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Dynamic and Static Assessment of Phonological Awareness in Preschool: A Behavior-Genetic Study

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Abstract

The genetic and environmental overlap between static and dynamic measures of preschool phonological awareness (PA) and their relation to preschool letter knowledge (LK) and kindergarten reading were examined using monozygotic and dizygotic twin children (maximum *N* = 1988). The static tests were those typically used to assess a child's current level of PA such as blending and elision, and the dynamic test included instruction in phoneme identity to assess the child's ability to respond to this instruction. Both forms were influenced by genes and by shared and nonshared environment. The static and dynamic versions were influenced by the same genes, and part of the total genetic influence was shared with LK. They were subject to both overlapping and independent shared environment influences, with the component in common also affecting LK. Nonshared environment influences were mostly independent. Scores from dynamic assessment added only minimally to variance explained in kindergarten reading after LK and static assessment had been factored in. Although one of the genetic factors that influenced both forms of PA also affected kindergarten reading, it was only the one shared with LK. We conclude that dynamic assessment of PA in preschool offers little advantage over the more commonly-used static forms, especially if LK scores are available, although we acknowledge its potential in cases of preschool educational disadvantage.

We are conducting a longitudinal study of early literacy development using twin children. The project includes samples from the USA, Australia, and Norway and Sweden ("Scandinavia" from here on). Twins are recruited in the year before formal schooling ("preschool"), and followed for the three subsequent school years, kindergarten to Grade 2 inclusive. We refer to the project as the International Longitudinal Twin Study (ILTS). In this paper we focus on the preschool phase, and in particular on a comparison of "dynamic" and "static" measures of phonological awareness (PA). We also examine these measures in relation to preschool letter knowledge (LK) and to word identification assessed at the end of kindergarten.

Background to the Current Study: Static and Dynamic Measures of Phonemic Awareness

In a seminal paper, Spector (1992) adapted a phoneme segmentation task earlier described by Yopp (1988) in which children are required to segment a word into its constituent phonemes. In Spector's dynamic version, children who fail to segment a word are given a series of prompts, ranging from saying the word slowly to explicitly modelling segmentation with coins. Spector administered a static version as well, with no feedback and no prompts. The dynamic version better predicted end-of-year word recognition results than the static version did. Spector suggested two explanations for this result; (a) dynamic assessment (DA) is a more sensitive measure of PA, due perhaps to being “cleaner” in the sense that Calfee (1977) introduced, namely less encumbered by cognitive demands unrelated to PA; (b) DA measures a new construct, *modifiability*. She considered that each interpretation was a plausible account of her data, and that further research was needed to disentangle them. The research reported in this article addresses the degree to which static and dynamic assessments of preschool PA can be differentiated in terms of their powers to predict later reading skills and in terms of the genetic and environmental factors that determine the levels that preschool children reach.

In designing the ILTS we elected to include measures of the ability of the children to learn new material that we presented to them, conceptualizing this measure in terms of responsiveness to instruction (RTI; see Wagner & Compton, this volume; also see Grigorenko, 2009, for a discussion of the relation of DA and RTI). Our actual design of the preschool instruction for the ILTS followed the structure normally associated with DA, namely “scaffolding,” a gradual increase in the amount of information the child received so as to gauge the point at which learning could be said to have occurred (also see Wagner & Compton, this volume). The specific goals for this paper are to trace the relations between the static and dynamic versions of PA assessment in preschool, and to determine how they relate to preschool LK and to kindergarten reading, all within a genetically sensitive design.

Samuelsson et al. (2005) presented preschool results from the ILTS for 627 pairs of identical and same-sex fraternal twin pairs. They reported heritability of .46 for a composite of several static PA tasks, syllable and phoneme blending and elision, phoneme identity, and rhyme. The shared environment effect was .25, and nonshared environment was .29. For a composite based on several dynamic PA tasks, described in detail in Method, the genetic, shared environment, and nonshared environment effects were .27, .34, and .39, respectively. In the current paper these estimates are updated with a larger sample size.

The Twin Design

Monozygotic (“identical,” or MZ) twins share all of their genes whereas dizygotic (“fraternal,” or DZ) twins share, on average, 50% of their segregating genes. This basic biology allows the use of twins to separately identify genetic and environmental factors governing individual differences. For characteristics that are fully determined by genes, MZ twins will be identical and DZ twins about 50% alike. The twin design also relies on an assumption that within families both types of twins share equally similar environments, an assumption that allows researchers to distinguish family-based (“shared”) environment influences from those that affect one twin but not the other (“nonshared environment”). For characteristics that are fully determined by shared environment, both types of twins will be identical. For characteristics that are fully determined by nonshared environment, twins will be no more alike than randomly selected individuals. From this, we can estimate the mix of genetic and environmental (shared and nonshared) factors affecting the trait of interest. Bazzett (2008) and Plomin, DeFries, McClearn, & McGuffin (2008) offer introductions to twin methodology.

Method

Participants

Data were collected from a maximum of 1988 children, 992 members of monzygotic pairs (496 pairs, 48% males) and 996 members of same-sex dizygotic pairs (498 pairs, 53% males). Mean age at preschool assessment was 59 months, and the children were approximately 18 months older at kindergarten assessment. The Australian twins were recruited from the National Health and Medical Research Council's Australian Twin Registry. Twins in the United States were recruited from the Colorado Birth Registry and twins from Scandinavia were recruited from the Medical Birth Registries in Norway and Sweden. The Australian and Scandinavian families were approached by mail, with an approximate 60% participation rate. In the US, the families of twins were approached by phone, with 88% of the 60% of families who could be contacted when the children were 4 agreeing to participate. The zygosity of 81% of the pairs was determined by DNA analysis, collected via a cheek swab, and in the remaining cases by items from the Nichols and Bilbro (1966) questionnaire.

Measures

For a full description of all preschool tests administered to the twins, see Byrne et al. (2002) and Samuelsson et al. (2005). For this article, we restrict our description of preschool assessment to the PA measures and to LK, which we incorporate into our analyses. We also describe kindergarten assessment of word identification. In the preschool phase, the full assessment occurred over five sessions, one each day within a one- or two-week period. In kindergarten, the assessment required a single session of about one hour.

Static PA Tests—A total of five static phonological awareness tasks was employed for the current analyses. All blending and elision tasks described below were made available by C. Lonigan (personal communication, 2000). Practice items preceded each test and feedback was provided by the experimenter after each practice trial. All tests were translated into Norwegian and Swedish for the samples from those countries.

Syllable and phoneme blending: Children were asked to combine syllables (e.g., *sister*) and phonemes (e.g., *m-o-p*) to form a word. The first half of the items included pictures, and in the second half items were just presented verbally. Analyses were based on the total score. Cronbach's α = .76.

Sound matching: Children were required to recognize which of three words started or ended with the same sound as a target word (e.g., *pan: pig, hat, cone* or *hill: doll, hat, whip*) (Wagner, Torgesen, & Rashotte, 1999). Twenty trials were presented both verbally and with pictures. The test was discontinued when subjects made four errors out of the last seven trials. Cronbach's α = .77.

Word elision: Children were asked to delete a single-syllable word from a compound word to form a new word (e.g., *boy* from *cowboy*). The first six trials were presented both verbally and with pictures and the last six trials were presented verbally only. Analyses were based on the total score. Cronbach's α = .77.

Syllable and phoneme elision: Children were asked to delete a syllable (three trials) or phoneme (nine trials) from a word to form a new word (e.g., *ger* from *tiger* or *h* from *hear*). There were six items presented both verbally and with pictures, and six items presented verbally only. Analyses were based on the total score. Cronbach's α = .49.

Rhyme and final sound: Children were asked to recognize rhyme (e.g., that *peep* rhymes with *sheep*), and final phoneme (e.g., that *bat* ends with the same sound as *kite*). There were ten rhyme and six final sound items in the test, and all trials were presented both verbally and with pictures. Analyses were based on the total score. Cronbach's α = .68.

Dynamic PA Assessment—After the static measures had been collected, the DA testing began. Each session consisted of four stages of instruction with built-in assessment, with a different phoneme covered in each of four sessions. The phonemes and the order in which they were given were initial /s/, initial /p/, final /l/, and final /t/. Each phoneme was administered on a separate day. Practice in identifying common sounds in words was given prior to the first teaching session using compound nouns (deciding which word, *basket, windmill,* or *tiger* started the same as *window*) and syllables (*camel*: *penguin, farmer, camera*).

The teaching procedure was identical for all four phonemes. There was a total of 24 trials in each phoneme training session, 6 trials within each of the 4 teaching stages (see below). Teaching for a phoneme ceased when the child achieved 6 correct responses out of the last 8 trials, or when they had completed all 24 trials. All items across trials were presented both verbally and with pictures, and the target word was the same throughout all 24 trials (e.g., *sun* for initial /s/). In the first teaching stage, the child was asked to listen to the way *sun* starts and then indicate which of three words starts with the same sound. Feedback was provided either by affirming that *sun* and, for example, *seal* (Item 1) start the same, or by pointing out that *seal* should be the answer because it starts the same as *sun*. Articulation was added in Stage 2, with the child being asked to verbally repeat all words. Feedback was provided as for Stage 1. In Stage 3, additional support was added by having the experimenter stressing the /s/ sound while pronouncing *sun* both in the instruction and in the feedback. The child, too, was asked to say *sun* with the /s/ stretched out. In Stage 4, both the experimenter and the child pronounced the word *sun* with the stressed /s/, pronounced /s/ separately in stretched form, and the experimenter made explicit the fact that *sun* starts with /s/. For the composite percent correct score averaged across the four sounds, Cronbach's $\alpha = .81$.

Letter Knowledge

Letter-name identification: In this task, the experimenter said the name of a letter and the child was required to point out one letter out of four on a card that represented that name. The 26 letters were presented to all children in the same non-alphabetic order.

Letter-sound knowledge: Children were presented with a row of four letters on a card and were asked to point to the correct letter as the tester said the sound of a letter. The 26 letters were presented to all children in the same non-alphabetic order.

Word Identification in Kindergarten—The reading measure we employ as the dependent variable in our examination of the relative predictive ability of static and dynamic PA was the Test of Word Reading Efficiency (TOWRE; Torgesen, Wagner & Rashotte, 1999). There are two subtests: sight-word efficiency (SWE) and phonemic decoding efficiency (PDE). Within each subtest the children were required to read as many real words (sight words) or nonwords (phonemic decoding) as they could from a list within 45 seconds. Each subtest has two forms; we used both for more reliable estimation and averaged the scores for each child. The published test-retest reliability for 6 to 9 year olds is .97 for word and .90 for non-word reading.

Procedure

Testing in the preschool phase took place over five sessions, either in the home or a quiet part of the child's preschool. As stated, the static PA tests were given prior to dynamic assessment, on Days 1 and 2. The phoneme identity instruction (DA) was administered on Days 2 to 5, and lasted 10-15 minutes per day. Funding restrictions meant that not all of the Australian sample was given the DA (see *N*s in Results). Kindergarten data were collected from the children during an assessment that lasted approximately one hour in a quiet room at school or home. The tests included measures other than the TOWRE, but in this report we use only the TOWRE results as the signature measure of reading. For a description of the full testing protocol at kindergarten, see Byrne et al. (2006,2007,2008).

Throughout the testing, in Australia and the US each twin within a pair was examined by a different tester, with both assessments conducted simultaneously. The children in Scandinavia were assessed by a single tester, with twins within a pair being tested on the same day (Samuelsson et al., 2005).

Results

Data Reduction

Scores for the DA were percent correct for each of the four phonemes. The intercorrelations of the scores are reported in Table 1. Because of the large *N*s involved, all correlations are significant beyond .001. We subjected these four DA items to a principal components factor analysis with an oblimin rotation run using SPSS, which indicated just one factor with an eigenvalue greater than 1, accounting for 65% of the variance. Therefore we created a single variable for further analyses by averaging percent correct across the four phonemes. We went through the same process for the five static PA measures, and also report their intercorrelations in Table 1. They, too, loaded together as the single factor in a factor analysis accounting for 49% variance, and were also amalgamated into a single, averaged score for the remaining analyses. (Because the tests varied in the number of items, each was standardized prior to averaging.) The four reading tests (two forms each of SWE and PDE) correlated highly (all correlations above .85) and so we created a single word identification measure from their average. We also reduced the two LK tests to a single number-correct variable.

Phenotypic analyses

In Table 2 we report means and standard deviations by country for the static and dynamic PA variables and for LK and word identification and in Table 3 their intercorrelations. The Australian sample tended to outperform the other samples, a pattern that is repeated throughout the project. We have speculated that recruitment method may partly account for this, with the Australian sample drawn from families who volunteer their twin children to be part of a pool of potential research participants. The relatively low scores for the Scandinavian children may reflect a cultural tradition of not teaching prereading skills to young children or teaching reading in kindergarten (Lundberg, 1999), and the higher scores for reading in Australia than the US may come about in part because of a longer school day (full day) in New South Wales kindergartens than the half day in Colorado kindergartens. Because of these differences, we standardized scores within country before conducting further analyses. As is normal practice in behaviour-genetic studies (Byrne et al., 2009), scores were residualized on age and sex.

The most commonly-asked question about static and dynamic assessment of a variable is whether the two methods make independent contributions to predicting a relevant outcome. In this study, the two variables correlated .65. Their contributions to kindergarten reading were examined in a hierarchical regression, entering LK, static PA, and dynamic PA in that order. Does dynamic PA add to the variance explained in kindergarten reading in addition to that explained by LK and static PA, which are the two most informative preschool predictors of subsequent reading levels, according to the review of Scarborough (1998)? The ΔR^2 values for LK, static PA, and dynamic PA in predicting reading were .28, .06, and .01, respectively. The large participant numbers meant that the variance explained added by dynamic PA was significant ($p < .01$) despite its minimal size. (Entering dynamic prior to static assessment after LK produces ΔR^2 values of .04 and .02 respectively, suggesting that static measures are marginally more predictive than dynamic ones.)

Behavior-genetic analyses

Table 3 displays the intraclass correlations for MZ and DZ twins for the four variables. The proportions of phenotypic variance attributable to genes and shared and nonshared environment for the two PA measures, using the Mx statistical package (Neale, Boker, Xie & Maes, 2002), are presented as the row marginal totals in Table 4 (further explanation of Table 4 follows). The heritability estimates of .45 and .39 for static and dynamic PA are of similar magnitude to the results from the earlier analysis with fewer twin pairs, .46 and .27 respectively (Samuelsson et al., 2005), as are the estimates of shared and nonshared environment (in order, .25 and .30 here compared with .25 and .29 in Samuelsson for static PA, and .23 and .37 here versus .34 and .39 for dynamic PA in Samuelsson).

To examine how genes and environment contribute to the covariability of the dynamic and static PA measures, a Cholesky decomposition model with all four measures was run. Within this model, the effect of genes and environment on one variable are assessed after the effects on other correlated variables are taken into account, in a manner similar to hierarchical regression. Thus, if separate genes contribute to the two forms of PA, in a model in which static PA is entered prior to dynamic PA there will be a second genetic source affecting dynamic PA over and above any genes that it shares with static PA. Similarly, overlapping and independent shared and nonshared environmental influences on the two measures can be identified.

The results are presented in Table 4. The entries are squared path coefficients, which represent total variance explained by that factor for the variable in question. For example, Factor 1 in the A matrix, represents the genetic variance that the PA and reading measures share with LK, and accounts for .22 of the variance in LK, .21 in static PA, .14 in dynamic PA and .40 in kindergarten reading (TOWRE). (The row [marginal] totals represent the univariate variance component estimates, A, C, or E, for that variable, as indicated above.) So a single genetic factor, Factor 1, influences all variables. The second genetic factor influences both static and dynamic PA, though not the TOWRE (nonsignificant loading of .01) independently of LK. There is no additional significant genetic influence on dynamic PA on top of that shared with static PA (the value of .01 for Dynamic PA in Factor 3 is not significant). Kindergarten reading may be influenced by a genetic factor, Factor 3, with a loading of .22, but on the current sample size this value does not reach significance.

Static and dynamic PA are influenced by the shared environment source that affects LK (Factor 1), as is kindergarten reading. In contrast to the situation for genetics, both static and dynamic PA are, in addition to the common influence of Factor 1, also affected by separate shared environment sources (Factors 2 and 3), with no significant overlap between these two paths (the value of .01 for Dynamic PA on Factor 2). There is a modest shared environment influence on reading, some in common with all other variables (Factor 1) and some independent of them all (Factor 4). Nonshared environment effects are largely limited to individual variables. This is consistent with the fact that nonshared environment includes measurement error, which by definition is independent from one variable to another.

The most pertinent aspect of the results for the goals of this article is that the same genetic factors affect both PA measures. Thus, while each PA measure is affected by two genetic factors in this analysis, Factors 1 and 2 in the A matrix, they are the same factors that affect both forms of PA. In terms of genetic influence, therefore, the two forms of PA assessment cannot be differentiated. The situation is somewhat different for shared environment: In the C matrix, there is both overlap, Factor 1, and independence, Factors 2 and 3, which tells us that dynamic PA is affected by a source of shared environment that does not affect static PA. Finally, nonshared environment is significant for both variables, and almost completely nonoverlapping. Nonshared environmental effects are more substantial than shared environmental effects--of the variance specific to static and dynamic PA, 71% (.29/.12 + .29) and 81% (.35/.08 + .35) respectively represent unique rather than family environment effects.

Discussion

Summary

A comparison of the relative contributions of static and dynamic assessment of PA in preschool to predicting kindergarten reading showed that although dynamic assessment adds to variance explained in kindergarten reading on top of the variance attributable to LK and static PA, the addition is small at 1%. The high degree of overlap between the two PA measures as predictors (in addition to LK) of the substantially heritable trait of kindergarten reading ability raises the question of whether they may be influenced by a common genetic source, an issue that our genetically-sensitive design can address. As shown previously (Samuelsson et al., 2005) and confirmed here, static and dynamic PA are both subject to the influence of genes as well as of shared and nonshared environment when measured in preschool. The data reported here have also shown that they are both affected by the same genetic sources, with no independent genetic influence on one compared with the other. In addition, there is both independence and overlap in the sources of shared environment influence. Nonshared environment affects each variable independently, implying that there are no child-specific effects such as motivation that carry over from one measure to the other. It is important to recall that nonshared environment also includes measurement error, often substantial when testing preschool children, and consequently the psychological significance of this source of variance is not clear and possibly not substantial.

Kindergarten reading, indexed by the efficiency of word and nonword recognition, is influenced by the genes that affect static and dynamic PA, but only those that are in common between the two PA measures and LK (Factor 1 in the A matrix in Table 4). We have documented this pattern previously (Byrne et al., 2005); genes that influence PA independently from LK do not project their influence into the early school years. Reading may also be affected by a new genetic source, although the confidence interval contains zero, casting doubt on its significance (Table 4).

Implications

There appears to be little advantage in electing to use the more time-consuming dynamic assessment of preschool PA over the conventional static method (recall that our DA took up to an hour per child). DA only adds minimally to variance explained (1%) in later reading. Both forms tap the same genetic sources and overlapping family environment influences, and other, nonshared influences, may comprise measurement error in part.

We caution, however, that extrapolating beyond the kindergarten TOWRE is not warranted, and in fact we have observed that genes that affect total preschool PA independently of print knowledge, essentially those represented by Factor 2 in the A matrix in Table 4, do exert an influence on Grade 2 reading, though most clearly on reading *comprehension* (Byrne et al., 2009). But with respect to the central question of this article, the relative value of static and dynamic assessment of PA, researchers and practitioners could base their choice, static or dynamic, on convenience, tempered by considerations of reliability and sensitivity.

Grigorenko (2009) points out that DA was originally developed in part to address assessment issues for children from circumstances, social or physical, that precluded their taking advantage of educational opportunities available to others. Thus, even though we have been unable to clearly distinguish the static and dynamic versions of PA assessment, there could still be a place for it in the circumstances that Grigorenko identifies, namely for children who have been deprived of learning opportunities available to others.

Insofar as the dynamic assessment used in this study shares features with RTI (Grigorenko, 2009), an implication is the RTI is not inevitably more informative than standard methods of assessment. Thus the present results, as a counter-example to others in which RTI has been found to offer advantages over more static forms of assessment, suggest that the relative merits of RTI need to be examined on a case-by-case basis.

Interpretations

How should we interpret the high genetic correlation between static and dynamic PA? On one view, pre-existing PA (that is, PA indexed by the static measures) supports the ability to profit from further instruction, and thus DA looks “genetic” to the extent that static PA already is. On a competing view, the genes that underlie performance in the DA situation, genes that play a role in learning itself, have previously also played this role in children’s development of PA from whatever learning opportunities that were available to them. Dynamic assessment detects the influence of genes that support learning, and static assessment captures the “crystallized” products of those genes’ prior activity.

Conclusion

We have been unable to distinguish between static and dynamic preschool assessment of PA in terms of underlying genetics. Both PA variables share genes and family environment influences with LK, and each is also affected by other family-based factors. We suggested that both static and dynamic assessment of PA reflect the actions of genes that influence learning processes, but this remains speculative. We also suggested that, despite the common ground that the two forms of assessment share, DA may still serve as a valuable technique for children from disadvantaged backgrounds. More research is needed to test the generality of our conclusions for other types of PA and its assessment, and to further elucidate genetic and environmental etiology of both forms of PA measurement.

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Table 1

Intercorrelations (Below Diagonal) and Correlation Ns (Above Diagonal) for the Four Individual Phonemes of Dynamic Assessment (A) and the Five Static Measures of Phonological Awareness (B)

A

	/s/	/p/	/l/	/t/
/s/		1843	1834	1839
/p/	.687		1834	1842
/l/	.488	.474		1837
/t/	.512	.512	.508	

B

	Syllable/ Phoneme Blending	Sound Matching	Word Elision	Syllable/ Phoneme Elision	Rhyme & Final Sounds
Syllable/ Phoneme Blending		1927	1925	1924	1921
Sound Matching	.365		1925	1924	1983
Word Elision	.349	.346		1925	1922
Syllable/ Phoneme Elision	.327	.333	.391		1921
Rhyme & Final Sounds	.363	.336	.466	.316	

Table 2
Mean and Standard Deviations by Country for All Measures

		N	Mean	SD
Australia	Static PA[a]	542	6.40	2.17
	Dynamic PA[b]	437	70.49	17.02
	LK[c]	542	14.91	6.03
	TOWRE[d]	534	105.45	9.41
US	Static PA	977	5.89	1.92
	Dynamic PA	961	58.23	18.93
	LK	976	14.98	6.00
	TOWRE	973	98.95	9.05
Scandinavia	Static PA	471	5.99	1.91
	Dynamic PA	470	51.09	16.26
	LK	470	11.31	5.67
	TOWRE	368	86.41	10.46

Note. TOWRE = Test of Word Recognition Efficiency. PA = phonemic awareness. LK = letter knowledge.

[a]Based on raw scores, maximum = 14.4.

[b]Percentage.

[c]Maximum = 26.

[d]Mean standard score.

Table 3

Intercorrelations (Below Diagonal) and Correlation Ns (Above Diagonal) of the four Composite Measures, and Correlations between Twin 1 and 2 for Monozygotic (MZ) and Dizygotic (DZ) Pairs

	Static PA	Dynamic PA	LK	TOWRE	MZ	DZ
Static PA[a]		1,988	1,867	1,871	.81	.70
Dynamic PA[b]	.550		1,868	1,873	.71	.47
LK[c]	.546	.650		1,752	.62	.44
TOWRE[d]	.538	.423	.523		.89	.57

Note. TOWRE = Test of Word Recognition Efficiency. PA = phonemic awareness. LK = letter knowledge.

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Table 4

Cholesky Decomposition of All Measures. (95% Confidence Intervals in Parentheses)

	Factor 1	Factor 2	Factor 3	Factor 4	Total
A					
LK	.22 (.14 - .32)				0.22 (.14 - .31)
Static PA	.21 (.09 - .38)	.24 (.09 - .39)			0.45 (.29 - .58)
Dynamic PA	.14 (.04 - .30)	.25 (.09 - .39)	.01 (.00 - .14)		0.39 (.19 - .52)
TOWRE	.40 (.24 - .61)	.01 (.00 - .09)	.22 (.00 - .34)	.00 (.00 - .32)	0.63 (.50 - .73)
C					
LK	.59 (.50 - .66)				0.59 (.50 - .66)
Static PA	.13 (.07 - .21)	.12 (.01 - .23)			0.25 (.13 - .40)
Dynamic PA	.14 (.07 - .23)	.01 (.00 - .09)	.08 (.00 - .14)		0.23 (.12 - .40)
TOWRE	.07 (.02 - .13)	.00 (.00 - .07)	.00 (.00 - .24)	.18 (.00 - .26)	0.25 (.15 - .38)
E					
LK	.19 (.16 - .22)				0.19 (.16 - .22)
Static PA	.01 (.00 - .01)	.29 (.25 - .33)			0.30 (.26 - .34)
Dynamic PA	.02 (.01 - .03)	.01 (.00 - .02)	.35 (.31 - .39)		0.37 (.33 - .43)
TOWRE	.00 (.00 - .01)	.00 (.00 - .00)	.00 (.00 - .00)	.11 (.10 - .13)	0.12 (.10 - .14)

Note. N pairs with semi-complete data, 994; N pairs with complete data, 836. TOWRE = Test of Word Recognition Efficiency. PA = phonemic awareness. LK = letter knowledge.