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J. Experimental Child Psychology 88 (2004) 213–233

Journal of Experimental Child Psychology

www.elsevier.com/locate/jecp

Knowing letter names and learning letter sounds: A causal connection

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Received 1 August 2003; revised 7 March 2004
Available online 20 April 2004

Abstract

Two experiments tested the common assumption that knowing the letter names helps children learn basic letter-sound (grapheme–phoneme) relation because most names contain the relevant sounds. In Experiment 1 ($n = 45$), children in an experimental group learned English letter names for letter-like symbols. Some of these names contained the corresponding letter sounds, whereas others did not. Following training, children were taught the sounds of these same "letters." Control children learned the same six letters, but with meaningful real-word labels unrelated to the sounds learned in the criterion letter-sound phase. Differences between children in the experimental and control groups indicated that letter-name knowledge had a significant impact on letter-sound learning. Furthermore, letters with names containing the relevant sound facilitated letter-sound learning, but not letters with unrelated names. The benefit of letter-name knowledge was found to depend, in part, on skill at isolating phonemes in spoken syllables. A second experiment ($n = 20$) replicated the name-to-sound facilitation effect with a new sample of kindergarteners who participated in a fully within-subject design in which all children learned meaningless pseudoword names for letters and with phoneme class equated across related and unrelated conditions.

Keywords: Letter names; Letter sounds; Alphabetic skills; Phonemic awareness; Literacy acquisition; Reading development

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0022-0965/$ - see front matter
doi:10.1016/j.jecp.2004.03.005

Introduction

Preschoolers' knowledge of the names of printed letters has long been known to be among the strongest predictors of future success in learning to read (e.g., Bond & Dykstra, 1967; Chall, 1967; Durrell, 1958; Share, Jorm, Maclean, & Matthews, 1984; Tunmer, Herriman, & Nesdale, 1988; Wilson & Flemming, 1938). The strength of this relation typically exceeds that of IQ (Share et al., 1984; Stanovich, Cunningham, & Feeman, 1984). The nature and significance of this association, however, continue to be the subject of both speculation and controversy (e.g., Adams, 1990; Durrell, 1980; Ehri, 1983; Gibson & Levin, 1975; Mates & Strommen, 1995/1996; Venezky, 1975). An understanding of this relation has important educational implications as there is considerable debate over the value of teaching preschoolers the names of letters (see, e.g., Durrell, 1980; Ehri, 1983; Feitelson, 1988; Mates & Strommen, 1995/1996).

There are a number of possible explanations for this relation, all or some of which may be partly correct. The most common account assumes that knowledge of letter names simply reflects the educational environment prior to school entry. Because parents and preschool/kindergarten teachers rightly or wrongly believe that teaching children letter names helps prepare them for school, letter-name knowledge may simply be a proxy for preschool and home background factors known to play an important role in promoting literacy (Share, Jorm, Maclean, Matthews, & Waterman, 1983; White, 1982). By this account, there is nothing to be gained by a child's mastery of the letter names as such. Raw correlation coefficients, however, indicate that letter name knowledge accounts for around twice as much variance in early reading as measures of socioeconomic status or more "dynamic" educational processes in the home, such as parents' story-reading activities (Share et al., 1983).

A second account of the relation between letter names and early reading views letter-name knowledge as a proxy for variance associated with phonological memory processes—the ability to learn and recall speech-based (phonological) information (Share, 1995; Share et al., 1984). It is now well established that a majority of variance in early reading skill is associated with the immediate, short-term, or long-term recall of phonological material, such as spoken pseudowords (Adams, 1990; Brady, 1986; Shankweiler & Liberman, 1989; Share, 1995; Snowling, 1991; Stanovich, 1986, 2000; Wagner & Torgesen, 1987). Furthermore, there is strong evidence that phonological processes play a causal role in reading acquisition (Wagner & Torgesen, 1987), although the precise role of these processes is still not fully understood (see, e.g., Adams, 1990; Shankweiler & Liberman, 1989; Share & Stanovich, 1995). According to what might be termed the "phonological proxy" hypothesis, letter names, like pseudowords, are essentially meaningless phonological strings; memorizing these labels should, therefore, rely heavily on basic phonological memory processes. Thus, phonological memory may represent a common cause for what might be a "spurious" relation between letter-name knowledge and early reading ability.

A third explanation for the predictive strength of letter names—the "visual familiarity" hypothesis—proposes that letter-name knowledge may tap a child's familiarity with letter shapes. Ehri (1986) has suggested that the ability to recognize, distinguish, and recall the form and orientation of a large number of visually confusable letter-symbols is a considerable achievement for a preschool or kindergarten child. Letter-name knowledge may provide an index of the extent to which a child has mastered this perceptual learning task.

It has also been proposed that knowing the names of letters makes a direct contribution to early reading by helping young children appreciate that writing represents spoken language rather than directly reflecting meaning. Because letter names sometimes match sequences of phonemes heard in words (e.g., *farm—R*, or *deaf—F*), whole syllables (*candy—D*), or even whole spoken words (e.g., *U = you*), knowing letter names can sensitize children to the fundamental phonological nature of writing. Both naturalistic (Gentry, 1982; Read, 1976; Treiman, 1993) and experimental studies (De Abreu & Cardoso-Martins, 1998; Levin, Patel, Margalit, & Barad, 2002; McBride-Chang & Treiman, 2003; Treiman, 1994; Treiman & Rodriguez, 1999; Treiman & Tincoff, 1997; Treiman, Tincoff, & Richmond-Welty, 1996) have demonstrated the influence of letter names on early attempts at reading and writing. For example, Treiman et al. (1996) found that preschool children were better at identifying the first letter of the spoken word *beach* that contains the name of the letter B, than the word *bone* that does not. Treiman et al. (1996) also found that the correspondence between a spoken word and a letter name can sometimes mislead children into identifying the letter Y as the first letter in the word *wife*, or C as the initial letter of the word *seem* (see also Levin et al., 2002).

This study focused on a related but distinct account of the role of letter-name knowledge in early reading. Because knowledge of letter names typically develops earlier than letter-sound knowledge (Mason, 1980; McBride-Chang, 1999; Treiman et al., 1996; Worden & Boettcher, 1990), and because letter names normally contain the relevant sounds, knowing the names of letters may make it easier for children to master the letter-*sound* (grapheme–phoneme) relation necessary for efficient decoding (Durrell, 1980; Ehri, 1986; McBride-Chang, 1999; Read, 1986; Stuart & Coltheart, 1988; Treiman & Kessler, 2003). Support for this "name-to-sound facilitation" hypothesis comes from a study by Treiman, Weatherston, and Berch (1994), who found that some children approaching the end of kindergarten spelled words with the initial /w/ sound using the letter Y (e.g., *war*—YR). When directly questioned, many kindergartners said that the letter Y makes the sound /w/. More generally, both preschoolers and kindergartners were more successful spelling phonemes such as /b/ and /l/ that are heard in the names of the corresponding letters than phonemes that are not part of the letter name (/h/ and /g/). Further support for the name-to-sound facilitation hypothesis was reported by Treiman, Tincoff, Rodriguez, Mouzaki, and Francis (1998). Pooling the data from three large-scale US surveys of letter-name and letter-sound knowledge, Treiman et al. (1998, Study 1) found that children were better at identifying the sounds of letters when the letter's name began with that sound, such as *b*, than when it was at the end, such as *f*, or when it was not in the name at all (e.g., *h*). In a follow-up training study, preschoolers with good letter-name knowledge but poor knowledge of letter sounds were directly taught the sounds of letters whose names they already knew (Treiman et al., 1998, Study 2). Letter-sound learning was best with letters with sounds at the beginning of their names (e.g., *b*), poorer for sounds at the end of names such as *l*, and worst for letters whose sounds are not in the names at all (e.g., *w*).

The following two experiments directly tested the "name-to-sound facilitation" hypothesis in a sample of cognitively normal kindergarteners who were not familiar with either the names or the sounds of English letters. In Experiment 1 there were two groups of kindergarten children: An experimental and a control group. The experimental group first learned a representative set of (English) letter names for artificial letter-like symbols. Following training, all children were taught the sounds for these same "letters." Ease of learning the letter-sound correspondences after having learnt the letter names provided a fairly direct test of the hypothesized causal connection between letter-name and letter-sound knowledge. To check the possibility that increased visual familiarity alone may account for any training effect, a control group learned the same set of symbols, but used phonologically unrelated labels—that is, semantically meaningful names rather than pseudoword names. For example, a child who learns that the figure)(is called *ESS* should, according to the name-to-sound facilitation hypothesis, find it easier to learn that this same symbol has the sound /s/ than a child taught that the same figure is named *BRIDGE*, a phonologically unrelated label. If letter-name knowledge only taps children's familiarity with the visual form of letters, there should be no significant differences between the experimental and control groups in criterion letter-sound learning once instructional time is equated. In fact, any difference should favor the control group because real-word names should be easier to learn, and should more readily provide a verbal label for each shape.

In addition to the between-group test of the name-to-sound facilitation hypothesis, Experiment 1 also included a within-subject test (among children in the experimental condition) of this hypothesis by comparing the learning of letters whose names contained the relevant letter sound with letters whose names did not contain the relevant sound.

In Experiment 1 also examined whether phonemic analysis mediates the relation between letter-name and letter-sound learning. A number of authors (e.g., Read, 1986; Treiman et al., 1998; Treiman et al., 1994; Venezky, 1975) have suggested that the ability to exploit the connection between a letter's name and its sound may depend on a child's skill at phonemic segmentation, an ability known to vary widely among preschoolers (Adams, 1990; Brady & Shankweiler, 1991). Thus, knowing the name of the letter *S* can help a child learn its sound /s/ only if s/he recognizes that the string *ESS* contains the phoneme /s/. If this "segmentation" hypothesis is correct, then phonemic analysis should correlate positively with letter-sound learning in the *experimental* group. That is, children better able to isolate sounds in spoken syllables should benefit more from learning phonologically related letter names. In contrast, pretest phonemic analysis should be unrelated to posttest letter-sound learning in the control group because criterion letter-sound learning does not depend on the ability to analyze previously learned letter names.

Experiment 1

Method

Participants

As most normal English-speaking preschool children are familiar with many of the letter names (Mason, 1980), this study was carried out in a population unfamiliar with English letter names—Israeli kindergartners—for whom the selected names and sounds constituted phonologically legal but unfamiliar strings.

Participants were recruited from two kindergartens located in an area of average socioeconomic status in Haifa. All children who neither were new immigrants nor had suspected learning disabilities were tested on a battery of pretest measures for the purposes of selecting two matched groups of children. Following the administration of these pretest measures, 24 children (12 pairs) in one kindergarten and 22 (11 pairs) in the other kindergarten were matched as closely as possible on relevant background, and pretest measures (see below). Within each kindergarten, members of each pair were then randomly assigned to experimental ($n = 24$), or to control treatments ($n = 22$). Children in each treatment group were matched both within and across kindergartens. Following training, one child in the experimental group was lost to the sample due to illness, leaving 23 experimental, and 22 control children.

Although a "within-setting" design in the case of experimental training studies introduces the possibility of contamination, whereby children in different treatments exchange information, this design was preferred because: (i) it is not susceptible to between-group (between-setting) effects that are common in educational settings and that are often beyond an experimenter's control; and (ii) any contamination tends to dilute training effects and consequently reinforces the validity of any obtained differences between groups.

Pretest measures

Discrimination/production of target sounds. All children were first checked to ensure that they were able to discriminate and produce all the target sounds to be used in criterion letter-sound learning. Each child was simply asked to repeat a sound spoken by an examiner. No child failed on any of these items.

Peabody Picture Vocabulary Test—Hebrew adaptation. This task was administered using standard procedures (Solberg & Nevo, 1979).

Hebrew letter names. Children were asked to supply the names of 12 consonant letters printed in large type (approximately 1 cm in size) and arranged in a fixed nonalphabetical order. Test-retest (3-week) reliability obtained in a separate study of representative kindergarten children was .82 ($n = 34$).

Initial phoneme isolation. This test required a child to isolate the initial stop consonant ("beginning sound") in 12 pseudoword CV syllables (e.g., /ka/ /de/). Two practice items were first given with feedback to ensure that the child understood the task. No feedback was given on the 12 test items. One point was awarded for each correct response.

Final phoneme isolation. This test required isolation of the final continuant phoneme ("end sound") in 12 VC pseudosyllables (e.g., /iv/ /an/). Two practice items with feedback preceded the test items. Again, no feedback was given on test trials. A combined phoneme isolation score was created by summing raw scores on the above two tasks which correlated .52 in this sample.

Procedure

Pretest measures. Administration of the pretests was carried out in two separate sessions with tests administered in the following fixed order: Discrimination/production of target sounds, final phoneme isolation, Peabody Picture Vocabulary (session 1), Hebrew letter names, and initial phoneme isolation (session 2). All testing was carried out individually with sessions on different (mostly alternate) days.

Training. Children were trained in pairs which were formed by random assignment within group. Training was carried out over ten 10-min sessions with two to three sessions per week spanning alternate days. Training time was carefully monitored to ensure that training times were matched for experimental and control groups. The training phase lasted approximately 6 weeks. All training was carried out by a trained psychologist and native Hebrew speaker who was not informed of the purpose of the study. The task was introduced by telling the children that they were going to learn some "secret symbols from another planet." Children in both experimental and control groups appeared to be highly and equally motivated to come and to work with the "visitor" who was continually pestered by children asking to be next in turn. There was no case of noncompliance.

Experimental (letter-names) group. This group was taught the associations between six letter names and six visual forms taken from Vellutino and Scanlon (1987) and they are reproduced here in Fig. 1. (Real English letter forms were not taught because Latin letters are relatively common in Israel, particularly in commercial settings.) Each form, which was approximately 3×2 in. in size, was presented on 5×4 in. cards, with one form per card. Each child was taught the associations between these forms and the names of six (English) letters. Prior pilot work had indicated the suitability of teaching this number of associations within the allotted timescale of the research.

The six letter names taught to the experimental group were chosen after consideration of the relation between the 26 English letter names and the corresponding sounds, which revealed that letter names fairly consistently fall into four major groupings: Consonant–vowel (CV) names containing initial stops (*B*, *D*, *K*, *J*, *P*, *T*), vowel–consonant (VC) names containing final continuants (*F*, *L*, *M*, *N*, *R*, *S*), vowel letter names representing the corresponding long vowel sounds (*A*, *E*, *I*, *O*, *U*), and a

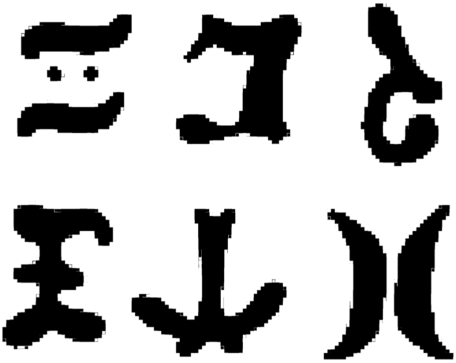

Fig. 1. Visual forms employed in Experiments 1 and 2 (Vellutino & Scanlon, 1987).

miscellaneous group comprising letter names either unrelated to letter sounds (*H*, *W*) or containing the relevant letter sound (or sounds) in a way that diverges somewhat from the above categories (*Y*, *Q*, *X*). Only four letters are clear exceptions to this scheme: Both *C* and *G*, which exist in both "soft" (continuant and affricate) and "hard" (stop) forms, assume names in the CV initial stop pattern, and the continuants *V* and *Z*, which also assume the CV initial stop pattern rather than the final continuant pattern.

Two letters were chosen from the initial stop group (*B*, *T*), and two from the final continuant group (*S*, *M*). Two additional letters were selected to represent letters whose names do not include the corresponding letter sound. One came from the vowel group (*E*) and one from the unrelated consonant group (*H*). Note that because the short vowel /ε/ was the letter sound taught in the criterion learning for the letter-like form labeled *E*, the letters *E* and *H* provided two exemplars of letter names that do not contain the relevant letter sound. The decision as to which letters to select from each category was based on several criteria: The two phonemes within a given category must differ in place of articulation and must be phonologically legal in Hebrew, and the letter names must not form meaningful Hebrew words. Because the names for the letters *B* and *M* are both real words in Hebrew, these were slightly altered to /bε/ and /ɑm/.

Associations between shapes and names were taught with a variety of traditional kindergarten tabletop activities. These included drawing the "letters" followed by naming, pasting colored thread onto the letter shapes accompanied by letter naming, identifying letter names following guided tracing with eyes closed, identifying a missing letter removed by a partner from the learned set, arranging cards in the order verbalized by the partner, cutting out shapes with accompanying naming, and coloring in.

In the first session, children were introduced to two letters. In subsequent sessions, an additional letter was added. In this way, the set of letters learned in each session gradually expanded from two to six, with each session including all previously learned letters to ensure retention. Because this training system implies that letters introduced in earlier sessions received greater exposure than letters introduced in later sessions, relative exposure to the three different letter types (stops, continuants, and unrelated) was equated by creating three subgroups (by random assignment) *within* the experimental group. All children were introduced to the same symbols at the same time and in the same order, but each subgroup learned a different name for this symbol with each of the three names belonging to one of the three letter types. This meant that each subgroup learned the letter names in a different order, but that each of the three letter types was exposed for an identical number of sessions within the experimental group as a whole. This arrangement also controlled for any possible differences between the letter-like shapes in memorability/confusability because each shape was associated with each of the three different types of letter names.

At the beginning of each session, all previously taught letters were tested for retention. This provided an ongoing measure of learning mastery.

Control group. Instead of letter names, the control group learned meaningful real-word Hebrew names for the symbols. These were concrete objects suggested by the visual forms. For example, two parentheses placed back-to-back as follows)(was called *gesher* (meaning *bridge*). In a similar manner, each of the six symbols was assigned a name: *ish* (*man*), *degel* (*flag*), *pe* (*mouth*), *ogen* (*anchor*), and *vav* (*hook*). In the control group, all children learned the same name-shape pairings.

Criterion learning of letter-sound correspondences

Posttest learning of letter-sound correspondences was carried out in three separate sessions each involving a series of paired-associate learning trials. Three phonemes were taught in the first session, the three remaining phonemes were taught in the second session, and all six phonemes were taught in the final session. At the end of each session, each letter-sound correspondence was tested three times giving a total possible learning score of 36 ($3 \times 3 + 3 \times 3 + 6 \times 3$).

The experimenter explained that the child had learned the "names" of the shapes and now was going to learn their "sounds." No reference was made to the connection or otherwise between names and sounds either here or at any stage during the study.[1] Moreover, no letter was explicitly referred to by its name in this phase of the study. Letters were presented one at a time together with their phonemes and the children were instructed to remember these sounds. Each of the first two sessions began by introducing the new letter-sound associations. Next, each of the three letters was presented three times in a fixed random order. Corrective feedback was given in the event that a child failed to supply the correct response within 6 s or supplied an incorrect response. In the final session, all six letters were tested three times each in a fixed random order with corrective feedback.

Because the three subgroups within the experimental group learned different sounds for the various symbols, children in the control group were split into three

[1] Israeli kindergarteners are not taught letter sounds—these are introduced only in Grade 1 when formal reading instruction begins. More details about the literacy practices of typical Israeli kindergartens can be found in Share and Gur (1999).

corresponding subgroups with each subgroup learning the same letters in the same order as the experimental children.

Results

Pretest scores for the experimental and control groups appear in Table 1 together with letter-learning scores indicating the extent to which children had mastered the names of the six "letters" taught during training. In each group, the data from all three (order-of-letter-learning) subgroups were pooled because there were no significant subgroup main effects or interactions. For the same reason, kindergarten site was also ignored.

It can be seen from Table 1 that the experimental and control groups were well matched on all pretest measures. *T* tests indicated that there were no significant differences between groups on any of the pretest measures. Only one *t* value (age) exceeded unity, $t(43) = 1.56$, $p = .13$, and here the control group enjoyed a slight (3-month) advantage.

It is also clear from Table 1 that the control group achieved a significantly greater level of mastery (30.5/32 = 95%) than the experimental group (24.4/32 = 76%) in learning the letter names assigned during training, $t(43) = 6.46$, $p < .05$. It is not surprising that kindergartners appear to find it easier to associate meaningful names with objects or graphic symbols than meaningless pseudoword names.

Criterion learning of the letter sounds appears in Table 2. Averaged over all six letters, there was a strong and significant difference in favor of the experimental group which scored approximately 50% higher than the control group in spite of the fact that the experimental group achieved only 76% mastery of the letter names.

Correlations between individual letter-name learning scores recorded during training and posttest letter-sound learning reinforced these results. Letter-name mastery correlated significantly, $r(21) = .52$, $p = .005$, with criterion letter-sound learning in the experimental group but not in the control group, $r(20) = .07$, although the latter coefficient is no doubt attenuated by range restriction.

Table 1
Pretest and letter name learning scores for experimental and control groups in Experiment 1

Pretest measures	Experimental group ($n = 23$)			Control group ($n = 22$)		
	M	*SD*	Range	*M*	*SD*	Range
Age in months	62.3	(6.0)	49–74	65.3	(5.97)	52–74
Gender	9 girls, 14 boys			8 girls, 14 boys		
Knowledge of Hebrew letter names (max = 12)	5.6	(4.02)	0–12	5.9	(3.74)	1–12
Peabody vocabulary (raw score)	47.8	(7.71)	34–59	47.5	(8.75)	31–71
Initial sound isolation (max = 12)	6.0	(3.10)	1–12	5.6	(3.58)	0–12
Final sound isolation (max = 12)	6.7	(3.66)	0–12	6.8	(3.50)	2–12
Letter mastery in training (max = 32)	24.4	(4.26)	14–31	30.5	(1.26)	27–32

Table 2
Posttest letter-sound learning scores for experimental and control groups in Experiment 1

Criterion variables	Experimental group ($n = 23$)			Control group ($n = 2$)			$F(1,43)$
	M	*SD*	Range	*M*	*SD*	Range	
All sounds[a]	19.04	(6.58)	9–35	12.55	(3.62)	6–20	16.62*
Related sounds (initial and final)	6.09	(3.54)	1–12	3.14	(1.18)	0–7	12.25*
Initial sounds	2.87	(2.12)	0–6	1.59	(1.26)	0–3	5.9*
Final sounds	3.17	(1.72)	1–6	1.59	(1.22)	0–5	12.29*
Unrelated sounds	2.43	(1.62)	0–6	1.64	(1.22)	0–4	3.47 *n.s.*

[a] Because each letter-sound correspondence was tested 6 times, the maximum possible score was 36.
* $p < .001$.

Overall, there was a clear advantage in knowing the names of letters when it came to learning letter-sound correspondences. Furthermore, this advantage cannot simply be attributed to greater visual familiarity with the letter shapes because both the experimental and control groups' exposure times were equated during training.

Relevant versus irrelevant letter names

If the advantage in knowing the names of letters accrues because most names contain the relevant letter sounds and thereby supply a recall cue, then it should be easier to learn sounds for letters whose names contain these sounds compared to letter names that do not. The results in Table 2 indicate that the experimental group learned significantly more letter sounds for "related" letters (those with names containing their sounds: *B*, *T*, *S*, *M*) than the control group. In contrast, the difference between the two groups in learning sounds for letters with "unrelated" names did not reach significance, $F(1, 43) = 3.47$, $p = .069$.

Table 2 also shows that the advantage in learning the sounds of letters whose names contain these sounds appears to be equally great for initial (CV) stops and final (VC) continuants. This finding contrasts with the English-language advantage reported by Treiman et al. (1998) and by McBride-Chang (1999) for initial stops. The present data, however, are quite consistent with both: (i) the pretest finding that the tasks of isolating initial stops and final continuants are of comparable difficulty for Hebrew-speaking prereaders, $t(45) = 1.82$, $p = .075$; and (ii) the fact that among this same population, there appear to be no intrinsic differences in difficulty learning either stop or continuant correspondences as borne out by the fact that the control group's posttest learning scores for both types of phonemes were identical. In fact, among controls, all three sets of sounds were virtually identical. Thus, differences between related and unrelated letters in the experimental group can be attributed to letter-name knowledge per se.

The interaction between group and letter type was directly tested in a multivariate analysis of variance (MANOVA) with a planned contrast representing the difference between related and unrelated letters. A significant group by letter-type interaction,

$F(1,43) = 6.57$, $p = .014$, confirmed that the experimental group, but not the control group, benefited more from learning the related letters than from learning the unrelated letters.

Correlations between individual letter-name learning scores in the training phase and criterion letter-sound learning reinforced the group results. For children in the experimental group, letter-name learning during training correlated strongly, $r(21) = .62, p = .001$, with letter-sound learning for related letters but only weakly, $r(21) = .38, p = .036$, for unrelated letters. In the control group, both these correlations were unambiguously nonsignificant (related letters, $r(20) = -.03$; unrelated letters, $r(20) = .06$). It might be speculated that the correlation between letter-name learning and criterion letter-sound learning for unrelated letters ($r = .38$) suggests that even the "unrelated" letters may provide some general information regarding phoneme class (e.g., front vowel, *E*, fricative consonant, *H*,) that may be useful in letter-sound learning.

Do the benefits of letter-name knowledge depend on phonemic analysis?

As discussed previously, it is commonly assumed that the ability to take advantage of the connection between a letter's name and its sound implies an ability to isolate the relevant sound in the name. If this is correct, then pretest phoneme segmentation skill should predict criterion letter-sound learning in the experimental group for which letter-name knowledge was found to assist letter-sound learning. By contrast, pretest phoneme segmentation scores should be unrelated to criterion letter-sound learning in the control group because the latter does not depend on the ability to analyze previously learned letter names. The alternative hypothesis, according to which the benefits of letter-name knowledge derive not from recognition of specific phoneme identity but from overall phonetic similarity, predicts that phoneme segmentation will be uncorrelated with letter-sound learning in both experimental and control groups.

Correlations were accordingly computed for experimental and control groups between criterion letter-sound learning scores and individual pretest measures of initial, final, and summed composite phoneme isolation. This latter composite score was designed to provide a more reliable general measure of phonemic segmentation skill.

In the control group all three correlations were negligible, r's$(20) = .13, .11$, and $.01$, and nonsignificant as predicted. In the experimental group, in contrast, two of the three correlations were significant (initial-sound isolation, $r(21) = .37$, $p < .05$; final-sound isolation $r(21) = .29$, n.s.; and combined phoneme isolation, $r(21) = .36$, $p < .05$, one-tailed). To check whether these correlations reflect a specific link between phoneme analysis and letter-sound learning rather than simply a common source such as general verbal ability, correlations were recomputed with Peabody Picture Vocabulary scores partialed out. In the experimental group, partial correlations were $r(20) = .44$, $p < .05$, for combined phoneme isolation; $r(20) = .47$, $p < .05$, for initial-sound isolation; and $r(20) = .33$, n.s., for final-sound isolation. For controls, these correlations remained negligible, r's$(19) = .01, .11$, and $-.12$. Overall, these analyses support the argument that the ability to benefit from letter-name knowledge when learning letter sounds depends on the ability to extract the component sounds in a name.[2]

Letter-sound learning errors

Close to 90% of the errors were either nonresponses (41%) or an incorrect letter sound from the set being taught (48%). An additional 8% of the errors were phonemes not drawn from those taught (inventions). These errors were mostly phonemes similar in terms of place or manner of articulation (e.g., /sh/ instead of /s/ or /p/ instead of /b/). Only 1% of the errors were letter names rather than letter sounds and these were divided evenly between two experimental and two control children. All these error types occurred with similar frequency in both the experimental and control groups. One error type, however, appeared only in the experimental group, namely, supplying one of the component phonemes in the letter's name, but the *wrong* one. Of the 23 children in the experimental group, six committed this error by supplying the initial vowel /ɑ/ for the letter "*OM*" whose sound was /m/. This would appear to be fairly direct evidence of what might be termed a "name-segmentation" strategy whereby a child isolates a component sound in a known letter name and offers this as a candidate letter sound. This would seem to be an experimental analogue of the naturally occurring finding of Treiman et al. (1994) that some kindergartners report that the letter *Y* makes the sound /w/. The frequency of 6/23 is almost certainly an underestimate because only this one error (supplying the initial vowel for the letter *M*) could be interpreted unequivocally as evidence of a name-segmentation strategy. In all other cases, the accompanying vowel was either another letter name (*E*) or another letter sound (/ε/), each of which was conservatively assigned to the latter categories.

Discussion

A number of findings converged on the conclusion that knowing the letter names helps preschool children learn the corresponding sounds. First, there was a substantial advantage in letter-sound learning for children taught letter names compared to matched children who learned unrelated labels for the same symbols. Second, letter-sound correspondences for letters with names that contained the relevant phonemes

[2] The contribution of Hebrew letter names to these individual differences analyses was also checked. Although Hebrew letter-name knowledge, somewhat surprisingly, was not found to be a reliable predictor of either letter-name or letter-sound learning in either the experimental or control groups, partialing out letter names in the analysis of the contribution of phonemic awareness to letter-sound learning in the experimental group did reduce the correlations from (unpartialed) .37, .29, and .36 to (partialed) .27, .19, and .26 for initial, final, and combined phoneme segmentation—the latter three coefficients were all nonsignificant. The simplest interpretation of these data (but by no means the only one) is that Hebrew letter-name knowledge did not have a direct impact on letter-sound learning in training, but contributed indirectly owing to its close relation with phonemic awareness. This conclusion, however, should be qualified: (i) by the fact that the Hebrew letter names measure was only designed as a "background" measure for equating groups, not as an independent variable; and (ii) by important differences between Hebrew and English letter names (see Levin et al., 2002).

were learned more easily than correspondences for letters that did not include the relevant phonemes. Third, the degree to which letter names had been mastered during training predicted criterion letter-sound learning in the experimental group, but not in the control group. Finally, there was some direct evidence in the form of errors among experimental but not control children pointing to explicit analysis of sounds in letter names in the course of criterion letter-sound learning.

The magnitude of the letter-name effect was large and not merely significant. Overall, letter-sound learning scores in the experimental group were around 50% higher than in the control group. For the four "related" letters—those with names containing the relevant letter sound—the experimental group mean was twice the control mean. Although scores for the "unrelated" letters were a little higher in the experimental group than in the control group, this difference was not significant. Nonetheless, the fact that letter-name learning scores in the experimental group were significant, albeit modest predictors of "unrelated" letter-sound learning ($r = .38$), suggests that even the two unrelated letters in this study (*E* and *H*) may have provided some general information about phoneme class that may have assisted letter-sound learning. Thus, even letters whose names are only poorly related to letter sounds (*Q*, *X*, *Y*, *H*) may not be entirely worthless with regard to learning grapheme–phoneme correspondences. The letter W is the sole instance of a name entirely unrelated (phonemically) to its English letter sound.

It might be argued that the poor performance of the control group was because these children initially learned associations that were nonarbitrary (for example the word *bridge* was associated with a bridge-like form) thereby inducing an associative strategy incompatible with the arbitrary associations required in the criterion phase. This issue was directly examined in a second experiment that eliminated this potential confound by testing the name-to-sound facilitation hypothesis in a fully within-subject design in which all children learned only meaningless monosyllabic letter names that either did or did not include the sounds taught in the criterion letter-sound phase. This second study also equated phoneme class across the two conditions: In Experiment 1, the comparison between related and unrelated letter names in the experimental group used names from different phoneme classes.

Experiment 2

Method

In this second experiment, a new sample of 20 children was drawn from two additional kindergartens in a similar neighborhood. As in Experiment 1, all children participating in this second experiment were able to discriminate and pronounce all the letter names and sounds correctly and were unfamiliar with English letter names.

All children in this study learned the same four letter-like shapes, representing the consonantal letters *B*, *T*, *S*, and *M*. Each child learned two related letter names (one stop and one continuant) and two unrelated letter names (stop and continuant).

For example, the name of the symbol representing the letter *S* was either learned as the related name /ɛs/ or as the unrelated name /ɛf/. Ten children learned the related names for *B* (/bɛ/) and *S* (/ɛs/), and the unrelated names for *T* (/gi/) and *M* (/ɑl/), while 10 children learned the unrelated names for *B* (/di/) and *S* (/ɛf/) and the related names for *T* (/ti/) and *M* (/ɑm/).

Letter names were taught to pairs of children over eight sessions using the same tabletop activities as in Experiment 1. Two letters were taught in each of the first six sessions, with related and unrelated pairs in alternating sessions, followed by two further sessions with all four letters. Criterion letter-sound correspondences were taught and tested over four sessions using the same procedure (paired-associate learning with corrective feedback) as in Experiment 1.

Results

Once again, there was a significant advantage in learning letter sounds, $t(19) = 2.14$, $p < .05$, when children were already familiar with a letter name containing that sound (Table 3). The magnitude of this difference (50 versus 39%) was very similar to the difference obtained in the experimental group in Experiment 1 between related and unrelated items (51 versus 41%), and indicates that the name-to-sound facilitation effect is robust and not attributable to either incompatible associative learning strategies or differences in phoneme class. As in Experiment 1, evidence for an explicit name-segmentation strategy was revealed in responses that included the vowel component of a letter name. Four children supplied the vowel phoneme /ɛ/ rather than the consonantal phoneme; another three children supplied the vowel /ɑ/.

Because training times were equated for both experimental and control children in Experiment 1 and for the related and unrelated conditions in Experiment 2, the advantage of knowing letter names cannot be attributed simply to greater familiarity with their graphic forms. Of course, the present data do not exclude the possibility that general letter-name knowledge also reflects visual familiarity with letter shapes, as this factor was held constant in both studies. An additional no-treatment control group with no exposure to letter forms prior to criterion letter-sound learning would be needed to assess the independent contribution of visual familiarity.

Table 3
Background characteristics and criterion letter-sound learning in Experiment 2

Variable	*M* (*SD*)	Range
Background characteristics		
Age in months	65.2 (3.79)	59–72
Gender	10 boys, 10 girls	
Hebrew letter name knowledge (max = 12)	4.9 (3.73)	0–12
Letter name mastery in training (max = 18)	11.0 (3.56)	3–18
Criterion letter-sound learning		
Related letter sounds (max = 24)	12.1 (5.11)	1–21
Unrelated letter sounds (max = 24)	9.4 (6.64)	0–20

General Discussion

The present pair of studies demonstrate that letter names provide more than just verbal labels for these forms. As with personal names, letter names supply convenient verbal labels that uniquely identify each letter, and that are important if a child is to understand the language of literacy. These labels also fulfill the essential function of distinguishing critical from noncritical features of letters. For example, *b* and *d* have the same forms but their names make clear that orientation is critical; *a* and a have different forms, but are functionally equivalent as are uppercase and lowercase letters. Because phonemes are abstractions representing families of phonetic sounds, so are letter identities abstract categories of (often) nonidentical graphic forms. Perhaps the chief service rendered by letter names is in drawing a child's attention to the abstract symbolic nature of letters. Because letter names sometimes map sequences of phonemes heard in spoken words (e.g., *OK*), they may also help prereaders understand the connection between print and speech (Levin et al., 2002; Read, 1975; Treiman, 1993; Treiman & Kessler, 2003).

In addition to these considerations, this study suggests that the *choice* of a name may also be important in early reading by virtue of the cues it can provide to assist letter-sound learning.[3] As Shakespeare's Juliet surmises, most names of everyday objects such as roses may well be arbitrary, and interchangeable. Printed letter names, in contrast, may be an important exception to this rule.

This study also showed that the advantage of knowing letter names depends, in part, on the ability to isolate phonemes in spoken syllables. Correlations between phonemic analysis and criterion letter-sound learning were generally significant in the experimental group but consistently nonsignificant for controls. These results point to a specific link rather than a common general ability factor, as correlations for the experimental group remained significant when vocabulary was partialed out. Evidence for the use of an explicit name-segmentation strategy solely in the experimental group in Experiment 1 reinforced the link between phonemic analysis and the letter-name effect. One weakness, however, with this strategy is that, in the case of English at least, it fails to specify reliably *which* of the component phonemes in a name is the critical one. For orthographies that adhere to the acrophonic principle, such as Hebrew and Arabic, this is unproblematic because a letter's sound is invariably the first phoneme in its name. In contrast, English letter names, as noted previously, are not entirely capricious. With the exception of *W* and *Y*, the target sound of consonant names is consistently the sole consonant (or consonants in the case of *X*) whether in initial or final position.

[3] Although it may seem odd to speak of the "choice" of a letter name given that letter names are relatively fixed features of a specific culture, letter names, like letter shapes, do evolve over time (see Naveh, 1982). At times of social and cultural upheaval, these changes can be quite dramatic, such as the change from complex multisyllabic names for Russian letters to simple English-style monosyllabic names at the time of the Bolshevik Revolution (Leikin, personal communication, 2002). On a smaller scale, consider also the US *zee* compared to the British *zed*.

The present sample of non-English speaking children provided an excellent control for pre-existing letter-name knowledge typical among English-speaking populations. But to what extent can results obtained with non-English speakers be generalized to the English language? As noted already, all letter names and sounds in this study were phonologically legal strings. The letter-like forms were drawn from a set used successfully in English-language studies of reading. The available Hebrew-language data (Levin et al., 2002; Shatil & Share, 2003) suggest that general levels of *Hebrew* letter-name knowledge among Israeli kindergarten children are similar to findings obtained with English-speaking samples at the same age (e.g., Share et al., 1984; Treiman et al., 1998). Other data, such as phonemic awareness training, point to important parallels between beginning reading in Hebrew and in English (Bentin & Leshem, 1993; Kozminsky & Kozminsky, 1995). As in North America, the overwhelming majority of Israeli kindergarten children are nonreaders, with formal reading instruction commencing in Grade 1 when children are age 6. Thus, there appears to be no a priori reason why the present results should differ systematically from results obtained with English speakers, although only direct evidence can confirm this.

In one regard, however, there may be a fundamental difference between English and Hebrew. McBride-Chang (1999) and Treiman et al. (1998) both reported that English-speaking preschoolers are more successful learning the sounds of letters with sounds at the beginning of the letter's name (*D*) than the sounds of letters with sounds at the end of their names (*L*). Treiman and Kessler (2003) argue that this reflects the perceptual salience of syllable onsets as opposed to codas (see also Treiman, 1992) and possibly the fact that consonant–vowel letter names are more common in English than vowel–consonant names. The present study with Israeli kindergartners, however, did not find any difference between these two types of items; in fact, there was a nonsignificant advantage in the *opposite* direction, namely, for sound-final (VC) letter names (see experimental group's data, Table 1). Furthermore, children in Experiment 1 found it equally easy to isolate initial sounds and final sounds with a nonsignificant trend once again favoring the final phoneme or coda. These findings point to possible psycholinguistic differences between Hebrew and English in phonological structure. This possibility was recently examined by Blum (2001) who found that native Hebrew-speaking preschoolers and older Grade 2 skilled readers alike found it easier to divide spoken CVC syllables into CV plus final C (coda) units than into onsets and rimes (C + VC). Blum (2001) concluded that onset/rime units might not be the indigenous subsyllabic units in Semitic languages.

If letter-name knowledge promotes early reading by virtue of the help it provides in learning grapheme–phoneme correspondences, why not simply replace the letter names with the letter sounds? After all, a letter sound is also a verbal label. There would seem to be several objections to this idea.

First, in many languages, two or even more letters have the same sound. Consider the problem of the letters *K* and *C*; both have the sound /k/. If we assign the letter *C* its alternate sound /s/ what becomes of the letter *S*? Many orthographies have alternate graphemes representing the same sound (see Harris & Hatano, 1999). For example, in Hebrew, approximately one third of all letters are homophonous, that is, represent phonemes that can be represented with alternate letters (Share & Levin, 1999). The English letter *C* also illustrates another problem—that of letters with two or more phonemic values. Not only do many letters have multiple sounds, but these phonemic values are often shared with other letters or digraphs. Thus, letter names would no longer provide unique identifiers for the letters, creating considerable potential for confusion between letters and the sounds they represent. Almost all English letters, both vowels and consonants, can appear as silent letters (approximately half the alphabet), can represent more than one sound (about one third of letters), or have sounds that can be represented by other graphemes or digraphs (about one third). Consider the case of the letter *S*, now to be renamed "s." The letter *C* often assumes this sound, as do other graphemes and grapheme-combinations (e.g., *SC*, *PS*, *SS*, etc.). Furthermore, the grapheme *S* itself does not always assume the /s/ sound; sometimes it falls silent (*ISLAND*) or marks other phonemes (e.g., *PRISON*, *SURE*, *MEASURE*). In fact, almost all English letters, with the possible exceptions of *N* and *V*, admit one of more of these complications. The point here is not to bemoan English spelling-sound inconsistency, but to suggest that labeling letters by their sounds would, in many situations, create considerable confusion for young learners and almost certainly require constant and cumbersome qualification by speakers referring to the "s" letter versus the "s" sound.

Another argument for retaining letter names is that letter names may be easier to learn than letter sounds because names are primarily syllabic and hence more perceptually salient—that is, word-like rather than isolated phonemes (Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). Treiman and Tincoff (1997) found that young children's knowledge of letter names (e.g., /ti/) sometimes caused them to spell a complete consonant–vowel sequence (*revi* versus *zevit*) with that single letter, thereby suggesting a special role for the syllable in early spelling development. For the same reason, it has often been proposed that alphabetic writing first be introduced syllabically to young children (see for example, Rozin & Gleitman, 1977). By this account then, letter names, by virtue of their syllabic and hence more word-like nature, may be both easier to learn, and have greater value than letter sounds in sensitizing children to sublexical speech units in the early stages of literacy. These considerations point to a need for a unique label for letters *in addition to* their sounds. What then might be the optimal form for these labels? The present study suggests that, first and foremost, the ideal letter names should include the corresponding letter sound or at least its most common sound. Second, the name should include a minimum of additional phonemes (ideally one) and be located in a position that is easiest to isolate. The work of Goswami and Bryant (1990) and Treiman (1992) on the onset/rime breakup of spoken syllables suggests that consonants may be easier to isolate in initial rather than final position, at least in English. In the case of stops, there is a further advantage for the initial position in that stops cannot be pronounced without appending a vocalic element, usually schwa. There may also be a problem with voiced stops in final position that seem difficult to distinguish in everyday speech from unvoiced stops (/p/:/b/, /t/:/d/, /g/:/k/). These alternations appear to be more easily identified in initial rather than in final position (Treiman & Kessler, 2003). The voiced forms, when in final position, seem to require an effort on the part of the speaker to emphasize voicing. In light of these speculations, the names for letters representing stop consonants would appear to be well suited to their task.

Is the syllable-final pattern also appropriate for the names of continuant phonemes? In this regard, it is noteworthy that unlike stop consonants that cannot be pronounced in isolation without adding a subsequent vocal element such as schwa, continuants such as /l/ and /m/ can be pronounced, and indeed "stretched," in isolation. This implies that VC-style names may be more appropriate for continuants than for stops, although it remains to be seen if continuants are more easily isolated/identified by preschoolers in final rather than initial position. And what of vowel names? Perhaps these too are near optimal. The long-vowel name has no consonantal element that might be confused with a consonant name, rather, it signals a different class of letters. Furthermore, the long-vowel sound is probably the most frequently occurring sound assumed by these letters after the short sound, which is not a phonologically legal entity in English (see Treiman & Kessler (2003) for a discussion of the legality criterion in letter names). If these speculations are not unfounded, it could be argued that the general system of English letter names (*W* and *Y* excepted) may be surprisingly well adapted to the task of providing both unique identifiers for English graphemes and aids to letter-sound learning.

In conclusion, this study succeeded in identifying at least one reason behind the predictive strength of a preschooler's letter-name knowledge. There are clearly other factors both cognitive and noncognitive that contribute to this relationship. As discussed at the beginning of this article, phonological memory could be one candidate source of variance. It seems reasonable to assume that another would derive from the fact that letter-name knowledge almost certainly taps educational/environmental factors in the home likely to have a direct and ongoing impact on literacy learning (Snow, Burns, & Griffin, 1998). To investigate these factors it will be necessary to undertake more qualitative investigations of the contexts within which children acquire letter-name knowledge and the uses to which this knowledge is put. It is doubtful that any one reason alone "explains" why letter-name knowledge is such a powerful predictor of early reading. Herein may lie its remarkable strength as a multidimensional measure of knowledge important in its own right and as an indirect index of additional cognitive and noncognitive factors.

Acknowledgments

The author thanks Smadar Reifer and Rivi Aspler for their invaluable assistance in carrying out this study.

Appendix A

Key to phonetic notation: /ɛ/ as in b<u>e</u>t, /ɑ/ as in (British) mop, /ə/ as in sof<u>a</u>.

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