

DETERMINANTS OF READING ACHIEVEMENT IN THE 1st GRADE: ONE YEAR FOLLOW-UP STUDY

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A one-year follow-up study of reading achievement has been conducted among 1st grade children. One hundred and nineteen children were followed up from the final month in kindergarten to the end of the first grade. The sample consisted of 65 girls and 54 boys. The average age of the participants at the beginning of the study was 6 years and 7 months. The aim of the study was to determine the predictors of reading achievement at the end of the 1st grade, reading achievement being defined according to 6 different criteria: reading accuracy, reading rate, text comprehension, reading fluency, midterm Croatian language grade in the 1st grade and final Croatian language grade in the 1st grade. Predictor variables were defined in 3 blocks: (1) parental coaching, which consists of variables preschool sound-letter knowledge and parental involvement; (2) child's cognitive functioning which consists of variables intelligence, spatial orientation, short-term memory (visual and audio); (3) child's phonological sensitivity consisting of variables onset-rhyme blending, word blending, word segmentation, first phoneme elision, pseudoword blending, phoneme elision. Six hierarchical stepwise multiple regression analyses were performed, with each regression equation testing the contribution of 3 blocks of independent variables to one of the 6 criteria of reading achievement. The most robust finding of the study was that all meaningful reading activities measured by reading fluency, comprehension and school language grades were best predicted by the pre-school sound-letter correspondence knowledge, while the contribution of the phonological and cognitive skills was mostly insignificant. The strong contribution of parental involvement was evident only to grade variables. These results are in agreement with those previous data which study reading as the meaning-searching process and not a word-decoding skill.

The results of many studies converge on several determinants of reading achievement. According to these studies, reading achievement may be influenced by cognitive functioning: general cognitive ability (Stanovich, 1988; Morris, Stuebing et al., 1998), short-term memory and spatial orientation (Stanovich, Siegel et al., 1997; Morris, Stuebing et al., 1998; Salonen, Lepola, & Niemi, 1998); simple speech perception (McBride-Chang et al., 1998), letter-sound knowledge (Stevenson & Newman, 1986; Wagner, Torgesen, Rashotte, Hecht et al., 1997) and phonological skills (Goswami & Bryant, 1990). Phonological skills in particular seemed to be predictive of the ability to learn to read, as they are necessary for word decoding, i.e. the awareness of the relationship between

sounds and letters (Whitehurst & Lonigan, 1998 and Snowling, 1996 for review). A growing number of research data pointed to the centrality of phonological awareness in the process of learning to read (Wagner, Torgesen, Rashotte et al., 1997; Wagner, Torgesen, Laughon, Simmons & Rashotte, 1993; Muter, Snowling & Taylor, 1994; Nation & Hulme, 1997; Muter et al., 1997; Goswami & Bryant, 1990). According to these data, phonological sensitivity was the critical factor in learning to read.

While the children who are early readers will show significantly higher sensitivity at all levels of phonological sensitivity (shallow, intermediate and deep) (Stainthorpe &

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Hughes, 1998), the slow readers may or may not show various levels of cognitive deficit, but the lack in phonological skills combined with deficient short-term memory and/or spatial orientation is their typical characteristic (Morris, Stuebing et al., 1998).

Also, it is widely evidenced that direct instruction in word segmentation (letter-sound correspondence) is the inevitable part of reading rehabilitation process (Snowling, 1996; Foorman, Francis & Fletcher, 1998; Whitehurst & Lonigan, 1998; Vellutino, Scanlon & Sipay, 1996; Vandervelden & Segel, 1997), while the pre-school coaching in phonological awareness (Lundberg, 1994) and letter knowledge (Bradley & Bryant, 1983; Cunningham, 1990) predicts better reading achievement by the end of the 1st grade.

However, there are also some inconsistencies and controversies in the research data explaining the relationship between reading achievement and phonological skills, especially those concerning the predictive value of the pre-school phonological awareness. For instance, an English study (Layton, Deeny, Upton & Tale, 1998) recently found that there were no significant differences in written language achievement between subjects who had received phonological training in the preschool stage and those who did not receive it. This finding challenges previous contentions that training preschoolers to pay attention to the sound structure of words promoted later literacy development. Similarly, low predictive value of phonological skills for reading achievement was found in a German language study of 560 children (Mayringer, Wimmer & Landerl, 1998).

Some controversies also can be found concerning the type of phonological skills which are predictive, and those which are not predictive for reading success. The long standing contention that rhyming ability is the crucial predictor of early reading process (Goswami & Bryant, 1990; Stainthorp & Hughes, 1998) or similarly so the rhyme and alliteration recognition and production

(Bryant, MacLean, Bradley & Crossland; 1990) is being challenged by some recent analyses that pre-readers showed two independent phonological factors: rhyming and word segmentation and that only the segmentation skills were predictive for reading achievement at the end of the 1st grade (Muter, Hulme, Snowling & Taylor, 1997). Also, not all kinds of segmentation skills seemed to be equally good predictors of future reading skills, as Nation and Hulme (1997) discovered. Their results indicated that only phonemic segmentation was an excellent predictor of reading achievement, while onset-rhyme segmentation was not, and that the best predictor among segmentation skills was phoneme elision (Nation and Hulme, 1997).

Another complication of the relationship between phonological skills stems from the possible bi-directionality of reading and phonological skills, as some research results indicate that learning to read, i.e. recognizing letters and learning the alphabet principle enhanced the development of phonological skills. Thus, children's preschool letter knowledge influenced the level of their phonological skills (Stevens & Newman, 1986; Wagner, Torgesen, Rashotte, Hecht et al., 1997; Wagner, Torgesen & Rashotte, 1994), but the whole word reading did not (Wagner, Torgesen, Rashotte, Hecht et al., 1997). Actually, the Stevenson & Newman (1986) results established the knowledge of the alphabet at the school entry to be one of the strongest single predictors of short and long-term literacy success.

So, in spite of enormous research efforts during the 80's and 90's, there are still many unanswered questions concerning the relationship between phonological skills and the reading achievement of children. Since individual differences in phonological sensitivity appear to be relatively stable from an early age (Lonigan, Burgess, Anthony et al., 1998), the efforts to identify early phonological skills and/or other factors that do predict future reading achievement, the

screening of children at risk for phonological sensitivity deficits and finding out the types of phonological skills that could and should be developed in pre-school years are the questions of great theoretical and practical significance.

There are several possibilities why no clear-cut answers to these problems from various research data could be given.

The first is the *failure to identify and treat separately different types and levels of phonological skills*. There are several attempts to classify phonological skills according to the developmental sequence, from very simple to complex. One developmental sequence was defined as the development of recognition ability according to the linguistic complexity from word-level, to syllable-level and finally to phoneme-level items (Lonigan et al., 1998). Smith (1998) offered a developmental sequence of phonological skills according to the difficulty of the task, finding 5 tasks at preschool level (rhyme providing, rhyme categorization, sound providing, sound categorization, blending) and 5 tasks at the school level (segmentation - counting, segmentation - naming phonemes, manipulation - deletion, manipulation - substitution, manipulation - reversal). Yet another differentiation of phonological skills is offered in many recent studies of children having reading difficulties. This is the differentiation into core phonological deficit (constitutionally determined, difficult to rehabilitate and best predicted by pseudoword segmentation and synthesis), and surface phonological deficit, amenable to rehabilitation providing adequate coaching is given (Stanovich, Siegel & Gottardo 1997; Vellutino, Scanlon, Sipay et al., 1996).

The second is the *failure to identify and treat separately various types and levels of reading achievement*. In most research reports the word-level reading was used as the measure of reading achievement. That means that accuracy and/or speed of decoding single words was measured. But modern views of the reading process do not regard decoding skills as the ultimate goal

of teaching reading. The reading in the modern view is 'a complex process which requires execution of specific skills at an automatic, even subconscious level which should occur as a byproduct of engagement in meaningful, realistic task', in meaning driven activity' (Marzano & Paytner, 1994; pp. 13-23). It means, that reading achievement can not be measured by a mere accuracy and speed of word decoding, but by a more complex task expressed in terms of reading fluency and text understanding.

The third is the *failure to control for the variables of actual practicing phonological, decoding and reading skills* which is provided before school and during the school year by parents or other adult caregivers. As the research results confirmed the bidirectionality between phonological skills and word-level decoding (Wagner, Torgesen & Rashotte; 1994) and also the direct and independent influence of preschool letter-knowledge on future reading achievement (Stevenson & Newman, 1986) it could well be the case that children coached in phonological skills and letter knowledge prior to entering the school have a double advantage and should show both more highly developed phonological skills and better advancement in literacy development.

It was the aim of this study to avoid some of these omissions of previous research by

- (a) determining the predictors of reading achievement at the end of the 1st grade by taking together all the possible determinants of reading achievement (child's cognitive functioning, phonological skills and preschool and out-of-school experience) and to analyze by the hierarchical regression model their separate and common predictive power for reading achievement;
- (b) defining reading achievement according to several criteria (accuracy, rate, comprehension, fluency, midterm Croatian language grade, final Croatian language grade) and carrying out a hierarchical regression analysis for each of the criteria separately;

- (c) entering into analysis 6 separate measures of pre-school phonological skill of various difficulty and determining the predictive power of each of these measures for the reading achievement at the end of 1st grade.

The general hypotheses of the study are that

- (1) Three sets of variables will determine reading achievement in the 1st grade: the child's pre-school phonological sensitivity, his/her cognitive functioning and pre-school and out-of-school actual reading practice;
- (2) Various predictors will determine different aspects (criteria) of reading achievement: phonological variables being most predictive for reading accuracy and rate, cognitive functioning being predictive for text comprehension, while actual practice in decoding and reading before and during 1st grade being predictive for all measures of reading achievement;
- (3) different pre-school phonological skills will not be equally significant in predicting reading achievement in the 1st grade, i.e. various forms of word segmentation, phoneme elision in particular, would be most predictive for all reading achievement criteria.

METHOD

Participants

Participants in this study were 125 children of the school entering age, in the city of Zagreb. Six children were excluded from the sample as they participated only in the first testing and could not be located later. A total of 119 children were tracked from the last month in the kindergarten to the end of the first grade. There were 65 girls and 54 boys. The average age of the participants at the beginning of the study was 6 years and 7 months.

Procedure

Children were tested 4 times from before the beginning to the end of the first grade.

First session

Children were first seen and tested during their first coming to school for registration, while they were still attending the kindergarten. They were tested for knowledge of sound-letter correspondence, for six different phonological skills and left-right orientation.

Second session

Two weeks after the school year began children were tested by the Raven's Colored Progressive Matrices (performance intelligence) and digit span test (audial short-term memory).

Third session

Two weeks later children were tested for visual short-term memory.

Fourth session

The fourth session took place during the last two weeks of the school year. A test of reading achievement was given to the children. At the same time the midterm and final Croatian language grade was provided by the teachers for all children.

All tests were administered individually.

VARIABLES AND INSTRUMENTS

Independent or predictor variables

Three groups (blocks) of predictor variables were defined.

First block consisted of two variables: preschool knowledge of sound-letter correspondence and parental school involvement. These variables should tap the before-school and out-of-school parental engagement and interest in child's reading development, so we identified this group of variables as *parental coaching*.

Preschool knowledge of sound-letter correspondence

Knowledge of sound-letter correspondence was measured by a shortened version of the *Academic Attainments Checklist Items -AACI* (Sloper et al., 1990). This instrument was originally constructed to test the literacy

skills of Down's syndrome children, so it seemed to be adequate for preliterate children. The reading skill part of the AACI consisted of 17 skills descriptions ranging from "matches pictures of most common objects" and "matches words up to five letters" up to skill level 16: "reads books and magazines for pleasure" and 17: "reads with understanding to get information, i. e. newspapers, brochures". The reading skills scale had to be thoroughly revised. The reduced reading skills scale consists of 10 categories (possible score range 0-10):

1. matches two pictures
2. matches two 5-letter words
3. recognizes own written name
4. reads globally (or phonologically) few very simple words (previous categories 4,5,6,7)
5. knows written alphabet (previous category 8)
6. reads and reacts to simple environmental print STOP, ENTER, EXIT (previous category 10)
7. reads phonologically simple words (previous category 11)
8. reads and follows simple short direction (previous categories 12,13,14)
9. reads books, magazines and game rules for pleasure (previous categories 15, 16)
10. searches for data in books (previous category 17).

The changes had to be made because of different nature of pre-reading skills in Croatian children who rarely or almost never relied on whole word identification or recognition of environmental print.

Parental involvement

Three types of parental involvement with child's school work were rated by the child's teacher on three 5-point rating scales:

Parental involvement with child's school work when asked by teacher, possible score range from 1 - not involved to 5 - highly involved); *Self initiated parental involvement with child's school work* possible score range from 1 - not involved to 5 - highly involved; *Parental involvement in school life* (PI school) defined as the parental

engagement in solving general school problems and in helping teacher with possible score range from 1 - not involved to 5 - highly involved. We summed up the scores in all three kinds of parental involvement to obtain the score in variable *Parental involvement*, possible score ranging from 1 - not involved to 15 - highly involved.

The Second block consisted of the variables performance intelligence, spatial orientation, short-term memory (visual), short-term memory (audio). These variables should monitor the various cognitive functions necessary for reading, so we identified this block as *child's cognitive functioning*.

Intelligence

Intelligence was measured by *Coloured Progressive Matrices* (Raven, 1976), the performance test often used with preliterate children. The *Total score* was the number of correct answers summed across the three scales, possible score range from 0 to 36.

Short term memory (audio)

The child was orally presented with two sets of numerical strings, each set ranging from 3 to 9 digits. After each hearing of the string, the child had to reproduce it. Only a correctly reproduced string obtained a score of 1. The theoretical range of scores was from 0 to 14.

Short term memory (visual)

Visual memory was measured by tasks constructed for the purpose of the study according to PASS methodology (Warrick & Naglieri, 1993). There were 22 pairs of simple graphic designs. The first was the stimulus design which the child was instructed to memorize (a diamond for example). After 6 seconds of looking at the stimulus the page was turned and the child was asked to find the simple design hidden in a complex one. The score was the number of correctly traced stimulus designs in complex designs. Possible range was from 0 - 22.

Left/right spatial orientation

Left/right spatial orientation was measured by the part of the Bangore test which

consisted of 10 requirements ranging in difficulty from 1 (indicating one's right hand to 10 (touching tester's right hand with one's left hand).

Third block consisted of phonological sensitivity variables: onset-rhyme blending, word blending, pseudoword blending, word segmentation, first phoneme recognition and phoneme elision and was identified as *phonological sensitivity*.

Before any formal teaching of reading has begun, six different measures of phonological sensitivity were obtained: 3 segmentation skills (First phoneme recognition, First phoneme elision, Word segmentation) and 3 blending skills (Onset-rhyme blending, Word Blending and Pseudoword Blending). The tasks were given visually (pictures) or orally in the manner described in the most of phonological skills research (Torgesen et al., 1992; Byrne & Fielding-Barnsley, 1993; Wagner, Torgesen & Rashotte, 1994).

First phoneme recognition (phoneme identity task) required children to indicate which of three pictures was beginning with the same sound as the target word. The children saw 4 cards in a row, said aloud the name of the first picture and indicated another picture in the row starting with the same sound. There were 15 different stimuli distributed in 15 rows, each row being showed separately to the child. There were as many practice items as needed for the task to be understood (Torgesen et al., 1992; Byrne & Fielding-Barnsley, 1993; Wagner, Torgesen & Rashotte, 1994).

Onset-rhyme task was given to the children orally by the administrator reading aloud a list of 15 words pronouncing the onset (initial consonant or consonant cluster) separately from the rest of the word. The child was asked to pronounce the whole word after each stimulus. Two separate items were practice items (Wagner et al., 1993; Wagner, Torgesen & Rashotte, 1994).

Word blending task was given by the administrator reading aloud list of 15 words segmented in phonemes. The child was asked to pronounce the whole word after

each stimulus. Two separate items were practice items (Wagner et al., 1993; Wagner, Torgesen & Rashotte, 1994).

Word segmentation task was given to the children orally, the administrator reading aloud 15 words and asking the child after each word to repeat it sound by sound. Two separate items were practice items (Wagner et al., 1993; Wagner, Torgesen & Rashotte, 1994).

Pseudoword blending task was given by the administrator reading aloud the list of 15 pseudowords segmented in phonemes. The child was asked to pronounce the whole pseudoword after each stimulus (Wagner et al., 1993; Wagner, Torgesen & Rashotte, 1994).

Phoneme elision task was also performed with the picture cards. Children were asked to say a word depicted in the picture, then say what that word would be if the first phoneme in the word were deleted. There were 15 pictures of 3 to 8- phoneme words. Separate two items were practice items (Byrne & Fielding-Barnsley, 1993; Wagner, Torgesen & Rashotte, 1994; Wagner et al., 1993).

All phonological tasks were given in 15 trials, so for all of them the possible score range was from 0 to 15.

Dependent or outcome variables

Six different reading achievement measures were defined as dependent variables. Four measures were obtained from direct observation of child reading aloud a short story *The cat is fat* which was constructed purposefully for the reading assessment in the study and no child was familiar with it. A simple story and language format yielded measures of reading achievement, with the observer measuring the time required to read the whole story, counting the number of mistakes (corrected and uncorrected together), assessing the number of correctly answered questions concerning the main points in the story and rating the overall fluency of reading on a nine point scale.

The assessment yielded four indices of reading achievement at the end of 1st grade:

Reading rate (inverse of the duration of reading whole text in minutes and tenths of minutes ranging from less than a minute to over 20 minutes);

Reading accuracy (inverse of total number of all mistakes in reading a passage);

Reading comprehension (answers to 5 questions on main story features, possible range from 1 to 5);

Reading fluency (score given by test administrator on a 9-point scale: from 1-no fluency at all to 9 - perfect fluency).

Two additional measures were language grades given by teacher in the 1st grade:

Midterm Croatian language grade given by teacher in the middle of the 1st grade (grades ranging from 1-fail to 5-excellent), and

Final Croatian language grade given by teacher at the end of the 1st grade (grades ranging from 1-fail to 5-excellent).

RESULTS

Descriptive statistics

The intercorrelations between all predictor and outcome variables are presented in Table 1.

As shown in Table 1., all predictors are mutually rather independent, the intercorrelations being low, except for some of the phonological skills, the highest correlations obtained between pseudoword and word blending (.89), word segmentation and pseudoword blending (.88) and word segmentation and word blending (.87). It seems that these phonological skills were forming a cluster of the most difficult skills for the first graders. The difficulty of each of the phonological skills is evidenced by the differences in M values which are: First phoneme recognition: M=12.93, SD=3.79; onset -rhyme: M=12.42, SD=3.86; word blending: M=11.42, SD=5.85; word segmentation: M=10.88, SD=5.46; pseudoword blending: M=9.71, SD=5.40; phoneme elision: M=7.90, SD=6.25. It is clear from our

data that the most simple phonological tasks for the 1st graders are the first phoneme recognition and onset-rhyme, that difficult tasks are word segmentation, and word and pseudoword blending, while the most difficult task is phoneme elision. These data are in accordance with Smith's (1998) categorization, by which only the first phoneme recognition and onset-rhyme are expected from children entering the 1st class, while the rest develops during the process of learning to read.

The correlations of predictors and outcome variables are highest in the language grade category, the highest predictors being word blending and word segmentation with midterm Croatian language grade (.62, $p<.001$ and .58 $p<.001$ respectively), while all other correlations between predictors and outcomes being in the range from low to medium (.18 to .55).

There were no statistically significant differences in any of the predictors or outcome variables between boys and girls.

Data analysis strategy

Six hierarchical stepwise multiple regression analyses were conducted. For each of the reading achievement criteria one regression equation tested the contribution of 3 blocks of predictor variables, i.e. the parental coaching, child cognitive functioning and phonological skills contribution. The contributions of each block and all the blocks together to 6 criteria of reading achievement are shown in tables 2 to 6.

1. Relationship of reading achievement with three groups of predictor variables

It was predicted that children of higher phonological sensitivity, better cognitive functioning and greater pre-school and out-of-school reading practice provided by parental coaching will have higher reading achievement during and at the end of the 1st grade. It was also predicted that various

Tablica 1. Interkorelacije među prediktorima i zavisnim varijablama

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. |
|-------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1. Preschool sound-letter knowledge | 1.0 | | | | | | | | | | | | | | | | | |
| 2. Parental involvement | .18 | 1.0 | | | | | | | | | | | | | | | | |
| 3. Intelligence | .38 | .06 | 1.0 | | | | | | | | | | | | | | | |
| 4. Spatial orientation | .14 | .21 | .24 | 1.0 | | | | | | | | | | | | | | |
| 5. Short-term memory (visual) | .22 | .08 | .52 | .14 | 1.0 | | | | | | | | | | | | | |
| 6. Short-term memory (audio) | .21 | .11 | .16 | .30 | .28 | 1.0 | | | | | | | | | | | | |
| 7. Onset-rhyme | .37 | .18 | .19 | .08 | .24 | .23 | 1.0 | | | | | | | | | | | |
| 8. Word blending | .52 | .28 | .24 | .25 | .25 | .29 | .73 | 1.0 | | | | | | | | | | |
| 9. Word segmentation | .53 | .18 | .24 | .20 | .30 | .33 | .77 | .87 | 1.0 | | | | | | | | | |
| 10. First phoneme recognition | .37 | .09 | .38 | .17 | .31 | .34 | .47 | .51 | .53 | 1.0 | | | | | | | | |
| 11. Pseudoword blending | .58 | .33 | .26 | .26 | .26 | .30 | .70 | .89 | .88 | .51 | 1.0 | | | | | | | |
| 12. Phoneme elision | .51 | .08 | .45 | .23 | .40 | .32 | .52 | .60 | .68 | .55 | .66 | 1.0 | | | | | | |
| 13. Reading accuracy | .33 | .33 | .23 | .18 | .23 | .29 | .19 | .25 | .30 | .21 | .34 | .34 | 1.0 | | | | | |
| 14. Reading rate | .43 | .29 | .27 | .11 | .14 | .17 | .26 | .37 | .35 | .18 | .33 | .33 | .56 | 1.0 | | | | |
| 15. Reading comprehension | .37 | .18 | .34 | .21 | .28 | .32 | .38 | .40 | .33 | .27 | .42 | .42 | .34 | .35 | 1.0 | | | |
| 16. Reading fluency | .53 | .28 | .38 | .21 | .23 | .33 | .24 | .37 | .39 | .33 | .44 | .44 | .71 | .63 | .48 | 1.0 | | |
| 17. Midterm Croatian lang. grade | .55 | .31 | .31 | .24 | .30 | .36 | .47 | .62 | .58 | .46 | .55 | .55 | .40 | .42 | .40 | .45 | 1.0 | |
| 18. Final Croatian lang. grade | .48 | .37 | .28 | .18 | .44 | .28 | .30 | .36 | .41 | .24 | .47 | .47 | .50 | .49 | .46 | .54 | .63 | 1.0 |

Table 2. Summary of hierarchical regression analysis to predict READING ACHIEVEMENT from groups of variables in 3 steps (parental coaching, parental coaching + child's cognitive functioning and parental coaching + child's cognitive functioning + phonological sensitivity)

| Reading criteria | step 1 | | step 2 | | | step 3 | | |
|------------------|-------------------|----------|---|----------|------------------|--|----------|------------------|
| | Parental coaching | | Parental coaching + cognitive functioning | | | Parental coaching + cognitive functioning + phonological sensitivity | | |
| | R1 ² | F1 | R2 ² | F2 | ΔR2 ² | R3 ² | F3 | ΔR3 ² |
| Accuracy | .05 | 3.18* | .09 | 1.91 | .04 | .17 | 1.79* | .08 |
| Rate | .05 | 3.25* | .14 | 3.06** | .09 | .19 | 2.09* | .05 |
| Comprehension | .22 | 16.48*** | .29 | 7.55*** | .07 | .32 | 4.17*** | .03 |
| Fluency | .39 | 36.53*** | .44 | 14.90*** | .06 | .49 | 8.32** | .04 |
| Midterm grade | .42 | 41.78*** | .47 | 16.62*** | .05 | .56 | 11.37*** | .09 |
| Final grade | .48 | 53.19*** | .58 | 25.43*** | .10 | .64 | 15.40** | .06 |

predictor blocks will have different impact on different reading outcome criteria. The results of hierarchical regression procedure testing these hypotheses are presented in table 2.

The results in Table 2. confirm both hypotheses: all three predictor blocks are predictive of all reading criteria, but the predictive power varies significantly with the type of criterion used. *Reading accuracy and reading rate* are predicted from the used predictors in the least degree, the common variance between them and three predictor blocks being only 17 and 19 percent respectively. This means that more than 80% of the reading achievement variance in these criteria must be explained by factors being different from parental coaching and cognitive and phonological skills. These could be the factors of personal tempo, task motivation, task understanding, or emotional security/insecurity or reaction to testing stress. This is a puzzling result, in stark contrast to much of the published research finding a high predictive value of pre-school phonological skills (see Whitehurst & Lonigan, 1998 and Snowling, 1996 for review) and at the same time being in accordance with the results obtained by Mayringer et al.(1998) and Layton et al.

(1998) who found pre-school phonological skills not to be a powerful predictor for reading achievement at the end of the 1st grade. The possible reason for these discrepancies may be in the difference of measuring accuracy and speed of reading. It is obvious that pre-school coaching and developed phonological skills might be highly predictive for accuracy and speed of word-level decoding, while not having so much influence in reading an integral meaningful text.

Only one third of the variance of *reading comprehension* criterion was explained by the three predictor blocks. Parental coaching was the most predictive block in this case, other blocks adding very little to the total variance of reading comprehension. One possible factor that was not taken into consideration and that might cover a big portion of variance of text comprehension results could be the child's vocabulary which was not entered into analysis and probably not covered by parental coaching in letter knowledge or reading skill practice.

Reading fluency was the criterion assessing the "reading maturity" of the child - that is the reading without mistakes, with appropriate tempo and word stressing and obvious comprehension and enjoyment of

humor and plot of the story. This kind of reading, that we might call mature and accomplished reading, was influenced in the most part by parental coaching block, two other blocks adding together only 10% of variance. Almost half the variance of the mature and fluent reading was explained by the three predictor blocks, the unexplained part being probably again emotional and motivational factors.

The biggest portion of variance explained by the three blocks was for the *grade criteria*: 56% of the midterm Croatian language grade variance and 64% of the final Croatian language grade was explained by three predictor blocks. Although, in both criteria the biggest contribution came from parental coaching block, while the other two blocks, (especially cognitive functioning) were adding a considerable portion of variance to the results.

2. Relationship of reading achievement with predictor variables

Separate contribution of the predictor variables to various criteria of reading achievement are presented in Tables 3 to 7.

The *pre-school sound-letter knowledge* proved to be of low predictive power in both reading accuracy and rate (Table 3 and 4), but of all the variables it was the most powerful predictor of text comprehension and reading fluency (Tables 5 and 6). As the reading fluency in our study was the criterion of mature reading, it seems that learning to read well in school is influenced mostly by before-school knowledge of sound-letter correspondence. This result is in agreement with those research results that stress the importance of pre-school sound-letter knowledge (Stevenson & Newman, 1986; Muter, Hulme et al., 1994) in opposition to those which stress mainly the pre-school phonological skills as the determinants of good future reading (Goswami & Bryant, 1990; Nation & Hulme, 1997; Muter, Hulme, Snowling et al., 1997). Only for the criterion Croatian language grade did the variable pre-school sound-letter knowledge prove to be somewhat less important than variable parental involvement (Tables 7 and 8).

Parental involvement, defined as a sum total of various kinds of attention and engagement that the child received from

Table 3. Hierarchical multiple regression to predict READING ACCURACY (end of 1st grade) from parental coaching, child's cognitive functioning and child's phonological sensitivity

| Independent variables | Beta | R ² | F | ΔR ² | F |
|---|------|----------------|-------|-----------------|-------|
| Step 1. Parental coaching | | .05 | 3.18* | | |
| Preschool sound-letter knowledge | .13 | | | | |
| Parental involvement | .16 | | | | |
| Step 2. Child's cognitive functioning | | .09 | 1.91 | .04 | 1.25 |
| Intelligence | .19* | | | | |
| Spatial orientation | .02 | | | | |
| Short-term memory (visual) | .02 | | | | |
| Short-term memory (audio) | .08 | | | | |
| Step 3. Child's phonological sensitivity | | .17 | 1.79* | .08 | 1.81* |
| Onset-rhyme | .25 | | | | |
| Word blending | .07 | | | | |
| Word segmentation | .39* | | | | |
| First phoneme recognition | .16 | | | | |
| Pseudoword blending | .27 | | | | |
| Phoneme elision | .28* | | | | |

*** $p < .001$; ** $p < .01$; * $p < .05$

Table 4. Hierarchical multiple regression to predict *READING RATE* (end of the 1st grade) from parental coaching, child's cognitive functioning and child's phonological sensitivity

| Independent variables | Beta | R ² | F | ΔR ² | F |
|---|------|----------------|--------|-----------------|-------|
| Step 1. Parental coaching | | .05 | 3.25* | | |
| Preschool sound-letter knowledge | .20* | | | | |
| Parental involvement | .07 | | | | |
| Step 2. Child's cognitive functioning | | .14 | 3.06** | .09 | 2.86* |
| Intelligence | .22* | | | | |
| Spatial orientation | .02 | | | | |
| Short-term memory (visual) | .11 | | | | |
| Short-term memory (audio) | .10 | | | | |
| Step 3. Child's phonological sensitivity | | .19 | 2.09* | .05 | 1.96* |
| Onset-rhyme | .16 | | | | |
| Word blending | .17 | | | | |
| Word segmentation | .16 | | | | |
| First phoneme recognition | .35 | | | | |
| Pseudoword blending | .12 | | | | |
| Phoneme elision | .13 | | | | |

*** $p < .001$; ** $p < .01$; * $p < .05$

Table 5. Hierarchical multiple regression to predict *TEXT COMPREHENSION* (end of 1st grade) from parental coaching, child's cognitive functioning and child's phonological sensitivity

| Independent variables | Beta | R ² | F | ΔR ² | F |
|---|-------|----------------|---------|-----------------|-----|
| Step 1. Parental coaching | | .22 | 16.48* | | |
| Preschool sound-letter knowledge | .42** | | | | |
| Parental involvement | .13 | | | | |
| Step 2. Child's cognitive functioning | | .29 | 7.55*** | .07 | |
| Intelligence | .24* | | | | |
| Spatial orientation | .03 | | | | |
| Short-term memory (visual) | .03 | | | | |
| Short-term memory (audio) | .08 | | | | |
| Step 3. Child's phonological sensitivity | | .32 | 4.17*** | .03 | .85 |
| Onset-rhyme | .07 | | | | |
| Word blending | .21 | | | | |
| Word segmentation | .20 | | | | |
| First phoneme recognition | .02 | | | | |
| Pseudoword blending | .10 | | | | |
| Phoneme elision | .21 | | | | |

*** $p < .001$; ** $p < .01$; * $p < .05$

Table 6. Hierarchical multiple regression to predict *READING FLUENCY* (end of 1st grade) from parental coaching, child's cognitive functioning and child's phonological sensitivity

| Independent variables | Beta | R ² | F | ΔR ² | F |
|---|--------|----------------|----------|-----------------|--------|
| Step 1. Parental coaching | | .39 | 36.53*** | | |
| Preschool sound-letter knowledge | .52*** | | | | |
| Parental involvement | .23** | | | | |
| Step 2. Child's cognitive functioning | | .44 | 14.90*** | .06 | 2.90** |
| Intelligence | .23** | | | | |
| Spatial orientation | .02 | | | | |
| Short-term memory (visual) | .07 | | | | |
| Short-term memory (audio) | .04 | | | | |
| Step 3. Child's phonological sensitivity | | .49 | 8.32*** | .04 | 1.41 |
| Onset-rhyme | .29* | | | | |
| Word blending | .07 | | | | |
| Word segmentation | .38 | | | | |
| First phoneme recognition | .13 | | | | |
| Pseudoword blending | .10 | | | | |
| Phoneme elision | .14 | | | | |

*** $p < .001$; ** $p < .01$; * $p < .05$

Table 7. Hierarchical multiple regression to predict *MIDTERM CROATIAN LANGUAGE GRADE IN THE 1st GRADE* from parental coaching, child's cognitive functioning and child's phonological sensitivity

| Independent variables | Beta | R ² | F | ΔR ² | F |
|---|--------|----------------|----------|-----------------|---------|
| Step 1. Parental coaching | | .42 | 41.78*** | | |
| Preschool sound-letter knowledge | .39*** | | | | |
| Parental involvement | .43** | | | | |
| Step 2. Child's cognitive functioning | | .47 | 16.62*** | .05 | 2.77** |
| Intelligence | .16 | | | | |
| Spatial orientation | .02 | | | | |
| Short-term memory (visual) | .12 | | | | |
| Short-term memory (audio) | .04 | | | | |
| Step 3. Child's phonological sensitivity | | .56 | 11.37*** | .09 | 3.71*** |
| Onset-rhyme | .06 | | | | |
| Word blending | .30* | | | | |
| Word segmentation | .02 | | | | |
| First phoneme recognition | .07 | | | | |
| Pseudoword blending | .05 | | | | |
| Phoneme elision | .09 | | | | |

*** $p < .001$; ** $p < .01$; * $p < .05$

Table 8. Hierarchical multiple regression to predict FINAL CROATIAN LANGUAGE GRADE IN THE 1st GRADE from parental coaching, child's cognitive functioning and child's phonological sensitivity

| Independent variables | Beta | R ² | F | ΔR ² | F |
|---|--------|----------------|----------|-----------------|---------|
| Step 1. Parental coaching | | .48 | 53.19*** | | |
| Preschool sound-letter knowledge | .39*** | | | | |
| Parental involvement | .49** | | | | |
| Step 2. Child's cognitive functioning | | .58 | 25.43*** | .10 | 6.50*** |
| Intelligence | .19** | | | | |
| Spatial orientation | .02 | | | | |
| Short-term memory (visual) | .23** | | | | |
| Short-term memory (audio) | .00 | | | | |
| Step 3. Child's phonological sensitivity | | .64 | 15.40*** | .06 | 2.85** |
| Onset-rhyme | .07 | | | | |
| Word blending | .17 | | | | |
| Word segmentation | .27 | | | | |
| First phoneme recognition | -.23 | | | | |
| Pseudoword blending | -.19 | | | | |
| Phoneme elision | .22 | | | | |

*** $p < .001$; ** $p < .01$; * $p < .05$

his/her parents during the process of learning to read in the 1st grade proved to be most significant predictor of the midterm and final Croatian language grade, even more important than pre-school sound-letter knowledge (Tables 7 and 8). Also a small but significant contribution of parental involvement was evidenced to the criterion reading fluency (Table 6). These results are in accordance with previous research data that found many positive schooling outcomes related to parental involvement (Schneider & Coleman, 1993; Grolnick & Sloviaczek, 1994; Fantuzzo et al., 1995) and especially those pertaining to parental involvement in the teaching of reading (Leach & Siddal, 1990). The lesser influence of parental involvement on actual reading fluency compared to that on school grades could be explained by the results of Schneider & Coleman study (1993), that home-based parental involvement reflecting mainly personal and cognitive involvement had the major influence on children's actual knowledge, while parental involvement reflecting parent-school social interactions mostly affected children's grades. It seems from our data that a larger part of the variable parental

involvement pertained to the teacher-parent interactions, having the most influence on child's grades, while a smaller part was reflected in parental cognitive engagement with the child, having some influence on actual knowledge to read (reading fluency).

Of all the child's cognitive functioning variables only a small contribution of *child's performance intelligence* was obtained for all the criteria of reading success, with the exception of midterm Croatian language grade (Table 8), probably due to the fact that some level of intelligence is needed to understand tasks of phonemic segmentation and applying the sound-alphabet principle. After this level is secured, factors other than intelligence are important in learning to read. The puzzling result is obtained concerning the *visual short-term memory* (Table 8). While some research found verbal short-term memory to be important independent contributor to the ability to read (Vellutino, Scanlon, Sipay et al., 1996; Hansen & Bowey, 1994; Pennington & Ozonoff, 1996) it is interesting that in our study the verbal (audio) short-term memory had no influence on any reading criterion, while the final Croatian language grade was influenced by

visual short-term memory. But, as short-term memory is the variable showing the highest correlation with the intelligence, it probably contributed to the final grade because of its tapping the general intelligence variable.

The influence of *pre-school phonological skills* on various reading achievement criteria was not as strong as might have been expected, based on the vast literature pointing to the pre-school phonological sensitivity as the best predictor of future reading achievement. *Word segmentation* and *phoneme elision* proved to be predictors of reading accuracy, but only mildly so (Table 3). These results are in agreement with the results of Muter, Hulme, Snowling & Taylor (1997) that word segmentation is the best phonological skill predictor of future reading accuracy and those of Nation & Hulme (1997) showing that only phonemic and not onset-rhyme segmentation is important. *Onset-rhyme* proved to be predictive for the fluency of reading (Table 4), while the *first sound recognition* was most predictive for reading rate. These results are difficult to explain, unless they signify the automatization process in mature reading. In that case, in fluent reading the segmentation process may be automated, while the recognition of the beginning and general structure of the word is important for quick and automatic word decoding, resulting in high fluency. Of all the phonological skills only the *word blending* proved to be predictive for the midterm Croatian language grade (Table 6), while not contributing at all to the final Croatian language grade (Table 8). It is probably the beginning of learning to read that is most influenced by phonological sensitivity, because most of the children improved in phonological sensitivity by actual reading and their further progress was determined by other factors.

DISCUSSION

Taken together, all the data of the present study signify the complexity of the process of learning to read. Many factors along with

the phonological skills determine reading achievement if we define reading as an intentional activity aimed at extracting meaning (Marzano & Paytner, 1994) and not as decoding skills at the word level. This explains some of the discrepancies between various results pointing to the importance of pre-school phonological skills (Goswami & Bryant, 1990; Nation & Hulme, 1997; Muter, Hulme, Snowling et al., 1997) or to its less importance (Mayringer et al., 1998; Layton et al., 1998). It might be that these discrepancies in the results came out from the differences in defining the reading achievement, phonological variables being important for the word-level accuracy and rate, while other variables contributed more to mature kind of reading defined as fluency. So it was justified to use various reading criteria and expect them to be differently predicted by pre-school phonological abilities.

The most robust finding of the present study is that all meaningful reading activities measured by reading fluency, comprehension and Croatian language grades were influenced mostly by the pre-school sound-letter correspondence knowledge (tables 4, 5, 6, 7 and 8). This result is in accordance with the Stevenson & Newman (1986) contention that "knowledge of the alphabet at entry into school is one of the strongest single predictors of short- and long-term literacy success". It is maybe because of the dominance of this variable that phonological skills variables seemed less important, because knowledge of sound-letter correspondence was already involving good phonological skills. Our data similarly pointed to the conclusion that phonological coaching combined by letter knowledge activities should be a part of every child's pre-school experience.

Interesting results were obtained with the parental involvement as a predictor of future reading success. Parental involvement is mediating background family characteristics to child's school success at least in 3 possible ways:

1. through parent's social interactions with school or community, 2. through parental personal involvement (interests and affects) and 3. through cognitive/intellectual involvement which might be in the form of indirect stimulation or direct instruction (Grolnick & Sloviaczek, 1994). It has been found that children from all family types benefited from high levels of parental involvement (Schneider & Coleman, 1993). However, as was pointed out in the Schneider & Coleman study (1993) the personal and cognitive involvement had the major influence on children's test scores while the parent-school social interactions mostly affected children's grades. Our results point to the strong effect of parental involvement on grades and much less strong one on the actual reading fluency. It could be that in the case of our parental sample the superficial and social-pressure kind of parental involvement was more represented than other types.

There are still many unanswered questions on the relationship between a pre-school child's characteristics and learning to

read. One is concerning possible contribution of many non-measured variables such as child's pre-school vocabulary (Whitehurst & Lonigan, 1998), pre-school and school reading motivation (Salonen, Lepola & Niemi, 1998), simple speech perception (McBride-Chang et al., 1998), and possible interaction of pre-school simple speech perception and phonological sensitivity with parental pre-school coaching. It should be a study of a longitudinal follow-up from the child's third year to the end of the 1st grade that could discern between the child's biological make up and the environmental influences, so that the real contribution of all these variables could be assessed. Also, the kind of teaching in the 1st grade could and actually should be the important determinant of reading achievement. On the practical level, the conclusion remains that parental pre-school engagement and involvement in the child's school progress is the best predictor of child's future reading success, assuming the school program is organized and taught as it is now.

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