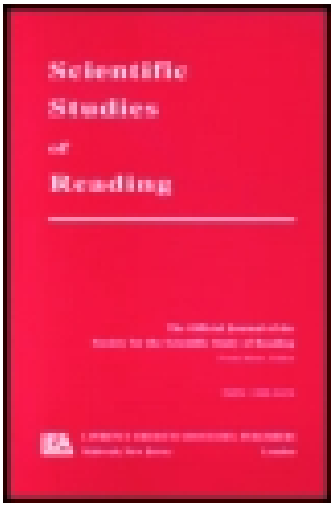

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Writing *Dinosaur* Large and *Mosquito* Small: Prephonological Spellers' Use of Semantic Information

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One influential theory of literacy development, the constructivist perspective, claims that young children believe that writing represents meaning directly and that the appearance of a written word should reflect characteristics of its referent. There has not been strong evidence supporting this idea, however. Circumventing several methodological concerns with previous studies, we examined written spellings of young children who did not yet use letters to represent the sounds of words, that is, prephonological spellers. We identified 38 prephonological spellers (M age = 4 years, 2 months) and measured the area of their writing productions. Prephonological spellers made significantly larger productions for words representing large objects than those representing small objects. This effect held true after controlling for the influences of other variables, including size of writing on previous trials and order of trial in a session. Our results suggest that young children sometimes use drawing-like features to communicate the meaning of words when writing.

To use an alphabetic writing system, children must learn the mappings between sounds in spoken words and letters in printed words (Treiman & Kessler, 2014). However, even before learning about specific mappings between letters and sounds, children need to understand that writing represents the sounds of spoken language. Grasping this idea is not easy (Byrne, 1998); young children may hold erroneous beliefs about what writing represents. The present study was designed to examine what U.S. children know about the relationship between written language and spoken language before they understand conventional sound-letter correspondences. Specifically, we tested one idea that children may have about the nature of writing—that writing represents meaning directly and that the spelling of a word should reflect characteristics of the object that it denotes (e.g., Ferreiro & Teberosky, 1982).

Most theories of literacy development (Ehri, 2005; Frith, 1985; Gentry, 1982) focus on children's increasing ability to map sounds onto phonetically appropriate letters and do not give much consideration to the knowledge of writing that children may possess before they begin to acquire some conventional sound-letter correspondences. One exception is the *constructivist* perspective of Ferreiro and colleagues (Ferreiro, 1983, 1984, 1985; Ferreiro & Teberosky, 1982), which has been particularly prominent in research and pedagogy in Romance-language speaking countries (e.g., Silva & Alves-Martins, 2002) and which has been applied to written language acquisition

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in English (e.g., Kamii, Long, Manning, & Manning, 1990; Vernon, 1993). Researchers in the constructivist tradition assert that young children hold certain hypotheses about the characteristics of writing even before they understand that writing represents the sounds of language. One of these, and the one of interest here, is that writing represents meaning directly. The characteristics of a written word should thus bear some resemblance to the characteristics of the object that it represents.

Support for the idea that young children believe that writing represents meaning directly comes from studies of Spanish-speaking nonreaders who, when asked to write words, used more or larger marks for words representing large objects than for words representing small objects (Ferreiro, 1983, 1985; Ferreiro & Teberosky, 1982). Such productions have been referred to as *referential writing*. For example, one interviewer presented a 4-year-old child with the written word 'GALLO' 'rooster' and asked the child to write the words for *gallina* 'hen' and *pollito* 'little chicken'. The child wrote 'GALL' for *gallina* and 'GAL' for *pollito*, explaining her responses in terms of the relative sizes of the animals. Even children who had not learned conventional letter shapes were observed to produce written marks that resembled the referents in some ways. For example, a 5-year-old child who used wavy lines to write words produced a longer scribble for the word *oso* 'bear' than for the word *pato* 'duck'. Such evidence is consistent with the view that young children's writing is influenced by the semantic content of words. However, the data of Ferreiro and colleagues were largely observational, and their conclusions lacked statistical support.

Other researchers have used recognition tasks to more systematically examine whether young children rely on semantic content to interpret written words. Bialystok (1991) presented English-speaking children with two pictures and two printed words and asked them to match each word with the picture that represented the same object as the word. In pairs such as *ball* and *ballerina*, which were called corresponding pairs, the word that represented the larger object was spelled with more letters than the word that represented the smaller object. In noncorresponding pairs such as *cat* and *caterpillar*, the word that represented the larger object was spelled with fewer letters than the word that represented the smaller object. Nonreaders performed better on corresponding pairs than noncorresponding pairs, suggesting that they used the relative sizes of objects to make decisions about the number of letters in printed words. Lundberg and Tornéus (1978) drew similar conclusions from a study in which they presented Swedish-speaking children with word pairs both aurally and visually and asked them to indicate which printed word went with each spoken word. Four- to 7-year-old nonreaders produced more correct responses when the relative lengths of the words were consistent with the relative sizes of the referents than when the two were not consistent. Similar findings have been reported for Hebrew-speaking children (Levin & Korat, 1993; Levin & Tolchinsky Landsmann, 1989). Together, such evidence provides support for the constructivist notion that nonreaders take written words to represent objects directly.

Although recognition tasks shed light on children's implicit understanding of writing, it is important to determine whether children use a referential strategy in their own productions. Even if they do so in recognition tasks, the sequential production of written marks that spelling requires may encourage children to engage in a more analytic approach (Levin & Korat, 1993). As mentioned earlier, Ferreiro and colleagues (Ferreiro, 1983, 1985; Ferreiro & Teberosky, 1982) provided compelling examples of referential writing but did not provide statistical support for

their claims. However, Jones (1990) did not find evidence for referential writing in her qualitative study of Scottish preschoolers.

Several studies have addressed the question of whether young children produce referential writing in a more quantitative way. Levin and Tolchinsky Landsmann (1989) asked 5- and 6-year-old Hebrew speakers to write pairs of words that were chosen to evoke a distinction in some property of the referents. For example, the Hebrew words פיל 'elephant' and נמלה 'ant' were chosen to evoke a distinction in size and the words עגבנייה 'tomato' and מלפפון 'cucumber' to evoke a distinction in color. Children's productions of the words in a pair were considered referential if they showed a distinction in the property that the pair was supposed to evoke. For example, writing was coded as referential when a child used more marks or larger marks to spell the word פיל 'elephant' than נמלה 'ant' or used a red crayon to write עגבנייה 'tomato' and a green crayon to write מלפפון 'cucumber'. Almost half of the children produced some instance of referential writing. However, Levin and Tolchinsky Landsmann did not compare the number of cases where children used more marks or larger marks to write the word for a large object than the word for a small object to the number of cases where children did the reverse, nor did they compare the number of cases where children used the object-appropriate color for each word of the pair to the number of cases where children's use of color was not related to the referent color. In another study relevant to the issue of referential writing, Noyer-Martin and Devichi (2014) asked French-speaking children to spell pairs of words with contrasting referent size and similar number of letters. The 4- and 5-year-old children's written productions seemed to be larger when they were asked to write words that represented large objects than when they were asked to write words that represented small objects. However, no statistical test was conducted to confirm this observation because Noyer-Martin and Devichi were primarily interested in how children's writing was influenced by the sizes of accompanying pictures.

Further evidence comes from a study by Levin and Korat (1993) in which 5- and 6-year-old Hebrew speakers were asked to write pairs of words that differed in phonological length and referent size. For some word pairs (e.g., עץ 'tree' vs. יער 'forest'), the longer word represented a large object consisting of or including the object denoted by the shorter word. For other word pairs (e.g., זר 'bouquet' vs. פרח 'flower'), the longer word represented a small object that was a subset of the object denoted by the shorter word. Children who were considered unable to spell phonetically were more likely to use a larger number of marks for the long words than the short words when the relative phonological lengths were consistent with the relative referent sizes than when these two features were inconsistent. This pattern suggests that children considered semantic information such as referent quantity or size to be related to the lengths of written words.

Although the results we have reviewed seem to provide some evidence that children consider the semantic content of words when they attempt to spell and interpret them, not all aspects of the results are consistent with this idea. For example, when presented with words for which the relative sizes of referents were inconsistent with the relative phonological lengths of the words (e.g., *cat* and *caterpillar*), children performed at the level of chance in matching words with corresponding pictures (Bialystok, 1991) or produced a similar number of marks to spell the words (Levin & Korat, 1993). Had children relied predominantly on semantic cues on these noncorresponding trials, they would have performed below the level of chance in Bialystok's task and used more marks to spell short words than long words in Levin and Korat's task.

Methodological concerns have also arisen in some previous studies. One concern is that the screening methods that were used may not have been well suited for the purpose of identifying children who do not yet use conventional sound-letter correspondences, that is, prephonological spellers. For example, Levin and Korat (1993) considered children to be prephonological spellers if they produced no more than 12.5% correct or phonologically plausible spellings in each of the four lists of words that they spelled. However, given that some children use phonetically appropriate letters for some but not all sounds in words (Ehri, 2005), this procedure may misclassify some phonological spellers as prephonological. In the present study, we adapted a statistically rigorous technique introduced by Pollo, Kessler, and Treiman (2009) to identify children who did not use phonologically motivated letters to represent individual sounds in words.

Another methodological concern with previous studies involves the way in which stimuli were presented. Given that pictures contain rich semantic information, the presentation of pictures in some studies (e.g., Bialystok, 1991; Noyer-Martin & Devichi, 2014) could have heightened the accessibility of the semantic attributes of words. In some other studies (e.g., Levin & Korat, 1993; Levin & Tolchinsky Landsmann, 1989; Lundberg & Tornéus, 1978), all of the words were presented in pairs that were chosen to evoke distinctions in dimensions such as referent size. Children might be particularly sensitive to semantic attributes in this context. Moreover, in natural settings, children do not typically spell words in pairs. To address this potential problem, children in the present study spelled one word at a time, each on a separate page. Rather than treating a referent as smaller or larger than the other member of a pair, we used a continuous measure of object size.

Yet another issue that has arisen in some previous studies concerns the measurement of children's writing productions. Levin and Korat (1993) based their coding on the number of marks that children produced for each word, and Levin and Tolchinsky Landsmann (1989) considered the number of marks and the sizes of the marks. What would seem to be most directly related to the size of a denoted object would be a characteristic that takes into account both the number of individual marks and their sizes: the total area of a production. Such a measure has been used in several recent studies (Noyer-Martin & Devichi, 2014; Treiman & Yin, 2011). In the present study, we measured the area of the smallest rectangle enclosing each writing production.

A final methodological concern is that previous studies did not take into account other factors that might influence size of writing productions, in addition to the size of the object a word represents. One possible influence is a general tendency to repeat what one has responded on previous trials even when the stimulus characteristics have changed. Children show such a carryover effect in a range of tasks, including sorting cards following a simple rule (Frye, Zelazo, & Palfai, 1995) and finding the location of an object using a symbolic model (e.g., DeLoache, 2000; O'Sullivan, Mitchell, & Daehler, 2001). In the domain of spelling, Pollo et al. (2009) reported that prephonological spellers tended to repeat spellings within a session more often than was expected by chance. In another study, in which children were asked to spell words in pairs, prephonological spellers were particularly likely to reuse letter strings and parts of letter strings that they had recently produced (Treiman, Decker, Kessler, & Pollo, 2015). To examine whether there would be a similar carryover effect on another aspect of spelling, size of writing productions, and to control for this possible influence, we included size of writing produced on previous trials in our analyses. We also controlled for phonological length, another factor that may influence the size of children's written productions according to Levin and Korat (1993). These researchers argued that prephonological spellers might produce more letters to spell long words than short words even

though their choice of letters is not phonologically motivated. Controlling for these other factors that might influence size of writing, we examined whether prephonological spellers produced larger writing for words representing large objects than those representing small objects.

METHOD

Participants

The participants were 75 children (30 girls) with a mean age of 4;4 (years;months) and a range of 3;3–6;1. The children attended daycare centers or preschools in the St. Louis, Missouri, area with English as the medium of communication and teaching. All the children were frequently exposed to print in their classrooms.

Stimuli

Spelling task. We selected 24 words that varied in number of phonemes (3–9) and size of the object they represented: *ant, asparagus, bear, beetle, bug, bus, butterfly, button, castle, dinosaur, drop, grasshopper, macaroni, mosquito, motorcycle, orangutan, spider, teacher, thermometer, tiger, truck, volcano, waterfall*, and *watermelon*. To obtain an estimate of the size of the object represented by each word, we first determined the position in which each object is typically portrayed in drawings familiar to children (e.g., front view or side view). We then located measures of the average length and height of each object when viewed from that angle. For example, because the side view of buses is typically portrayed in drawings, we obtained the average distance from the front to the rear of a typical bus and the average height of a bus. The area of each object (in m^2) was computed by multiplying the average length and height. For each word, we created a seven-word sentence containing the word in order to help specify its meaning. A 21.5 $\times$ 21.5 cm booklet containing 48 empty pages was prepared for each child to produce their spellings in. A beginner pencil was provided for children to write with.

Reading task. We included a reading task to allow for comparisons with previous studies such as that of Pollo et al. (2009). As in that study, we used 11 cards each containing two common words and one colored picture. The words were printed in uppercase letters. The pictures were not related to either word on each card and were included to make the task less frustrating for children who could not read. The words were *book, come, dog, eat, go, green, in, is, it, jump, look, no, play, red, see, stop, the, up, yellow, yes, you*, and *we*.

Procedure

Children were tested individually at a quiet location at their school. They were tested over three sessions, which were, on average, 10 days apart. Each session lasted approximately 15–20 min. On the 1st day of testing, the children completed the reading task and spelled half of the words in the spelling task. On the 2nd day of testing, children spelled the remaining words in the spelling task. Children performed a different task on the 3rd day, which is not the focus of this article and is not discussed here. Children received a sticker at the end of each session.

Spelling task. We presented the spelling task with the aid of a dinosaur puppet and a rabbit puppet. The dinosaur puppet dictated the first 12 words, and the rabbit puppet dictated the remaining 12 words. The experimenter first explained that the puppet wanted to see how children spelled some words. For each word, the experimenter said the word and the puppet said a sentence containing the word. The children were asked to repeat the word before spelling it. They spelled each word on a separate page of the booklet and therefore could not see their previous productions. They were told, "Don't worry if you don't know how to spell the word like your teacher does, we just want you to try your best." After the children finished spelling each word, the experimenter asked them to identify the letters they used. Children were praised for all of their responses. When the letters that children identified seemed to differ from those they produced, we used the letters they orally reported as their spelling response. The order of presentation of the words was randomized for each child.

Reading task. Children were shown the cards, one card at a time, and were asked to identify items that they could recognize. If a child did not identify any of the items, the experimenter pointed to each item and asked the child if he or she knew it. The experimenter praised all responses the children made. Each child had a different randomized order of presentation of the cards. The number of correctly identified words was scored.

RESULTS

Identification of Prephonological Spellers

To identify prephonological spellers among children who orally reported some or all symbols in their productions, we adapted a procedure introduced by Pollo et al. (2009). This procedure used string-edit metrics to measure the extent to which each spelling represented the sounds in each target word. The scoring scheme that we adopted, Automated Measure of Phoneme Representation (Treiman & Kessler, 2004), used not only the orthographically correct letters but also letters that are consistent with conventional sound-letter correspondences and those that are common in young children's spelling errors. We also included 'i' as an acceptable spelling for /i/ because 'i' is the correct spelling of this sound in two words in our list (*macaroni* and *mosquito*). The scoring procedure did not penalize extraneous letters, nor did it require letters to be in the correct sequence. We counted 1 unit of distance for each letter addition that was needed to transform a spelling to a phonologically plausible spelling. For each spelling response, we computed the distance between it and each of the phonologically plausible spellings and used the lowest possible distance score. Higher distance scores indicate greater deviations from plausible spellings. For example, a child who spelled *beetle* as 'bitl' would have a distance score of 0; no change is needed to make the spelling phonologically plausible. A child who spelled *beetle* as 'btr' would receive a distance score of 2, because it would require two additions to make the spelling phonologically plausible; the extraneous *r* did not influence the distance score. In a Monte Carlo test (Good, 1994), we rearranged the pairings between target words and each child's spellings 10,000 times and tested the hypothesis that a child's original score was no better than the score of the rearranged spellings. For a child to be classified as a prephonological speller, we required that the p value of the Monte Carlo test was greater than .20. To be more confident

in our classification, we also conducted the analyses of phonological plausibility using the first letter of children's spelling responses and the first phoneme of the target words' pronunciations. This procedure was motivated by the observation that young children find it easier to spell initial phonemes than those in other positions (Treiman, Berch, & Weatherston, 1993). If the *p* value of the Monte Carlo test was greater than .20 according to both the whole-word analyses and first-letter analyses, we classified a child as a prephonological speller. Two children who were not able to identify any letters in their productions were also considered prephonological spellers. Using these criteria, 38 prephonological spellers were identified. These children's spellings, on average, required addition of 4.43 letters to make them phonologically plausible (*SD* .68). Data from these prephonological spellers, who had a mean age of 4;2 (*SD* = 0;7, range = 3;3–5;5), were the focus of the present study. Most of the prephonological spellers, like those in previous studies (e.g., Pollo et al., 2009), could not read any words on our reading task. Their mean score on this task was 0.03 (*SD* = .16, range = 0–1).

Measurement of Size of Writing Productions

For each writing production, we measured the area of the smallest rectangle enclosing the entire production (in cm^2). Marks that a child explicitly identified as drawings were excluded from the measurement. A second judge measured 25% of the prephonological spellers' writing productions. The reliability between the two judges was high, ICC(2, 1) = .968, $p < .001$.

Data Analyses

We conducted multilevel analyses to examine whether various variables predicted area of writing production. We used the R software package lme4 (Bates et al., 2014) to conduct linear mixed-effects analyses and the package lmerTest (Kuznetsova, Brockhoff, & Christensen, 2014) to compute *p* values. Because log transformation improved the normality of area of object represented by each word and area of writing on a current trial and on previous trials, we log-transformed these variables prior to analyses.

In a preliminary analysis, we examined whether area of writing on previous trials influenced area of writing on a current trial and how far any such influence extended. We first built a model with participant and item as random factors and area of writing on the immediately preceding trial, trial $N - 1$, as a fixed factor (log-likelihood = −697.98, $df = 5$). Because previous-trial information was not available for the first trial, data from the first trial of each session were not included in this model. Similar data removal was done for the subsequent models. There was a significant effect of area of writing on trial $N - 1$, such that area of writing on a current trial increased as writing on trial $N - 1$ became larger ($\beta = .48$, $SE = .04$, $p < .001$). In a second model, we added area of writing on the antepenultimate trial, trial $N - 2$, as a fixed factor into the first model. Through a log-likelihood test, we found that the second model (log-likelihood = −676.88, $df = 6$) explained significantly more variance than the first model, $\chi^2(1) = 42.19$, $p < .001$. In a third model, we added area of writing on trial $N - 3$ as a fixed factor. The third model (log-likelihood = −661.31, $df = 7$) performed significantly better than the second model, $\chi^2(1) = 31.13$, $p < .001$. A fourth model that included area of writing on trial $N - 4$ as an additional fixed factor (log-likelihood = −657.40, $df = 8$) explained more variance than the third model, $\chi^2(1) = 7.83$, $p < .01$. When we added area of writing on trial

$N - 5$, the model (log-likelihood = −657.36, $df = 9$) did not explain significantly more variance, $\chi^2(1) = .08$, $p = .77$. Therefore, we included area of writing on trials $N - 1$, $N - 2$, $N - 3$, and $N - 4$ in the subsequent analysis.

In our main analysis, we built a linear mixed-effects regression model, which included participant and item as random factors and area of object represented by each word, number of phonemes, and area of writing on trials $N - 1$, $N - 2$, $N - 3$, and $N - 4$ as fixed factors. Because exploratory analyses suggested that two other variables were also associated with area of writing, these variables were included as additional fixed factors in the model. These variables were day of testing (Day 1 vs. Day 2) and order of word presentation (ranging from 5 to 12). Object area had a significant effect on area of writing production ($\beta = .01$, $SE = .01$, $p = .011$), such that prephonological spellers produced larger writing for words representing large objects than those representing small objects. The mean area was 105.83 cm^2 for objects that were above the median in size and 88.68 cm^2 for objects that were below the median in size. Number of phonemes had no effect on area of writing ($p = .343$); prephonological spellers produced writing of similar size for words with different number of phonemes. Day of testing was significantly associated with area of writing ($\beta = –.17$, $SE = .07$, $p = .015$), such that children produced larger spellings on the first day of the spelling task ($M = 106.46$ cm^2) than the second day ($M = 88.18$ cm^2). There was also a significant effect of order of presentation ($\beta = –.04$, $SE = .01$, $p = .003$); prephonological spellers tended to produce larger writing on early trials than on late trials within a session. Area of writing on trial $N - 1$ significantly predicted area of writing on a current trial ($\beta = .37$, $SE = .04$, $p < .001$): The larger the production on the preceding trial, the larger the production on the current trial. The mean area of writing was 106.62 cm^2 when the area of writing on trial $N - 1$ was above the median for a given child and 88.06 cm^2 when the area of writing on trial $N - 1$ was below the median. Similarly, area of writing on trial $N - 2$, trial $N - 3$, and trial $N - 4$ were all positively associated with area of writing on the current trial ($\beta = .19$, $SE = .04$, $p < .001$ for $N - 2$; $\beta = .16$, $SE = .04$, $p < .001$ for $N - 3$; $\beta = .14$, $SE = .04$, $p < .001$ for trial $N - 4$). The decrease in the coefficient for area of writing on trials $N - 1$, $N - 2$, $N - 3$, and $N - 4$ indicates that area of writing on trial $N - 1$ had the largest effect and that the area of more distant trials had successively smaller effects.

Although number of phonemes did not have a significant effect in the main analysis, it is possible that children might use phonological information at the level of syllables. To test this, we ran a separate linear mixed-effects regression model in which number of phonemes was replaced by number of syllables. Number of syllables did not significantly predict area of writing production ($p = .395$). To further examine whether the prephonological spellers' writing was influenced by the phonological lengths of words, we conducted a set of similar analyses with number of written elements as the outcome variable. When children reported letters in their productions, we scored number of written elements as the number of letters that they reported. When children were not able to identify letters in their productions, we counted number of elements that did not connect to any other parts of the same production. A second rater scored number of written elements for approximately 25% of the trials in which children did not report any letters. The reliability between the two judges was high, ICC(2, 1) = .993, $p < .001$. Number of written elements was log transformed to make the distribution more normal. We included number of phonemes and number of syllables in two separate linear mixed-effects regression models predicting number of written elements. Number of written elements on trials $N - 1$, $N - 2$, $N - 3$, and $N - 4$,

day of testing, order of presentation, and object area were also entered in each of the two models. Neither number of phonemes ($p = .381$) nor number of syllables ($p = .736$) significantly predicted number of written elements.

DISCUSSION

The present study was designed to examine the constructivist notion of Ferreiro and colleagues (Ferreiro, 1983, 1984, 1985; Ferreiro & Teberosky, 1982) that young children use writing to directly represent meaning and think that written words should in some ways resemble their referents. Our main research question was whether the sizes of young children's writing productions were influenced by the sizes of the denoted objects. We found evidence, stronger than in past studies, supporting the constructivist idea: The prephonological spellers produced larger writing to spell words denoting large objects than those denoting small objects. In the course of addressing our main research question, we found new information about other factors that influence the size of children's writing productions. In what follows, we first discuss effects of variables that are not directly linked to our main research question but that are pertinent to understanding children's writing. We then discuss findings that are directly related to our research question.

In a number of situations, young children have been observed to repeat their previous responses even when they should respond differently (e.g., DeLoache, 2000; Frye et al., 1995; O'Sullivan et al., 2001). We found a similar pattern in spelling: The prephonological spellers tended to produce writing similar in size to that produced on previous trials. Of interest, this carryover effect extended quite far. Even the size of writing produced four trials before a current trial was positively associated with the size of writing on the current trial, although the effects of more distant trials became smaller. Our results extend previous evidence of carryover of letter sequences (Pollo et al., 2009; Treiman et al., 2015) by demonstrating a similar carryover effect on another aspect of writing, size of productions. One potential explanation for this effect is that children have difficulty inhibiting traces of their previous responses, such as the visual form of a preceding production or the motor movement involved in producing a preceding spelling. Alternatively or in addition, reuse of patterns or strategies may reflect children's limited knowledge about writing.

Day of testing and order of presentation also influenced size of writing on a particular trial. The prephonological spellers produced smaller writing on the 2nd day of testing and on the later trials in each session. The effect of order within a session is likely to be due to fatigue experienced during the task. The effect of day may have arisen because children were less motivated to perform the spelling task on the 2nd day, giving rise to relatively small productions. Our findings suggest that, when possible, literacy tasks should be designed to reduce carryover, fatigue, and motivational effects. Alternatively, statistically controlling for such effects can help reveal influences that may otherwise be obscured.

Levin and Korat (1993) suggested that even prephonological spellers show some sensitivity to the phonological structure of words. Our findings speak against this idea, however, because the prephonological spellers did not make larger productions or use more marks for words with more phonemes than those with fewer phonemes. Similarly, and in line with findings reported by Cardoso-Martins, Corrêa, Lemos, and Napoleão (2006) and Treiman, Pollo, Cardoso-Martins,

and Kessler (2013), prephonological spellers' writing was not influenced by number of syllables in words. Our results suggest that the children we identified as prephonological spellers did not in fact use phonology in their spellings. These results are consistent with the idea that young children do not readily conceive of writing as a representation of phonological structure, either phonemes or syllables (Byrne, 1996).

Turning to findings regarding our main research question, the prephonological spellers in our study produced larger writing to spell words representing large objects than those representing small objects. Our results are stronger than those of previous studies in several ways. We orally presented words one at a time without accompanying pictures, avoiding the presentation of additional cues that might make semantic information particularly salient (e.g., Bialystok, 1991; Levin & Korat, 1993; Levin & Tolchinksky Landsmann, 1989; Noyer-Martin & Devichi, 2014). We also addressed potential problems with previous methods of selecting prephonological spellers (e.g., Levin & Korat, 1993). Possible misclassification of some children's spelling ability could have given rise to the inconsistencies seen in the literature. Using a more rigorous procedure to identify prephonological spellers, we found influences of semantic context but not those of phonology in the productions of this group of children.

Why might prephonological spellers' attempts to write words be related to the referents of those words by virtue of physical resemblance? Although prephonological spellers of similar ages to those tested here have some knowledge about the visual form of writing, including knowledge about common letters and letter sequences (Kessler, Pollo, Treiman, & Cardoso-Martins, 2013; Pollo et al., 2009), our results suggest that these children do not yet understand that writing symbolizes spoken language. That is, these children do not grasp the concept that writing represents the sounds of language, which in turn represents meaning (Vygotsky, 1978). As a result, children may sometimes resort to using drawing-like features to communicate the meaning of words, producing features that resemble those of the referents. The effect of object size on children's writing was relatively small, suggesting that this may be a fallback strategy for children who have little understanding of how writing works.

In the present study, we focused on the influence of just one property of the referent, size. Other properties of the referent such as color and shape may also influence young children's writing (e.g., Levin & Bus, 2003; Levin & Tolchinsky Landsmann, 1989; Noyer-Martin & Baldy, 2005). Evidence supporting the influence of these referent properties has often been qualitative in nature, however. It will be important to conduct additional quantitative studies of well-characterized groups of prephonological spellers in order to examine the semantic factors and other factors that influence their productions.

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