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DEVELOPMENT OF AN ASSESSMENT BATTERY FOR READING AND WRITING DIFFICULTIES IN THE SECOND GRADE: SHOULD MEASURES OF HANDEDNESS BE INCLUDED?

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SUMMARY

Background: This study investigated whether tasks assessing hand preference should be included in an assessment battery for reading and writing difficulties in the second grade. Central to the investigation was the hypothesis that children with different hand preferences will differ in their reading and writing scores.

Material/ Methods: Instruments to measure hand preference and manual dexterity were used in a sample of 350 second-grade schoolchildren (157 boys and 193 girls). along with reading and writing measures.

Results: The results tend to show that left-handed children are at risk for reading and writing difficulties. Nevertheless, further research is needed to answer the laterality and literacy question correctly.

Conclusions: Our results indicated that hand preference measures should be included in an assessment battery for reading and writing difficulties. It seems reasonable to think about the longitudinal research in future where laterality question will be answered in the context of the development of reading and writing skills and teaching method of reading and writing skills.

Key words: lateralization, manual dexterity, dyslexia, dysgraphia

INTRODUCTION

Literacy research has demonstrated that one of the most important steps in preventing reading and writing difficulties is the identification of children at risk in the earliest stages of learning literacy skills (Bishop 2003).

Teaching to read and write in Lithuania

In Lithuania children enter obligatory kindergarten (pre-school group) in the year of their sixth birthday. In kindergarten there is no formal teaching of reading and writing skills. Formal literacy instruction starts at Grade 1, when children are about 7 years of age. Simultaneous reading and writing instruction is used in primary schools. In Lithuanian primary schools, reading and writing is taught not only through the analytic-synthetic phonics strategy, but also through the whole language strategy. The former strategy stresses the importance of learning speech sounds and sound-symbol correspondences, while the latter strategy uses the learning of word recognition in sentences. Normally, by the end of the first year most schoolchildren are relatively fluent decoders and spellers of simple words. It seems that rapid development of literacy skills depends on the orthography of the Lithuanian language. Lithuanian is a Baltic language and uses Latin script. The alphabet consists of 32 letters (20 consonants/45 phonemes and 12 vowels/12 phonemes). The Lithuanian language has six diphthongs (ai, au, ei, ie, ui, uo), letters with caudata (ą, ę, į, ų) and letters with diacritics (č, ž, š, ė, ū). It is a highly inflected language. According to sound-symbol correspondence, Lithuanian orthography is largely transparent for reading. But this is not the case for spelling, as at least two principles – phonetic and morphologic – are used to write Lithuanian words.

The second grade as a critical period for future literacy success

As Bogdanowicz et al. (2008) have shown, the second grade of primary school is the critical period for a child's academic success in the future. Moreover, the individual assessment of a child's reading and writing skills for the purpose of assessing dyslexia risk is important at the beginning stages of learning to read and write.

Predictive research in Lithuania has been limited by the lack of measures to evaluate children at risk for reading and writing difficulties. In 2007, a joint project of Gdansk University and Klaipeda University was initiated within the framework of the *Neighbourhood Programme* for Lithuania, Poland and the Kaliningrad region of the Russian Federation. The aim of the project was to develop a battery of appropriate psychological methods that would enable children at risk for reading and writing difficulties to be assessed individually in the second grade of primary school.

During the preparation of the battery, tasks for the assessment of hand preference and manual dexterity were included. The decision to include these laterality tasks was motivated by long-lasting discussions on the relationship between laterality and literacy difficulties. Along with other investigators, we chose to use behavioral measures of laterality (e.g. handedness), despite having in mind the

cautionary statement of Hiscock and Kinsbourne (1982), that human laterality cannot be measured with perfect reliability and validity.

Reading skills and laterality: pros and cons

According to Gaddes (1978, p.38), "certainly, no neuropsychological phenomena have more significance for normal and impaired learning than cerebral dominance, laterality, and hemispheric localization." The peak of the discussion on this issue was reached in the 1960s and 70s. For instance, Harris (1979) indicated that 88 papers on some aspect of the relationship between lateral dominance and reading were noted in *Psychological Abstracts* between 1968 and 1977. This topic has been explored not only medically by neurologists and neurosurgeons, but also behaviorally by psychologists and neuropsychologists.

During the entire history of the investigations, theoretical speculations and studies of associations between laterality and reading have yielded many conflicting and contradictory findings, as well as many hemisphere-related explanations for dyslexia (Hiscock & Kinsbourne 1982; Francks et al. 2003).

Kerchner and Stringer (1991) pointed out that the dyslexia-laterality question was first advanced by Orton in 1937. At that time the majority of psychologists supported Orton's contention that incomplete (or non-established) cerebral dominance contributes to a confusion of mental processes and results in a variety of learning disabilities. There were numerous reports about the positive relationship between laterality patterns and reading, claiming that incomplete or mixed dominance is a characteristic of children with reading disabilities (Capobianco 1967). In some studies of this period, a higher incidence of inconsistent lateral preference or left-hand preference was found in children with reading disability (Belmont & Birch 1965). In other studies, however (for example, in Capobianco 1967), no apparent differences in several reading performance tests were indicated between subjects with established and non-established laterality. Accordingly, Capobianco (1967) concluded that the determination of laterality preferences as part of a diagnostic assessment appears to possess dubious practical value.

Crithley (1970), discussing left-handedness and the reading question, argued that children with dyslexia are not more often left-handed than controls, but they are more often badly lateralized. He claimed that mixed laterality was a factor of special importance in children with dyslexia, who might, for example, prove to be left-eyed, right-handed and left-footed. Kershner (1975) supported this idea. On the basis of his findings he formulated a reasonable hypothesis: consistent hand and eye preference, in comparison with crossed ocular-manual preference, may very well facilitate the acquisition of reading skills. This hypothesis is still popular. According to De Agostini and Dellatolas (2001), at least in France, the popular view is that discordance between eyedness, footedness, and handedness may be a marker of some developmental disorder that could influence cognitive performance. This view is maintained, as there are suggestions that laterality is a marker of hemispheric specialization (De Agostini & Dellatolas, 2001). But according to Hiscock and Kinsbourne (1982), eyedness and hand-

edness appear to be largely independent of each other, and it seems that laterality measures other than handedness can contribute little to our understanding of cerebral lateralization. Foot preference might be related to speech lateralization, but it is unlikely that the association between footedness and speech lateralization is stronger than that between handedness and speech lateralization.

The results of research on laterality and reading performed during the 1980s reveal different tendencies. For example, the results of Annett and Manning (1990) showed that extreme right- and extreme left-handed children are poorer at reading than those of intermediate handedness (Palmer & Corballis 1996; Savage & Frederickson 2006; Brenneman et al. 2008).

Later Annett et al. (1996) formulated the hypothesis that incidences of sinistrality and mixed dominance would be higher in samples selected for below-average reading ability. It is important that phonological processing has continually been demonstrated to be vital for reading development skills. This research indicated that left-handedness is a risk factor for poor phonological processing; the results of the study showed that below-average readers, selected on the basis of phonological or orthographic processing, differed significantly, with sinistrality associated specifically with phonological deficits (Savage & Frederickson 2006). Annett's right shift theory, as well as Geschwind's and Galaburda's cerebral dominance theory, linked laterality and cognitive performances in the same directions: a disadvantage of left-handers in verbal skills, related to non-optimal development of the left cerebral hemisphere; enhanced visuospatial skills among left-handers are due to overdeveloped functioning of the right hemisphere. Some studies provided empirical support showing increasing verbal skills, particularly phonology-related, with dextrality; however, such a relation has not always been found (Hiscock, Kinsbourne 1982). Savage and Frederickson (2006) published research results showing no evidence of a relationship between handedness, below average reading and phonological processing.

The hypothesis of Annett et al. (1996) was confirmed by the results of De Agostini and Dellatolas (2001). They found that right-handers outperformed left-handers when required to read pseudo words, but not when required to read real words.

The results of Brenneman et al. (2008) suggested that lateral preference does significantly add to the regression model in predicting reading skills and reading processes. Individuals with more extreme handedness, either right or left, may have a disadvantage related to basic reading skills, global reading comprehension and auditory working memory, as measured by performance on composite variables.

In this paper we ask the following question: is there evidence for differences in reading and writing skills in children with different laterality patterns?

MATERIAL AND METHODS

The study sample included 350 second grade pupils (157 boys and 193 girls) with a mean age of 99±3.4 months, attending 19 Lithuanian schools in the municipalities of Klaipėda, Tauragė, Šilutė, Pagėgiai and Jurbarkas.

Lateral hand preferences

Handedness assessment (Bogdanowicz et al. 2008). Three tasks were used to determine hand-preference. The child was asked to show which hand he/she uses in the following three activities: writing, brushing teeth, eating soup. If he/she was unsure, or showed hesitation, he/she was asked to mime the action. The child was judged to be *right*-handed if all three tasks were done with the right hand; *left*-handed if all three tasks were done with the left hand; inconsistent if in the series of three tasks there was any inconsistency in hand usage.

Manual dexterity assessment: *loops* (Bogdanowicz et al. 2008). The child was presented with a lined paper sheet with a sample of four loops that touched the upper and lower lines of the lined sheet. The experimenter added four more loops. The child observed the addition. Then the child was asked to write (replicate) identical loops as fast and accurately as possible. Four attempts were made, changing the hands successively. Each attempt lasted 1 minute. In order to evaluate the results, athe rithmetical average between the correctly written number of loops using right (or left) and left (or right) hand was calculated. When the difference was higher than 10, the hand which was used to write more loops was considered dominant. When the difference was lower, it was concluded that the dominant hand had not been determined.

Reading measures

One-minute word reading assessment (Bogdanowicz et al. 2008). The child was asked to read aloud as many words as possible from a card (there were 136 unrelated words) in 1 minute. The score was the number of correctly read words during 1 min.

One minute non-word reading assessment (Bogdanowicz et al. 2008). The child was asked to read aloud as many non-words as possible from a card (there were 92 unrelated words) in 1 minute. The score was the number of correctly read non-words during 1 min.

Reading comprehension assessment (Bogdanowicz et al. 2008). The child was asked to read a story aloud, and when the child finished the story, the experimenter asked questions on the reading. While the child was reading, the experimenter marked all oral reading errors. The experimenter was not supposed to give any assistance in decoding a word. However, if the child stopped reading for 5 to 10 seconds or asked for help, the experimenter could pronounce the word. After the child had read the entire story, the experimenter removed it from the child's sight and asked five comprehension questions, noting the child's responses. It was appropriate for the experimenter to ask the child "Tell me more" or "Explain" if the child's response was incomplete or vague. The score was the sum of the correct answers; the maximum score was 5. The score for reading errors was the sum of 7 reading errors (substitution, omission, addition/insertion, mispronunciation, reversal, words aided, repetition).

Writing measures

Real word writing (spelling) assessment (Bogdanowicz et al. 2008). The child was asked to write down each word in a sentence, as it was presented orally by the experimenter. There were 3 sentences with 3 words presented. The score was the sum of 4 writing errors (substitution, omission, addition/insertion, inversion).

Non-word writing (spelling) assessment (Bogdanowicz et al. 2008). The child was asked to write down each non-word in a sentence, as it was presented orally by the experimenter. There were 3 sentences with 3 non-words presented. The score was the sum of 4 writing errors (substitution, omission, addition/insertion, inversion).

Procedure

School and parental permissions were obtained to gather data from the children. The children were examined during the fall term (October-November) of the second grade. Each child was examined individually at the school. All the tasks were carried out by trained psychologists and took place in a suitable room on the primary school premises.

Statistical analysis of the data was performed with the statistical package SPSS 17.0 for Windows. Descriptive statistics were calculated to assess the means and standard deviations of variables. ANOVA analysis of variance was performed to compare the hand preference groups' scores.

RESULTS

The results on hand preference for the whole sample, for boys and girls, are presented in Table 1. The majority of the children were predominantly right-handed (86.6%), 5.7 % were left-handed, and 7.7 % had a handedness rated as "inconsistent". There were no differences in hand preference between boys and girls (χ^2=0.381, df=2, p=0.826).

The results on manual dexterity for the whole sample, for boys and girls, are presented in Table 2. The children as a whole were predominantly right-hand dominant (90%); only 7.4% were left-hand dominant, and 2.6% were rated as inconsistent in hand dominance. There were no differences in manual dexterity between boys and girls (χ^2=0.762, df=2, p=0.683).

Discordance between the data from the hand preference and manual dexterity tests were recoded according to rating criteria. The child was judged as *right*-handed if the hand preference and manual dexterity ratings were-right hand-

Table 1. Hand preference in the whole sample, in boys and girls

Participants	Right hand	Left hand	Inconsistent
Total (N=350)	303 (86.6%)	20 (5.7%)	27 (7.7%)
Boys (n=157)	134 (85.4%)	10 (6.4%)	13 (8.2%)
Girls (n=193)	169 (87.5%)	10 (5.2%)	14 (7.3%)

dominant; *left*-handed if the hand preference and manual dexterity ratings were left-hand-dominant; *non-consistent* hand in the case of other combinations. According to these criteria, three groups were formed: group 2 (right-hand dominance – 302 children), group 2 (left-hand dominance – 20 children) and group 3 (non-consistent hand dominance – 28 children).

ANOVA analysis of variance was run to assess the between-group differences on reading and writing tasks. Table 3 presents the means, standard deviations, and results of ANOVA analysis comparing the three different hand-dominance groups for the reading measures. Table 3 shows that there were no statistically significant differences comparing children's scores on decoding of real and non-words per minute, or the scores on reading comprehension. It took approximately 1.5–1.8 seconds to decode a real word, and about 2.4–2.8 seconds to decode a non-word for all three groups. There were no differences found comparing the scores of the three groups on reading comprehension.

ANOVA analysis of variance indicated that there were significant differences comparing the scores in reading errors between the three groups. The left-hand dominance group made significantly more specific reading errors than the other groups. The children from the right-hand dominance group made the least number of reading errors.

Table 2. Manual dexterity in the whole sample, in boys and girls

Participants	Right hand	Left hand	Inconsistent
Total (N=350)	315 (90.0%)	26 (7.4%)	9 (2.6%)
Boys (N=157)	141 (89.8%)	13 (8.3%)	3 (1.9%)
Girls (N=193)	174 (90.2%)	13 (6.7%)	6 (3.1%)

Table 3. ANOVA results (means and standard deviations, F-test values) for the analysis of reading measures

Tasks	Right-hand dominance	Left-hand dominance	Non-consistent dominance	F	p
	M±SD	M±SD	M±SD		
One minute word reading	39.92±17.43	36.80±24.32	33.30±14.92	1.937	0.146
One minute non-word reading	24.76±12.29	21.05±15.06	20.70±10.51	2.044	0.131
Reading comprehension	2.97±1.48	3.10±1.80	2.56±1.37	1.063	0.346
Reading errors	5.40±7.01	12.00±18.95	7.56±5.48	6.911	0.001

Table 4. ANOVA results (means and standard deviations, F-test values) for the analysis of writing measures

Tasks	Right-hand preference	Left-hand preference	Non-consistent hand preference	F	p
	M±SD	M±SD	M±SD		
1. Real word writing	1.74±3.57	6.00±9.59	2.11±2.75	10.199	0.000
2. Non-word writing	2.97±3.72	6.50±9.26	3.63±3.27	6.793	0.001

Table 4 presents the means, standard deviations, and results of ANOVA analysis comparing the scores on writing measures between the three different hand dominance groups.

The results of F-tests revealed that the children from the left-hand dominance group made more errors writing real words and non-words. The children from the right-hand dominance group made the least errors writing real words and non-words.

DISCUSSION

This study investigated whether tasks assessing handedness should be included in the assessment battery for reading and writing difficulties in the second grade. Central to the investigation was the hypothesis that children with different hand dominance will differ in their reading and writing scores.

The decision to include hand dominance tasks in the assessment battery was motivated by long-lasting contradictory discussions on the relationship between handedness and reading difficulties. The discussion of the neuropsychological concepts of left and right in relation to reading disabilities was started by S.T. Orton's work (Leong 1984). Handedness was perceived as a marker of hemispheric specialization (De Agostini & Dellatolas 2001). Later on, Orton's ideas on dyslexia-laterality association inspired not only empirical research, but the development of hemisphere-related models of dyslexia.

The idea of an association between dyslexia and laterality has not been investigated in Lithuania. There has been no research assessing the reading and writing abilities of children with different hand dominance. The only known research in this field is a study that investigated the cognitive and personality characteristics of 7-8-year-old left-handers and right-handers (Gudonis & Brazdeikienė 2005).

As expected, in our study, the children as a whole were predominantly right-handed (86.3%), 5.7% were left-handed, and 8% had inconsistent hand preference. There were no differences in hand dominance between boys and girls. As Vuoksimaa and Kaprio (2010) pointed out, hand dominance is known to develop during childhood to its ultimate adult form by approximately 6 years of age. The analysis of 16 studies concerning children's laterality made by Gabbard and Iteya (1996) revealed that about 80% of children (from 3 to 11 years old) display right-

handedness, and about 7% left-handedness, while mixed-handedness was displayed in 14%.

A series of ANOVAs comparing the hand dominance groups' scores on reading measures revealed no significant differences between groups. There were no differences found comparing the scores in reading real words and non-words per minute, except for a significant difference in errors made in text reading. In this case, children from the left hand dominance group made significantly more specific reading errors than others (see also Pachalska et al. 2010). Children from the right hand dominance group made the least number of reading errors.

Several implications emerge from these results. As we suggested in the introduction of this article, the Lithuanian writing system is quite transparent for reading. This means that most children can decode simple words made from two syllables with the CVCVC pattern (for example, *namas* – *house*, *ragas* – *horn*) at the end of first grade. The reason for such achievement is the teaching method used to help children learn to read, which is based on the principle of whole word recognition. This teaching method helps children to develop a sight vocabulary of simple Lithuanian words used in the textbooks of first and second grade. It seems reasonable to think that the teaching method of whole word recognition is based on a perceptual strategy of reading. According to Bakker (1990), initial reading (up to approximately 8 years of age), in contrast to advanced reading, appears to be a function more of the right than the left hemisphere. Reading and spelling abilities proved to be related to the word-related potentials in the right hemisphere at an early age, and to those in the left hemisphere at more advanced ages (Pachalska et al., 2007). These results indicate that the balance of hemispheric activity does tip from right to left with the progression of the learning-to-read process (Bakker 1990). According to Bakker's idea, using the perceptual strategy at this stage of learning to read would be advantageous for the left-hand dominace group. Nevertheless, this perceptual strategy is not efficient for the left-hand dominance group in text reading. The children from our left hand dominance group made significantly more errors than others. It would appear that the phonetic strategy was very important to use in this case, in order to read the text efficiently. The high number of specific reading errors could be interpreted as a risk factor for reading difficulties.

We found significant differences comparing the scores from the writing measures between the hand dominance groups. The children from the left hand dominance group made significantly more errors in writing real words and non-words. The right-hand preference group made the least errors in writing real words and non-words. There are several implications arising from these results. As is generally known, word writing (or spelling), like reading, involves vocabulary knowledge and temporary memory processes, as well as metalinguistic knowledge. Although the correlations for individual performance on single-word reading and spelling tasks are high (Pearson's r=0.89 for 157 children, Gedutienė 2008), children with language impairments and those at risk for dyslexia often find spelling more problematic than reading (Yeong & Liow 2011). It seems that spelling is

the more challenging task, because unlike reading it requires fully specified orthographic lexical representations (Angelelli et al. 2010).

CONCLUSIONS

As stated in the introduction, Lithuanian orthography is largely transparent for reading, but this is not the case for spelling, as at least two principles – phonetic and morphologic – are used to write Lithuanian words. In order to write down separate words, and especially non-words, one needs the ability to apply phonological analysis of words. The results showing a higher incidence of writing errors in our left hand dominance group support Annet's idea that left-handedness is a risk factor for poor phonological processing.

Our results confirmed the conclusions of other researchers that left-hand dominance is a risk factor for poor phonological processing. The word and non-word writing tasks require good skills in phonological processing. The children in the left hand dominance group made the greatest number of mistakes.

According to the results of our study the implication concerning differences in reading and writing measures between left- and right-dominance groups is that right-handed children, in comparison to left-handed children, use both perceptual and phonological strategies in reading and writing. The question to answer for future research is whether or not this is connected to hemispheric specialization.

According to the results, it seems reasonable to include handedness measures in an assessment battery for reading and writing difficulties. The results tend to show that children with left hand dominance are at risk for reading and writing difficulties. Nevertheless, further research is needed to answer the laterality and literacy question thoroughly. Future longitudinal research, where the laterality question will be answered in the context of the development of reading and writing skills and the teaching method for reading and writing skills, is clearly indicated.

REFERENCES

Angelleli, P., Marinelli, C.V. & Zoccolotti, P. (2010). Single or dual orthographic representations for reading and spelling? A study of Italian dyslexic-dysgraphic and normal children. *Cognitive Neuropsychology*, *27(4)*, 305-333.

Bakker, D.J. (1990). *Neuropsychological Treatment of Dyslexia*. New York: Oxford University Press.

Belmont, L. & Birch, H. (1963). Lateral dominance and right-left awareness in normal children. *Child Development, 34,* 257-270.

Belmont, L. & Birch, H. (1965). Lateral dominance, lateral awareness, and reading disability. *Child Development, 36,* 57-71.

Bishop, A.G. (2003). Prediction of first-grade reading achievement: a comparison of fall and winter kindergarten screening. *Learning Disability Quarterly, 26,* 189-200.

Bogdanowicz, M., Kalka, D., Karasiewicz, K., Radtke, B.M. & Sajewicz-Radtke, U. (2008). *Diagnoza przyczyn niepowodzeń szkolnych. Podręcznik*. Program Sąsiedztwo EU. Gdansk: University of Gdansk.

Brenneman, M.H., Decher, S., Meyers, J. & Johnson, K. (2008). Does a continuous measure of handedness predict reading processes and reading-related skills across the lifespan? *Laterality, 13(6),* 481-503.

Capobianco, R.J. (1967). Ocular-manual laterality and reading achievement in children with special learning disabilities. *American Educational Research Journal, 4(2),* 133-138.

De Agostini, M. & Dellatolas, G. (2001). Lateralities in normal children ages to 3 to 8 and their role in cognitive performances. *Developmental Neuropsychology, 20(1),* 429-444.

Francks, C., Fisher, S.E., Marlow, A.J., MacPhie, I.L., Taylor, K.E., Richardson, A.J., Stein, J.F. & Monaco, A.P. (2003). Familial and genetic effects on motor coordination, laterality, and reading-related cognition. *American Journal of Psychiatry, 160,* 1970-1977.

Gabbard, C. & Iteya, M. (1996). Foot laterality in children, adolescents, and adults. *Laterality, 1(3),* 199-205.

Gaddes, W.H. (1978). The neuropsychology of reading disorders, part II. *Journal of Learning Disabilities, 11(10),* 37-44.

Gudonis, V. & Brazdeikiene, L. (2005). *Kairiarankystės fenomenas* (The Phenomenon of Left-Handedness). Šiauliai: Šiaulių universiteto leidykla.

Harris, A.J. (1979). Lateral dominance and reading disability. *Journal of Learning Disabilities, 12(5),* 57-63.

Hiscock, M. & Kinsbourne, M. (1982). Laterality and dyslexia: a critical view. *Annals of Dyslexia, 32,* 177-228.

Kershner, J.R. (1975). Reading and laterality revisited. *Journal of Special Education, 9(3),* 269-279.

Leong, C.K. (1984). Confessions of a schoolman – on dyslexia and laterality. *Annals of Dyslexia, 34,* 15-27.

Pachalska, M., Jastrzębowska, G., Lipowska, M. & Pufal, A. (2007). Specific language impairment: neuropsychological and neurolinguistic aspects. *Acta Neuropsychologica, 5(3)*,131-154.

Pachalska, M., Wachowicz, N. & Bidzan, M. (2010). Disintegration of higher language functions in patients with right hemisphere damage. *Acta Neuropsychologica*, 8*(2)*, 68-98.

Palmer, R.E. & Corballis, M.C. (1996). Predicting reading ability from handedness measures. *British Journal of Psychology, 87,* 609-620.

Savage, R.S. & Frederickson, N. (2006). Beyond phonology: what else is needed to describe the problems of below-average readers and spellers? *Journal of Learning Disabilities, 39(5),* 399-413.

Vuoksimaa, E. & Kaprio, J. (2010). Sex differences in left-handedness are also evident in Scandinavia and in twins. *Psychological Bulletin, 136(3)*, 344-347.

Yeong, S.H.M. & Rickard Liow, S.J. (2011). Cognitive-linguistic foundations of early spelling development in bilinguals. *Journal of Educational Psychology, 103(2),* 470-488.

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