Abstract

***This exploratory study examined the relationship between stages of orthographic development (Henderson, 1990) and writing fluency. It was hypothesized that subjects in the beginning stages of orthographic development would copy less fluently than subjects at more advanced levels of orthographic development and reading acheivment. Forty-one first- through third- graders copied seperately four nonsense sentences: two sentences used a legal orthography, two used illegal letter strings. A standardized reading achievement test and a 20-word developmental spelling inventory were administered. Based on the results of the spelling inventory, subjects were placed in one of two stages of developmental word knowledge. Reading achievement and spelling performance predicted copying speeds, and copying speeds prompted significant, increasing linear trends across the two groups of word knowledge. The beginning readers and spellers approached the orthography in a linear fashion, and tended to copy in smaller units, often copying letter-by-letter. Children with a more sophisticated knowledge of words copied in larger units, and often at the whole word level. The results support the hypothesis that the graphemic output lexicon of beginning readers and writers is not sufficiently detailed to allow a fluent output.***

# Copying Fluency and Orthographic Development

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The relationship between reading and learners' theories of how words are written, learners' orthographic knowledge, has been explored in some detail recently (Ehri, 1987a, 1987b; Stanovich, 1988). A number of parallels between reading and orthographic knowledge have been observed particularly during the beginning stages of development, (Chomsky, 1970; Ferroli & Shanahan, 1987; Foorman & Liberman, 1986; Juel, 1988; Morais, Bertelseon, Cary & Alegria, 1986; Morris & Perney, 1984; Schreiber, 1980). Beginning readers have been characterized as slow, word-by-word, and disfluent readers who tend to read aloud to themselves and fingerpoint read (Bear, 1989; Clay & Imlach, 1971; Clay, 1979). Several researchers have observed that the development of reading fluency must wait on the development of orthographic awareness and word knowledge (both in terms of the depth of the lexicon and the automaticity in recognition) (Bear, in press; Brown, 1981; Freud, 1891/1953; Perfetti, 1985; Schreiber, 1980.)

In a number of studies, spelling development, as a measure of orthographic knowledge was related to reading development (Bear, in press; Bear & Barone, 1989; Beers, 1980; Ehri, Wilce & Taylor, 1988; Gill, in press; Henderson, 1981, 1990; Invernizzi, 1985; Mann, Tobin & Wilson, 1988; Morris, 1981; Zutell & Rasinski, 1989). Most of these studies have drawn on the spelling stages formulated by Henderson. Six stages of spelling development have been described (Henderson, 1981). The developmental sequence of the first four stages is evident in the invented spelling of *sick* and *soap:*

| **Stages:** | *sick:* | *soap:* |
|---|---|---|
| Preliterate | 34ndm | />2)dl |
| Prephonetic | s, sk | s, sp |
| Letter Name | sek | sop |
| Within Word Pattern | sik, sick | sope, soap |

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The final two stages involve syllable combinations and roots, and have been labeled, therefore, as the Syllable Juncture and Derivational Constancy stages. For a detailed description of these stages, see Templeton and Bear (in press). Of the six stages, the Prephonetic and the Letter Name stages have been most closely related to beginning reading. In terms of a reading and writing connection, Bear (1989) found that the movement from Letter Name spelling to Within Word Pattern spelling paralleled the movement from disfluent to more fluent reading. Children in Prephonetic and Letter Name stages of spelling were disfluent oral readers, even with a familiar text.

A potentially important relationship has not been examined, however, and this is the relationship between handwriting speed and orthographic awareness. If a common developmental pattern were found, a simple or integrated view of literacy development would be supported theoretically (Bear, in press; Juel, 1988); and pedagogically, this finding would be useful to teachers in diagnoses and for gauging writing production in a designated period of instruction. If, indeed, a developmental pattern were found, it would suggest that the verbal planning prerequisite to a coherent written production may be constrained in part by the writer's orthographic knowledge (cf. Barone, 1989; Deese, 1980).

Recently, Bradley (1983) examined the relationship between copying speed and accuracy, and reading ability. In this study, 62 disabled readers were matched with two groups: 30 younger normal readers at the same reading level, and 30 normal readers matched for chronological age. Disabled readers were significantly slower in copying than the normal readers, and like the younger normal readers matched for reading ability, they copied in a letter-by-letter fashion. While the longitudinal nature of the study is unclear, Bradley observed that, over time, the younger readers (6-year-olds) began to copy in larger units, but that the backward readers (9-year-olds) continued to use a letter-by-letter strategy. Bradley concluded the discussion of copying by attributing the disabled readers' difficulties in copying to an "inability to organize their written copy into meaningful, spatially distinct units" (Bradley, 1983:252). While subjects were matched on the basis of reading scores, Bradley did not study word knowledge qualitatively, that is, in terms of orthographic development. It is possible that what is considered a "spatially distinct unit" can be described explicitly by examining devel-

opmental stages of word knowledge.Other researchers have examined writing fluency and, occa- sionally, beginning writers have been described as disfluent or word-by-word writers and copiers (Dyson, 1985; Graves, 1983) who, like disfluent beginning readers, are constrained by word knowledge and orthographic knowledge (Luria, 1980).

The neuro-biological foundations of handwriting and reading appear to be similar in several respects. In terms of an information processing model, research in handwriting suggests that there is a linear as well as a parallel structure (Van Galen, Meulenbroek, & Hylkema, 1986). Writing movements work from a base of phoneme-grapheme correspondences at the same time that higher level processing takes place; e.g., syntactic or semantic levels of processing. Within each language system, the information has to be stored and held in waiting order until the motor output is completed. Researchers have suggested that a graphemic buffer may hold information from either a phoneme-grapheme conversion mechanism or from a graphemic output lexicon. The graphemic buffer allows processing time for integrating information and consequent output through either a letter name conversion mechanism for oral spelling or an allographic, or algorithmic conversion mechanism for written spelling (Caramazza, Miceli, Giampiero, & Romani, 1987). From a developmental perspective, Simner (1986) has observed a relationship between early reading achievement and writing form accuracy. Timing is an important factor in motor programming, and developmentally, it would seem that fluency would be affected by the writer's ability to "chunk at higher levels" (Huey, 1908/1968). It is clear from eye movement research that visual processing is related to reading achievement (Levin & Addis, 1979).

The study reported in this paper examined the relationship between writing production and copying fluency of orthographically legal and illegal "sentences," reading achievement, and orthographic knowledge as observed in invented spellings. The aim was to explore the possible parallels between reading and orthographic development observed in previous research with the inclusion of copying fluency. Assuming that writing, like reading, is a motor activity which is supported by both a phonological and graphemic output lexicon, it was hypothesized that the developmental stage of word knowledge, as reflected in spelling, could predict relative fluency in copying. Specifically, it was hypothesized that children in the early

stages of spelling developmental would be more disfluent in copying that students in the more advanced stages of spelling.

## Method

*Subjects*

The sample was comprised of 43 subjects as follows: 19 subjects were able readers in a multigrade classroom covering first through third grade; 24 subjects were disabled readers achieving between a first- and third-grade level, and enrolled in a summer tutorial program. Ages ranged from 6 years, 11 months, to 9 years, 11 months (mean age = 8.24), and the mean score on the Gates-MacGinitie Reading Test (MacGinitie, 1978) was 2.60. The children in this study represent diverse academic abilities and socioeconomic backgrounds. All subjects were enrolled in a public school district in the west.

*Materials and Procedures*

All subjects participated in four copying tasks, a spelling task, and a reading achievement test. Subjects in the multigrade classroom were tested in June and subjects enrolled in the tutorial clinic were tested during the fifth week of the summer session in August.

*Copying.* To examine copying fluency and the influence of orthographic structure on copying, subjects copied two orthographically legal and two orthographically illegal nonsense "sentences." In the two legal sentences, all words were pronounceable and followed legal forms in English. The words in the illegal sentences did not follow standard orthographic rules and were unpronounceable. Sentences were on the average five words long, or 25 characters long, with two three-character words, one four-character, and one five-character word.

In watching people copy, it is difficult to determine how often a writer looks at the stimulus. Some copiers kept an eye on the stimulus while continuing to copy. In this study, a 10" x 10" board was placed between the stimulus and the subjects for the third and fourth sentences. The board was high enough to deter simultaneous reading and copying, and thus, it was easier to note when the subjects were glancing at the sentences. The board was placed to the left of right-handed children and to the right for left-handed children. A pilot study indicated that while the board facilitated the examiner's

recording, subjects' took more time to copy. Given these factors, it was predicted that copying speeds would be slower than without the board. The copying tasks were administered individually, and took about 10 minutes.

Subjects were instructed to copy as fast as possible, and they were told that they would not see real words. Subjects were given as much time as needed to copy the sentences. copying times were recorded, and scores were obtained based on the characters copied per second. The examiner made a running record of the number of characters subjects wrote between glances at the stimuli, and made anecdotal records of general copying strategies.

*Spelling inventory.* To determine a level of spelling development for each student, a 20-word spelling inventory was administered. Based on Schlagal's qualitative spelling inventory (1982), the developmental spelling inventory was designed to generate errors typical of each of the spelling stages described by Henderson (1981, 1990). The spelling list, procedures for administration, and the scoring followed Bear and Barone (1989). Subjects were tested in small groups or individually and were instructed to spell each word the best they could. The total number of words spelled correctly was tabulated.

To determine a spelling stage score, the researcher and an experienced rater conducted a spelling-by-stage assessment (Bear & Barone, 1989). The goal of this assessment was to identify each student's place on a continuum of developmental spelling knowledge in which the five stages were divided into thirds:

| | |
|---|---|
| 14 | *High* Derivational Constancy |
| 13 | *Middle* |
| 12 | *Low* |
| 11 | *High* Syllable Juncture |
| 10 | *Middle* |
| 9 | *Low* |
| 8 | *High* Within Word Pattern |
| 7 | *Middle* |
| 6 | *Low* |
| 5 | *High* Letter Name |
| 4 | *Middle* |
| 3 | *Low* |
| 2 | *High* Prephonetic/Preliterate |
| 1 | *Middle* |
| 0 | *Low* |

Students' spelling inventories were scored on a 15-point scale which placed each subject's work in either a late, middle, or early level of one of the stages of spelling. (In this sample, no subjects performed at the Preliterate stage of spelling.) For example, the Letter Name stage was divided into three stages where three represented early Letter Name, and five represented late Letter Name spelling.

Since the major hypothesis in this study was to differentiate copying speeds between beginning and more advanced stages of word knowledge, subjects were divided into two groups. Group I consisted of 20 Prephonetic and Letter Name spellers, and Group II consisted of 21 Within Word Pattern, Syllable Juncture, and Derivational Constancy spellers.

*Reading Achievement.* In small groups, subjects were administered the Gates-MacGinitie Reading Test, Levels A-C, Form 1. Subjects in the multigrade classroom took the test in June and subjects enrolled in the clinic took the test in August.

## Results

### *General Findings*

The raters' spelling-by-stage assessment were reliable, with an inter-rater reliability correlation of .92 and a correlation of .94 between the number of words spelled correctly and the spelling-by-stage assessment, (p's < .001). As can be seen in table 1, the two developmental spelling groups were closely matched for age. The intercorrelations reported in table 2 were all significant. Univariate tests of differences documented that, again, except for age, the groups were significantly different. (Up to four cases were omitted in some analyses for missing data.)

Table 1 **Descriptive Statistics**

| | Variable | Group I Mean (sd) | Group II Mean (sd) | F | (p) |
|---|---|---|---|---|---|
| 1. | Legal | .5496 (.38) | .7523 (.36) | 10.58 | (.0024) |
| 2. | Illegal | .4335 (.24) | .6455 (.31) | 9.70 | (.0035) |
| 3. | LegBoard | .4459 (.20) | .6527 (.30) | 10.08 | (.0029) |
| 4. | IllBoard | .3365 (.20) | .5191 (.22) | 10.24 | (.0028) |
| 5. | SpxSt | 4.0000 (.93) | 8.4550 (2.06) | 78.78 | (.0000) |
| 6. | RdgAch | 1.7059 (.30) | 3.4773 (1.54) | 22.85 | (.0000) |
| 7. | Age | 8.106 (1.04) | 8.3680 (.92) | .06 | (.8099) |

Variables:
1. Legal copying, characters/sec.
2. Illegal copying, characters/sec.
3. Legal copying with board, characters/sec.
4. Illegal copying with board, characters/sec.
5. Spelling by Stage Assessment, scale from 0-14.
6. Reading Achievement, Gates-MacGinitie Reading Test.
7. Age

Group 1, (N=19), is composed of Prephonetic and Letter Name stage Spellers.
Group 2, (N=22), is composed of Within Word Pattern and above.

Table 2 **Correlations**
Copying, Writing, Spelling and Reading Achievement

| Variable | 1. Legal | 2. Illegal | 3. Legal Board | 4. Illegal Board | 5. Spelling by Stage | 6. Gates | 7. Age |
|---|---|---|---|---|---|---|---|
| 1. Legal | — | — | — | — | — | — | — |
| 2. Illegal | .74** | — | — | — | — | — | — |
| 3. LegBoard | .75** | .81** | — | — | — | — | — |
| 4. IllBoard | .75** | .85** | .88** | — | — | — | — |
| 5. SpxSt | .56** | .54** | .60** | .57** | — | — | — |
| 6. RdgAch | .53** | .55** | .61** | .59** | .81** | — | — |
| 7. Age | .21 | .25 | .15 | .27 | .14 | .22 | — |

N = 43 * = p<.005. ** = p<.001.

*Copying* The copying speeds, reported in charaters per second in table 1, were faster for legal that for illegal sentences. The intercorrelations among the copying tasks were significant, but the differences between the legal and illegal copying speeds were also significant ($p < .05$), as were the differences in the copying speed with the board placed between the subject and the legal and illegal sentence stimuli ($p < .001$).

Generally, the copying task was an easy, if somewhat boring activity. Subjects were quite accurate in their copying. However, four subjects did delete whole words. The characters per second measure took omission into account.

The differences between groups were also significant for all copying tasks. For example, copying speed of the legal sentence, the task most like a typical copying task, was .55 characters/second for Group I subjects, and .75 for Group II students, ($\underline{F}(1,39) = 10.58$, $\underline{p} < .003$). Copying speed increased significantly across the two groups of developmental word knowledge ($p < .005$).

*Spelling and Copying*
Overall, the mean spelling-by-stage score was 6.32, which would place this sample in the early Within Word Pattern stage of spelling. However, there were significant differences between groups, with the Group I mean in the middle range of Letter Name spelling, and the Group II mean solidly in the Within Word Pattern stage. Analyses of variance showed that all four copying tasks prompted significant, increasing linear trends across the two groups of word knowledge ($p < .05$).

The trend was also observed for the total number of words spelled correctly.

In a regression analyses of the spelling-by-stage assessment, the spelling-by-stage assessment accounted for approximately 36 percent of the variance; for Legal Copying, $\underline{F}(1,41) = 22.01$, and on Illegal Board Copying, $\underline{F}(1,41) = 28.43$, $\underline{p}$'s $< .001$. As expected, spelling and reading achievement were highly related, and spelling scores were significantly related to age. A Discriminant Function Analysis significantly discriminated among the groups. As can be seen in table 3, spelling group membership classified 76 percent of the subjects' copying speeds correctly; ten of the 41 cases in this discriminant analysis were classified incorrectly.

*Reading Achievement*

Significant differences between Groups I and II on the Gates-MacGinitie Reading Test were noted; $\underline{F}(1,39) = 22.81$, $\underline{p} < .001$. Univariate tests between these two groups revealed significant differences between copying speed and reading achievement for all four copying conditions; (e.g., for the Legal Board Copying task, $\underline{F}(1,40) = 25.45$, $\underline{p} < .001$).

Table 3

**Discriminant Analysis Summary Table**
Legal and Illegal Copying Tasks Grouped by Spelling Stages

*Number of cases classified into groups by copying speed:*

| | Predicted Group Membership | | |
|---|---|---|---|
| Form Group | Letter Name and Below | Within Word and Above | Total Cases |
| Letter Name and Below | 15 | 4 | 19 |
| Within Word Pattern and Above | 6 | 16 | 22 |

*Number of grouped cases correctly classified: N = 31; 76 percent*

| Variable | Wilks' Lambda | F | Significance |
|---|---|---|---|
| Legal | .893 | 4.664 | .0370 |
| Illegal | .833 | 7.826 | .0080 |

Canonical Correlation=.4129 Wilks' Lambda = .8296 Chi-Squared = 7.1007, p = .0287

## Discussion

The results indicate that, indeed, the beginning readers and spellers in this study were less fluent in copying than the children who were at more advanced levels of reading and orthographic development. In the exploratory study, the significant findings relating reading achievement, copying speed, and orthographic development give some support for an elaboration of integrated, developmental models (Bear, in press; Henderson, 1985; Templeton, 1989).

The idea that readers use their knowledge of the orthography was substained by the differences between the legal and illegal copying tasks. Given the differences in copying speed between the spelling groups, this research suggests that one's knowledge of the orthography plays a facilitative role in copying.

Obviously, the ecological validity of the copying tasks in this study must be questioned. Children bring a number of pragmatic functions to copying which, in turn, direct the semantic orientation (Dyson 1985). In this study, the procedure for copying encouraged subjects to approach copying as a speed task. The differences across copying conditions indicate that the board made it easier for the examiner to observe copying strategies, but increased the difficulty of the copying. Observations in a naturalistic environment, as in Dyson's work, need to be included in studies relating writing to orthographic awarness. Accordingly, as part of a larger study, and in addition to the copying tasks in this study, subjects were asked to write about a familiar incident. The total number of syllables written was modestly related to copying speed, but not to spelling development. In preliminary analyses, the writing production seems to be quite variable in the summer clinic group.

Just as it is not quite accurate to say that beginning readers read "word-by-word," (Bear, 1989; Clay & Imlach, 1971), "letter-by-letter" copying does not accurately describe the children in this study. (Although Bradley did observe a predominance of letter-by-letter copying among the lower level readers in her study.) Subjects copied the legal sentences in slightly larger units than the illegal sentences, but even the subjects in the early Letter Name stage of spelling copied two to four letters in a single glance,

Figure 1 **Synchrony among reading, spelling and writing**

Beginning Reading ——————————> Transitional
Disfluent Oral Reading ——————————> Approaching Fluency
Prephonetic ——————> Letter Name ——————> Within Word Pattern
Disfluent Copying ——————————> Fluent Copying

approximately 50 percent of the time. The results in this exploratory study lend support to a model of literacy development where there is a synchrony among reading, spelling and writing. This relationship is illustrated in figure 1.

The copying strategies of two subjects, one from each developmental spelling group, illustrate the typical differences observed among subjects (see figure 2). Michael, who was placed in Group I, copied slowly, but often included several letters between glances. Brandon (Group II), on the other hand, recorded several characters between glances in the Legal copying task, and in the Illegal copying, he often copied letter-by-letter.

Figure 2 **Legal and Illegal Copying Stimuli**
Copying Strategies of Two Subjects

| | | |
|---|---|---|
| *Legal Stimulus* | | |
| Legal w/o Board: | San gob penk yown reff breet | |
| Legal w/Board | Fam bol clen screll mien | |
| Copying Strategy (letters/glance): | | |
| Michael[a]: | S/AN/GOB/P/E/N/K/Y/OWN/REFF/BR/EE/T<br>1-2-3-1-1-1-1-1-3-4-2-2-1 | 50" |
| Brandon[b]: | SAN/GOB/PENK/REFF/BRE/ET<br>3-3-4-4-4-3-2 | 35" |
| *Illegal Stimulus* | | |
| Illegal w/o Board | Lmert psfrt rga lihmb | |
| Illegal w/Board | Cgrml tpwde ffecsb jko epgrh | |
| Copying Strategy (letters/glance): | | |
| Michael: | L/ME/RT/P/SF/RT/RG/A/L/IH/MB<br>1-2-2-1-2-2-2-1-1-2-2 | 58" |
| Brandon: | LM/ER/T/P/S/FR/T/R/G/A/L/I/H/M/B<br>2-2-1-1-1-2-1-1-1-1-1-1-1-1-1 | 48" |

aMichael: Age - 9.8, Letter Name-4 bBrandon: Age - 9.0, Within-Word Pattern-8

Several studies have examined the ballistic movements in handwriting (cf. Kao, Van Galen & Hoosain, 1986); this study did not make such fine-grained analyses, but speed was the dependent variable. It was clear that the more advanced spellers were faster copiers; in the records of students' copying strategies, the children who approached the orthography in a linear fashion in spelling tended to copy in smaller units, often copying letter-by-letter, and students with a more sophisticated knowledge of words, and who worked with the orthography at a more abstract level, copied in larger units, and often at the whole word level.

The impetus for this study came from teachers' observations of beginning writers. Teachers often commented that most beginning writers were unable to write more than a few lines during freewriting periods. This limited production has been frustrating to some teachers. What can be done to improve writing fluency and production? The results of this study confirm these teachers' observations, and suggest that it would probably be best to have students expand their writing with drawings and Language Experience dictations. The dictations, in particular, allow children to express themselves fully with teacher support.

The theoretical implications of this study suggest to teachers that they can expect greater writing fluency as students begin to chunk the orthography at higher levels. The results reported support the hypothesis that the graphemic output lexicon of beginning spellers is not sufficiently detailed to allow a fluent output. Luria expressed similar ideas when he noted that "(t)he process of articulation (speaking aloud), which plays a decisive roll in the early stages of education has little to do with the highly automatized form of writing." In regard to familiar words, writing "no longer requires acoustic analysis but is performed as a complex motor stereotype," (Luria, 1980, p. 529). This line of reasoning is not new to reading research. Interestingly, some time ago, Freud hypothesized that "sound images" were the detailed result of "kinaesthetic word images." In modern parlance, automaticity in word recognition, sophistication in visual imaging of words, and orthographic knowledge, more generally, are needed for fluent production. With invented spellings serving as a window to orthographic awareness (Morris, 1981), it is now possible to investigate qualitatively and quantitatively what power in orthographic knowledge is prerequisite to orchestrating a steady movement across text in reading and across the page in writing.

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