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Variation and Repetition in the Spelling of Young Children

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Abstract

A number of investigators have suggested that young children, even those do not yet represent the phonological forms of words in their spellings, tend to use different strings of letters for different words. However, empirical evidence that children possess a concept of between-word variation has been weak. In a study by Pollo, Kessler, and Treiman (2009), in fact, prephonological spellers were more likely to write different words in the same way than would be expected on the basis of chance, not less likely. In the present study, preschool-age prephonological and phonological spellers showed a tendency to repeat spellings and parts of spellings that they had recently used. However, even prephonological spellers (mean age 4 years, 8 months) showed more repetition when spelling the same word twice in succession than when spelling different words. The results suggest that children who have not yet learned to use writing to represent the sounds of speech show some knowledge that writing represents words and should thus vary to show differences between them. The results further suggest that in spelling, as in other domains, children have a tendency to repeat recent behaviors.

Keywords: spelling; writing; phonology; between-word variation; priming; repetition

Variation and Repetition in the Spelling of Young Children

Human behavior, in language and other domains, includes both repetition and variation. People have a tendency to repeat what they have done before, as when they use a syntactic form they have used recently (Pickering & Ferreira, 2008). But people must also vary their output, for example using different linguistic expressions to express different meanings. The present study was designed to examine repetition and variation in one domain of language, spelling production, and one age group, preschool-age children. Before describing the possible roles of repetition and variation in this domain, we provide a brief overview of the development of spelling skill.

Spelling development, for learners of alphabetic writing systems, is often described in terms of the ability to map sounds that are heard in words onto phonologically appropriate letters (Treiman & Kessler, 2014). A four-year-old who is asked to write a word may produce a string of letters that seems to lack all phonological plausibility, such as <geirar> for *took*. Such children have been called *prealphabetic* (Ehri, 1997) or *prephonological* (Pollo, Kessler, & Treiman, 2009) writers. Children who are more advanced in spelling symbolize some sounds in words in plausible ways, omitting or producing implausible spellings of others. Examples include <sa> for *stay* and <ghioc> for *gum*. Such spellings, which are common in U.S. children around the age of 6, are often labeled *partial alphabetic* (Ehri, 1997). Later, during what has been called the *full alphabetic* phase (Ehri, 1997), children represent all of the phonemes in words with correct or phonologically plausible letters. For example, they may write <gum> for *gum* or <tuck> for *took*.

Writing systems generally use different written forms for different words, helping to distinguish words and convey meaning. We refer to this property of writing as *between-word variation*. A number of investigators have suggested that learners of alphabetic writing systems grasp the concept of between-word variation before they learn that the letters in printed words

symbolize elements of words' phonological forms (Clay, 1979; Ferreiro & Teberosky, 1982; Kamii, Long, Manning, Manning, & Manning, 1990; Tolchinsky, 2003). According to this view, therefore, even prephonological spellers have some understanding of an important feature of writing. Although the idea that children possess the concept of between-word variation from an early age is widespread in the literature, empirical support for this idea is rather weak. Ferreiro and Teberosky (1982) cited such evidence as the case of a four-year-old Spanish speaker who wrote *sapo* 'toad' as <Aron>, *pato* 'duck' as <Aorn>, and *casa* 'house' as <IAon>. Ferreiro and Teberosky suggested that this child had a small stock of graphic forms that she used for writing and that she used these forms in different orders and combinations to convey different meanings. However, anecdotal evidence of this kind does not support strong conclusions.

At first glance, stronger evidence that prephonological spellers deliberately arrange letters in different combinations so as to represent different words comes from data mentioned by Silva, Almeida, and Alves Martins (2010). These researchers stated that 50 of the 87 Portuguese prereaders (mean age around 5½ years) who they screened for inclusion in a training study initially used different combinations of letters when asked to write different words but did not use phonologically plausible letters. These numbers appear to indicate that the majority of prephonological spellers deliberately use letters in different orders to write different words. However, a child who spelled words as a sequence of 4 letters drawn at random from the 15 letters she knew—numbers which appear to be typical in the study of Silva et al.—could produce 15^4 , or 50,625, words with different spellings. Chance alone would make it highly unlikely that a random speller would repeat the same spelling twice unless the child were making many hundreds of attempts; thus there is no need to appeal to any preference for avoiding repetition. Moreover, Silva et al. appeared to classify children as prephonological spellers if they produced no spellings in which all of the letters were phonologically plausible. However, these children's

spellings may have included some phonologically plausible letters, even if not all letters were phonologically plausible. If the children had some understanding of sound-to-letter correspondence, this would cause them to use different spellings for words that sound different.

In a study of Brazilian and U.S. preschoolers, Pollo et al. (2009) addressed these issues pertaining to classification of prephonological spellers and number of repeated spellings that would be expected by chance. These researchers asked children to write 36 different items over the course of three days of testing, telling the children that they were not concerned with the correctness of their spellings. Quantitative procedures were used to identify 35 Brazilian and 23 U.S. children (mean age about 4 years, 8 months) who were prephonological spellers. In one analysis, Pollo et al. counted the number of times that prephonological spellers wrote different items exactly alike on the same test day. The researchers compared the amount of repetition in the children's spellings to the amount of repetition that would be expected to occur by chance given the limited number of letters that the children used in their spellings. Pollo et al. reported that both U.S. children and Brazilian children showed significantly more repetition than expected by chance, not less. One interpretation of this finding is that prephonological spellers of this age do not possess a concept of between-word variation. Between-word variation may emerge later, perhaps as a side effect of learning that writing represents phonological forms and that words with different phonological forms generally have different spellings.

Although the findings of Pollo et al. (2009) could be interpreted to suggest that prephonological spellers lack a concept of between-word variation, it is also possible that children have a tendency to repeat spellings they have used recently. Children might show this tendency whether the words being spelled are same or different, but they might be even more likely to repeat a spelling when they spell the same word again than when they spell different words. Such results would suggest some knowledge that different words should be spelled

differently, overlaid on a general tendency to repeat. This idea cannot be tested using the data of Pollo et al., however, because all of the items that the children were asked to spell in that study were different.

No study other than that of Pollo et al. (2009) has examined repetition of recently used spellings or parts of spellings in preschool-age children. However, priming effects in spelling have been found in adults and in some studies of primary school children. In one study, for example, university students who spelled *porcelain* using the correct <ai> and who were then asked to spell *chaplain* were more likely to spell the latter correctly than those who had not previously spelled *porcelain* (Abrams, Trunk, & White, 2007). In addition, those students who misspelled *porcelain* as <porcelin> were more likely to misspell *chaplain* as <chaplin> than those who did not previously spell *porcelain*. These effects lasted for at least 15 minutes. Priming studies with primary school children and other studies of adults (e.g., Folk & Rapp, 2004; Martin & Barry, 2012) have used a different procedure in which participants listen to but are not asked to spell a word (e.g., /sop/ *soap*) and are then asked spell a nonword (e.g., /bop/). Using this procedure, Campbell (1985) found priming in a group of 10½-year-old children whose reading level was at least 6 months higher than expected on the basis of their chronological age. Priming may occur because people mentally spell the prime word and then reuse some of the letters (e.g., <oa>) or letter–sound correspondences (e.g., the mapping from /o/ to <oa>) when spelling the nonword. Although 10½-year-old good readers tested by Campbell showed priming, children of the same age who were relatively poor readers did not show significant priming. Suspecting that the lack of priming in Campbell’s poorer readers may have reflected the children’s unfamiliarity with the words’ spellings, Nation and Hulme (1996) selected words that were easier for children to spell. They found a significant priming effect in 6–7-year-olds. In another study, Dixon and

Kaminska (1994) found priming in 9-year-olds that was similar in magnitude to that seen in adults.

The present study was designed to determine whether preschool children show a tendency to repeat previously used spellings and parts of spellings and whether this tendency is attenuated when the words being spelled are different. To address our research questions, we asked 3- to 5-year-old children to write to dictation six pairs of words in each of two test sessions. In half of the pairs, the two words that children were asked to spell were the same. Trials of this sort are called *homogeneous* trials. The other half of the trials were *heterogeneous*, meaning that the two words in the trial were different. The child was asked to write the first word of each trial on the top page of a two-page spread in a booklet that opened vertically. The child then wrote the second word on the bottom page, with the top page still visible. This procedure should help the child to spell the second word like the first if the child believed that it was appropriate to do so. To ensure that being asked to spell the same word twice in a row on some trials would not seem strange to children, the words were dictated by the experimenter and a puppet. The experimenter dictated the first word of each trial. The puppet was inside a toy house while this occurred and, the child was told, could not see or hear anything that was happening outside the house. The puppet then emerged from its house and asked the child to spell the second word of the trial. Because the puppet did not know about the child's earlier spelling, according to the story, it was plausible that the puppet would sometimes ask a child to spell a word that he or she had spelled previously.

Our first research question was whether children show more repetition when spelling the same word twice than when spelling different words. Such a result would suggest some knowledge of between-word variation. To address this question, we examined children's spellings of words within trials. Specifically, we asked whether children were more likely to

produce identical spellings on homogeneous trials than on heterogeneous trials. For example, if the experimenter dictated *book* as the first word of a trial and a child wrote ⟨iki⟩, was the child more likely to repeat ⟨iki⟩ if the puppet then dictated *book* rather than a different word, such as *pig*? We examined not just identical spellings, as in previous studies of between-word variation, but also similar spellings. We did this because a prephonological speller who wrote, for example, ⟨iki⟩ for *book* might try to produce the same spelling when asked to spell *book* again but might inadvertently omit the second ⟨i⟩, producing ⟨ik⟩. Prephonological spellers are the main group of interest for these analyses. Phonological spellers, whose spellings reflect the sounds in words, should definitely be more likely to repeat a spelling when writing the same word a second time than when writing a word with a different pronunciation and a different meaning.

Our second research question was whether children have a tendency to repeat spellings and parts of spellings even when they are spelling different words. Priming of spelling has not been investigated previously in preschool-age children, and so it is of interest to determine whether both prephonological spellers and phonological spellers show these effects. To address this question, we compared children's spellings of words that were presented on different trials. The words being spelled were different in these cases, and the child's spelling of one word was not visible when the child wrote the other. We conducted two sets of analyses relevant to the second research question. In the first set of analyses, we compared children's spellings of pairs of words that were presented on different test days and pairs of words that were presented on the same test day but on different trials. For example, did a child who spelled one word as ⟨remy⟩ on Day 1 spell a different word that was presented later on Day 1 as ⟨rem⟩, repeating many of the same letters and letter sequences, or as ⟨remy⟩, reusing the entire string? We asked whether repetition of complete spellings and parts of spellings was more common for words that were presented on the same day than for words that were presented on different days. In another set of

analyses relevant to our second research question, we compared spellings of words that were presented on adjacent trials on the same test day to spellings of words that were presented on nonadjacent trials on the same day. For example, suppose that *nap* was presented in Trial 1 on Day 1 and that a prephonological speller wrote it as ⟨remy⟩. If *fish* was one of the words in Trial 2 on Day 1, might the child spell it the same way or with a similar sequence of letters? Would identical spellings and similar spellings be more common for words in adjacent trials, such as Trials 1 and 2 of Day 1, than for words in nonadjacent trials, such as Trial 1 and Trial 4 of Day 1? An affirmative answer would suggest that children tend to reuse spellings and parts of spellings that they have used recently.

Method

Participants

Fifty-eight children (33 girls) between the ages of 3 years and 4 months and 5 years and 6 months completed the study. The children's mean age was 4 years, 8 months. All of the children were native speakers of English from the area of St. Louis, Missouri. The children attended childcare centers in which they were read to and exposed to print. These programs did not provide formal reading instruction. One additional child participated in only the first session of the study due to problems in scheduling a second session; this child's data are not included in the analyses.

Stimuli

Spelling task. We selected 24 frequent nouns that have consonant-vowel-consonant phonological structure in General American English: *ball, bath, book, bus, chin, cup, dish, door, fish, food, foot, gum, hat, head, juice, leg, man, moon, nap, pig, pool, rock, soup, and tooth*. We used the norms of Dale and Fenson (1996) to select the items, picking words that the large majority of 2½-year-old children were reported to produce in their spontaneous speech (mean of

93% across the 24 items). Given that the children in the present study were older than 2½, it is highly likely that they were familiar with the words and their meanings. To prepare the trials for the spelling task, we arranged the 24 words into pairs that did not have any phonemes in common. For example, *ball* and *chin* was one such pair. The words in each pair were arranged into four trials. In homogeneous trials, one word of the pair was presented twice. The homogeneous trials for our example pair were *ball ball* and *chin chin*. Heterogeneous trials consisted of two different words: *ball* followed by *chin* and *chin* followed by *ball* for the example pair. Each of the four trials for a particular pair was assigned to a different list of trials. Each list included six homogeneous trials and six heterogeneous trials. Within a list, no word occurred in more than one trial. Across the four lists, each word occurred equally often in homogeneous and heterogeneous trials. Approximately one quarter of the children were assigned to each list. The order of the trials within a list was randomized for each child.

Reading task. This task used the words *book, come, dog, eat, go, green, in, is, it, jump, look, no, play, red, see, stop, the, up, we, yellow, yes, and you*. Eleven cards were prepared, each of which contained two words. The words were written in uppercase letters because these are generally more familiar to U.S. children than uppercase ones (e.g., Worden & Boettcher, 1990). To make the task less frustrating for children who could not read the words, each card also contained an easily identifiable picture that was not related to either word. The order of the cards was randomly chosen for each child.

Procedure

Each child was tested individually in a quiet location at his or her childcare center. The experiment was conducted in two sessions. During the first session, children did six trials of the spelling task and then the reading task. During the second session, which took place an average of 11 days after the first, children did the remaining six spelling trials. This procedure was

modified for one child who wished to stop the spelling task early on the first day of testing. This child completed the spelling trials from the first session and then the trials from the second session on the second day of testing.

At the beginning of each session, the experimenter introduced the child to two puppets and the toy house in which they lived. The experimenter explained that the puppets liked to be in their house sometimes. When they were in their house, they could not see or hear anything outside the house. The child's understanding of this concept was checked before the spelling task began, halfway through the spelling task, and again at the end of the task. All children, when asked whether the puppets could see or hear anything outside their house when they were inside it, correctly responded that they could not.

Before the first spelling trial on a test day began, the child was asked to select the puppet that he or she would like to play with that day. The experimenter explained that she and the puppet would take turns saying words and that the child would repeat each word and then write it. The experimenter said that she would say the first word and that the puppet would go into its house until it was its turn. The experimenter pronounced the first word of the first trial, asked the child to repeat it, and then asked the child to use letters to try to write it. The experimenter told the child not to be concerned if he or she did not write like grown-ups do. The child wrote the words in a booklet that opened vertically, writing the first word on the top page of a two-page spread. When the child had finished writing, the experimenter praised the child's efforts and asked the child what letters he or she had used. The letters the child articulated were scored as the child's spelling. We used this method because the marks that children produced were not always well-formed letters, as expected for children of this age. After this procedure had been completed for the first word of the trial, the experimenter asked the child to knock on the door of the house and invite the puppet to play. The puppet, on emerging, stated that it had not been able

to hear or see anything that happened outside the house. The puppet then asked the child to say and spell the second word of the trial. The child was asked to write this word on the bottom page of the same two-page spread. Thus, the child's spelling of the first word of the trial was visible when he or she wrote the second word. This procedure was repeated for each trial, the child spelling the words for each trial on a separate two-page spread of the booklet.

For the reading task, which was given after the spelling trials on the first test session, the experimenter showed the child each card in turn. The experimenter asked the child to identify any words or pictures that he or she knew on the card. If a child did not spontaneously do so, the experimenter pointed to each word and picture in turn and asked if the child knew it. We scored the number of correctly read words.

Results

In what follows, we first describe how we distinguished between prephonological and phonological spellers. We then present data on children's spellings of words within trials. These analyses address our first research question: Are children more likely to repeat spellings on homogeneous than heterogeneous trials, and are their spellings more likely to be similar on homogeneous than heterogeneous trials? We then turn to children's spellings of words across trials. These analyses address our second research question: Do children show a tendency to repeat spellings and parts of spellings they have recently used even when the words being spelled are different?

Classification of Children as Prephonological or Phonological Spellers

To determine children's ability to spell on a phonological basis, we adapted a procedure used in several previous studies (Kessler, Pollo, Treiman, & Cardoso-Martins, 2013; Pollo et al., 2009; Treiman, Pollo, Cardoso-Martins, & Kessler, 2013). This procedure uses string-edit metrics to compute the distance between each spelling and the pronunciation of the target word

by finding the best possible match between the sounds and the letters. As is common in string-edit metrics, we assigned a base score of 0 to phonologically perfect spellings and assigned positive penalties for any divergences. The specific scoring system that we used, AMPR (Treiman & Kessler, 2004), scores children's spellings using not only the orthographically correct letter but also phonologically plausible spellings for each sound. For example, both <c> and <q> were considered plausible spellings for the /k/ of *book*, in addition to the correct <k>. The scoring system accepts additional letters, some of which may be plausible, and it does not require letters to be in the correct sequence. We counted one unit of error for each addition needed to transform the child's spelling into a plausible spelling. For example, a child who spelled *book* as <booc> would receive an error score of 0 because no changes are needed to make the spelling phonologically plausible. A child who wrote
 for *book* got an error score of 2 because 2 additions would be required to produce a plausible spelling of *book*; the extraneous <r> did not detract from the child's score. The spelling <oot> for *cup* received an error score of 3 because 3 additions would be required to produce a plausible spelling.

We summed the error scores across all of a child's spellings to obtain the aggregate error score for that child. We then randomly matched the child's spellings to the target words and rescored the spellings as if they had been attempts to spell those words. This rearranged aggregate error score gives one view of what the child's score would be if the spelling were not informed by the phonology of the target word. We performed this rearranged scoring 10,000 times using the program Ponto (Kessler, 2009), and we then computed the proportion of rearranged spellings for which the aggregate error score was at least as good as the original score. To identify participants for whom there was no convincing evidence that the spellings reflected the phonemes in the words, we required that the *p* value of the hypothesis that spellings reflected phonemes was greater than .20. By using a *p* value of .20, we can say that any apparent

resemblances between a child's spellings and phonologically plausible spellings were due to chance with a higher degree of confidence than if we had used, for example, a p value of .05. To be more confident in our identification of children as prephonological spellers, we also conducted the analyses of phonological plausibility based on the first phoneme of the target words' pronunciations and the first letter of children's spellings. Because the ability to represent the first consonant of a consonant-vowel-consonant word tends to emerge earlier than the ability to represent other phonemes (Treiman, Berch, & Weatherston, 1993), scoring the spellings in this manner may pick up the earliest signs of phonological spelling. We considered that a child was a prephonological speller if the p value of the hypothesis that the child's spellings reflect phonemes exceeded .20 according to both the first-phoneme analysis and the whole-word analysis.

Using the procedures just described, we identified 26 of the 58 children as prephonological spellers. These children had a mean age of 4 years, 8 months. None of them could read any words on the reading task, and none produced any correct spellings on the spelling task. Another 20 children—those whose p value was lower than .05 according to both the first-letter and whole-word analyses—were classified as phonological spellers. The phonological spellers had a mean age of 4 years, 10 months. Their mean reading score was 4.30 (SD 7.09), and their mean proportion of correct responses on the spelling task was .04 (SD .10). Twelve children did not meet the criteria for either the prephonological or the phonological group, and their spellings were not analyzed further.

Spellings Within Trials

To address our first research question—whether children show more repetition when spelling the same word twice than when spelling different words—we examined spellings of items that were presented on the same trial. The words were identical on homogeneous trials and

different on heterogeneous trials, and on both types of trials children could see their spelling of the first word when spelling the second.

Table 1 shows the proportion of homogeneous and heterogeneous trials on which children spelled the two words exactly alike. A mixed model analysis with random intercepts for participants and word pairs and the fixed factors trial type (homogeneous vs. heterogeneous) and spelling ability (prephonological vs. phonological) found a main effect of trial type ($\beta = 2.734$, $SE = 0.330$, $p < .001$), such that there were more exact matches on homogeneous than heterogeneous trials, and a main effect of spelling ability ($\beta = 1.746$, $SE = 0.500$, $p < .001$), such that phonological spellers produced more exact matches than prephonological spellers. This and other mixed model analyses were conducted using the R package lme4 (Bates, Maechler, Bolker, & Walker, 2013); we used a logit link function when the dependent variable was binary. When the interaction between trial type and spelling ability was added to the model, its fit improved significantly according to a log likelihood test ($p < .001$).

Given the significant interaction between trial type and spelling ability, we conducted separate analyses for prephonological and phonological spellers. For prephonological spellers, there was a main effect of trial type such that identical spellings were significantly more common for homogeneous trials than for heterogeneous trials ($\beta = 0.774$, $SE = 0.394$, $p = .047$). As Table 1 shows, prephonological spellers produced identical spellings 17% of the time when the words in a trial were same as compared to 10% of the time when they were different. For example, one child produced <irfierr> for both occurrences of *head*. This spelling bears little relationship to the phonemes in the spoken word. Indeed, the identical spellings that the prephonological spellers produced fit our criteria for prephonological spelling when we treated them as coming from a single child and analyzed them according to the whole-word and first-phoneme criteria described earlier. For phonological spellers, the proportion of identical

spellings was, as expected, higher for homogeneous trials than for heterogeneous trials ($\beta = 5.442$, $SE = 0.888$, $p < .001$). The difference between the two types of trials was quite large for phonological spellers: 62% identical spellings on homogeneous trials as compared to 2% on heterogeneous trials. The significant interaction between trial type and spelling ability in the combined analysis of phonological and prephonological spellers thus reflects the fact that the difference between homogeneous trials and heterogeneous trials was larger for phonological spellers than for prephonological spellers.

Table 1

Mean Proportion of Trials in Which Both Words Were Spelled Identically

Trial type	Prephonological spellers (<i>SD</i>)	Phonological spellers (<i>SD</i>)
Homogeneous	.17 (.23)	.62 (.33)
Heterogeneous	.10 (.20)	.02 (.05)

Even if a child did not spell the words in a homogeneous trial exactly alike, the spellings might be similar. To determine whether children's spellings were more similar in homogeneous trials than in heterogeneous trial, we used string-edit techniques to score the similarity of the spellings. In this application, we counted one unit of distance for each deletion and addition that was necessary to transform one spelling into the other and 1.4 units for each substitution. For example, the distance score for <ad> and <ady>, 1.0, is lower than the distance score for <ad> and <i>, 2.4. When different ways of applying these rules gave different scores, we used the lowest score. For example, transforming <ad> to <i> could be considered to involve two deletions and one addition, for 3.0 points, but counting it as a deletion and a substitution yielded a lower score, 2.4

points. Because children produce few transpositions when writing by hand (Treiman, 1993), we did not treat transpositions as a special case; thus <ad> is separated from <da> by one insertion and one deletion, for a score of 2.0. A low distance score between two spellings means that they share more letters and letter sequences than spellings with a higher distance score.

Table 2 shows the mean distance scores between the spellings in homogeneous and heterogeneous trials. A mixed model analysis was conducted with random intercepts for participants and word pairs and the fixed factors trial type and spelling ability. Distance was log transformed in this and subsequent analyses in order to make its distribution more normal, and we used the R package *lmerTest* (Kuznetsova, Brockhoff, & Christensen, 2013) to calculate *p* values based on Satterthwaite's approximation. We found a main effect of trial type ($\beta = 0.221$, $SE = 0.021$, $p < .001$), such that distance scores were lower on homogeneous than heterogeneous trials, and a main effect of spelling ability, such that distance scores were lower for phonological than prephonological spellers ($\beta = 0.141$, $SE = 0.054$, $p = .012$). Adding the interaction between trial type and spelling ability significantly improved the fit of the model ($p < .001$ by a log-likelihood test).

Given the significant interaction between spelling ability and trial type, we conducted separate analyses for prephonological and phonological spellers. For prephonological spellers, the distance between spellings in a trial was significantly smaller when the words were the same than when they were different. Confirming this, a mixed model analysis with random intercepts for participants and word pairs and the fixed factor trial type showed a significant effect of trial type for prephonological spellers ($\beta = 0.060$, $SE = 0.027$, $p = .029$). The main effect of trial type was also significant for phonological spellers ($\beta = 0.429$, $SE = 0.027$, $p < .001$). The interaction between trial type and spelling ability in the analysis including both groups of spellers thus reflects the fact that difference between homogeneous and heterogeneous trials was larger for

phonological spellers than for prephonological spellers.

Table 2

Mean Distance Between Spellings Within Trials

Trial type	Prephonological spellers (<i>SD</i>)	Phonological spellers (<i>SD</i>)
Homogeneous	3.44 (2.02)	1.22 (1.55)
Heterogeneous	3.91 (2.32)	3.91 (1.88)

Spellings Across Trials

Our second research question concerns the extent to which children repeat spellings and parts of spellings when the words being spelled are different. One way to address this issue is to compare pairs of spellings that were produced on different test days to those that were produced on same test day but on different trials. The first two rows of data in Table 3 show the proportion of identical spellings for each these cases. In both cases, the spelling of one word was not visible when the child wrote the other and so any repetition could not reflect copying of visible letter strings. A mixed model analysis using random intercepts for participants and test day (same vs. different) and spelling ability as fixed factors showed a main effect of test day, such that children produced more identical spellings for different words that were presented on the same test day than for different words that were presented on different days ($\beta = 0.711$, $SE = 0.120$, $p < .001$). Adding the interaction between day of testing and spelling ability significantly improved the fit of the model ($p < .001$). Given this interaction, we conducted separate tests for prephonological and phonological spellers using test day as a factor. Prephonological spellers produced significantly more identical spellings of different words on the same test day than on different

days ($\beta = 0.946$, $SE = 0.140$, $p < .001$). There was no significant effect of test day for phonological spellers, who rarely spelled different words exactly alike.

We next examined use of identical spellings for pairs of words that were presented on the same test day, comparing the results for pairs of words that were presented on adjacent trials and pairs of words that were presented on nonadjacent trials. Again, the words were different in both cases and the child could not see his or her spelling of the first word when spelling the second. The third and fourth rows of data in Table 3 show the results. A mixed model analysis using random intercepts for participants and the fixed factors trial adjacency (adjacent vs. nonadjacent) and spelling ability showed a significant effect of spelling ability ($\beta = 1.894$, $SE = 0.942$, $p = .044$), such that prephonological spellers produced more identical spellings than phonological spellers. Adding the interaction between adjacency and spelling ability did not significantly improve the fit of the model ($p = .095$).

Table 3

Mean Proportion of Identical Spellings of Different Words in Different Trials

Test day and trial adjacency	Prephonological spellers (<i>SD</i>)	Phonological spellers (<i>SD</i>)
Different day	.03 (.09)	.01 (.03)
Same day (regardless of trial adjacency)	.06 (.13)	.01 (.04)
Same day, nonadjacent trials	.06 (.13)	.02 (.04)
Same day, adjacent trials	.07 (.15)	.01 (.03)

The two sets of analyses reported above were repeated for distance scores. The first two rows of data in Table 4 show the mean distance scores for pairs of spellings of different words

that were presented on different test days and those that were presented on the same day. A mixed model analysis with random intercepts for participants and the fixed factors test day and spelling ability found a main effect of test day ($\beta = 0.046$, $SE = 0.003$, $p < .001$). Spellings of different words that were produced on the same day had smaller distance scores (i.e., were more similar) than spellings of different words that were produced on different days. Adding the interaction between test day and spelling ability significantly improved the fit of the model ($p < .001$). We conducted separate tests for prephonological and phonological spellers to follow up on the interaction. For prephonological spellers, distance scores for different items that were spelled on the same day were significantly smaller than those for items that were spelled on different days ($\beta = 0.066$, $SE = 0.004$, $p < .001$). A significant effect of test day was also found for phonological spellers ($\beta = 0.021$, $SE = 0.003$, $p < .001$). The effect of test day was larger for prephonological spellers than for phonological spellers, explaining the interaction between spelling ability and test day in the analysis that included both groups of participants.

Finally, we examined distance scores for spellings of different words that were produced on the same test day as a function of whether the words were in adjacent or nonadjacent trials. The third and fourth rows of data in Table 4 show the results. A mixed model analysis with random intercepts for participants and the fixed factors adjacency and spelling ability found a main effect of adjacency ($\beta = 0.025$, $SE = 0.005$, $p < .001$), such that distance scores were smaller for spellings produced on adjacent trials than for spellings produced on nonadjacent trials. When the interaction between adjacency and spelling ability was added to the model, its fit improved significantly ($p = .015$). Follow-up tests showed a significant effect of adjacency for both prephonological spellers ($\beta = 0.035$, $SE = 0.007$, $p < .001$) and phonological spellers ($\beta = 0.012$, $SE = 0.005$, $p = .028$). The interaction between adjacency and spelling ability in the analysis that included both sets of participants reflects the fact that the effect of adjacency was

smaller for phonological spellers than for prephonological spellers.

Table 4

Mean Distance Between Spellings of Different Words in Different Trials

Test day and trial adjacency	Prephonological spellers (<i>SD</i>)	Phonological spellers (<i>SD</i>)
Different day	5.24 (2.77)	4.28 (2.12)
Same day (regardless of trial adjacency)	4.62 (2.72)	4.05 (1.95)
Same day, nonadjacent trials	4.76 (2.82)	4.10 (1.98)
Same day, adjacent trials	4.34 (2.58)	3.95 (1.91)

Discussion

It is often asserted that that young children, even children who are not yet able to represent the phonological forms of words in their spellings, expect different words to be spelled differently (Clay, 1979; Ferreiro & Teberosky, 1982; Kamii et al., 1990; Tolchinsky, 2003). That is, the ability to use different written forms for different words is thought to precede the ability to represent phonemes with letters. Empirical evidence that young children possess the concept of between-word variation is weak, however. In fact, the results of Pollo et al. (2009) suggest that prephonological spellers are more likely to use the same spellings for different words than would be expected on the basis of chance, not less likely. This finding could be interpreted to mean that prephonological spellers lack a concept of between-word variation. Alternatively, children might have a general tendency to reuse spellings they have used recently, and any tendency to produce different spellings for different words might have to compete against this tendency to repeat. The present study was designed to distinguish between these possibilities.

Our first research question was whether children show more repetition when they write the same word twice in succession than when they write different words in succession. We found an affirmative answer to this question. Prephonological spellers used the same spelling for the second word of a trial 17% of the time when it was identical to the first word of the trial as compared to 10% of the time when it was different. The significant difference between these two figures suggests that, even at this early point in writing development, children have some knowledge of between-word variation. We did not collect data on children's eye movements, but we observed a number of cases in which children looked at their spelling of the first word of a trial before spelling the second word or while spelling the second word. In some cases, children even commented on the repetition. Such observations suggest that repetition of spellings for words in homogeneous trials may reflect a deliberate strategy. Although our data suggest that prephonological spellers have some knowledge of between-word variation, this knowledge is not very strong. Exact repetitions of spellings were in the minority even though the spelling of the first word of a trial remained visible when children spelled the second word. Some of the similar spellings that we observed for repeated words, however, could have arisen when children attempted to copy the spelling of the first word but did not succeed in producing an exact copy. Phonological spellers, as expected, had a stronger tendency to use the same spelling when writing a word for the second time. Even they, however, did not always use identical spellings on homogeneous trials. For example, one child spelled *foot* as <fifhovifhi> and then as <fosihove>, exclaiming "We just did foot up there!" while producing the second spelling. As further evidence that phonological spellers do not consistently represent the same word with the same spelling and different words with different spellings, 6- and 7-year-olds sometimes use the same spelling for words such as *say* and *stay*, even though they know that the words sound different (Treiman, 1991).

Our second research question was whether preschool-age children show a tendency to repeat spellings and parts of spelling they have used recently. We found an affirmative answer to this question. Prephonological spellers occasionally used the same spelling for two different words that were presented within a testing session, producing significantly more repetitions within a session than across sessions. This result is consistent with the finding of Pollo et al. (2009) that prephonological spellers produce more exact repetitions of spellings within a session than expected by chance. Extending the findings of Pollo et al., we found that prephonological spellers' productions of different words tended to be more similar within a session than across sessions and, within a session, more similar if produced closer in time. The similarities that we observed in these cases did not involve copying of visible spellings and, we suspect, did not involve conscious processes.

These results with prephonological spellers shed light on the basis of priming as it occurs in spelling. Priming could reflect reuse of letters and letter sequences or reuse of sound-to-spelling correspondences, and most studies with primary school children and adults were not designed to distinguish between these possibilities. For example, a participant who uses <oa> in her spelling of /bop/ soon after she has heard and mentally spelled *soap* may do so because of a tendency to reuse <oa> or because of a tendency to reuse the mapping from /o/ to <oa>. The few studies that have attempted to disentangle these possibilities, which were conducted with adults, found mixed results. Folk and Rapp (2004) suggested that priming involves both orthographic and phonological mechanisms, whereas Abrams et al. (2007) suggested that priming is based purely on shared orthography. Prephonological spellers do not yet use correspondences between sounds and spellings, so the priming that we observed with these children must reflect a tendency to reuse letters and groups of letters that were used previously. Orthographic priming, our results suggest, is developmentally prior to phonological priming.

The phonological spellers in our study hardly ever used the same spellings for different words, but they tended to use more similar spellings on the same day of testing than on different days and, within a day, more similar spellings for words presented closer in time. These results demonstrate priming in phonological spellers who are younger than those in previous studies (Campbell, 1985; Dixon & Kaminska, 1994; Nation & Hulme, 1996). Our results also suggest that priming weakens across time, in line with earlier findings with adults (Martin & Barry, 2012; Perry, 2003). Carryover from previous spellings might help to explain why children who are beginning to spell phonologically sometimes include implausible letters in their spellings. For example, a child who spells *foot* as <fwt> might reuse <f> when spelling the next word on a list, producing <dif> for *dish*. It would be valuable in future research to test this idea directly. It would also be valuable to examine priming and its time course when words are presented one by one rather than in pairs as in the present study.

Prephonological spellers have been much less studied than children who have begun to spell phonologically, and our results shed new light on what these children know and do. Previous studies suggest that prephonological spellers possess some knowledge about certain visual features of writing. For example, it is rare for a written word in English or another language to consist of a string of repeated letters. Even three-year-olds appear to have some knowledge of this fact, for they are more likely to accept as an example of writing a string of varied symbols, such as <TOODLE>, than a string of repeated symbols, such as <TTTTTT> (Lavine, 1977). As another example, four-year-olds who do not use phonologically plausible letters to write words may nevertheless use letters and pairs of letters that are common in the written language to which they are exposed (Kessler et al., 2013; Pollo et al., 2009). Evidently, these children have begun to learn about the frequency with which letters occur and reoccur in written texts. Our results suggest that prephonological writers are beginning to learn not only

about the visual appearance of writing but also that different written forms are generally used for different words. Thus, they are less likely to spell two words alike when the words are different than when they are the same. The tendency to use different spellings for different words is not as large as expected given the examples presented by such researchers as Ferreiro and Teberosky (1982), but it was apparent in our data. One interpretation of the results is that even prephonological spellers know that writing represents words. Thus, they show some tendency to produce contrasting spellings for different words. Another possible interpretation is that prephonological spellers treat writing as representing ideas. Thus, they show some tendency to use different spellings for words that convey different ideas. Further research, for example studies comparing children's spellings of words that are and are not synonymous, would be necessary in order to distinguish between these interpretations.

More generally, our results shed light on the interplay between repetition and variation as it occurs in one aspect of language behavior, spelling. In the production of written language, as in the production of spoken language, partial or complete repetition helps the producer by reducing the need to construct and produce something new (Pickering & Ferreira, 2008; Treiman, Seidenberg, & Kessler, 2014). But repetition can result in a lack of contrast, making things difficult for the perceiver and hindering communication. Thus, variation is required as well. Both repetition and variation, our results suggest, influence spelling production in young children.

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