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Coordination of reading and spelling in early literacy development: An examination of the discrepancy hypothesis

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Abstract. The Discrepancy Hypothesis posits that children early in the acquisition process read visually (holistically) and spell phonologically. This claim was examined and rejected. We investigated reading and spelling in Grade 1 and Grade 2 children using controlled nonword and word materials with a variety of orthographic patterns. While reading and spelling were strongly correlated even among the younger readers, discrepancies between performance levels occurred in both directions. Children's responses were affected by word characteristics and whether or not they received school phonics instruction. Phonologically complex words, such as those containing consonant clusters, were particularly difficult for Grade 1 children to read, while words that were difficult to spell correctly but not to read tended to have multivalent mappings from sound to spelling. The generation of reading responses to specially selected nonwords was affected by both implicit and explicit phonological sources of knowledge. Orthographic knowledge gained in spelling did not always transfer to reading, and vice versa.

Key words: Discrepancy hypothesis; Induced sublexical relations, Knowledge sources, Learning to read and spell, Teaching effects, Word characteristics

Given that reading words and spelling them are the two abilities that constitute basic alphabetic literacy, it seems natural to ask how these abilities are coordinated in the learner. Does skill in one automatically transfer to the other? If not, can the method of teaching and the selection of materials influence the crosstalk between them? These questions, though long debated, have not been resolved. In this report, we examine a recurring proposal by Bradley and Bryant (1979), Bryant and Bradley (1980), Frith (1980), and Goswami and Bryant (1990) that reading and spelling are initially quite separate abilities. The claim is that early in the acquisition process children tend to read visually (holistically) and, at the same time, to spell phonologically. Only later do the two activities become closely linked. On this view, beginners' spellings already reflect word representations that are at least partly segmented phonemically, whereas their reading is largely dependent on words' overall shapes, not on apprehension of their segmental structure. The *discrepancy hypothesis* presents a challenge to the idea that reading and spelling are simply manifestations of one and the same ability to use the orthography.

In their elaboration of the discrepancy hypothesis, Bryant and Bradley (1980) conjectured that children's early approaches to reading and spelling reflect a bias in cognitive development that is to a considerable degree unresponsive to differences in instructional approach. This idea, if confirmed, would undercut the rationale for making an effort to coordinate instruction in reading and spelling. Therefore, it seemed appropriate to take a close look at the relations between abilities in reading and spelling early in the acquisition of literacy. Accordingly, our purpose in this paper is to review the evidence bearing on the discrepancy hypothesis, and to contribute new data to examine the coordination of reading and spelling abilities in six-year-old children who are beginning readers in the first year at elementary school and in children in the second year who are a year older.

Although young children's skills in reading and spelling are ordinarily well correlated, there are, of course, instances in which a discrepancy occurs. The occurrence of words that can be read but not spelled correctly (+R–S) is not surprising, given that producing language tokens is generally more difficult than recognizing them. In addition, the structure of English orthography poses a more specific reason for expecting that spelling in English should be more difficult than reading. English orthography exhibits bidirectional asymmetry: phoneme-to-grapheme mapping is more multivalent, and therefore more ambiguous, than grapheme-to-phoneme mapping to the phonological forms of words already in the child's oral vocabulary. Consequently, there are more phonetically plausible ways to misspell English words than there are to misread them (Bosman & Van Orden, 1997; Ehri, 1997). (As an example, consider that within each group of spellings, brane/brein/brain and cleen/kleen/clean, two of the three spellings are pseudohomophones, phonetically equivalent nonwords). Yet in spite of cogent reasons why spelling should be the harder task, there are occasions when children spell words correctly that they cannot read (–R+S). These pose a challenge for explanation. The case for claiming that children at first tend to use different strategies for spelling and reading rests on the existence of significant numbers of instances of this kind.

In their initial study, summarized in Bryant and Bradley (1980), these researchers gave a group of British school children 18 words to read and spell. The children were between the ages of 5 years 8 months (5:8) and 8:7, with average intelligence, and average reading and spelling scores. The authors reported a partial disconnection between reading and spelling. That is, although most words were either read and spelled correctly (+R+S) or neither read nor spelled (–R–S), there were a number of words in the discrepant categories of read but not spelled (+R–S, mean = 2.1), and not read but spelled correctly (–R+S, mean = 1.4). The authors expressed doubt that the pattern of results could have been greatly influenced by instructional method because the children had been taught by an eclectic or 'mixed' approach, combining features of phonic and look-say approaches. The phenomenon they described was age-limited: Bryant and Bradley found that the greater the age and reading level, the less likely were children to have words in the –R+S category. Thus, they maintained that use of discrepant strategies in reading and spelling is ordinarily a temporary phenomenon, confined to the early part of literacy acquisition.

A further study was reported by these authors, based on additional groups of children aged 6:6 to 7:0, and 7:0 to 7:6. The stimulus list consisted of high-frequency words that varied in the ease with which they could be constructed on a letter-by-letter basis. Bryant and Bradley reasoned that the more regular words would be easier to spell than to read if children spelled by phonological segments but read by larger units. The results confirmed their previous findings. The existence of discrepant words seemed to support the possibility that children read and spell differently, perhaps tending to read holistically at a time when they were already able to spell segmentally (i.e., phonologically). They reported that for the younger group the four words most commonly read but not spelled (+R–S) were: *school, light, train, egg*, all classified by them as irregular, and the words most commonly spelled but not read (–R+S) were regular words: *bun, mat, leg, pat*. Although regular, the latter are not as visually distinctive as the former. When words in the –R+S category were embedded in a list of nonsense words, the children showed improvement in their reading of them. This result suggests that a phonological reading strategy had been available all along but not used.

Gough, Juel and Griffith (1992) proposed an alternative interpretation of the Bryant and Bradley findings. They suggested that the existence of discrepant responses could reflect an inconsistency in performance *within* the contexts of beginning reading and spelling, but probably not a genuine incompatibility in children's approach to the tasks of reading and spelling. Using most of the words from the Bryant and Bradley word lists, they asked a group of British beginning readers, who they claimed had received the same kind of reading instruction as those studied by Bryant and Bradley, to read and spell these words twice, in the course of four sessions spread over a week. They found the same pattern of discrepant responses that Bryant and Bradley reported, but the response categories contained mainly different words at each testing. Gough et al. concluded that novice readers exhibit the same degree of inconsistency on successive readings (or spellings) as they do between reading and spelling. In other words, they read and spell in the same way on different occasions, albeit inconsistently.

Differences in the phonological composition of the test words may exert a systematic influence on the pattern of errors in reading and spelling. Shankweiler and Lundquist (1992) discussed research from 6-year-old children (also receiving mixed instruction in reading) who were asked to read and spell words that represented a variety of spelling patterns. Based on a subset of regularly spelled words that were phonologically complex, as many of them contained consonant clusters at the beginning or end, Shankweiler and Lundquist noted that reading performance exceeded spelling performance by a wide margin, as only 6% of the words were not read but spelled (–R+S) correctly, compared with 37% read but not spelled (+R–S). Indeed, the findings reported by Bryant and Bradley (1980) also show this pattern, in that more words (21%) are read but not spelled (+R–S) than vice-versa (13%). The spellings of consonant cluster words by Shankweiler and Lundquist's subjects showed that initial consonants were represented in 95% of the words, but that representation of the second segment of initial consonant clusters tended to be omitted (an observation also made by Treiman, 1991). Moreover, the incidence of these omissions was a good predictor of overall spelling and reading achievement.

The difficulty in analyzing clusters into their separate components would be expected if many of the children lacked the requisite phoneme awareness. Performance on a measure of phoneme awareness (a sound categorization test) was, in fact, similarly correlated with both reading and spelling accuracy. Based on these results, Shankweiler and Lundquist argued that there is reason to question the generality of the discrepancy hypothesis which claims that children are disinclined to use phoneme awareness effectively in reading at a time when they are able to use it for spelling. Finally, Shankweiler and Lundquist's findings illustrate that beginning readers can have difficulty not only in spelling irregular words, as Bradley and Bryant claimed, but also with the spelling of regular words when the words are phonologically complex.

Other findings, while confirming that beginners' reading and spelling patterns can diverge, suggest that *how* they diverge may reflect the complexity of the spelling-to-sound mapping within the test words and, in addition, school instruction factors (discounted by Bryant and Bradley). Thompson, Cottrell and Fletcher-Flinn (1996) studied children being taught to read by a 'book-experience' approach (New Zealand Department of Education, 1985; Thompson, 1993) which emphasizes as cues to word recognition the semantic-syntactic context of the word and the initial letter of the word. The children do not receive explicit instruction in the pronunciation of isolated letters or in the correspondence between component letter sequences of words and corresponding pronunciations. Because they had no exposure to such explicit phonics instruction, it was proposed that their main knowledge source for generating nonword reading responses would be induction from their reading experience. For children so instructed, attempts to read nonwords would rely on implicitly learned connections between orthographic components of the items and corresponding phonological components specific to positions within words (referred to as "induced sublexical relations").

Thompson et al. (1996) asked children with a mean chronological age of 5:10 and similar reading level to read and spell 24 two-grapheme (CV or VC) nonwords. The nonwords were made up of a vowel letter and the consonant graphemes *b*, *th*, *t*, *m* which appeared in either initial (e.g., *bu*) or final (e.g., *ub*) position. These consonants were chosen because they represented instances of sharp contrast in word-initial and final positional frequencies within the corpus of word types in the children's reading texts. The graphemes *t* and *m* appeared frequently in both word-initial and word-final positions, in contrast to *b* and *th* which appeared frequently in word initial but infrequently in final position. The results supported the use of induced sublexical relations as the children's pronunciations of these items (see Table 3, for nonphonics sample) reflected the positional frequencies of the targeted graphemes in the corpus of printed material the children had encountered. Evidence that such a mechanism of implicit lexicalized phonological recoding can be used in learning to read has also been obtained in other studies (Fletcher-Flinn & Thompson, 2004).

There is much emphasis in New Zealand schools on self-expression in writing, and at the early levels children are encouraged to invent spellings for words as they attempt to write their own stories. After reading what they have written to the teacher, the correct version is usually written out for the child, and hence any spelling errors are corrected. Spelling lists of words for memorization and phonics workbooks are not used. This being the case, the children were also tested with a parallel spelling completion task to examine the possibility that phoneme-to-grapheme correspondences acquired in spelling could be a source of grapheme-to-phoneme correspondences for generating pronunciations in reading. The children were provided with the spoken form of each nonword (e.g., "bu", "ub", "thu", "uth" and variants using other vowel letters) and were asked to choose a letter or letter pair out of an array of 10, to complete the spelling of each (e.g., *_u*, *u_*, *_u*, *u_*). The results showed that accuracy for choosing phoneme-to-grapheme correspondences was high, averaging 80% for the phonemes corresponding to *b*, *th*, *t*, *m*, in initial and final positions. But, unlike the reading condition, the spelling completion condition did not yield a significant position effect, and there was no significant variation between the four phonemes in the extent of any position effect. Thompson et al. concluded that knowledge from spelling did not readily transfer to reading: the learners' knowledge of phoneme-to-grapheme correspondences employed in spelling was not used to generate pronunciations in reading.

The same conclusion was reached in a separate study (Thompson, Fletcher-Flinn & Cottrell, 1999) with different stimuli. The materials used in the Thompson et al. (1996) study contained grapheme-phoneme correspondences that were almost always context-free, insofar as the correspondences hold regardless of the surrounding letters. English orthography, however, also presents many grapheme-phoneme correspondences that are contingent on variations in graphemic context. For example, in the dialect of English considered here, /i:/ (vowel sound of *we*) is the phoneme corresponding to the final grapheme *y* in *baby*, *happy*, etc., whereas /aI/ (vowel sound of *pipe*) is the phoneme that corresponds to the grapheme *y* in monosyllabic words *my*, *fly*, etc. Thompson and Fletcher-Flinn (1993) examined these two context-contingent mappings for the phonemes corresponding to the final-position grapheme *y*, along with the cases in which the grapheme *y* is a component of the digraph *ay* in final position, (e.g., *day*, *play*). In none of these cases is the phoneme corresponding to final *y* the same as when *y* appears in word-initial position. These mappings were incorporated into nonwords with appropriate differentiating graphemic contexts for the three classes of mappings of *y* (e.g., *goky*, *ky*, *vay*). A group of normally progressing children (mean chronological age, 6:4; mean reading age, 6:7) was tested for reading and for spelling of these nonwords. In the reading condition performance on the three classes of mappings was consistent with their relative frequency in the word types of the children's reading experience. However, accuracy in the spelling condition was much lower than reading for each of the three classes (mean 43% for reading and 16% for spelling completion). This inverts the reading/spelling relation obtained with context-free grapheme-phoneme correspondences.

The findings of Thompson et al. (1996) and Thompson and Fletcher-Flinn (1993) from nonword stimuli requiring the use of phonology in both reading and spelling conditions show that the difference in relative difficulty of reading and spelling can cut both ways; which way it cuts may depend on the complexity of the grapheme-phoneme correspondences within the test words, and on the sources of knowledge the children have available from the school instruction they have received.

The foregoing examination of the evidence on the relation between novice readers' development of reading and spelling skills suggests that issues raised by the discrepancy hypothesis remain open. The characteristics of words with discrepant reading and spelling performance need further study. Further, the findings we have discussed lead us to question Bryant and Bradley's (1980) view that the occurrence of words that can be spelled yet not read reflects an intrinsic bias on the part of novice readers to adopt discrepant strategies for reading and spelling. Although the potential influence of instruction on the incidence of words spelled but not read was discounted by Bryant and Bradley (1980), in part because the children they studied had received eclectic 'mixed' teaching (both phonics and 'look and say'), other studies have shown that focused instruction can influence several aspects of reading and spelling activities (Barr, 1975; Connelly, Johnston & Thompson, 1999, Elder, 1971; Johnston & Thompson, 1989; Lesgold, Resnick & Hammond, 1985; Sowden & Stevenson, 1994).

The aim of this study was to investigate the coordination of reading and spelling abilities in children at two different stages of acquiring literacy, using controlled materials manifesting a variety of spelling patterns. The data are based on reading and spelling responses to an extensive sample of age-appropriate words spanning a range of difficulty. Nonwords were also included in the test materials to obtain an independent measure of decoding skill and to permit further control of structural factors that may influence reading and spelling accuracy. In addition to possible effects of phonological complexity, the inconsistencies of orthographic mapping may affect the occurrence of discrepancy between reading and spelling performance. Given a reader/speller with only partial knowledge of English orthography, we could expect (following Bosman & Van Orden, 1997) that word spellings that present the greatest number of possible phonologic realizations should turn up among the words that are most commonly misread whereas phonologic patterns that have the greatest numbers of spelling possibilities should be misspelled most often. We conducted an exploratory analysis to investigate this issue.

In evaluating our findings, we have exploited information about the characteristics of children studied in different localities to look for clues regarding the influence of the kind of reading instruction children have had on performance with comparable materials. To complement what has been learned with children receiving 'mixed' (e.g., Bryant & Bradley, 1980) or 'book experience' (Thompson et al., 1996) instruction, we selected children whose literacy instruction was dominated by a strong 'phonics' component. Our study examines children's responses at two levels of reading experience: beginners mid-way through first grade, and second graders with an additional year of instruction and experience behind them.

Method

Participants

The children were from first- and second-year classes (Grades 1 and 2) in a school with a phonics emphasis, located in a working class area of southern New England, USA. They were tested midway through the school year. Hence, the Grade 1 children were still beginning readers, and the Grade 2 children were a year beyond them in reading and writing experience. The sample consisted of 13 children (6 girls, 7 boys) from Grade 1, and 15 children (10 girls, 5 boys) from Grade 2. The mean chronological age (CA) for the Grade 1 children was 6.45 years ($SD = 0.34$) and for Grade 2 it was 7.43 years ($SD = 0.27$).

Measures

Peabody Picture Vocabulary Scale – Revised Form M (PPVT; Dunn & Dunn, 1981). The Peabody Picture Vocabulary Test is a standard test of receptive vocabulary; it consists of a test booklet with four pictures on each page. The child is asked to point to the picture of a word that is said orally.

Wide Range Achievement Test – 3 (WRAT3; Wilkinson, 1993). The Wide Range Achievement Test – 3 (WRAT3) is a word reading test in which the child is asked to read isolated words of increasing difficulty to a criterion of 10 consecutive errors. Only the TAN form was used. Both the standard score and the number of items correct were calculated. The latter was used for the correlation analysis.

Phonological awareness (Rosner Test of Auditory Analysis; Rosner, 1975). The Rosner Test of Auditory Analysis (RTAA) is a syllable and phonemic awareness deletion task in which the child is presented with two practice items followed by 13 test items. The practice items and the first three test items require syllable deletion (e.g., "Say cowboy without the boy"); the next three items require initial phoneme deletion (e.g., "Say coat without the /k/"); followed by three items requiring final phoneme deletion (e.g., "Say game without the /m/"), two items requiring the initial phoneme in a consonant cluster to be deleted (e.g., "Say clap without the /k/"), and two items requiring the second phoneme of the cluster to be deleted (e.g., "Say stale without the /t/"). The procedure recommended by Rosner is to discontinue testing after two consecutive errors, but we chose to give all the children the entire set of 13 items in order to maximize the reliability of the measure. Thus, the scores we give in Table 1 (and used for the correlation analyses) are the percent

Table 1. Age-adjusted standard scores (SS) for vocabulary and word reading, and percent (%) correct for phoneme awareness, decoding and the experimental reading/spelling lists (SDs in parentheses).

Measures	Grade 1	Grade 2
PPVT	102 (15)	106 (11)
WRAT3	106 (10)	111 (10)
Phoneme awareness	52 (26)	75 (17)
Decoding	12 (13)	62 (22)
List 1 read	55 (25)	96 (6)
List 1 spell	43 (20)	94 (9)
List 2 read	32 (25)	88 (14)
List 2 spell	43 (14)	80 (8)
List 3 read	33 (23)	84 (15)
List 3 spell	33 (22)	76 (13)
List 4 read	N/A	87 (17)
List 4 spell	N/A	72 (17)

correct based on the 13 items. Scores using the stop rule were also calculated to permit us to relate the children's performance to the established norms.

Decoding Skills Tests (Phonic Patterns; Richardson & DiBenedetto, 1986). Only the nonword portion of the Decoding Skills Test (DST) was administered. It consists of two parts: Part 1 comprises 30 monosyllabic nonwords and Part 2 consists of 30 polysyllabic nonwords. Testing is discontinued after 10 consecutive errors. The child is told, "I am going to show you some funny-looking words. They sound like real words, but they are not real words because they don't mean anything. They are nonsense words and you have probably never seen any of them before. You can read these words only if you sound them out. Remember, do not try to make them into real words."

Nonword tasks (Thompson, Cottrell & Fletcher-Flinn, 1996). These tasks followed the method and procedure described by Thompson et al. (1996). The same test materials were used. Twenty-four two-grapheme nonwords were constructed from four vowel letters, *i*, *a*, *o*, *u*, and four consonant graphemes *t*, *m*, *b*, *th* in initial position: *ta*, *ti*, *tu*, *mi*, *mo*, *mu*, *ba*, *bo*, *bu*, *tha*, *thi*, *tho*; and in final position: *et*, *ot*, *ut*, *im*, *om*, *um*, *eb*, *ib*, *ob*, *eth*, *ith*, *uth*. Each grapheme (including *th* and the vowel letters) was printed on a separate card. Items were constructed with these letter cards, as the child observed. The items presented for reading were grouped in presentation sequences by common vowel letter, in blocks of three items. Each block was preceded by two demonstration items constructed from the same vowel letters and the two graphemes, *k* and *z*, in initial position: *ka, za*; *ki, zi*; *ko, zo*; *ku, zu*; and in final position: *ek, ez*; *ik, iz; ok, oz*; *uk, uz*. Each demonstration item was pronounced by the experimenter and the child was required to imitate, with correction provided if necessary. The demonstration items provided the child with a pronunciation for the vowel letter which was common to the block of items that followed. The nonword items for spelling completion were parallel to those for reading. The stimulus items were presented auditorily, e.g., "bo", "ob". The child was asked to repeat each item, with correction if necessary, and then to find the correct consonant card to complete the presented print display consisting of a vowel letter preceded or followed by a blank, e.g., *_o, o_*. The array of graphemes to choose from for the spelling completion task was: *t, m, b, th, k, z, y, a, e, o*.

The presentation of the reading and spelling nonword tasks was counterbalanced across participants, as was the presentation of blocks of items with initial or final consonant graphemes. The order of items was randomized for each participant within blocks, and the order of blocks was also individually randomized. Scoring for reading was based only on the correct pronunciation of the consonant grapheme, irrespective of the pronunciation for the vowel. Lexicalizations were scored as incorrect. For spelling, the correct grapheme card had to be chosen from the array of presented graphemes.

Experimental word lists. Test words were organized into four lists (See Appendix); Grade 1 children did not receive List 4. List 1 consisted of the 30 words used by Bradley & Bryant (1980). These words are all high frequency with some regular and some irregular spellings. List 2 comprised 31 words, 26 with pronounced consonant clusters, divided between initial and final position. List 3 comprised 30 words. Fifteen words had nasal/liquid clusters occurring in final position, ending in a voiced or voiceless stop consonant. The remaining 15 items were CVC monosyllables. List 4 comprised 39 words; most were of high or medium-high frequency, and nearly all were monosyllabic. These words presented more phonological and spelling complexities, on the whole, than the words in the preceding lists. They included words with initial or final clusters, nasals and liquids plus lateral-[r], examples of vowel digraphs, including some with unusual vowel spellings (such as bear, bread, plus control words for the latter: bed, bled), flapped intervocalic alveolar consonants with variable spellings (rider, writer, bottle, water: these medial consonants are phonetically [d] in most American dialects), past-tense morphemes with (largely predictable) phonetic variation (wanted, pulled, pushed), plural morphemes realized as phonetic [z] (sees, races), plurals realized as phonetic [s] (cakes, helps), instances of vowel + final e spellings (lame).

Procedure

The children were administered phonemic awareness, word, and nonword reading tests individually in a quiet room in their school. Standard administration and scoring procedures were followed for all published tests. Following these they received the nonword reading and spelling tasks using the materials and procedure of Thompson et al. (1996). The reading and spelling conditions were counterbalanced with a median duration of 3 days intervening (Range 2–7 days). Then, the children were asked to read the experimental word lists, beginning with List 1, followed by List 2, List 3, and List 4, each on a separate day (the Grade 1 children were not given List 4 because these items were considered too difficult). Approximately 10 to 13 days later, the children were asked to spell the words in each list in the same order as when they read the words, one list per day. The children in Grade 1 spelled the first half of the list in the morning and the second half in the afternoon as the teacher thought they would have difficulty doing the entire list at one time. The lists were not divided up for the children in Grade 2, and they spelt each word list in one session per day. The spelling sessions were conducted by the classroom teachers. The teachers had been rehearsed in the procedure: Each word was said orally, then said in a sentence context, and then repeated orally again. The children printed their spelling responses, one word to a line. In the reading condition, the children were strongly encouraged to attempt each word, feeling free to guess if unsure. For spelling, they were encouraged to spell each word the best way they could even though they might feel unsure of the standard spelling. With the exception of the spelling task, all tasks were administered by the first author.

Results

Means and standard deviations for all tasks are given in Table 1. As may be seen from the standard scores, listening vocabulary (PPVT) and word reading (WRAT3) were well within the average range for both groups of children. The Grade 1 children were on grade level for phoneme awareness (Rosner, 1975) and for nonword decoding skills (Richardson & DiBenedetto, 1986). The children in Grade 2, although slightly below their grade level in phonemic awareness, obtained decoding scores in the range obtained in other studies

Table 2. Mean percentage of words in the four possible response categories for each word list for Grade 1 and Grade 2.

Word lists	Words read and spelled (+R+S)	Words neither read nor spelled (–R–S)	Words read but not spelled (+R–S)	Words not read but spelled (–R+S)
List 1 (30 words)				
Grade 1	34	37	21	8
Grade 2	91	1	5	3
List 2 (31 words)				
Grade 1	20	44	12	23
Grade 2	74	6	14	6
List 3 (30 words)				
Grade 1	21	56	12	12
Grade 2	69	9	15	7
List 4 (39 words)				
Grade 1	N/A	N/A	N/A	N/A
Grade 2	67	8	20	5

with nonimpaired readers making normal progress (Kochnower, Richardson & DiBenedetto, 1983; Richardson, personal communication).

Experimental word lists

For the children in Grade 2, a mean of 89 percent of the 130 words were read correctly. This exceeded children's spelling performance, which yielded a mean of 80 percent. This level of performance shows that by mid-second grade, these children were reading and spelling basic words with fairly high accuracy. Where discrepancies occurred, most, but not all, of the errors were in spelling. For the less-experienced Grade 1 children, reading and spelling these words posed a greater challenge, as expected. The percent of words correctly read (out of the total 91 words they received) and those correctly spelled was equal at 40 percent for both, with some variation on the individual lists, as we note in the following paragraphs. Table 2 shows the distribution for each group of responses among the four possible reading/spelling outcomes for the words in each list. Turning first to the discrepant responses, words spelled but not read (–R+S) and words read but not spelled (+R–S) each averaged 15 percent of the words presented to Grade 1 children. For

Grade 2 children, those spelled but not read were 5 percent of the total (130), whereas words read but not spelled were more numerous, accounting for 14 percent of the total.

We now report the findings for the individual lists (Table 2), focusing on the Grade 1 children where reading-spelling differences could be considered most telling. For the Bryant and Bradley (1980) words (List 1), more words were read than spelled correctly ($F(1,12) = 23.97$, $MSE = 3.55$, $p < 0.001$). Of these, the words most frequently read correctly but not spelled were: cut, pen, from, milk (none of these were among those cited by Bryant and Bradley, 1980). Those most frequently spelled but not read were: ran, bag, bun (only the last was cited by them). Words of List 2 ($N = 31$), many of them containing consonant clusters involving stop consonants, such as step and pets, were difficult for these children. More of these words were spelled than read ($F(1,12) = 5.56$, $MSE = 14.64$, $p < 0.04$). Of the total number of reading errors (274), the largest proportion involved substitution of another real word (49%). Nonword responses (19%) and refusals to respond (31%) accounted for the remainder. Large numbers of refusals were encountered from only two children; with these children eliminated the revised percentages were: real word substitutions (59%), nonwords (23%), and refusals (18%). The initial phoneme, whether it was a singleton initial consonant or the first segment of a consonant cluster at the beginning of a word, was usually represented; it was omitted in 19% of cases. In contrast, interior segments of consonant clusters were frequently omitted, accounting for 36% of cases. Final consonants, whether singletons or part of a consonant cluster at the end of a word, were omitted in 35% of cases. Vowels were misread on 24% of words, accounting for 19% of errors when the consonant cluster was correct. The level of performance was similar on List 3, which contained many nasal/liquid clusters, and on these each discrepancy occurred with the same frequency. Performance levels on Lists 2 and 3 are lower than on List 1, probably because of the greater phonologic complexity of many of the stimulus items.

Although Lists 2–4 were constructed to provide words which vary in phonological complexity, we note that only the List 1 words from Bradley and Bryant (1980) are exclusively high frequency. Examination of the stimuli using an age-appropriate word count (American Heritage) confirmed that List 1 words had a greater mean printed word frequency than the other word lists. Thus, a question might arise about the possible contribution of frequency of the test words to the pattern of reading and spelling discrepancies. If early in the acquisition process children read visually (holistically) and spell phonologically, we would expect the higher frequencies of these words to reveal an asymmetry that favors reading over spelling because words that have been seen many times presumably would be more likely to be recognizable as

Table 3. Mean percentage of correct responses to consonants in each position of nonwords on reading and spelling for the Grade 1 children (phonics) and the Thompson, Cottrell, and Fletcher-Flinn nonphonics sample.

	Phonics		Nonphonics	
	Initial position	Final position	Initial position	Final position
Reading				
t	87	80	68	49
m	85	82	74	42
b	67	51	74	26
th	39	46	57	22
Spelling				
t	97	97	86	79
m	100	100	92	90
b	100	97	90	82
th	54	54	67	56

global visual patterns than words seen rarely. The results for List 1 words for Grade 1 children seem consistent with this line of reasoning: 21% of the words were read but not spelled (+R–S) compared to only 8% spelled but not read (–R+S). To check systematically whether differences in frequency could account for the obtained discrepancy effects, we correlated frequency of occurrence in the word count with the number of instances for each word in which children produced +R–S and –R+S discrepancies. Frequency did not correlate significantly with either discrepancy direction, either within or across lists (all r $< +/- 0.20$, $p > 0.15$), indicating that the frequency variable did not contribute to observed discrepancy patterns. In a following section, we consider whether other variables, those related to consistency of the mapping between orthography and phonology may relate to the discrepancy patterns.

Nonwords

Results for the reading and spelling completion of the consonant graphemes of the nonwords are reported only for Grade 1, as the children in Grade 2 were at ceiling on this task. The stimuli were so constructed that each consonant occurred equally often in initial and final positions of the nonwords. The mean percentages of correct responses to initial and final positions for the reading and spelling conditions are shown in Table 3. An analysis of variance with two within-subjects factors (position and graphemes) was applied to the

Table 4. Correlations between reading and spelling scores for Grade 1.

	Decoding	WRAT3	Nonword-r	Nonword-sp	List-r	List-sp
Phonemic awareness	0.67*	0.64*	0.80**	0.64*	0.68*	0.74**
Decoding	—	0.85**	0.66*	0.68*	0.84**	0.82**
WRAT3		—	0.82**	0.73**	0.91**	0.91**
Nonword-read			—	0.75**	0.81**	0.81**
Nonword-spell				—	0.79**	0.79**
List words-read					—	0.95**

**$p < 0.01$ (2-tailed).
*$p < 0.05$ level (2-tailed).

reading and spelling data separately. For reading, there was a significant main effect of graphemes, $F(3,36) = 8.40$, $MSE = 1.12$, $p < 0.001$, but no main effect for position nor any interaction, $F < 1.0$. Accuracy of pronouncing *t* and *m*, in either position, was high compared with *b* and *th*, $F(1,25) = 18.51$, $MSE = 24.038$, $p < 0.001$. Accuracy for *th* was particularly low, which is not surprising as the Grade 1 teacher confirmed that she had not yet introduced this digraph in the children's lessons. Confusions with the graphemes *d* or *p* made up 15% of responses to all initial *b* items presented, and 28% of the final *b* items presented. There was a low incidence of refusal (don't know responses). The ANOVA for the spelling completion was similar to the reading condition, there was a main effect of graphemes, $F(3,36) = 10.07$, $MSE = 1.17$, $p = 0.001$, but no effect of position or position x grapheme interaction, $F < 1$.

For spelling completion, it is noteworthy that accuracy on all graphemes, in either position, is at ceiling except for *th*. Thus, unlike the situation with real words, spelling performance on these nonword items is higher than performance in reading. This is especially notable for *b* where the average accuracy rate over positions is 99% for spelling, but only 59% for reading.

Interrelations among the measures

Tables 4 and 5 show the bivariate correlations among the various measures for children of Grades 1 and 2, separately. From Table 4, giving the results for Grade 1, it is apparent that all the correlations are large and significant. Thus, the baseline reading measure (WRAT3) is significantly correlated with items read and spelled correctly on the experimental word lists, and with decoding and spelling nonwords. Reading and spelling of list words and nonwords are each intercorrelated about 0.80. For this sample of children, then, even

Table 5. Correlations between reading and spelling scores for Grade 2.

	Decoding	WRAT3	List-r	List-sp
Phonemic awareness	0.73**	0.86**	0.75**	0.63*
Decoding	—	0.79**	0.81**	0.67**
WRAT3		—	0.93**	0.83**
List words-read			—	0.84**

**Significant at the 0.01 level (2-tailed).
*Significant at the 0.05 level (2-tailed).

the youngest (those in Grade 1) showed a considerable degree of integration of their orthographic knowledge. The corresponding results for Grade 2 are displayed in Table 5. On the whole, the degree of integration of reading and spelling skills was even stronger for the Grade 2 children across the measures.

Relating reading/spelling discrepancies to word mapping consistency

Many studies have shown that words with multivalent or "inconsistent" orthographic-to-phonologic (O-P) mappings produce slower naming latencies and more errors relative to words with consistent O-P mappings, both with skilled readers (Glushko, 1979; Jared, Seidenberg & McRae, 1990; Taraban & McClelland, 1987) and novice readers (Zinna, Liberman & Shankweiler, 1986). As we mentioned earlier, phonologic-to-orthographic (P-O) mappings are also highly inconsistent in English and recent research has shown that skilled readers produced slower responses and more errors to P-O inconsistent relative to P-O consistent words in word naming and lexical decision (Stone, Vanhoy & Van Orden, 1997; Ziegler, Montant & Jacobs, 1997). Based on this research and the proposals of Bosman and Van Orden (1997), we decided to explore whether words that exhibited a discrepancy between spelling and reading performance differed in terms of their mappings between orthographic and phonologic forms.

The data from Grade 1 and Grade 2 students were tabulated and analyzed separately. For each word, we calculated a discrepancy score (i.e., the number of instances in which children produced a discrepancy between their reading and spelling for each word). If the number of instances in which a word was read but not spelled correctly was greater than the number of instances in which a word was spelled but not read correctly, the item was categorized as a +R–S word; if the opposite occurred the item was categorized as a –R+S word. Words in which the number of instances in which a word was read but not spelled correctly was equal to the number of instances in which a word

Table 6. Consistency characteristics of the discrepant words for Grade 1 and Grade 2 (mean values).

Consistency variables	Grade 1		P value	Grade 2		P value
	+R–S	–R+S		+R–S	–R+S	
Number of P-O correspondences	3.19	2.51	0.07	3.51	2.80	0.12
Number of P-O enemies	5.27	2.26	0.01	8.84	2.95	0.004
P-O Consistency ratio	0.72	0.88	0.03	0.63	0.78	0.02
Number of O-P correspondences	1.38	1.49	ns	1.37	1.60	0.11
Number of O-P enemies	0.73	1.10	ns	1.20	1.30	ns
O-P Consistency ratio	0.92	0.90	ns	0.83	0.87	ns

P values of the t-tests are reported only when less than 0.20.

was spelled but read correctly were excluded from analysis. The percentages for each grade were as follows: Grade 1 (out of 91 words): +R–S = 41%; –R+S = 43%; excluded = 16%; Grade 2 (out of 130 words): +R–S = 50%; –R+S = 16%; excluded = 34%.

Our expectation was that words with highly inconsistent P-O mappings should appear most frequently among those words selectively hard to spell (+R–S words), whereas the inverse, high O-P inconsistency, should appear more among those words that were selectively difficult to read (–R+S words). In order to assess whether our data provided support for this line of reasoning, we conducted a series of exploratory analyses (t-tests), utilizing several consistency metrics for both P-O and O-P consistency as dependent measures. Mean values for the two discrepancy conditions are presented in Table 6 for Grade 1 and Grade 2, along with significance levels for each comparison.

Examination of Table 6 reveals that the results of the analyses were generally in keeping with expectations with respect to phonologic-to-orthographic consistency measures. Considering first the mean number of P-O correspondences (the number of ways to spell a word body given its pronunciation, e.g., /if/ which can be spelled *_eef*, *_eaf*, or *_ief* as in *beef*, *leaf*, and *thief* compared to /oUb/ which maps to a single spelling, *obe* as in *globe*); words with higher values on this variable should be associated with a discrepancy such that they were relatively more difficult to spell than read (i.e., higher values for +R–S than –R+S). As shown in the table, the mean values were in the expected direction for both Grade 1 and Grade 2, and the difference was marginally significant for Grade 1. Higher values on the number of P-O enemies (the number of words that share a word body that is spelled differently) should also be relatively more detrimental to spelling than reading and the exploratory analyses supported this expectation for both Grade 1 and Grade 2. Our final measure of P-O consistency is a weighted measure, calculated as the number of words that share the same word body and pronunciation as the target ("friends"), divided by sum of the number of friends and the number of P-O enemies. This ratio varies from 0 to 1, with a value of 1 indicating that a given word is completely consistent and a value of 0 indicating the word is completely inconsistent. Thus, lower values for the P-O consistency ratio should be associated with relatively more difficult spelling than reading, and the results supported this expectation for both grades as well.

Turning to orthographic-to-phonologic consistency, our expectation that greater O-P inconsistency should be associated with a discrepancy such that they were relatively more difficult to read than spell (i.e., higher values for –R+S than +R–S) was supported numerically, but not statistically. Only mean number of O-P correspondences (the number of ways to pronounce a word body given its spelling, e.g., *_int* which can be pronounced /aI/ as in *pint* or /I/ as in *mint* compared to *_ill* which maps to a single pronunciation, /Il/ as in *mill*) revealed a marginal difference for Grade 2 in the expected direction. Neither the number of O-P enemies (the number of words that share a word body that is pronounced differently) nor the O-P consistency ratio (the number of friends divided by the sum of the number of friends and number of O-P enemies) revealed any differences. The lack of a statistically significant mean difference is likely due to the low variability on these O-P consistency measures across the stimulus set (O-P enemies, M = 1.14, SD = 2.38; O-P consistency ratio, M = 0.86, SD = 0.28). Future studies that incorporate greater variability on this consistency dimension will be needed to address this issue more fully.

A final set of analyses was carried out, eliminating the middle of the distribution of reading/spelling asymmetries, to address the concerns of Gough et al. (1992) regarding the reliability of discrepancy scores. By examining only the most polarized words, one removes from consideration items that are close to the 0 point and hence likely to be unstable on retest. The results of this more stringent analysis were very similar to the findings based on the more inclusive procedure described above. Numerically, the mean differences changed very little, and, similarly, the F values did not change very much. In view of this, we report only the former analyses for the sake of greater statistical power. Overall, these exploratory probes support the idea that patterns of reading and spelling performance in learners at relatively early stages are influenced by the direction of consistency mapping relations, as we expected based on the account of Bosman and Van Orden (1997) and has been shown for more experienced reader/writers (Katz & Frost, 2001).

Discussion

The findings, based on extensive, multiple comparisons, show that children's accuracy of reading and spelling the same words and nonwords is closely correlated even at the early stages of literacy acquisition (after about 4 months of schooling). The children who read well generally also spell well. This confirms indications of earlier research (e.g., Shankweiler & Lundquist, 1992; Shankweiler, Lundquist, Dreyer & Dickinson, 1996; Treiman, 1993). Nonetheless, our results are also consistent with others (Bryant & Bradley, 1980; Gough et al., 1992) in confirming that among first graders there are appreciable occurrences of words that are spelled correctly but not read (–R+S). Such occurrences are notably less frequent in second grade. By then, reading and spelling have become even more strongly connected, and discrepancies, when they occur, are more common in the opposite direction; some words can be read but not spelled correctly.

The distribution of reading/spelling responses among the four categories for the phonics-trained Grade 1 children on the same 30 words used by Bryant and Bradley (1980) was similar to that reported by them for a group of 6-year-old normally progressing readers, who had received "mixed" reading instruction. However, our results differ in that the discrepant words were, chiefly, not the same ones noted by Bryant and Bradley. This raises the possibility suggested by Gough et al. (1992) that random oscillations in performance may govern the specific words that turn up in discrepant reading/spelling responses. While we concur that a degree of instability within and between each task is characteristic of the novice learner, we consider that our findings showing reading and spelling discrepancies do capture systematic variation because the frequencies of discrepant responses vary with the characteristics of the items in a meaningful way, as is attested by the children's responses to a diversity of items. Two factors, word characteristics and instruction, seem to be influential in determining children's responses.

With regard to word characteristics, Bryant and Bradley (1980) claimed that among the children they studied irregular words were read more often than spelled (+R–S), whereas regular words predominated among those that were more often spelled than read (–R+S). Bryant and Bradley do not give a precise criterion for classifying words as regular or irregular, giving as a loose criterion of regularity words whose *pronunciation* is well specified by simple grapheme – phoneme – phoneme rules, and taking as irregular words that violate these rules. By this criterion, there is nothing obviously irregular about the words that Bryant and Bradley list as most frequently occurring in the read but not spelled (+R–S) class. Indeed, when we classified the set of 30 items from Bryant and Bradley (1980; Experiment 2) as regular or irregular according to the grapheme-phoneme conversion rules compiled by Coltheart and Rastle (1994), only 4 of them were irregular. What the spellings of *school, light, train, and egg* most apparently have in common are consonant combinations (two of these items, *train* and *school*, are also phonologically complex). Also, in contrast to Bryant and Bradley, our Grade 1 children found some short, regular words, *cut* and *pen*, easy to read but difficult to spell.

Various definitions of regularity have been proposed, based on assumptions (not always explicit) about spelling rules. Indeed, the practice of categorically classifying words for research purposes as regular or irregular has come under criticism in recent years (Jared, McRae & Seidenberg, 1990; Plaut, McClelland, Seidenberg & Patterson, 1996). An alternative approach examines whether reading and spelling behavior more accurately reflect continuous variation in the consistency of mapping between words' phonology and their spellings. It can be expected that words with relatively less consistent mappings, hence greater ambiguity in bi-directional sound-spelling relations, would tend to be more difficult to learn to read or to spell than those with relatively consistent mappings. Also, as we noted, mapping may be more variable in one direction than the other. Intuitively, words with high pronunciation to spelling ambiguity (P-O) should be selectively difficult to spell, whereas words exhibiting the opposite ambiguity (O-P) should be selectively difficult to read. We examined our children's discrepancy responses in relation to the consistency characteristics of our test materials for evidence for such effects. The analyses showed that words with high P-O inconsistency values do tend to be selectively hard to spell. In a similar vein, Katz and Frost (2001) find evidence of effects of mapping inconsistencies in adult spelling behavior. In experiments involving judgments of spelling acceptability, they found the greatest proportion of errors and the most unstable spelling judgments on words with highly multivalent sound-to-letter (P-O) relationships (as is the case in many words containing doubled consonants and short vowels rendered as schwa).

Phonological complexity of the test words could also be expected to influence children's reading and spelling success. One kind of complexity that is common in English, consonant clusters, is heavily represented in our Lists 2 and 3. Like Bryant and Bradley's subjects, our Grade 1 children found words containing clusters difficult. However, in contrast to Bryant and Bradley, our sample of Grade 1 children was able to spell more of these words than they could read. The error analysis based on the 31 words in List 2 showed that most errors in reading (81%) preserved the initial consonant whether or not that consonant was part of a consonant cluster. In contrast, the interior segments of consonant clusters were frequently omitted (35% of errors), confirming an earlier finding by one of us (Shankweiler &

Lundquist, 1992) and by Treiman (1991). We maintain that these errors are better viewed as unsuccessful attempts to decode print phonemically than as visual errors. Thus, they represent not a general tendency on the children's part to read holistically, but errors of simplification, reflecting difficulties in reading analytically when words are difficult to parse into phoneme segments. Cluster words may be more challenging to children's phoneme segmentation abilities than single CVC words because breaking a cluster requires a more advanced level of phoneme awareness (Treiman, 1991).

By Grade 2 the phenomenon of words spelled but not read correctly is much reduced, with words consistently read more frequently than spelled across all lists (+R–S), and with only an average of 5% of the words spelled but not read (–R+S). The percentage in this latter category varies across the word lists, with the highest proportion in List 4, which contains words of lower frequency. Our results with the older (Grade 2) children, in keeping with age effects noted by Bryant and Bradley, show that with a second year of school experience and phonics instruction, most children have consolidated their knowledge of orthographic mapping across reading and spelling activities. However, there is nothing in the data to suggest that the improvement from Grade 1 to Grade 2 is a result of a global strategy shift in how children approach the task of reading. Indeed, the responses of our younger children, who were given instruction in reading and spelling that emphasizes phoneme awareness and explicit letter-sound knowledge, lead us to infer that they used their phonological abilities consistently for both activities. But, being beginners, they had only partly mastered the links between spelling and phonemic structure, so their reading and spelling were each somewhat error prone, even for the most basic CV or VC nonwords. In learning to read, children are likely to exploit all alphabetic knowledge (both explicit and implicit forms) available to them from instruction and from print experience. In reading the two-grapheme nonwords, the phonics-taught Grade 1 children showed the same overall mean level of accuracy (69.5%) for graphemes in initial position as the New Zealand sample (68.5%). However, this nonphonics sample showed lower accuracy for final position graphemes, especially *b* and *th*, which reflected the positional frequency of occurance of these graphemes in their print vocabulary experience. Without explicit phonics instruction, this would be expected, if their alphabetic knowledge derived largely from induced sublexical relations in a mechanism of implicit lexicalized recoding, (Fletcher-Flinn & Thompson, 2004).

Instructional differences, then, is the other factor that seems to influence the relation between early reading and spelling. It must be appreciated that the present findings are not based on a controlled comparison of types of instruction, but on inferences based on a comparison of results of separate studies in which we can take advantage of the existence of different regional teaching practices. Although Bryant and Bradley tended to discount a role for instructional effects, conjecturing that children inherently prefer to adopt holistic reading strategies initially, they nonetheless presented evidence for children's sensitivity to context created by neighboring items: Their children could be led to adopt a phonological strategy by embedding the words previously spelled but not read (–R+S) in a list containing nonwords. This resulted in the children then being able to read many of them, presumably because the presence of nonwords in the list elicited an analytic decoding strategy. This sort of evidence of children's plasticity in their approach to word reading led us to anticipate instructional differences. We expected that the children in our sample would adopt an analytic approach to reading – the use of taught letter-sound correspondences, because that was the main instructional approach of their teachers. Our findings with nonwords indicate that this is, in fact, what they did.

The findings with nonwords are based on a comparison of the phonics-trained American children of the present study with children from New Zealand (Thompson et al., 1996) who were taught by a 'book experience' approach with no explicit phonics teaching. The results we obtained for reading the Thompson et al. nonwords are clearly at variance with those of the New Zealand children studied by Thompson et al., in that the phonics-trained children's responses showed no positional asymmetries for the target graphemes. This difference in outcome was to be expected because, in addition to their use of any induction of distributional properties of the orthography, the phonics-trained children would have been able to use their knowledge of explicitly-taught (positionally independent) grapheme-phoneme correspondences to generate responses. This source of knowledge was not available to the children studied by Thompson et al., who did not receive explicit phonics instruction. The absence of a difference in accuracy on initial and final letters in the present study, in contrast to the New Zealand children's results, is evident even for the grapheme *b*, which, among the items tested, had the largest positional asymmetry. In other respects, the two groups of children behaved similarly. For example, in the present study the incidence of confusions of *b* with the graphemes *d* and *p* in final position (28%) almost exactly matches the percentage obtained by Thompson et al. (26%). But, again, only the latter children showed an influence of position: They made a negligible number of these errors when *b* was in initial position (4%), compared with the 15% shown by the phonics-trained children.

In addition, there is evidence that some of the phonics-trained Grade 1 children in the present study were able to induce a sublexical relation for the *th* digraph. Despite *th* not yet having been taught in the curriculum, there was a fairly high degree of success in rendering this digraph (mean 42.5%) combining over positions, which was close to the New Zealand children's results (mean 39.5%). However, unlike these children without phonics, the children in the present study showed no effect of position. Accuracy on reading *th* was positively correlated with phoneme awareness ($rp = 0.83$, $p < 0.001$) and nonword decoding ($rp = 0.67$, $p < 0.02$), and word recognition ($rp = 0.71$, $p < 0.006$). Thus, the children who were most successful in generating reading responses to *th* were also best at using the analytic skills associated with explicit phonological decoding as well as word reading. Although there is general dispute about the relationship between explicit and implicit memory systems (Krashen, 1992), it may be that with regard to reading, phonics instruction results in the storage of letter-sound associations from which is formed a general implicit principle that sounds for letters are the same irrespective of position. This principle then has a direct impact on the formation of induced sublexical relations at this early level.

Although the findings just discussed give grounds for inferring differential effects of the mode of instruction on nonword reading, it is noteworthy that in the results of the present study, as in those of Thompson et al. (1996), spelling performance was higher than reading performance for all consonants. Thus, we concur with Bradley and Bryant (1979) and Thompson et al. (1996) and Thompson et al. (1999) that for beginners, knowledge gained in the context of spelling does not necessarily transfer to reading. Is it because, as Bryant and Bradley (1980) maintained, children at this age are predisposed to use incompatible strategies for reading and spelling? Our findings do not support this conjecture. One can accept the validity of Bradley and Bryant's contention that reading and spelling are not fully integrated in many beginning reader/writers without embracing the idea that children's early attempts to spell are phonological and their early attempts to read are nonphonological.

As we noted, it has generally been assumed that of the two activities spelling is ordinarily the more difficult because it requires production of a structure, whereas reading, in principle, only requires recognition, and that, in English, the mapping of phonology on to the orthography is more variable than the reverse mapping of orthography to pronunciation. Indeed, among the older, more experienced, Grade 2 children, spelling discrepancies, words correctly read but misspelled, were consistently more numerous than the converse reading discrepancies. Variability in the direction of reading discrepancy is more characteristic of the younger, less experienced Grade 1 children.

For these children, there arise situations, as with consonant graphemes of nonwords in the present study, where reading is the more difficult task. The most likely reason for the spelling advantage for nonwords in our study is the greater multivalence (hence ambiguity) for nonword reading, compared with spelling completion in which the letter responses all belong to a limited set that is readily available to the child. In addition, the spelling completion task requires phonemic segmentation, but unlike reading, it does not require synthesis (blending). Considering some of the errors on the nonword task, this aspect of explicit phonological recoding may be a major hurdle for beginning readers.

In stressing the differences in the *activity* of reading and spelling, the discrepancy hypothesis has stimulated questions about how word characteristics affect users' relative success in reading and spelling. Our findings on the effects of variations in mapping consistency hold promise in this regard, more promise, we think, than queries based on binary classifications of regular/irregular words. Looking to the future, we expect that research that exploits consistency descriptors will prove useful in elucidating the sources of difficulty in learning to read and to spell the various sectors of the vocabulary. Moreover, we believe that such research can ultimately aid teachers in helping learners to negotiate the difficulties successfully.

Proponents of the discrepancy hypothesis make a convincing case for the importance of studying the development of reading and spelling in a coordinated way. Moreover, their claims are partly right. The hypothesis is correct in emphasizing that beginning reader/writers generally lack a full degree of integration of phonology with its representation by the orthography. **Consequently, reading and spelling may not be in perfect synchrony during** early acquisition, even though each may draw upon the same knowledge base. Moreover, it is conceivable that reading may lend itself to a greater variety of knowledge sources and procedures than spelling. Spelling, on the other hand, seems to require a segmental approach by the very fact that to write a word one must produce the letters individually, one letter at a time. Like Bryant and Bradley (1980) we would stress the central importance of grasping the alphabetic principle underlying the orthography both for learning to read and to spell, but, unlike them and other proponents of the discrepancy hypothesis, we do not find that novice learners are initially unable or unwilling to apply their phonological and alphabetic knowledge (whether explicit or implicit) to reading. The present findings challenge the contention that a holistic word recognition strategy is necessarily preferred at any stage of reading acquisition, irrespective of the instructional context.

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Appendix

List 1.

tree	milk	egg	book	see
cut	mat	in	school	sit
frog	bun	ran	out	bag
ten	pat	clock	train	light
leg	dot	pen	yet	think
dream	crowd	week	keep	from

List 2.

drip	crash	slip	smile	snap
spill	step	trap	chip	skid
scot	stare	stall	stop	still
bird	shark	pills	limes	pans
lips	pets	part	pitch	disk
task	rest	lost	post	list
lisp				

List 3.

sent	bent	sink	wink	lamp
limp	built	bolt	cart	pert
send	bend	sing	wing	lamb
limb	build	bold	card	purred
set	bet	sick	wick	lap
lip	bit	boat	cat	pet

List 4.

bread	bled	matches	fright	slap
sled	snail	roared	cakes	fits
helps	rest	pulled	led	water
sees	nail	nap	metal	rushes
lame	lap	rain	races	rider
writer	pushed	fight	light	flight
right	gives	bear	wanted	bed
red	toes	bottle	cane	

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