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AUTHOR Griffith, Priscilla L.; Klesius, Janell P.
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ABSTRACT

A study investigated the relationship among the linguistic units that make up spoken language, the symbols of written language, and how spoken language is mapped onto written language (the alphabetic principle). Subjects, 79 kindergarten children from 5 classrooms in 4 schools in a large southeastern school district, were tested for their knowledge of the alphabetic principle, phonemic awareness, letter name knowledge, and orthographic knowledge. Results indicated that: (1) significant amounts of the variance in understanding of the alphabetic principle can be explained by phonemic awareness and letter name knowledge; but (2) these two variables did not do a very good job of explaining the variance in scores measuring children's understanding of the orthographic patterns of written English; (3) the distribution of scores on the orthographic information measure indicated that children were aware that words did not contain numbers and that most children were able to discern mock and letters in words; and (4) phonemic awareness rarely developed in the absence of letter name knowledge. Instructionally the implications are that experimentation with paper and pen may be as important to the literacy development of children as is reading. (Six tables and three figures of data.) (RS)

Kindergarten Children's Developing Understanding of the Alphabetic Principle

Priscilla L. Griffith
Janell P. Klesius
University of South Florida

Address correspondence to
Priscilla L. Griffith
College of Education EDU 208B
University of South Florida
4202 E. Fowler Ave.
Tampa, FL 33620-5650

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Kindergarten Children's Developing Understanding of the Alphabetic Principle

The acquisition of literacy is a primary goal of schooling. Early success appears critical to the attainment of this goal. In a longitudinal study of children from first grade to fourth grade, Juel (1988) reported a probability of .88 that a child who was a poor reader in first grade would remain a poor reader in fourth grade. Researchers (Adams, 1990; Clay, 1985; Griffith, 1991; Juel, Griffith, & Gough, 1986; Lomax & McGee, 1987; Tunmer, Herriman & Nesdale, 1988) have studied the relationships among a collection of variables thought to have an impact on literacy development. Variables which have emerged from the research as predictors of successful literacy development include phonemic awareness, and letter name knowledge.

As children learn to read and write they discover information about the form of written language. This information includes knowledge about (1) the linguistic units that make up spoken language, including words and phonemes; (2) the symbols of written language, i.e., the letters; and (3) how spoken language is mapped onto written language, i.e., the alphabetic principle (Gough & Hillinger, 1980).

When children learn to use and understand language, they learn to speak using phonemes. But, while children may be able to use phonemes to produce meaningful language, they may not be consciously aware that phonemes exist. This insight is difficult for some children to grasp because phonemes are very abstract units of language. They carry no meaning, and children are accustomed to thinking of words in terms of their meanings, not in terms of their linguistic characteristics. In fact, children's experiences with spoken language prior to learning to read and write are focused primarily on conveying meaning.

As children experiment with paper and pen their drawings begin to be distinguished from their scribbles which gradually begin to resemble letters. At first these mock letters only approach the conventional letters of English orthography. Eventually, however, children learn letter names and how to more accurately form English letters.

Knowledge of these abstract and arbitrary units of spoken and written English are quite useless to children, except that they are the units by which spoken language is mapped onto written language. They are the building blocks of the alphabetic principle.

The fact that children do not acquire these concepts in an all-or-none fashion has been documented through emergent literacy studies (Ferreiro & Teberosky, 1982; Teale & Sulzby, 1986; Taylor, 1986). That understanding of these concepts is a strong predictor of later literacy achievement has been documented in longitudinal studies of literacy development (Juel, 1988; Juel, Griffith, & Gough, 1986; Lundberg, Frost, & Petersen, 1988; Lomax & McGee, 1987).

The purpose of this study was to investigate the relationship among these variables and how they impinge upon kindergarten children's developing understanding of the alphabetic principle. Specifically the study addressed the following questions:

1. What is the relationship between the development of phonemic awareness and kindergarten children's knowledge of letter names?
2. How well can kindergarten children's understanding of the alphabetic principle be explained by letter name knowledge and phonemic awareness?
3. What is the relationship between phonemic awareness, letter name knowledge and kindergarten children's acquisition of orthographic information?
4. What kinds of growth do children make in their understanding of the alphabetic principle as they are exposed to print in the kindergarten class?

Method

Subjects

Seventy-nine kindergarten children from five classrooms in four schools in a large southeastern school district participated in the study. There were 42 females and 37 males in the study. Seven of the children were African American; three were Hispanic; and 69 were White.

Materials

The children were tested with measures that assessed the following variables:

1. Alphabetic Principle. This variable was measured by both recognition and production tasks. For the recognition task children were shown two low frequency words and told to mark the one pronounced by the researcher. The words were of different lengths but contained some common letters. The reliability for this measure, computed using the K-R 21 formula on the adjusted scores, was .93. Additional qualitative data were collected by asking the children "How did you know that was {word pronounced by researcher}?" We referred to the variable measured by this test as Implicit Understanding of the Alphabetic Principle. For the production task children were asked to spell five words: late, wind, shed geese, and jumped. We referred to the variable measured by this test as Explicit Understanding of the Alphabetic Principle.
2. Phonemic Awareness. This variable was measured using a test described by Yopp (1988). Following practice, the children were asked to segment 22 words into their individual phonemes. The reliability for this measure, computed using the K-R 21 formula, was .95.
3. Letter Name Knowledge. This variable was measured using Clay's (1985) letter identification test. The test assesses knowledge of upper and lower case letter names. The reliability for this measure, computed using the K-R 21 formula, was .97.
4. Orthographic Knowledge. This variable was measured with a test consisting of pairs of letter strings, one containing only letters and the other containing a number or mock letter (e.g., GJM or GJ4) or one containing a pronounceable and the other an unpronounceable letter string (e.g., HNJ or MUS). The children were shown the letter string pairs and told to choose the one that looked more like a word. The reliability for this measure, computed using the K-R 21 formula on the adjusted scores, was .92.

Procedures

Testing. The children were tested individually on all measures. Phonemic awareness, letter knowledge and orthographic information data were collected longitudinally in December and May. The alphabetic principle data were collected in May.

Scoring. Both the alphabetic principle-recognition and the orthographic knowledge measures were forced-choice tests. Responses to each item were scored as correct or incorrect. Total scores on each measure were computed by totaling the number of correct responses. The phonemic awareness test was scored by totaling the number of words completely segmented. Similarly, the letter name knowledge test was scored by totaling the number of letters correctly identified. Responses to the alphabetic principle-production (i.e., spelling) items were scored for how orthographically and phonologically similar each child's spelling was to the target word. An orthographic score was assigned based upon the number of letters positionally in common with each target word. Phonologically scores were based upon how many sounds were represented in each child's spelling of the target word. Orthographic and phonological scores were combined into one score for each of the unique spellings of the five words.

Analyses. The data were analyzed quantitatively and qualitatively.

Multiple regression was used to determine the impact of phonemic awareness and letter knowledge on children's understanding of the alphabetic principle and on their acquisition of orthographic information. Three regression equations were formed with the December phonemic awareness and letter name knowledge measures as the predictor variables and each of the alphabetic principle measures and the May orthographic information measure as dependent variables. Additionally, the relationship between phonemic awareness and letter knowledge was plotted on scattergrams and compared using cross-lagged panel correlations. Mean scores of phonemic awareness and letter name knowledge were used to divide the scatterplot into four quadrants. A chi square was performed on the frequency of cases in each quadrant.

Qualitative data were analyzed to determine the children's understandings about the alphabetic principle. Children's feedback data from the alphabetic principle-recognition measure were grouped into response categories. These categories were then correlated with the numerical scores to determine what types of strategies were the most effective for recognizing words. Finally, a list of each unique spelling for each word was compiled. Like spellings were then grouped into categories which revealed different types of understanding of orthographic patterns found in English spelling.

Results

Descriptive data are reported in Table 1. Intercorrelations among all of the variables are reported in Table 2.

What is the relationship between the development of phonemic awareness and kindergarten children's knowledge of letters?

Figure 1 shows the relationship between phonemic awareness and letter name knowledge in May. The upper left quadrant contains only seven cases indicating that children rarely performed well on the phonemic awareness test in the absence of letter name knowledge. The chi square of 3.00124 (df = 1), computed from the frequencies in the four quadrants of the scatterplot, approached significance ($p < .08$).

Figure 2 shows the cross-lagged panel correlations of the phonemic awareness-letter name knowledge relationship. According to the logic of cross-lagged panel analysis, if the correlation between December letter name knowledge and May phonemic awareness is significantly larger than the correlation between December phonemic awareness and May letter name knowledge, then it can be concluded that changes in letter name knowledge are followed by changes in phonemic awareness. Using procedures suggested by Steiger (1980) a Z score was computed to compare the two dependent correlations described above. The computed Z of 1.38 approached significance ($p < .08$).

How well can kindergarten children's understanding of the alphabetic principle be explained by letter knowledge and phonemic awareness?

Figure 3 shows the results of the regression analyses for each of the alphabetic principle measures. (The numbers on each path are standardized beta weights.) Thirty-six percent of the variance in the measure of implicit understanding of the alphabetic principle was accounted for by phonemic awareness and letter name knowledge. The standardized regression coefficients indicate that phonemic awareness and letter name knowledge exert about an equal influence on implicit understanding of the alphabetic principle, specifically implicit understanding increases .38 of a standard deviation for each standard deviation increase in phonemic awareness compared to a .36 standard deviation increase for each standard deviation increase in letter name knowledge. When orthographic information was entered as a predictor variable in the model explained variance increased to 40%

The children's ability to spell words was used to measure explicit understanding of the alphabetic principle. Fifty-seven percent of the variance in spelling scores was accounted for by the two variables. Phonemic awareness appeared to exert the more powerful influence, as indicated by the standardized regression coefficients (phonemic awareness = .51 and letter name knowledge = .41).

Tables 3 and 4 compare spellings of children with various levels of phonemic awareness and letter name knowledge. We identifies the individual children in each of the quadrants of the scatterplot described above. Unique spellings produced by children in each of the four phonemic awareness-letter name knowledge groups are listed in Table 3. Notice that the spellings of children low in both phonemic awareness and letter name knowledge were the most deviant from the standard spellings of the words, and that several words were spelled with letter strings or with combinations of real and mock letters. However the children who were high in one variable but low in another did not fare much better. Their spellings appeared to be incomplete, especially when compared to the spellings produced by the children high on both variables. It appears that letter name knowledge in the absence of phonemic awareness is no more helpful to a child than is phonemic awareness in the absence of letter name knowledge. Table 4 provides quantitative support for these qualitative results. Mean spelling scores for the words in each group were computed using the score assigned to each spelling for the computation each individual's total spelling score on the alphabetic principle-explicit knowledge measure (i.e., the combined orthographic and phonological scores). These means are reported in Table 4. Significant differences were not calculated, however scrutiny of Table 4 suggests that children high in both phonemic awareness and letter name knowledge were superior spellers.

What is the relationship between phonemic awareness, letter knowledge and kindergarten children's acquisition of orthographic information?

Phonemic awareness and letter name knowledge were not strong predictors of children's acquisition of orthographic knowledge. Only 9% of the variance in the orthographic knowledge scores could be explained by these two variables.

The distribution of scores on this measure indicated that the children generally did not have trouble with the items containing numbers and/or mock letters. In fact, the children frequently commented that words did not contain numbers or, in the case of the items with the mock letters, that a letter was written backwards or upside down. However, many were baffled by the pronounceable and unpronounceable letter strings. In more than one case a child commented that they both looked like words. These data seemed to suggest that by kindergarten most children are aware that words are comprised of letters, but their understanding of the role that vowels play in words is at best at an emergent level. While some children included vowels in the spellings they produced, they were not able to use that information to make conscious decisions about words.

What kinds of growth do children make in their understanding of the alphabetic principle as they are exposed to print in the kindergarten class?

We used our qualitative data to answer this question. As part of the alphabetic principle - implicit understanding measure, we asked children to tell us how they were able to decide which word had been pronounced. We grouped their responses into categories. These response categories are reported in Table 5. We also correlated these response categories to success in recognizing words. Although many children reported looking at letters in the words, the children who were most successful with this task (i.e., children correctly recognizing 9-10 of the items on this 10-item test) looked at multiple letters in the word. That is, they looked at the beginning, middle, and end of the word, or at word parts (e.g., the "ter" in "enter" or the "ger" in "germ"). The least successful students were unable to be very specific about what sorts of strategies they used. Typically, they responded with "I just knew" or "I had it in my mind." Another unproductive strategy was to look only at one part of the word (e.g., the beginning). Many children reported word length as a cue. However, the efficacy of this strategy varied, as several low-scoring children reported its use.

The children's spellings on the alphabetic principle - explicit understanding were also an indication of their different understandings of the alphabetic principle. The types of spellings produced by the children are reported in Table 6. Some children seemed to be starting to be aware of word length, as evidenced by children who tried to make their spellings look more complete through the use of some type of a vowel spaceholder to separate beginning and ending sounds or the use of letter strings tacked onto the ends of

words. We hypothesize that in some cases a child could distinguish one or two sounds in a word and represent them fairly accurately. Then, realizing that there were other sounds in the word but being unable to distinguish what they were, the child may have just written random letters. A case in point is the strategy used by one child to spell jumped. He began by saying "jump, jump, jump," each time emphasizing the initial sound. Then he wrote a "j." Next he repeated the strategy of saying jump several times. He said, "I know there is a 't' and it's far away from the 'j.'" He wrote a "t," but left a space between it and the "j." Finally he filled in the space between the "j" and the "t " with some random letters.

In addition to the types of spellings listed in Table 6, the children produced some classic invented spellings (e.g., lt, lat, gs, ges, yd, yed, yid, sid). Additionally, we observed a tendency for children to interchange voiced and voiceless consonants (e.g., p/b, t/d, and c,k/g) as well as stop consonants distinguished by place or articulation (e.g., b/d/g and p/t/k,c).

Conclusions

The regression analyses indicate that significant amounts of variance in understanding of the alphabetic principle (i.e., > 30% for implicit understanding and > 50% for explicit understanding) can be explained by phonemic awareness and letter name knowledge. In contrast these two variables do not do a very good job of explaining the variance in scores measuring children's understanding of the orthographic patterns of written English. The distribution of scores on the orthographic information measure indicated that children were aware that words did not contain numbers and that most children were able to discern mock and letters in words.

The data on the relationship between phonemic awareness and letter name knowledge are very interesting. The distribution of cases on the scatterplot suggests that phonemic awareness rarely develops in the absence of letter name knowledge. Although, the statistical analyses (i.e., the chi square and the cross-lagged panel correlations) did not reach significance at a probability of .05, that they approached significance ($p < .08$) is reason to continue to investigate the relationship between these two variables. Clearly the analyses of the types of spellings produced by the four phonemic awareness-letter name knowledge groups formed through a mean split of scores on the two axes of the scatterplot support the notion that phonemic awareness and letter name knowledge interact as knowledge about the alphabetic principle emerges.

Both Ehri (1991) and Adams (1990) discuss why letter name knowledge may be such a strong predictor of later reading success. The names of letters are closely related to the sounds they represent and therefore a knowledge of letter names mediates the ability to remember letter-sound correspondence information. That letter names are closely related to sounds that comprise spoken words may also help enhance the development of phonemic awareness. Perhaps when a child knows the names of some letters she may become more conscious of hearing what appears to be that letter name in a spoken word. For example a child who knows the letter name "t" may be aware that "t" or something very similar is heard in a word such as "late." This attention to word parts in spoken language may create a spiral effect resulting in increased facility with the manipulation of sounds in words. Instructionally the implications are that experimentation with paper and pen may be as important to the literacy development of children as is reading to children. Clay (1985) has said that children practice many of the skills of reading in another form when they write. When children write they have to face head-on the problem of mapping spoken language onto written language. Serendipitous to this can be an understanding of the structure of spoken language, because the more children write, the better they become at segmenting sounds into words.

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Table 1

Descriptive Statistics

Variable	M	SD	Range
Phonemic Awareness - December	5.58	5.89	0-22
Phonemic Awareness - May	10.04	7.38	0-22
Letter Name Knowledge - December	42.94	13.13	0-54
Letter Name Knowledge - May	47.81	9.77	0-54
Orthographic Knowledge - December	5.27	4.70	3-16
Orthographic Knowledge - May	5.92	5.36	4-16
Alphabetic Principle - Implicit	4.68	3.95	3-10
Alphabetic Principle - Explicit	83.05	32.01	22-139

Table 2

Intercorrelations of All Variables

Variables	1	2	3	4	5	6	7	8
1. Phonemic Awareness - Dec.	1.00	.71	.33	.26	.23	.23	.48	.63
2. Phonemic Awareness - May		1.00	.39	.37	.25	.30	.51	.48
3. Letter Name Knowledge - Dec.			1.00	.85	.29	.26	.50	.55
4. Letter Name Knowledge - May				1.00	.28	.22	.46	.47
5. Orthographic Knowledge - Dec.					1.00	.20	.37	.27
6. Orthographic Knowledge - May						1.00	.31	.34
7. Alphabetic Principle - Implicit							1.00	.68
8. Alphabetic Principle - Explicit								1.00

Table 3

Spellings of the Phonemic Awareness Groups

	Words				
Group	late	wind	shed	geese	jumped
Low Phon. Awr.	noe	oeo	eom	ehe	one
Low Let. Name Know.	moqw	vwqmc	maqvwm*	ged	jti
	lts	wdn	sd	ecs	gpda
	haik	klli	di**	bo*	mt
	esesthag	meacth	cttme	dectch	httsteh
	let	wnd	sheda	gecsd	gedt
	anokvap	binllen	drs	dnn	ton*ab
	lt	yd	gd	kc	jt
	lamt	wd	pew	guv	jmm
	n	y	i	a	l
	lat	ypdn	sadt	ga	jda
	leat			seem	jep
High Phon. Awr.	la	ya	rs	ef	jef
Low Let. Name Know	l	yw	he	gsees	tj
	lat	wd	ad	ec	jegt
	lt	yat	fb	ls	pt
	lo	of	lo	kgt	gtgt
	mteag	fnb	es	dsig	cpi
		ynd			gj
Low Phon. Awr.	lat (3)	wd	thd	gec	got
High Let. Name Know.	let	o	fi	e	g
	lt (5)	sttet	sd (2)	44	jt
	hrcdikefg	yws	tgrt	gts	etgef
	ts	wnd	ehs	ges	ghst
	t	ct	htd	cg	jpt
	lant	wend	dl	gesa	gtn
	ltcdnc	wbdc	and	ecson	gamp
	lakt	qdt	wcdoe	gst	gnces
	latrgai	ol*t	shdt	gote	i
	lap	wid	tog	ga	ate
	k	wp	tah	raki	jep
	lot	veyco	purle	brjanddily	rarty
	lkt	e	k	jo	jyra
	lert	wabe	sab	gss	b
	lm	wt	st	es	jat
	ddll	st	sahsh	gstl	f
	l	has	lamie	dh	gs
	ltn	aaim	sod	gj	jjh
		wod	todayo	ses	jaas
		wyd	d	totyaa	jopt
		dw	cd	cs	goaa
		d	g	j	jbj
		y	hck	q	f
		ym		gkc	j
					jpj

Table 3 (cont.)

	Words				
Group	late	wind	shed	geese	jumped
High Phon. Awr.	li	yd	snd	es	j
High Let. Name Know.	lat (22)	wind (3)	sad (6)	ges (14)	jopt (4)
	lit	wid (3)	cete	gis	jud
	late	yiec	sed (3)	gese	jat (2)
	laalt	wnd (4)	had (3)	ecm	gme
	lata	wund	thad	gees (3)	gnt
	ltae	wed (2)	hae	gel	jupt
	*mdjmd	whd	chd	ese	japd
	lt	wda	chad	gsa	jep
		wan	sap	gess	jmp
		wanda	shadd	geaes	jet
		wen	aed	das	je
		wnid	sada	smosm	jaat
		wad (2)	tod	dsa	jat (3)
		wnb	sahd	eiry	japa
		wand	shad (3)	gays	jimt
		yodmo	cmodam	gs	gnp
		hnd	wnt	gek	gapt
		ynt	hsed		gaeit
		wri	shd		gatp
		woad	sab		gmdiam
		wab	cad		jpt
		wd			tgab
		hn			jbd
					jap (2)
					jo

Note. Numbers in parentheses following a spelling indicate that more than one child produced the spelling. The inclusion of mock letters in a spelling are indicated with and asterisk.

Table 4

Mean Spelling Scores for Phonemic Awareness-Letter Name Knowledge Groups

	Group			
Word	Low Phon. Awr.-Low Let. Name Know.	High Phon. Awr.-Low Let. Name Know.	Low Phon. Awr.-High Let. Name Know.	High Phon. Awr.-High Let. Name Know.
late	13.50 (8.74)	16.17 (7.25)	15.53 (6.85)	21.00 (6.34)
wind	12.00 (7.71)	13.71 (4.79)	12.80 (8.37)	20.96 (8.15)
shed	11.45 (7.69)	10.67 (4.89)	11.67 (4.86)	18.50 (5.73)
geese	11.58 (5.82)	14.00 (6.07)	12.12 (6.66)	18.33 (7.13)
jumped	12.25 (6.28)	12.14 (3.34)	11.62 (5.76)	18.31 (5.08)

Note. Standard deviations are shown in parentheses.

Table 5

Word Recognition Response Categories

No. Giving the Response	Response Category
34	Word Length
30	Letter Sound Correspondence - Final Position
29	Letter Sound Correspondence - Middle Position
26	Letter Sound Correspondence - Beginning Position
18	Letter Sound Correspondence - Beginning and Final Position
15	Word Parts
11	Sounded Out A Sequence of Letters
8	Don't Know
7	Letter Sound Correspondence - Middle and Ending Position
6	Letter Sound Correspondence - Beginning and Middle Position
6	Named Letters in the Word
8	Random Responses Not Related to Letters - "Just know," "In my mind"
3	Knew How To Spell It
3	Sounded It Out
3	Knew How To Read It
2	Just Guessed

Table 6

Types of Spellings Produced

Type	Example
Pictures	
Scribbles	
Mock letters mixed with real letters	
Single letters - real	
Excessively long letter strings	esoftgh, rphbtnt, sofoethi
Letter strings near the length of target word	bohd, kono
Letter strings beginning with the correct initial letter	ly, lio (late) guv, gkc (geese) wp, wz (wind) jseri, jyna (jumped)
Representation of initial and final sound followed by random letters	ltcdnc, lth (late) gskl, gstl (geese) wdsc (wind) jpe, jda, jtam (jumped)
Beginning and ending sounds separated by consonant or consonant and vowel placeholders	lcrt, likt (late) gts (geese) skrd, snd, sterd (shed) wbcd, whd (wind) jrmt, jiwt (jumped)
Beginning and ending sounds separated by any vowel	let, leat, lit, lot (late) geaes, ges (geese) saad (shed) wad, woad, wod (wind) jep, jopt, jap, jip (jumped)

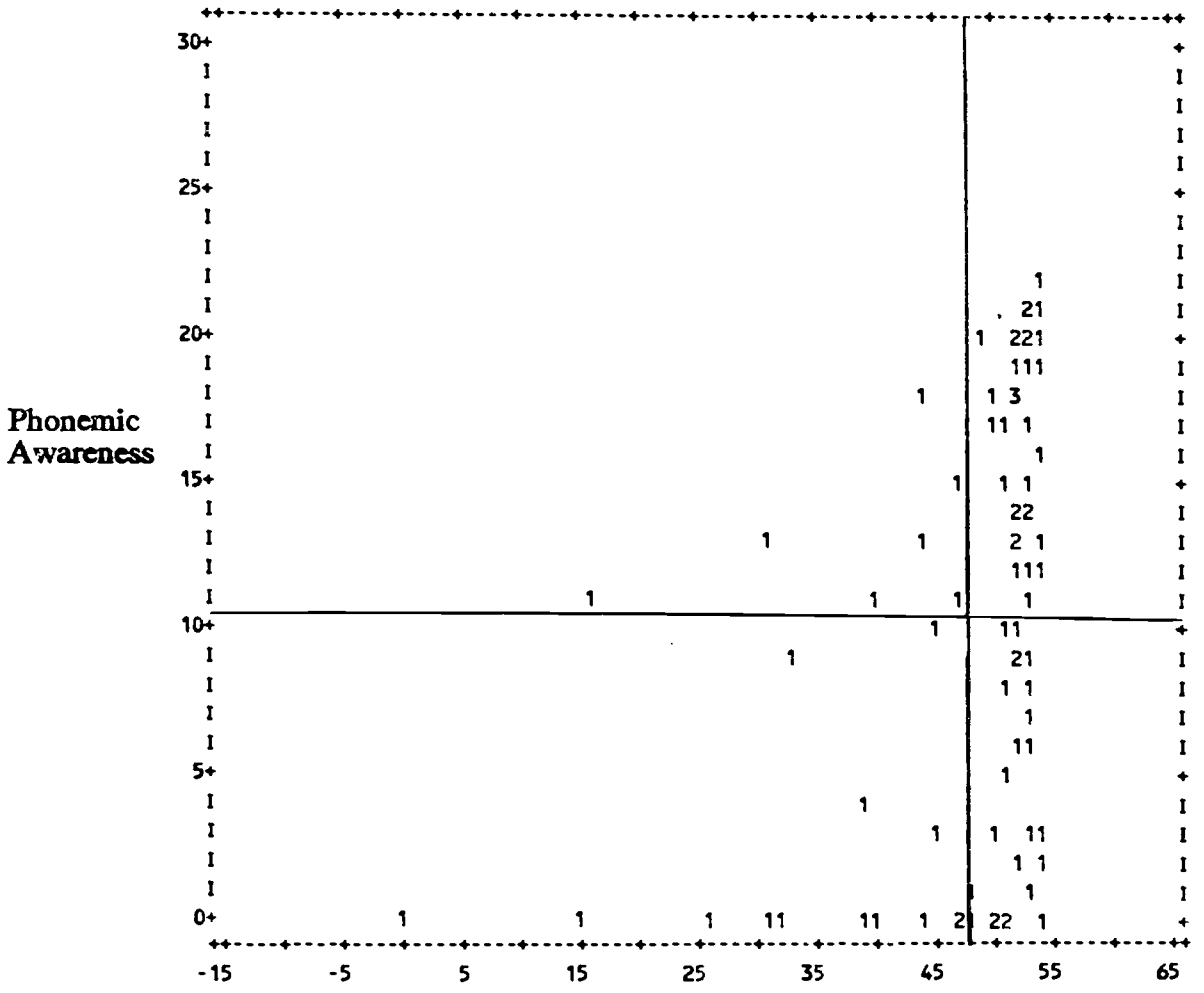

Figure 1

Scatterplot of phonemic awareness and letter name knowledge.

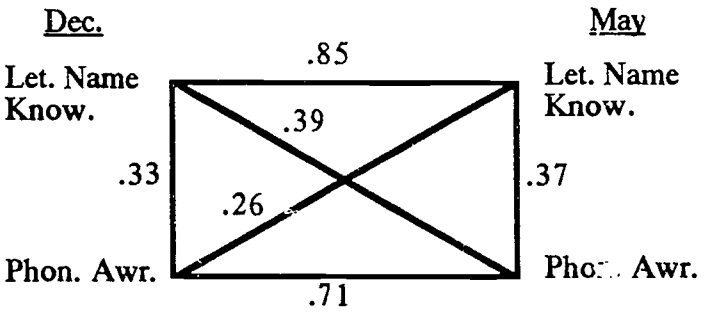

Figure 2

Cross-Lagged Panel Correlations

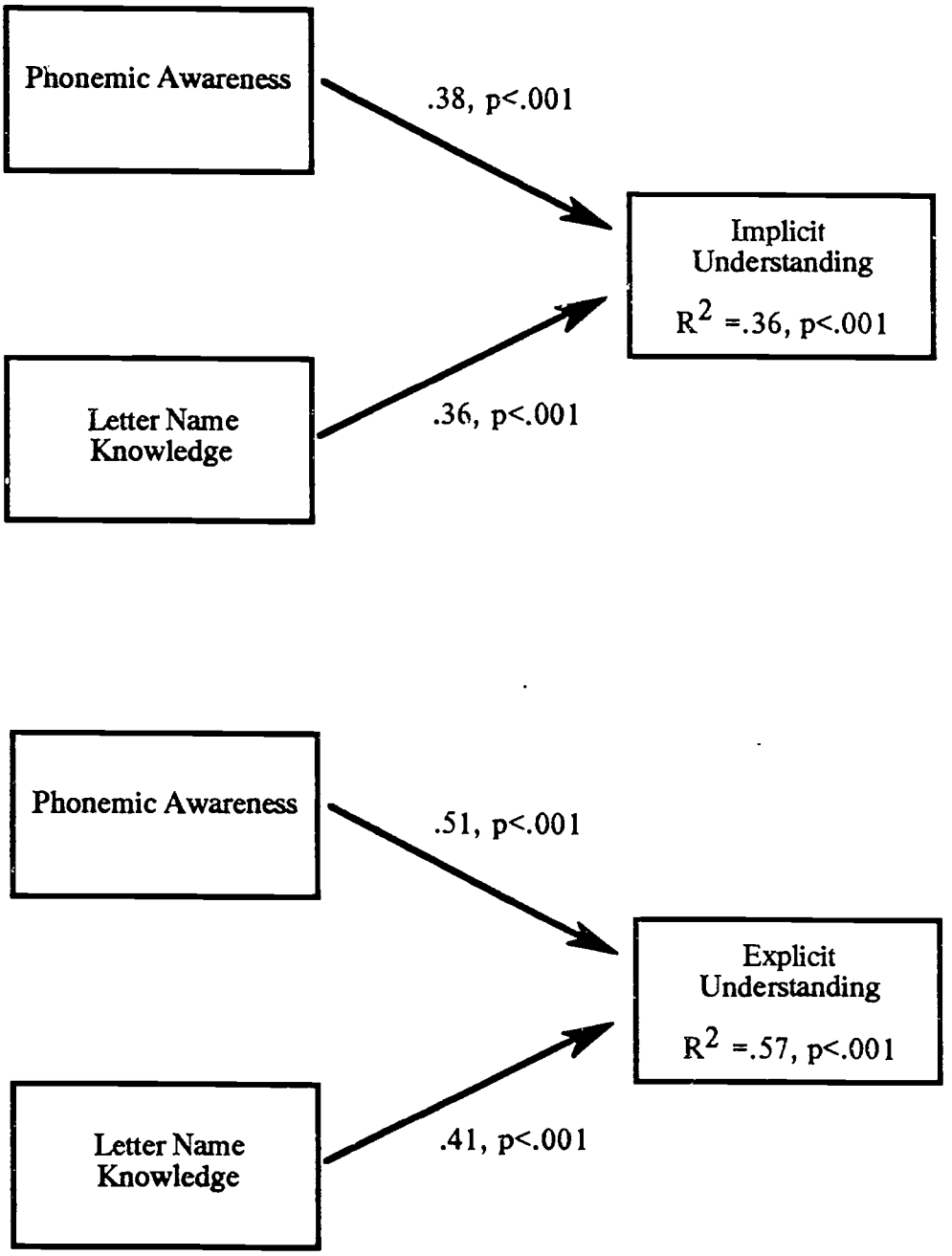

Figure 3

Results of regressions analyses with understanding of the alphabetic principle as the dependent measure.