored below 90% on a phonological test were more likely to become poor readers. In line with him, a cut-off score of 15% produced optimal diagnostic accuracy in this sample. A score of 15% or less on the PPST identified 95% of the first-grade students who later experienced major academic problems in second, third or fourth grade.

According to the results, all the tasks in PPST battery are successful in predicting reading failure because they measure processes that are causally involved in literacy acquisition and if these processes are not fully developed, they make reading acquisition difficult.

The present study provides additional data on the PPST's adequate reliability and validity among several samles of students. It produces equivalent results for boys and girls, and PPST's diagnostic accuracy appears excellent. The simple scoring rules make it easy to use and time-efficient. It seems to be a promising new tool for classroom teachers and other educational professionals charged with assessing and predicting the reading and spelling skills of young children.

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