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Age and Schooling Effects on Early Literacy and Phoneme awareness

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Abstract

Previous research on age and schooling effects is largely restricted to studies of children who begin formal schooling from the age of 6 and the measures of phoneme awareness used have typically lacked sensitivity for beginning readers. Our study addresses these issues by testing children aged 4-6 (first two years of formal schooling in the UK) on a sensitive dynamic measure of phoneme awareness and tests of early literacy. There were significant effects of both age and schooling on dynamic and static measures of phoneme awareness, word reading, spelling and letter-name knowledge but no significant age × time interactions. This indicates that older children within this age group generally outperform their younger classmates (although they do not make faster progress), and that this advantage is developed prior to the start of school.

Keywords: Reading, spelling, phoneme awareness, letter knowledge, dynamic assessment

Age and Schooling Effects on Early Literacy and Phoneme awareness

There are well-established effects of schooling on phonemic awareness (Christian, Morrison, Frazier, & Massetti, 2000) with evidence of only minimal levels of this skill in pre-schoolers (Carroll, 2004). Similar results have been shown with regard to early literacy with the effect of one year of schooling being consistently stronger than the effect of one year extra age on reading and spelling during the first years of school (Crone & Whitehurst, 1999; Morrison, Griffith, & Alberts, 1997). However, it may be that significant age effects have been underestimated by previous research because a) the children tested all began formal schooling around the age of 6, therefore minimizing differences in relative age within the sample, and b) the phoneme awareness measures used lacked sensitivity/ reliability. The current study investigates these possibilities by examining age and schooling effects on dynamic and static measures of phoneme awareness, reading and spelling in children aged 4-6 (first two years of formal schooling in the UK). The 'cut-off' method is used whereby the oldest and youngest children in first grade (age effect) are compared with the oldest children in kindergarten (schooling effect).

Age effects may be more visible in children who begin schooling at a younger age. For example, the difference in performance between a 4 and 5 year-old Kindergartner (25% difference in age) may be greater than between a 5 and 6 year-old Kindergartner (20% difference in age). Children in Australia and the US (and most European countries) typically begin formal reading instruction in first grade at the age of 6-7, although letter learning and instruction in phonics usually begins in Kindergarten (age 5-6), and many children pursue reading-related activities earlier at home and in pre-school (National-Reading-Panel, 2000). In the UK, children are age 4-5 when they begin learning how to read at school, and there are associated concerns

about the performance of the youngest children (e.g., Alexander, 2009; Sharp, George, Sargent, O'Donnell, & Heron, 2009). Therefore, it is of increasing relevance to know about age effects on reading in children below the age of 6.

Often, floor effects are evident on tests of phoneme awareness in children who have been in formal schooling for less than a year which leads to a variable that is not statistically viable for analyses due to a positive skew and lack of variation (e.g., Carroll, Snowling, Hulme, & Stevenson, 2003). The current study avoids these difficulties by using a dynamic measure of phoneme awareness. During a dynamic test, if the child initially provides an incorrect answer, the experimenter gives gradually increasing assistance in order to guide the child to the correct response (Spector, 1992). The level of assistance required can be used as an indication of learning potential as well as current attainment. This approach should reduce poor scores due to lack of understanding, as well as increasing reliability. Consequently, age effects (if there) should be more accurately reflected.

Age effects on literacy and phoneme awareness are likely to be caused by informal experience of language outside of school. For example, activities such as rhyming games, music and poetry can enhance phonological awareness (Fazio, 1997). Reading and spelling skills can be stimulated by exposure to ‘reading-readiness’ activities such as alphabet learning and word recognition games. It follows that older children would begin school with higher levels of phoneme awareness and early literacy than their younger peers due to longer exposure to these activities both at home and in pre-school. This hypothesis is supported by evidence of a significant age effect on phoneme awareness (Bentin, Hammer, & Cahan, 1991; Cunningham & Carroll, in press; Morrison, Smith, & Dowehrensberger, 1995) and emergent literacy (Crone & Whitehurst, 1999; Morrison, et al., 1997) during pre-school.

The picture after the onset of school is less clear. Studies have shown that by the end of Grade 1/ beginning of Grade 2, there is no longer a significant difference in phoneme awareness between older and younger children in the same grade (Bowey & Francis, 1991; Morrison, et al., 1995). This implies that once formal reading instruction begins, its effect on phoneme awareness is so strong as to supersede the age effect. Similarly, a large-scale study by Crone and Whitehurst (1999) found no significant age effects on measures of reading and spelling during first and second grade, despite such effects in Kindergarten, while a similar study by Morrison et al. (1997) found a small but significant age effect on reading during first grade. Such evidence implies that in general, older children fail to maintain a lead in literacy and phonological skills after formal schooling begins. However, in all the above studies, mean differences were in favour of the older children and it is possible that age effects were underestimated.

In the case of Bowey and Francis (1991), one possibility is that an age effect was present but that it was not detected due to the nature of the phonological awareness tasks used. First, oddity tasks were used, which often lack reliability (Hulme, et al., 2002) and do not require explicit phoneme awareness (Carroll & Snowling, 2001). Second, none of the Kindergarten children scored above chance on the task requiring phonemic analysis, suggesting a lack of sensitivity. The use of a dynamic test of phoneme awareness in the current study will improve reliability and sensitivity. This is particularly important when testing very young children who are more likely to exhibit floor effects on static tasks.

Finally, other studies in this area (including those mentioned above) have typically tested children who begin formal reading instruction no earlier than the age of 5-6. Our sample is unique in consisting of children who are particularly young at the onset of formal schooling (4-5 years). Children of this age enter the ‘Reception’ year (roughly equivalent to kindergarten in the

US), where they are taught reading via systematic instruction in synthetic phonics. Therefore, we hypothesise that our sample will be more likely to exhibit significant age effects. In addition, children in our study were reassessed after six months to test for age × time interactions. This allowed us to see whether the older children made faster progress than their younger counterparts, as well as showing absolute levels of performance.

Method

Participants

Participants were 45 children recruited from one state-funded school in England. At this school, all children entered Reception in the September regardless of birth date. To be consistent with other studies in the area, Reception will be referred to as kindergarten and Year 1 as first-grade in the current paper. However, it should be noted that children in the UK begin reading instruction from the start of kindergarten. Fifteen of the oldest children in kindergarten were compared to 15 of the youngest children in first-grade, who in turn were compared to 15 of the oldest children in first-grade.

All groups completed the BPVS vocabulary test (Dunn, Dunn, Whetton, & Burley, 1997) at the start of kindergarten. BPVS data for the two first-grade groups were collected one year prior to the other measures during screening for a previous longitudinal study (see Cunningham & Carroll, in press). There were 15 older children in kindergarten born within 3 months of the cut-off date (31st August); therefore, all were included in the final sample. In first grade, there were 22 older children and 17 younger children, allowing for some degree of selection to take place. Fifteen children in each group were pairwise-matched on vocabulary score (within 4 points).

At time 1 the average age in the old kindergarten group was 5;0 years, range 4;11 -5;2. In the young first-grade group it was 5;2 years, range 5;1 -5;4, and in the old first-grade group it was 5;11 years, range 5;10- 6;0. Word reading data were not collected from one child in the old kindergarten group due to refusal to participate. There were no significant differences between the groups in standardized vocabulary, maternal and paternal education level, shared book reading at home, family literacy and age that parent began reading to their child. However, as expected, the young first-graders had spent fewer months in pre-school than the old kindergarteners, $t(38)= 2.15$, $p <.05$, $r = .33$, and the O1s, $t(38)= 3.08$, $p <.01$, $r = .45$, due to the month of their birth (see Table 1).

Design and procedure

The full sample was tested at two time points during the course of one school year, once during October-November (time 1) and again six months later during April/May (time 2). Children were tested by the first author in a quiet corner of the school.

Time 1. Word reading, letter-sound knowledge, letter-name knowledge, phoneme deletion, dynamic (and static) phoneme segmentation, vocabulary, home literacy environment.

Time 2. Word reading, spelling, letter-sound knowledge, letter-name knowledge, static phoneme segmentation.

Materials

Phoneme awareness tasks.

Dynamic phoneme segmentation. A dynamic test of phoneme segmentation was developed based on the task presented in Spector (1992). Children were asked to segment 12 non-words into their constituent phonemes e.g. 'what are the sounds in *shreb*?*',* and were given

increasingly explicit prompts to help them to do this e.g. ‘what’s the first sound you hear in *shreb*?’. There were 7 prompts in total which were negatively coded. Sample-specific reliability was high, Cronbach’s α = .94.

Static phoneme segmentation. A static phoneme segmentation score for time 1 was derived from the dynamic assessment by giving a score of 1 if no prompts were required and a score of 0 if any prompts were required (as would be the case had it been administered as a static task). At time 2, the same items from the dynamic task were administered again as a static task; no prompts were given. Sample-specific reliability was good, Cronbach’s α = .81.

Phoneme deletion. The Phoneme Deletion (beginning and end sounds) sub-test from the Phonological Abilities Test (PAT) (Muter, Hulme, & Snowling, 1997) was administered as an additional static measure of phoneme awareness. This task was not administered again at T2 due to ceiling effects at T1. Sample-specific reliability was high, Cronbach’s α = .95.

Literacy tasks

Letter-sound knowledge. Each of the 26 lower case letters were presented individually on cards in random order. Children were asked to pronounce the sound of the letter. Sample-specific reliability was high, Cronbach’s α = .95.

Letter-name knowledge. Same as above except that children were asked to pronounce the name of the letter, not the sound. Sample-specific reliability was high, Cronbach’s α = .94.

Word reading. Test was from the British Ability Scales 2 (BAS) (Elliot, Smith, & McCulloch, 1996). Children were asked to read as many words as possible from a list. The published split-half reliability of this test was high at .88.

Spelling. Spelling was measured using the British Ability Scales 2 spelling test (Elliot, et al., 1996). Children were asked to spell individual words presented orally by the experimenter within a sentence. Sample-specific reliability was high, Cronbach's $\alpha = .94$.

Home literacy environment.

A questionnaire was sent home to parents. It consisted of 16 questions that focused on the child's exposure to literacy-related activities in the home, one question on number of months spent in pre-school and two questions on parental education level.

Results

Table 1 shows descriptive statistics and between-subjects ANOVA results for the phoneme awareness and literacy measures at time 1 and time 2. In total, 13 ANOVAs and 20 pairwise comparisons were conducted. In the case of multiple comparisons, procedures for controlling familywise error rate (e.g. Bonferroni) are usually conducted. These are conservative, but are performed at the expense of power. Therefore, instead, adaptive linear step-up procedures were adopted to control the false discovery rate (the expected proportion of false positives among significant results) at 5% (Benjamini, Krieger, & Yekutieli, 2006). Since a large number of our comparisons were highly significant (14/33 $p \leq .001$), linear step-up resulted in an increase in the critical value required for significance. Eighteen null hypotheses were rejected at the first stage of the two-stage procedure run at level 0.05/1.05. At the second stage, the procedure was run at level $(0.05/1.05) \times 33/ (33\text{-}18) = 0.105$, resulting in the rejection of 25 null hypotheses. Adjusted p values are given below using equation 15 reported in Dudoit, Gilbert, & van der Laan (2008; p.723).

Three 3-way mixed ANOVAs were conducted on scores for the static phoneme segmentation task, word reading and letter-name knowledge at time 1 and time 2. Improvement

in letter-sound knowledge was not analyzed due to ceiling effects at time 2. Time was entered as a two level within-subjects factor and group as a three level between-subjects factor. Planned contrasts comparing the young with the old first-graders revealed age effects while contrasts between the old kindergarteners and young first-graders showed schooling effects. There was a significant effect of time on all tasks, indicating that groups made significant progress between time 1 and time 2. Contrasts between the progress (from time 1 to time 2) of the old kindergartens and young first-graders showed schooling × time interactions while age × time interactions were determined by comparing the progress of the young and old first-graders.

There were significant schooling effects on word reading, (mean score across time points: old kindergarteners= 6.65, young first-graders= 21.17) $t(41)= 3.48$, $p < .01$, $r = .48$, letter-name knowledge, (old kindergarteners= 10.24, young first-graders= 16.44) $t(42)= 2.91$, $p <.01$, $r = .41$, and static phoneme segmentation, (old kindergarteners= 5.04, young first-graders= 7.14) $t(41)= 2.28$, $p =.02$, $r = .34$. There were significant age effects on word reading, (old first-graders = 29.14) $t(41)= 1.94$, $p =.04$, $r = .29$, and letter-name knowledge (old first-graders= 20.8), $t(42)= 2.05$, $p =.04$, $r = .30$, but not for the static phoneme segmentation task (old first-graders= 8.24) $t(41)= 1.22$, $p =. 13$, $r = .19$.

For the word reading measure, contrasts revealed non-significant schooling × time, $t(41)= 1.13$, $p = .14$, $r = .17$, and age × time, $t(41) = 0.08$, $p = .45$, $r = .01$ interactions. For letter-name knowledge there was no schooling × time interaction, $t(42)= 0.44$, $p =.33$, $r = .07$. However, there was a significant age × time interaction in a negative direction; the young first-graders made more progress than the old first-graders (mean change scores: young first-graders= 7.13, old first-graders= 3.87), $t(42)= -1.78$, $p <.05$, $r = .27$. For phoneme segmentation, both interactions were significant in a negative direction; the old kindergarteners made more progress

than the young first-graders (old kindergarteners= 6.36, young first-graders= 4.80), $t(41)= -1.95$, $p = .03$, $r = .29$, and the young first-graders made more progress than the old first-graders (old first-graders= 2.60) $t(41)= -2.81$, $p < .01$, $r = .40$. It is likely that these effects are due to ceiling effects on these measures at time 2.

Four one-way ANOVAs were performed to look for between-group differences on measures performed at one time point only. Contrasts revealed that there were significant schooling effects on dynamic phoneme segmentation (mean scores: old kindergarteners= 20.73, young first-graders= 45.40) $t(42)= 4.52$, $p < .01$, $r = .57$, phoneme deletion (old kindergarteners= 3.73, young first-graders= 9.53) $t(42)= 3.25$, $p < .01$, $r = .45$, letter-sound knowledge (old kindergarteners= 12.20, young first-graders= 23.67) $t(16.67)= 5.91$, $p < .01$, $r = .82$, and spelling (old kindergarteners= 9.60, young first-graders= 16.93) $t(20.76)=3.69$, $p < .01$, $r = .63$. There were significant effects of age on dynamic phoneme segmentation, (old first-graders= 56.13) $t(42)= 1.97$, $p = .04$, $r = .29$, and spelling (old first-graders= 21.93) $t(27.45)= 1.85$, $p < .05$, $r = .33$, and a near-significant effect on phoneme deletion, (old first-graders= 12.60) $t(42) = 1.72$, $p = .06$, $r = .26$. There was no significant age effect on letter-sound knowledge, $t(26.75)= 0.80$, $p = .22$, $r = .15$.

Discussion

This study investigated age and schooling effects on the development of phoneme awareness and early literacy skills in children aged 4-6 during the first two years of formal schooling. We found significant effects of age and schooling on almost all measures, with the effect of one year of schooling being roughly twice as large as the effect of up to one year's difference in age. There were no significant age × time interactions indicating that the older first graders did not make faster progress across the year than the younger first graders. This would

suggest that the advantage of the elder group was developed during pre-school and the kindergarten year, and maintained during first grade, rather than increased.

The existence of strong schooling effects is unsurprising given that the young first-graders had received an additional year of school-based instruction compared to the old kindergarten group. There is also a strong focus on reading tuition via a phonic approach during the first two years of school in the UK which may have enhanced the observed schooling effects. More novel is the discovery of significant age effects during first grade. This is in contrast to previous research which has found no significant effect of age on similar measures of phoneme awareness (Bowey & Francis, 1991; Morrison, et al., 1995) and literacy (Crone & Whitehurst, 1999; Morrison, et al., 1995) in first grade. A possible explanation for these different findings may be the relative ages of our children. Samples from the above studies were one year older at the onset of formal schooling (5-6 years) than the current UK sample (4-5 years). The difference in performance between a 4 and a 5 year old may be greater than between a 5 and a 6 year old, therefore leading to larger age effects. With regard to phoneme awareness, there was a significant age effect found on the dynamic task, but not the two static tasks. This may be because our dynamic test was a more sensitive measure of phoneme awareness than the oddity tasks used by Bowey and Francis (1991), which showed floor effects.

All groups experienced significant in the six months between time 1 and time 2, but there were no age × time interactions. This is inconsistent with the hypothesis that older children respond better to instruction than their younger classmates, and raises the question of how mean level differences in favour of the older children developed in the first place. A possible explanation is that the older children entered school with higher levels of skill than their younger peers, but that once formal reading instruction began, its influence was so strong that it affected

all children equally, regardless of starting ability. Older children may develop better phoneme awareness prior to school as a result of longer exposure to phonologically enhancing activities such as rhyming games, music and poetry at home and in pre-school (Fazio, 1997). With regard to word reading and letter-knowledge, it may be that parents of relatively older children do more 'reading readiness' activities (alphabet learning, word recognition games) at home prior to school because they know that children of the same age are being exposed to these activities at school.

Negative interactions for the phoneme segmentation task (old kindergarteners made more progress than the young first-graders, who made more progress than the old first-graders) may be explained by ceiling levels of performance on this task for the two first grade groups. It may also be reflective of the efficacy of the synthetic phonic approach, particularly during the first year, when growth in phoneme awareness may be at its highest. The better progress of the young compared to old first-graders on letter-name knowledge is most likely due to the fact that letter knowledge is expected to be complete by the end of first-grade; therefore, given their initial advantage, the older children had less scope for improvement than their younger counterparts.

There are two main limitations to the current research. First, our sample was from an area of relatively high socio-economic status. It is possible that more affluent parents spend longer on reading-readiness activities with their older children prior to school, thus leading to an exacerbation of the age effect. However, although the school was in a middle-class area, average maternal education level was not particularly high; between the equivalent of a school certificate (age 16) and a high school certificate (age 18) for the two first grade groups and just beyond a high school certificate for the old kindergarten group. Second, the small sample size raises issues of power, although the adoption of linear step-up procedures reduces this problem in the present

experiment. Nevertheless, further research with a larger, more diverse sample would be necessary to test the robustness of our results.

The significant age effects observed are especially relevant in light of recent concerns about the performance of the youngest children during the first years of school which would appear to be, to some extent, warranted (e.g., Alexander, 2009; Sharp, et al., 2009). It would be useful for educators to know that older children, on average, are likely to have better reading and phoneme awareness skills during the first two years of school, although they are not expected to develop these skills faster. They can then take this into account when organising ability groups and differentiating lessons. There are also implications in terms of standardized cognitive tests, which normally use either age-based or school year based standardization. For this age group, both types of standardization may be advisable to take into account age and schooling effects.

References

Alexander, R. (2009). The Cambridge Primary Review. Retrieved 20th October, 2009, from http://www.primaryreview.org.uk/

Benjamini, Y., Krieger, A. M., & Yekutieli, D. (2006). Adaptive linear step-up procedures that control the false discovery rate. *Biometrika, 93*(3), 491-507.

Bentin, S., Hammer, R., & Cahan, S. (1991). The Effects of Aging and 1st-Grade Schooling on the Development of Phonological Awareness. *Psychological Science, 2*(4), 271-274.

Bowey, J. A., & Francis, J. (1991). Phonological Analysis as a Function of Age and Exposure to Reading-Instruction. *Applied Psycholinguistics, 12*(1), 91-121.

Carroll, J. M., & Snowling, M. J. (2001). The effects of global similarity between stimuli on children's judgment of rime and alliteration. *Applied Psycholinguistics, 22*(3), 327-342.

Carroll, J. M., Snowling, M. J., Hulme, C., & Stevenson, J. (2003). The development of phonological awareness in preschool children. *Developmental Psychology, 39*(5), 913-923.

Christian, K., Morrison, F. J., Frazier, J. A., & Massetti, G. (2000). Specificity in the nature and timing of cognitive growth in Kindergarten and First Grade. *Journal of Cognition and Development, 1*(4), 429-448.

Crone, D. A., & Whitehurst, G. J. (1999). Age and schooling effects on emergent literacy and early reading skills. *Journal of Educational Psychology, 91*(4), 604-614.

Cunningham, A. J., & Carroll, J. M. (in press). Reading-related skills in earlier and later schooled children. *Scientific Studies of Reading*.

Dudoit, S., Gilbert, H. N., & van der Laan, M. J. (2008). Resampling-Based Empirical Bayes Multiple Testing Procedures for Controlling Generalized Tail Probability and Expected

Value Error Rates: Focus on the False Discovery Rate and Simulation Study. *Biometrical Journal, 50*(5), 716-744.

Dunn, L. M., Dunn, L. M., Whetton, C., & Burley, J. (1997). *The British Picture Vocabulry Scale. Second Edition*. Windsor, Berkshire: National Foundation for Educational Research - Nelson.

Elliot, C. D., Smith, P., & McCulloch, K. (1996). *British Ability Scales: Second edition*. Slough: National Foundation of Educational Research.

Fazio, B. B. (1997). Memory for rote linguistic routines and sensitivity to rhyme: A comparison of low-income children with and without specific language impairment. *Applied Psycholinguistics, 18*(3), 345-372.

Hulme, C., Hatcher, P. J., Nation, K., Brown, A., Adams, J., & Stuart, G. (2002). Phoneme awareness is a better predictor of early reading skill than onset-rime awareness. *Journal of Experimental Child Psychology, 82*(1), 2-28.

Morrison, F. J., Griffith, E. M., & Alberts, D. M. (1997). Nature-nurture in the classroom: Entrance age, school readiness, and learning in children. *Developmental Psychology, 33*(2), 254-262.

Morrison, F. J., Smith, L., & Dowehrensberger, M. (1995). Education and Cognitive-Development - a Natural Experiment. *Developmental Psychology, 31*(5), 789-799.

Muter, V., Hulme, C., & Snowling, M. (1997). *Phonological Abilities Test*. London: Psychological corporation.

National-Reading-Panel. (2000). *Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction*. Wasington, DC: National Institute of Child Health and Human Development.

Sharp, C., George, N., Sargent, C., O'Donnell, S., & Heron, M. (2009). *International thematic probe: The influence of relative age on learner attainment and development*: NFER.

Spector, J. E. (1992). Predicting Progress in Beginning Reading - Dynamic Assessment of Phonemic Awareness. *Journal of Educational Psychology, 84*(3), 353-363.

Table 1

Background characteristics, phoneme awareness, literacy scores and between-groups ANOVAs

	Max. score	Old Kindergarteners	Young first-graders	Old first-graders	ANOVA	
Variable		*M (SD)*	*M (SD)*	*M (SD)*	*F* (*df*)	r^2
Age at T1[a]	-	60.20 (0.94)	62.07 (1.01)	71.27 (0.70)	609.72 (2,42)**	.97
Age at T2[a]	-	65.93 (0.88)	68.80 (1.01)	77.53 (0.74)		
Standardized Vocabulary	160	112.57 (12.22)	112.07 (9.95)[b]	112.20 (10.04)[b]	0.01 (2,42)	<.01
Maternal education	7	3.31 (1.06)	2.71 (0.83)	2.71 (0.91)	0.97 (2,40)	.05
Paternal education	7	3.21 (1.63)	2.71 (0.83)	3.00 (1.62)	0.45 (2,39)	.02
Shared book reading at home	55	42.80 (6.35)	42.71 (8.01)	45.20 (5.96)	0.64 (2,41)	.03
Family literacy	18	8.79 (2.08)	9.79 (2.19)	9.67 (1.35)	1.17 (2,40)	.06
Age began reading to child [a]	-	6.87 (5.13)	6.36 (4.73)	7.93 (4.62)	0.40 (2,41)	.02
Months in pre-school	-	27.86 (10.68)	18.38 (9.33)	31.93 (13.69)	4.95 (2,38)*	.21
Dynamic phoneme seg. T1	72	20.73 (17.07)[c]	45.40 (15.49)	56.13 (11.76)[d]	22.15 (2,42)**	.51
Phoneme deletion T1	16	3.73 (5.15)[c]	9.53 (5.15)	12.60 (4.32)[d]	12.72 (2,42)**	.38
Static phoneme seg. T1	12	1.73 (2.34)[c]	4.73 (2.60)	6.93 (2.96)	6.20 (2,41)**	.23
Static phoneme seg. T2	12	8.21 (3.77)	9.53 (1.85)	9.53 (2.30)		
Word reading T1	90	0.64 (0.93)[c]	13.73 (10.88)	21.60 (12.93)[d]	14.82 (2,41)**	.42
Word reading T2	90	12.64 (7.91)	28.60 (15.51)	36.67 (14.95)		
Letter-sound knowledge T1	26	12.20 (7.17)[c]	23.67 (2.23)	24.40 (2.77)	32.87 (2,42)**	.61
Letter-sound knowledge T2	26	24.53 (1.46)	24.80 (1.57)	25.20 (0.86)	-	-
Letter-name knowledge T1	26	7.07 (7.32)[c]	12.87 (7.42)	18.87 (5.03)[d]	12.41(2,42)**	.37
Letter-name knowledge T2	26	13.40 (7.81)	20.00 (4.96)	22.73 (4.70)		
Spelling T2	75	9.60 (3.48)[c]	16.93 (6.86)	21.93 (7.91)[d]	14.22 (2,42)**	.40

Note. T1 = time 1, T2 = time 2. Degrees of freedom reflect reduced sample sizes due to no responses on some of the Home Literacy Environment questions and refusal of one old kindergarten child to participate in the word reading tasks.

[a] in months, [b] measured one year prior when the young first-grade group was age 51.93 months and the old first-grade group was 60.93 months, [c] = schooling effect, [d] = age effect. Standardized vocabulary = British Picture Vocabulary Scale; Phoneme deletion = Phonological Abilities Test of Phoneme deletion (beginning and end sounds); Word reading = British Ability Scales 2 word reading test; Spelling = British Ability Scales 2 spelling test. *p<.05, ** p<.01

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