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The Use Of Visual Recognition Testing In Spelling By Fourth Grade Children

David Wilton Batstone

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THE USE OF VISUAL RECOGNITION TESTING IN SPELLING BY FOURTH GRADE CHILDREN

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Submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy

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ABSTRACT

According to Simon and Simon (1973), much of a child's spelling knowledge can only be retrieved from memory storage when written spellings are available as retrieval cues. A child who cannot immediately recall a correct spelling, therefore, may be able to make a decision by writing out trial spellings and 'testing' them for recognition.

Five experiments were conducted to test Simon's model. The results of Experiments 1 and 2, in accordance with the model, showed that fourth-grade children were able to recognize whether or not their own spelling attempts were correct, and to discriminate between correct and incorrect spellings of words which they could not spell to dictation. Moreover, when they were given a choice between misspellings which they had themselves produced twice in exactly the same form and correct spellings of the same words, they chose the correct spellings in the majority of instances. These results indicate that children do have information available in memory which they are unable to retrieve and apply in the initial production of written spellings.

Experiment 3 tested the hypothesis that visual cues contribute to spelling decisions by facilitating access to information stored in memory. In this experiment, children were required to choose between visually or orally presented alternatives for words which they had not been able to spell to dictation. As predicted, the children made significantly more correct choices in the visual presentation condition than in the oral presentation condition.

Simon's model was tested further in Experiments 4 and 5 by encouraging children to use visual recognition testing and assessing the effects on their spelling performance. In both experiments, subjects who were prompted to use the recognition testing strategies described by Simon produced significantly fewer errors than control subjects who had no opportunity to use these strategies.

The results from these five studies support Simon's contention that children have spelling information available in memory storage which they do not use in the production of their initial spelling attempts. Visual testing of written trial spellings facilitates the retrieval of this information from memory storage and contributes in a substantial way to spelling decisions.

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CHAPTER I

Statement of Purpose

Spelling is an important practical skill and because of the nature and complexity of the psychological processes involved, it is interesting from a theoretical perspective. In spite of this, there has been relatively little psychological research concerned with spelling or much discussion of related theoretical issues. Instead, the spelling literature has been dominated by comparisons of teaching methods, studies of spelling disabilities, and debates about reform of the spelling system.

Theoretically oriented research has been impeded by certain common misconceptions about spelling and the English orthographic system. Spelling has sometimes been regarded as simply the converse of reading. Spelling differs from reading in many important ways, though, and studies by Barron (1980) and Bryant and Bradley (1980) have shown that children may use quite different strategies in the two tasks.

Spelling has also been characterized as a simple rote memory task, or as a rather mechanical process involving the transcription of speech sounds into letter sequences. These views are also ill-founded. Linguistic research has shown that English spellings reflect the meanings of words and underlying linguistic relationships as well as speech sounds (e.g. Chomsky, 1970; Haas, 1970; Venezky, 1967). Psychological studies have shown that competent spellers can apply sound-letter correspondences,

morphological and orthographic patterns, semantic knowledge, and 'visual' or word-specific information in spelling tasks (e.g. Schwartz, 1975; Secrist, 1976; Zutell, 1979; Smith, 1980; Baron, Treiman, Wilf, and Kellman, 1980; Barron, 1980; Sloboda, 1980). We still know very little about how these various skills, strategies, and sources of information are integrated and applied and there is a need for much more empirical research.

Dorothea Simon and her associates have developed of model of spelling performance, based on an information-processing approach (Simon and Simon, 1973; Farnham-Diggory and Simon, 1975; Simon, 1976). The model specifies in some detail the "stock of spelling facts" children may use in spelling, and the processes that may be involved in perceiving and analyzing the word to be spelled, retrieving information from memory, producing the response, checking the output, and correcting errors.

According to this model, visual recognition testing is an important step in the multi-stage process of spelling a word. Simon claims that spellers are able to recognize whether or not their own written spelling attempts are correct, and that 'testing' the correctness of one's own output is therefore a useful supplement to simple, direct recall. According to this account, children who are uncertain about a word may be able to recognize whether their attempted spellings are correct or not, or to choose between plausible alternative spellings once they are written out. A child might make a decision about a word, therefore, by thinking of a 'possible' spelling, writing it, and 'testing' whether it is

recognized as the correct version. If it is not, it may be corrected or other spellings may be generated, written, and tested until the correct version is found.

Common experience suggests that recognition testing is a useful strategy, but there is little empirical evidence that this is so. As will be explained in the next chapter, different assumptions about the causes of children's spelling errors lead to different predictions about the potential effectiveness of a recognition testing strategy.

In the experiments to be described in the following chapters, hypotheses derived from Simon's analysis of recognition testing processes were tested. According to the model, fourth-grade children should be able to detect their own spelling errors once they are written, and should also be able to differentiate between correct and incorrect spellings of words that they cannot spell correctly to dictation. These hypotheses were tested in Experiments 1 and 2. Simon's contention that visual cues are important in spelling recognition decisions was investigated in Experiment 3. The model was tested further in Experiments 4 and 5 by prompting children to use recognition testing strategies in a spelling task and assessing the effects of these strategies on their spelling accuracy.

CHAPTER II

Visual Recognition Testing in Spelling: A Review of the Literature

The literature related to visual recognition testing in spelling will be reviewed in this chapter, and particular attention will be given to describing the role of recognition testing in Simon's information-processing model of spelling behaviour. A number of other investigators have mentioned recognition testing in theoretical analyses of spelling processes and their views will be compared to those of Simon. The various claims and hypotheses about recognition testing found in the literature are based on limited data but the empirical studies that have been reported will be examined.

In this discussion, a distinction will be made between visual recognition testing in spelling and visual encoding of spelling information. An individual might produce a spelling by using his or her knowledge of the relationships between sounds and letters (a phonological or phonemic strategy) or by referring to an internal visual representation of the word (a 'visual' strategy). Likewise, someone may 'test' a spelling and recognize that it is correct because it matches a visually encoded internal representation of the word or because it conforms to some internalized set of rules or sound-letter correspondences. This thesis will focus on the issue of whether spellers are indeed able to use recognition testing effectively in spelling, rather than on questions about the

nature of the encoded information used by children in 'testing' their own written output.

Simon's Model of Spelling Performance

The research of D. Simon and her colleagues has been concerned with analyzing the behaviour of individual spellers, defining the processing requirements of spelling tasks, and explaining the psychological processes underlying spelling competence and performance (Simon and Simon, 1973; Farnham-Diggory and Simon, 1975; Simon, 1976). Their model of spelling behaviour is based on an information-processing approach, and it defines both the nature of the encoded information that spellers may call from memory to perform spelling tasks and the types of organized processes that may be involved in applying such information. The model provides a broad framework for the analysis of spelling behaviour, but hypotheses concerning the nature of the psychological processes involved are quite tentative.

Simon (1976) claims that the memory store of a "versatile, efficient speller" will include:

1. The meanings of all words and phrases used in directions to perform spelling tasks.

2. Representations of the names and shapes of letters, and motor programs for writing them.

3. Information about the relationships between speech sounds and letters (phoneme-grapheme correspondences).

4. Auditory, visual, or motor representations of specific words. Some words may also be 'tagged' for special attention if

they are members of a particular class (e.g. homophones) or if they are associated with a special mnemonic (e.g. "a friend to the end").

5. Morphological and orthographic rules, and other types of generalizations and mnemonics (e.g. change a 'y' to 'i' before adding 'es', a 'q' is always followed by a 'u').

6. Information about external sources and how to use them (e.g. dictionaries, spelling lists, teachers).

The model also describes how this information may be retrieved from memory and applied through a series of steps and alternate 'routes'. Simon and Simon described three strategies that a child could use in spelling words to dictation: 'direct recall', 'direct phonemic spelling', or a 'generate-and-test' strategy.

The simplest strategy is to encode the sound of the stimulus word, determine its meaning, and search for a complete representation of the spelling of the word in the long-term memory store. The spelling pattern may be associated in memory with either an auditory or semantic representation of the word. It could be stored in various forms--as a detailed visual image, an auditory representation of an oral spelling, an integrated motor program for writing the word, or perhaps in some more abstract form. If a complete spelling pattern for a word is retrieved from long-term memory, a motor program is activated and the written spelling is produced.

This 'direct recall' strategy could be used for familiar and overlearned words. The number of complete spelling patterns that a child might learn and retain in memory must be limited, though, and

to rely solely on a 'whole-word' or 'direct recall' strategy would be needlessly inefficient. To do so would be to ignore the alphabetic principle and to treat English words as if they were Chinese ideographs.

The model therefore allows for an alternative strategy--'direct phonemic spelling'. If a word is not immediately recognized, or if its complete spelling pattern is not stored in memory, then the child may apply his or her knowledge of sound-letter correspondences. The child may analyze the phonemic structure of the word and 'generate' a spelling by writing the graphemes which are associated in memory with each of the phonemes. The child might do this by simply writing in sequence the graphemes that most frequently represent the phonemes in the word, or he or she may take into account the context and relative positions of the phonemes (for example, a 'ck' may be selected to represent the /k/ sound at the end of a word after a short vowel, but a 'c' may be used at the beginning of a word).

In fact, most children are able to produce plausible spellings for unfamiliar and nonsense words (Schwartz, 1975) and they tend to produce many phonologically accurate misspellings (Barron, 1980; Thomas, 1979; Gates, 1937). These facts indicate that children can and do use phoneme-grapheme correspondences in spelling. Nevertheless, there are serious limitations to a purely 'phonemic' spelling strategy. Speech sounds are continuous and dynamic--words are not composed of discrete and distinctive sound units (Winitz, 1969). The phoneme is essentially only a theoretical abstraction

and phonemic segmentation of words requires quite a high degree of linguistic competence.

The usefulness of a purely 'phonemic' spelling strategy is also limited by the complexity and variability of the sound-letter relationships in English. Most speech sounds can be represented by a number of different letters or letter combinations (e.g. /s/ = seal, city, less, science) and since most words contain several phonemes, the number of plausible spellings of a given word may be very large. It is important to note that sound-letter relationships are not completely illogical and unpredictable. The choice of a letter to represent a given phoneme is often dictated by its place in the word and its phonological context. Hanna, Hanna, Hodges, and Rudorf (1966) have shown that when position, stress, and context variables are taken into account, phoneme-grapheme correspondence rules accurately predict the spelling of about 80% of the phonemes in the 17,000 most common English words. However, since each word may contain several phonemes even perfect application of such rules will produce correct spellings for less than 50% of commonly used English words.

The deviations from perfect phoneme-grapheme regularity in English are not just haphazard 'flaws' in the orthographic system. They reflect the fact that the English spelling system is based on more than a purely alphabetic principle. Spellings sometimes reflect morphemic, semantic, and even etymological information at the expense of phoneme-grapheme regularity (Smith, 1980; Venezky, 1967). When all of these systematic relationships are taken into

account, the predictability of English spellings may be much higher than indicated by Hanna et al.'s analysis.

It should be apparent from this discussion that while children may indeed be able to exploit sound-letter associations in spelling, they clearly cannot spell 'by sound' alone. They may be able to supplement a 'phonemic spelling' strategy by using morphological spelling patterns and other kinds of regularities. However, the underlying rules of English spelling are subtle and complex and there is some doubt about the degree to which children are able to use the higher-order regularities in the spelling system.

Simon and Simon (1973) suggested a third strategy that children might use to overcome the limitations of the 'direct recall' and 'phonemic spelling' approaches. They argued that children store in memory at least partial visual representations of all words in their reading vocabularies. Much of this information may be inaccessible for direct recall, but children may still be able to use it to evaluate their written spelling attempts. They suggested, therefore, that if a child was uncertain about a word and could not derive a unique spelling by applying phoneme-grapheme correspondences, he or she might be able to recognize whether a written spelling looked correct. The child could simply 'generate' a plausible spelling (by phoneme-grapheme conversion), write it, and then 'test' whether it was recognized as the correct version. If it was not, other plausible spellings could be 'generated' and 'tested' until the correct one was found. This process, which they

called a 'generate-and-test' strategy, is illustrated in Figure 1.

Simon and Simon clearly regard recognition testing as more than just a means of screening out slips of the pen and careless mistakes in words that the child knows quite well. It is assumed that this is a viable means of making substantive spelling decisions when the child is truly unable to recall some word or part of a word, and when the phoneme-grapheme correspondence rules are ambiguous.

Simon and Simon concluded their theoretical analysis of spelling processes by suggesting that it should be possible to enhance children's spelling accuracy by making them ...

> " ... explicitly aware of the generate and test technique for spelling, and encouraging them to try out alternatives, rather than arriving immediately at 'the one correct spelling' (Simon and Simon, 1973; p. 136)."

This was only tentative advice, based on theory rather than experimentation, and Simon acknowledged that " ... it would be highly desirable to have some empirical research aimed at testing the utility of such procedures."

Limitations of the Generate-and-Test Strategy

Simon's analysis of spelling strategies is based on theoretical arguments and no-one has demonstrated empirically that visual recognition testing has any effect on children's spelling decisions. Whether or not the recognition testing strategy is effective may depend upon the validity of Simon's assumptions about the sources of children's initial spelling errors.

Simon assumes that retrieval problems are an important cause of

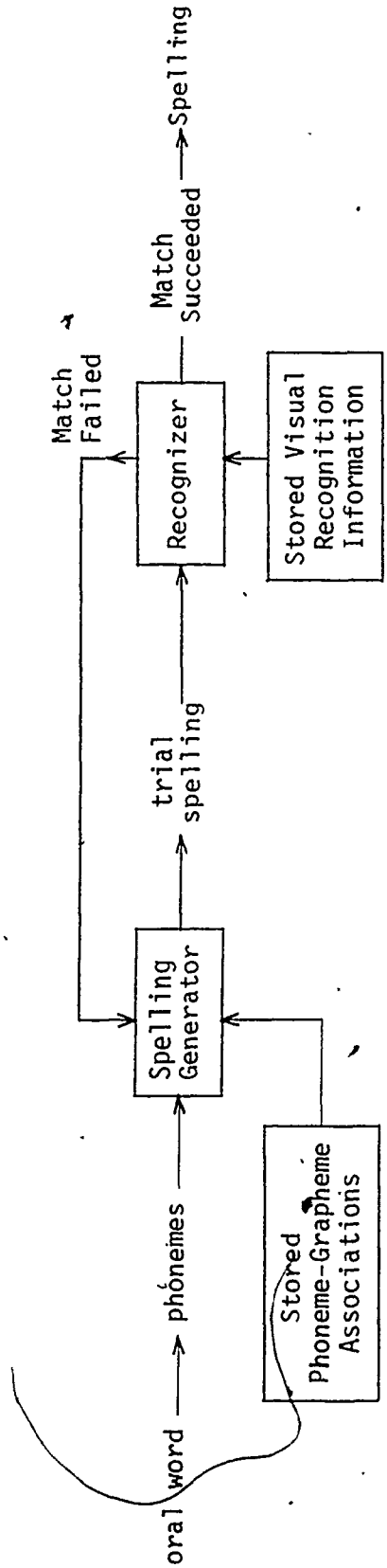

Figure 1. Spelling by means of a generate-and-test strategy (from Simon and Simon, 1973).

recall failures in spelling. She argues that when children misspell words they often have accurate information about those words available in memory storage. This information may be inaccessible during the production of the initial spelling attempt, but it can be used to evaluate the correctness of the written attempt or to choose between two or more 'trial' spellings. One might question why a child would not use 'visual' information about words at the production stage if the information was indeed available in memory. If a child had a representation of the word 'circle' encoded in memory, for example, and if the mental representation was sufficiently detailed to allow him to determine that an 'ir' looked correct and an 'er' did not, then he or she should be able to recall and use that information before writing the word. Simon's explanation is that much of the 'visual' spelling information acquired through reading...

> " ... can only be retrieved on presentation of the appropriate visual stimulus--that is, of the appropriate word, perhaps not quite correctly spelled (Simon and Simon, 1973; p. 103)."

Frith (1978) has expressed a similar view, arguing that ...

> " ... the poor speller may have no problems in either the initial [perceptual] analysis [of words] or in his memory for words, but may fail in the retrieval of spelling patterns. In this case, a child would recognize whether or not a word was correctly spelled, but would be unable to spell it to dictation (p. 282-283)."

The idea that retrieval problems are an important factor in the production of spelling errors has not been widely accepted, or investigated through empirical research. Most of the currently

popular methods used in remedial programming are based on the assumption that learning and perceptual problems are the most important causes of difficulty. Many remedial programs are designed to facilitate the initial learning process by improving study habits (e.g. Allred, 1977; Peters, 1967) or by encouraging attention to word details and spelling patterns (e.g. Thomas, 1979). Some programs are designed to strengthen mental images of words through multi-sensory techniques (Fernald, 1943) or imagery training (Radaker, 1963).

Auditory perception difficulties are another potential source of spelling errors (Liberman, 1973; Bradley and Bryant, 1978). Children may have difficulty perceiving spoken words correctly and breaking them down into their constituent sounds. For example, a child might 'hear' a /d/ sound in the word 'victim' (instead of a /t/ sound) and spell the word accordingly. Children are sometimes given practice in listening for the sounds in different parts of words, or in classifying words according to their phonological structure (e.g. Gentry and Henderson, 1980; Gillet and Kita, 1980), in an effort to overcome spelling errors due to faulty auditory perception.

Different assumptions about the causes of spelling errors lead to different predictions about the potential viability of the recognition testing strategy. If spelling errors are attributable mainly to problems in the acquisition and/or retention of spelling knowledge, then the recognition testing strategy may <u>not</u> be effective. Neither the production of correct spellings nor

effective evaluation of written spelling attempts should be possible if the necessary spelling information is simply not available in memory, or if the information in memory is inaccurate.

Recognition testing may also have little or no value in correcting errors due to auditory perception difficulties. A child who 'hears' a word incorrectly may be expected to misspell the word and also to accept as correct any written spelling attempt that conforms to his or her misperception.

In summary, if spelling errors occur because of failure to retrieve and apply available spelling knowledge during the initial spelling attempt, then the visual recognition testing strategy described by Simon may indeed be a useful means of correcting those errors. On the other hand, if learning, retention, or perceptual problems are the major sources of children's spelling errors, the use of visual recognition testing may have little value.

Other theoretical models

Other researchers have also commented on the role of recognition testing in spelling, but no-one has developed a detailed analysis or theory of recognition testing processes that competes with Simon's. For example, Barron (1980) questioned why spellers would ever use a phonological strategy, given the inconsistency of English spellings, and speculated that:

> "It would appear to be much more efficient for them to always use a visual-orthographic strategy and produce a spelling based upon information retrieved from the visual-orthographic entry in the lexicon. It is possible, however, that the visual-orthographic entries do not actually have procedures for producing

> spellings as they may only influence spelling indirectly through a checking process. This checking process might operate by first comparing rule generated spellings against visual-orthographic entries in the lexicon and then correcting those spellings which fail the comparison test (Barron, 1980, p. 210)."

Barron found that poor readers in grades 4 to 6 produced a greater proportion of phonetic errors on irregular words than did good readers, and he speculated that the poor readers may have failed to use the 'checking mechanism' when it was needed. An alternative explanation is that the poor readers may have been over-reliant on 'phonics' in the initial production of spellings. The good readers, on the other hand, may have used either 'visual-orthographic' representations of words at the production stage, or their knowledge of the underlying structure in the orthographic system.

Morton (1980) has recently extended his 'logogen' model of linguistic processes to incorporate orthographic information, and he also has included a 'checking mechanism' in his description of spelling processes. Logogens are hypothetical internal representational units which contain information about the characteristics of specific words. Sensory mechanisms collect information about linguistic stimuli (e.g. spoken or written words) and when the amount of information exceeds a certain threshold, a logogen corresponding to the stimulus word is activated and a response is made available (see Morton, 1969; 1970; 1979; for more complete explanations of the concept of a 'logogen').

In spelling, auditory input logogens accept information about spoken words. If a certain threshold is exceeded (i.e. if the word

is recognized), an input logogen is activated, a code is sent to the cognitive system and the output logogens, and a written or oral spelling is produced. In reading, information about printed words is accepted by visual input logogens, and word pronunciations are produced by the output logogens.

According to Morton, the logogen system could be by-passed in reading or spelling. Nonsense words or unfamiliar words would not be represented in the auditory input logogen system but could be spelled by auditory analysis and phoneme-grapheme conversion. Such words could be read by visual analysis and grapheme-phoneme conversion (i.e. 'sounding out').

Although Morton does not discuss recognition testing in much detail, he suggests that it may be possible to check one's own written spelling attempts via the visual input logogen to output logogen route. This could be done to resolve uncertainties or, if a word had been spelled initially by phoneme-grapheme conversion (by-passing the logogen system), to confirm that the 'generated' spelling matched the pattern of a real word. Only correct spellings would excite visual input logogens and give the feeling of being correct. He explains that ...

> " ... the [phoneme-grapheme] rule system would not know whether the output string did indeed correspond to a real word. So if we are going to use the idea of writing via the phoneme-grapheme rules at all then we have to introduce an extra stage in the sequence. This stage would take the letter string which the rules had generated and check this for its word-ness and for its pronunciation, to check whether it corresponded to the target in this respect. This could not, of course, be done using the

> grapheme-phoneme rules, for that system has no concept of word either ... The checking would have to be done by passing through some word-based systems which took an orthographic input and produced a phonological output, such as the visual input logogen to output logogen route. The production of an output would guarantee that a word had been produced and the output itself could be used to check the pronunciation (Morton, 1980; p. 126)."

Morton presented no experimental evidence to support this model as it applies to spelling in general or to recognition testing in particular.

Information about words is organized differently in Morton's model than in Simon's, but the two models are similar in several other respects. In the logogen model there are two alternate 'routes' to a correct spelling: through the word-based logogen system, or through phoneme-grapheme conversion "by-pass". These correspond to two of the strategies described by Simon: direct recall of whole-word spellings from the lexicon, and the 'phonemic' spelling strategy. In both models, the strategy based on phoneme-grapheme correspondences may be supplemented by a visual checking mechanism, based on whole-word information. Both authors acknowledge the possibility of checking a spelling by sounding it out (converting graphemes to phonemes) and comparing the pronunciation obtained to the sound of the stimulus word. However, they point out that such an approach to recognition testing would allow phonologically accurate misspellings to pass undetected, and therefore would be of limited value.

It must be emphasized that neither author claims that

recognition testing is used on all words or by all spellers. However, they do suggest that recognition testing is a viable mechanism that is available for use when and if the whole-word strategy fails and/or when phoneme-grapheme correspondence rules are ambiguous. They conclude that writing out and 'testing' alternative spellings might be a useful practical technique for resolving spelling difficulties.

Empirical Studies

Simon's theoretical analysis of recognition testing processes is based more on logical argument than experimentation, and much of the evidence cited in support of the model is indirect. Simon and Simon (1973) constructed a computer spelling algorithm based on the generate-and-test strategy described earlier. The computer was programmed to accept input in the form of sequences of symbols representing the phonemes in spoken words. The memory store contained (1) lists of graphemic options for each phoneme (e.g. /n/ = n, nn, kn), and (2) partial lists of the letters in each word (e.g. kn__l___e for the word 'knowledge'). These partial lists for specific words represented the incomplete visual word-representations that a child hypothetically would acquire through reading. The algorithm generated a spelling for each 'dictated' word by converting phonemes into graphemes and then altering the output to fit with the hypothesized partial 'visual' representation of the word.

The spellings produced by this algorithm for a few difficult words were very similar to the spellings produced by 47

fourth-grade children who spelled the same words to dictation. Another algorithm which was based solely on phoneme-grapheme correspondences (Rudorf, 1966) performed much more poorly than either the 'generate-and-test' algorithm or the human spellers, and it produced qualitatively different errors.

These results provide some indirect evidence for the hypothesis that children are able to combine phonemic and 'visual' information, but Simon's findings do not show that visual information was applied through recognition testing. The children may have retrieved visual representations of the words from memory before they wrote them, and used these representations at the production stage.

Simon and Simon (1973) also referred to the uneven distribution of errors within words as evidence that children do use visual recognition testing in spelling. They noted that children attend more closely to the beginnings of words than to other parts during reading (Smith and Groat, 1979). They hypothesized, therefore, that the 'visual representations' of words that are stored in memory should often be incomplete, and information about the middle or ends of words should be 'missing' more often than information about the first few letters. They predicted that children who used these incomplete visual representations in recognition testing would be least successful in screening out spelling errors in the middle and at the end of words.

In fact, children's spellings do show this pattern--errors are most common near the middle and toward the end of words (Jensen,

1962; Kooi, Schutz, and Baker, 1965; Jorm, 1977). This does not necessarily mean that children use a visual recognition testing strategy, however. A child who used a purely 'phonemic' spelling strategy could be expected to produce this same pattern of errors. Phoneme-grapheme relationships are least variable and most predictable at the beginnings of words (Venezky, 1967; Hanna et al., 1966). Therefore, a child who spelled entirely by applying phoneme-grapheme correspondences could be expected to produce the same uneven distribution of errors across different positions within words.

The evidence cited by Simon and Simon in support of their model is clearly too weak to justify their conclusion that "much of the spelling behaviour of fourth-graders can be explained on the hypothesis that they use a phonetic generator combined with a recognition-test in order to spell words of which they are not entirely sure (Simon and Simon, 1973; p. 135)".

Simon's claim that recognition testing is a useful supplement to direct recall is based on the hypothesis that children can recognize correct spellings or evaluate plausible spelling alternatives for words they cannot recall directly. Comparisons between multiple-choice spelling tests and dictation-format tests have sometimes been cited in support of this idea. Although errors are less frequent in multiple-choice tests than in dictation tests based on the same words (Nisbet, 1939; Moore, 1937; Northby, 1936), this may be because dictation test scores are affected by purely mechanical errors. A child writing a word to dictation can form a

letter incorrectly, for example, or carelessly omit a letter or syllable. Responses on multiple-choice tests (underlining, circling, or pointing to a spelling) are simply easier to execute. One could distinguish between words misspelled through carelessness on a dictation test and words a subject was truly unable to recall by presenting each word twice. If a word was misspelled on one occasion and spelled correctly on the other, the error could reasonably be attributed to a temporary lapse rather than an inability to recall the word.

The relative 'easiness' of multiple-choice spelling tests may also depend in part on the way that spelling alternatives are selected for the words. The incorrect spellings on multiple-choice tests are supplied by the author of the test and may often by quite different from the misspellings a particular child would produce himself or herself. For example, imagine a child who is asked to spell the word finally to dictation. She knows part of the word quite well (fi_ally) but cannot recall whether it has one 'n' or two. She guesses incorrectly and writes finnally. Now she is given the same word in a multiple-choice test, with four alternatives to choose from (finely, finnelly, finally, finnaly) and she is successful in identifying the correct version. Does this show that she was able to recognize that the single 'n' was correct? It does not at all, of course. She may have simply eliminated any choice that did not contain a double 'll' or an 'a', since she was quite certain about these parts of the word. This would have left only the correct spelling. If this same child were

given a choice between her own misspelling and the correct version (finnally vs. finally) we might find that she would make the same incorrect decision in the recognition task (multiple-choice test) as in the recall task (dictation test)--that is, she may choose the double 'nn' in both situations.

This is not a trivial problem because very few words are misspelled consistently in the same way by different individuals. Gates (1937) found that only 16% of 3876 common words had a common misspelling that accounted for more that 50% of the misspellings of the word. For comparisons between dictation tests and multiple-choice tests to be meaningful, therefore, the multiple-choice options should include misspellings produced by the subjects themselves.

Another important assumption in Simon's analysis is that the opportunity to use visual cues facilitates spelling decisions. Comparisons between dictation spelling tests and multiple-choice tests have been cited in support of this idea, as well. Tenney (1980) has pointed out, however, that the effects of providing spelling alternatives must be separated from the effects of allowing visual inspection of potential spellings. It may be easier, in fact, to make a spelling recognition decision (i.e. choose between spelling alternatives) than to recall a spelling directly, but visual factors are not necessarily important in such decisions. One might find, for example, that a child who could not spell words to dictation would still be able to choose correctly between orally presented spelling alternatives for the words. Such

a finding would not contradict the idea that recognition testing might be useful, but would call into question the hypothesis that recognition decisions are based on visual cues, or a sense of when a spelling 'looks right'.

Farnham-Diggory and Simon (1975) have shown that visual cues can be helpful in spelling recall tasks. These investigators presented words visually to one group of 8-year-old subjects. The same words were spelled aloud for a second group of subjects. The children were required to write each word after 12 to 15 seconds of interpolated activity. Spelling of the words was more accurate when they were presented visually than when they were presented orally. Farnham-Diggory and Simon concluded that visual word presentation provides more efficient access to information in long-term memory than auditory presentation.

Tenney (1980) has provided the most direct test of the hypothesis that spelling decisions are facilitated by the opportunity to actually look at potential spellings. He conducted two experiments to test this hypothesis, using university undergraduates as subjects.

In the first experiment, subjects were required to choose between the correct spelling and a common misspelling for each word in a 36-word list. In one condition, the spellings were printed in the normal way, one above the other (e.g. visable / visible). In the 'zigzag' condition, the physical appearance of each alternative was distorted by mis-aligning the letters (e.g. v i s a b l e / v i s i b l e). Subjects had more difficulty identifying correct spellings in the

'zigzag' condition. This appears to support the hypothesis that spelling decisions are affected by the appearance of words, but some subjects had difficulty deciphering the zigzag writing (some read $i_n s_i s_t e_n c_e$ as instance, for example). The distorted writing, therefore, made it more difficult for subjects to determine what word they were supposed to be spelling, as well as interfering with their actual decisions about the alternatives.

In Tenney's second experiment, subjects were again required to choose between correct and incorrect spellings, but in this study the two alternatives for each word were described orally. For example, the experimenter would say "Nickel. Nickel begins N-I-C-K, followed by E-L or L-E. Nickel. Is it E-L or L-E?" In the 'writing' condition, subjects wrote out the two alternatives before choosing one of them. In the 'no-writing' condition, subjects simply thought about the alternatives before responding orally. Significantly fewer errors were made in the 'writing' condition. This finding supports the hypothesis that the opportunity to look at potential spellings of a word facilitates spelling decisions.

Although the results of Tenney's experiment suggest that visual inspection of possible alternatives can be helpful when the alternatives are supplied by an experimenter, they do not answer the question of whether it is possible to apply visual recognition testing effectively to one's own spelling output. The words which Tenney's subjects 'recognized' may have been ones that they would also have spelled correctly to dictation. If that were the case,

recognition testing would be superfluous with those words. Also, as mentioned earlier, evaluating one's own spelling attempts might be more difficult than evaluating spellings from external sources. Spellers probably produce misspellings that seem reasonable to them and that reflect their misconceptions about words, rules, and regularities. Therefore, a subject who is asked to choose between his own misspelling (presumably one that seemed plausible to him before he produced it) and a correct spelling may have a strong tendency to choose his own spelling. Visual cues may not help in such a situation.

It is important to note that Tenney's subjects were adults, with vastly larger word recognition vocabularies than children. We do not know, therefore, whether children can also benefit from the use of visual cues in making spelling decisions.

Summary

Simon has developed a detailed model of spelling processes which includes visual recognition testing as an important component. Although a number of researchers have speculated about this aspect of spelling behaviour, there have been few efforts to investigate it experimentally. We do not know whether children are actually capable of using visual recognition testing in spelling tasks. The inclusion of visual recognition testing mechanisms in theoretical models of spelling processes, therefore, may not be justified.

As we have seen in this chapter, few of the assumptions that underly Simon's model have been adequately tested. If misspellings

are produced because of difficulties in retrieving available information from memory, as Simon and Frith have suggested, then recognition testing may indeed be a useful supplement to direct recall. On the other hand, if all available 'visual' representations of words are retrieved before the words are written and used in the initial production of spellings, then recognition testing would contribute nothing further to the spelling process and the generate-and-test strategy would not be effective. The strategy would also fail if critical spelling information was simply not available in long-term memory, or if the child had learned an incorrect spelling pattern or rule, or if the child's perceptual analysis of the word was incorrect.

The idea that the retrieval of spelling information is facilitated by the opportunity to look at a written spelling is a fundamental assumption in Simon's analysis. She argues that some information about words will only be retrieved " ... on presentation of appropriate visual stimulus--that is of the appropriate word, perhaps not quite correctly spelled (Simon and Simon, 1973; p. 103)." Comparisons between dictation spelling tests and multiple-choice tests are sometimes cited to support this hypothesis, but the relative 'easiness' of multiple-choice tests may be due to factors other than the opportunity they afford for visual inspection of alternatives. The two studies by Tenney reviewed in this chapter support the hypothesis that visual cues facilitate spelling decisions. Tenney used university students as subjects, however, and we do not know whether children are also

able to benefit from the use of visual cues in making spelling decisions. Also, it may be more difficult to evaluate one's own spelling attempts rather than spellings from external sources. The effects of visual cues on spellers' evaluations of their own spelling attempts have not been explored.

Simon and Simon (1973) suggested that children's spelling might be improved if they were encouraged to write out spelling alternatives and to examine them before making final decisions. However, this advice was based upon theoretical assumptions rather than empirical evidence that recognition testing is actually a viable strategy for children.

The general purpose of the research to be described in the following chapters was to determine whether fourth-grade children are capable of using visual recognition testing in spelling as Simon has proposed. Fourth-grade children were chosen as subjects for this research so that comparisons could be made with earlier studies (e.g. Simon and Simon, 1973). The purpose of the first two experiments was to test Simon's contention that children are able to: (a) evaluate the correctness of their own initial spelling attempts; and (b) discriminate between correct and incorrect spellings of words that they cannot spell correctly to dictation. The role of visual cues in spelling recognition decisions was investigated in the third experiment by comparing children's decisions about orally presented and visually presented spelling alternatives. In the fourth and fifth experiments, children were encouraged to use two different visual recognition testing

strategies described by Simon, and the effects of these strategies on their spelling accuracy was evaluated.

CHAPTER III

Experiment 1

According to Simon, visual 'testing' of written spellings allows children to retrieve and apply spelling information that is available in memory storage but inaccessible during the actual course of writing a word. If Simon's analysis is correct, then children should be able to (a) judge whether their own written spelling attempts are correct or incorrect, and (b) choose between correct and incorrect spelling alternatives for words which they cannot spell correctly to dictation. The purpose of the first experiment was to test these two predictions.

In the first part of the experiment, subjects were given two dictation tests using the same words on both occasions. In both tests, subjects were required to rate the correctness of each of their own spelling attempts, using a four-point rating scale. It is important to note that the dictation test was given twice so that we could distinguish between words misspelled through carelessness and words the children were truly unable to spell correctly. If a child misspelled a word on only one of the two tests, the misspelling was classified as a 'lapse'. If a word was misspelled on both tests, but in two different ways, the misspellings were classified as 'inconsistent' errors. If a word was misspelled on both tests in exactly the same way, the misspellings were classified as 'consistent' errors. If children are indeed able to apply a recognition test effectively to their own spelling output, then the subjects should give significantly

higher correctness ratings to their correct spellings than to their misspellings. All three types of misspellings should be judged 'incorrect' by the children more often than correct spellings.

The second part of the experiment was designed to test Simon's contention that " ... the correctness or incorrectness of a spelling may be recognized in situations where one cannot recall the correct spelling (Simon and Simon, 1973; p. 117)." All subjects returned for a third session in which they were presented with two typed spelling alternatives for each of the words that they had earlier attempted to spell to dictation. Correct spellings produced by the child were paired with common misspellings of the same words, and the child's own misspellings were paired with correct spellings. In each case, the child was required to identify the correct spelling. One would expect children to be able to choose between correct and incorrect spellings of words that they <u>can</u> spell correctly to dictation. If Simon's hypothesis is correct, one should also expect children to be able to choose between correct and incorrect spellings of some words that they <u>cannot</u> spell correctly to dictation. In other words, one should expect the children to reject many misspellings of their own making and to choose the correct alternatives provided by the experimenter instead. Although misspellings that are repeated twice in the same form by the child are clearly more than just 'slips of the pen', children may reject even these 'consistent' misspellings if they are given the opportunity to see potential alternatives in written form.

Method

Subjects. The 30 children who served as subjects in this experiment included 12 males and 18 females. All were grade-four pupils at Clara Brenton Public School in London, Ontario. Their ages ranged from 108 to 127 months, with a mean of 113.0 months (9.4 years) and a standard deviation of 4.9 months.

Materials. In selecting spelling words for this study, it was necessary to allow for the wide differences in spelling ability among children in the same grade. We wished to obtain a sufficient sample of spelling errors from every subject, but without presenting large numbers of words that were either far beyond the capacity of the poor spellers or far too easy for the good spellers. Rather than give the same words to all subjects, therefore, we used a 'basal' and 'ceiling' procedure. First, 180 words were selected from Thomas's list of the 3,000 words most frequently used by Canadian school children in their written compositions (Thomas, 1979). These ranged from words that are misspelled by only 25% of fourth-grade students, up to words that are misspelled by 99% of fourth-graders (according to Greene's normative data; Greene, 1954). The selected words, which were distributed evenly over this range, were placed on a list in order of increasing difficulty.

In the dictation test to be described later, the experimenter established a 'basal' for each child by presenting every sixth word in the list until the second error occurred. He then worked backward through the list (giving progressively easier words) until

a 'basal' of six consecutive correctly spelled words was established. The 'ceiling' was established by proceeding forward through the list until six consecutive words were misspelled. This procedure ensured that each child was given words that were suitable to his or her abilities, yet difficult enough to produce a sufficient number of errors.

Procedures. All subjects were tested individually, and each of them participated in three separate sessions conducted about one week apart. The testing was done in a small room equipped with a table and chairs, located near the children's classroom. When a child entered the testing room at the beginning of a session, he or she was greeted and given a seat across the corner of the table from the experimenter. The purpose of the testing was explained in very general terms. The child was re-assured that he or she would not be graded on the test, but was urged to think carefully about the words and to do his or her best to spell them correctly. Once the child seemed at ease, the specific procedures were explained and demonstrated and the test was administered.

A. Dictation tests. A spelling dictation test was given in the first session. This same test was re-administered one week later. In both tests, subjects were required to write words to dictation and immediately thereafter to make a judgement about the correctness of each written spelling attempt. The basal and ceiling procedure described earlier was used to ensure that the particular words given to a child were neither too easy nor too far beyond his or her capacity.

The experimenter began the first session by placing a lined data sheet before the child. Four symbols were printed at the right-hand side of each line on the page. These symbols (✓ ✓? X? X) were to be used by the child to indicate his or her evaluation of each spelling attempt. The following instructions were given:

> "I'm going to give you some words to spell. When I dictate a word, think carefully about how it should be spelled. Then, write it on this page." (The experimenter demonstrated by dictating a sample word and writing it on the first line of the data sheet.) "Next, I want you to check your spelling. Look at what you have written and decide whether or not it is the correct spelling. If you are sure your spelling is right, circle the check-mark (The experimenter pointed to each symbol as he described it.) If you think it is right, but you are not sure, circle the check and question mark (✓?). Sometimes you will not be able to spell the word correctly. If you are sure your spelling is wrong, circle the 'X'. If you think it is wrong, but you are not sure, circle the X-question mark (X?)."

This procedure was demonstrated with several sample items. For each sample item, the experimenter wrote a spelling (sometimes a misspelling), gave an evaluation verbally, and then circled the appropriate symbol. He then prompted the child to follow the same procedure with a few sample words. When the child appeared to understand the procedure, he or she was asked to explain what each of the four symbols meant. All of the subjects were able to explain the symbols adequately.

After the demonstration items, the child was given a new data sheet and the dictation test was begun. The experimenter dictated

each word by pronouncing it and using it in a short sentence. The child was prompted to write the word, to look at the written spelling, and to indicate his or her evaluation of it by circling the appropriate symbol.

When this dictation test was re-administered in the second session, all of the words that were between the child's basal and ceiling on the first test were dictated again, using the same procedures. As in the first dictation test, the child was required to evaluate each of his or her written spelling attempts, using the four-point rating scale.

As stated earlier, the purpose of re-testing was to differentiate between words misspelled through carelessness and words the child was truly unable to spell. The two spellings produced by a subject for each word were compared, and these comparisons were used to classify the spellings into four categories: correct spellings; 'lapse' misspellings (when the word was misspelled on only one of the two tests); 'inconsistent' misspellings (when the word was misspelled twice but in two different ways); and 'consistent' misspellings (when the word was misspelled twice in exactly the same way).

B. Two-Alternative Spelling Recognition Test. The subjects returned for a third and final session, one week after the second dictation test. In this session, they were given a two-alternative spelling recognition test. The purpose of this third session was to determine whether subjects could choose between correct and incorrect spellings for words that they themselves had not been

able to spell correctly to dictation. Each child's 'recognition' test was based on the same words he or she had attempted to spell previously in the two dictation tests. For each word, the child was shown two alternative spellings typed one above the other (e.g. singel). The child was required to circle the one he or she thought was correct. For words the child had previously misspelled to dictation, the two alternatives consisted of the correct spelling and the child's own misspelling of the word. (If the child had produced two different misspellings for the word on the two dictation tests, then only the more recently produced misspelling was used). Words the child had spelled correctly to dictation were also used in this test, to control for the possibility that subjects might simply reject any spelling that they recognized as one of their own making. For these words, the two alternatives consisted of the correct spelling and a common misspelling of the word. The relative positions of the correct and incorrect alternatives varied randomly from word to word.

The instructions given to the subjects were as follows:

> "I'm going to dictate some words to you, and for each one I'll show you two different spellings. One spelling will be correct, and one will be wrong. Circle the correct spelling for each word."

After demonstrating the procedure with five easy items, the experimenter presented the typed list prepared in advance for that specific child. He dictated each word, and directed the child to look at the two alternatives for the word and to circle the correct spelling. (The procedures for Experiment 1 are summarized and illustrated with examples in Appendix A).

Results

The results will be presented in two sections. First, I will describe the correctness ratings which subjects gave immediately after writing the words to dictation. Next, I will describe the results of the recognition test, in which subjects were required to choose between the two spelling alternatives for each word.

(a) Correctness ratings on the two dictation tests. The reader will recall that spellings produced on the two dictation tests were classified into four categories: correct spellings, 'lapse' misspellings, 'inconsistent' misspellings, and 'consistent' misspellings. The mean correctness ratings given by subjects to the four different types of spellings are shown in Table 1. (This table also shows the mean number of spellings produced per subject in each category.)

The correctness ratings for the four categories of spellings were compared by analysis of variance, and the overall differences among means were found to be significant ($F_{(3,87)} = 65.275$, $p < .001$). Pairwise comparisons between means indicated that correct spellings were given significantly higher correctness ratings than any of the three types of misspellings (Tukey's HSD test, $p < .01$). These results show that subjects were far more likely to accept their own written spellings as correct when they were actually correct than when they were wrong. Even the 'consistent' misspellings were recognized as being errors in many cases, and these misspellings were also given significantly lower correctness ratings than the subjects' own correct spellings. Some

Table 1;

Subject's ratings of the correctness of their own written spelling attempts (pooled data from two dictation tests).

Type of Spelling	Number Produced per Subject per Test	Mean Correctness Ratings (4 = ✓ : 3 = ✓? : 2 = X? : 1 = X)
[a] Correct Spellings	27.7	3.70
'Consistent' Misspellings	4.7	3.01
'Lapse' Misspellings	8.4	2.71
'Inconsistent' Misspellings	8.2	2.59

[a] Correct spellings of 'lapse' words (misspelled on one of the two tests) are included with the correct spellings produced on both tests.

accurate information about the misspelled words must have been available in memory for the subjects to be able to evaluate their own spelling attempts so successfully.

It should be noted that the correctness ratings did vary as a function of the particular error type. Although 'consistent' misspellings were given significantly lower correctness ratings than correct spellings (Tukey's HSD test, $p < .01$), they were given significantly higher ratings than either the 'lapse' misspellings or the 'inconsistent' misspellings ($p < .01$). This indicates that the children were less inclined to reject or question one of their own misspellings, if it was one that they had produced twice in the same form in their two attempts to spell the word to dictation. Nevertheless, about one-quarter (26.5%) of these 'consistent' misspellings were recognized as being 'wrong' immediately after they were produced.

(b) Performance on the Two-Alternative Recognition Test. The results of the recognition test are summarized in Table 2. As expected, the subjects had no difficulty in choosing between correct spellings which they had produced themselves and common misspellings of the same words. Given this type of choice, subjects chose the correct spelling in 97.0% of all instances. When they were asked to choose between misspellings that they had produced themselves and correct alternatives, subjects again chose the correct spellings in a significant majority of instances (see Table 2 for *t*-test results). The percentage of correct choices was significantly greater than 50% for all three types of

Table 2

The mean percentage correct in a two-alternative spelling recognition task, for four categories of words.

Word Category	Alternatives Given in the Recognition Task	Percentage Correct
Words Recalled Correctly on both Dictation Tests	S's own correct spelling vs. Common Misspelling	97.0% **
'Lapse' Words	S's own correct spelling vs. S's own misspelling	91.5% **
'Inconsistent' Words	Correct spelling vs. S's own misspelling	82.5% **
'Consistent' Words	Correct spelling vs. S's own misspelling	68.4% **

** For all four categories of words, the percentage correct was significantly greater than 50% (t-tests, $p < .001$).

misspellings. That is, subjects rejected even their own 'consistent' misspellings in favour of the alternative spellings provided by the experimenter, in the majority of instances.

The fact that subjects rejected 68.4% of their own 'consistent' misspellings in the recognition test is quite remarkable. These misspellings apparently represented the children's 'best efforts' at spelling the words. However, when they were given a choice between these 'consistent' misspellings and the alternatives provided by the experimenter, the children recognized that their version was wrong and the experimenter's version was correct (68.4% of the time). This degree of accuracy is significantly better than subjects could have achieved by choosing randomly between alternatives (t_{29}= 4.20, $p < .01$).

The significance of these results was further underscored when the ratings given to 'consistent' misspellings at the production stage (immediately after they were produced in the dictation tests) were compared with the choices for these same words in the recognition task. Subjects gave 'correct-sure' (√) ratings to 37.6% of their own 'consistent' misspellings immediately after they produced these misspellings on the second dictation test. Since the children were initially confident that these spellings were correct, one would expect them to choose virtually all of them over other alternatives in the recognition task. They did not do so, however. 'Consistent' misspellings judged 'correct-sure' at the production stage were rejected 58.2% of the time when correct spellings were provided as possible alternatives .

Subjects gave 'correct-not sure' (✓?) ratings to 35.9% of their 'consistent' misspellings immediately after they produced these spellings on the second dictation test. Although the subjects were less confident about these words, they still regarded their misspellings as correct. In spite of this, the children rejected 74.4% of these misspellings in the recognition task.

In summary, the data show that even when children are initially confident that their spelling of a word is the correct one, they may be able to recognize that it is wrong if they are given an alternative to consider. This supports Simon's contention that it is possible to recognize a correct spelling for a word even when one cannot spell the word correctly to dictation.

Discussion

One of the purposes of this experiment was to test Simon's claim that children are able to recognize whether or not their own spelling attempts are correct. It was predicted that if children were required to evaluate their own written spelling attempts immediately after producing them, they would give higher correctness ratings to their own correct spellings than to their misspellings. This prediction was confirmed. Subjects almost always recognized their correct spellings as being correct, but they immediately rejected over one-third of their own misspellings.

The errors rejected by the children did not appear to be just 'slips of the pen' or careless misspellings of words they knew quite well. Even when children misspelled a word twice in exactly the same way, they often recognized that their misspelling of the

word was not correct. Although the 'consistent' misspellings were not as easily detected as other types of misspellings, they were rejected much more often than correct spellings.

The results of the two-alternative recognition test also supported Simon's contention that " ... the correctness or incorrectness of a spelling may be recognized in situations where [one] cannot recall the correct spelling (Simon and Simon, 1973; p. 117)." When the children were given a choice between correct and incorrect spelling alternatives for words they were unable to spell correctly to dication, they chose the correct spelling in the majority of instances. They did so even when misspellings that they they had produced consistently themselves were used as the incorrect alternatives.

The children's evaluations of these 'consistent' misspellings were particularly interesting. One might assume that a misspelling that is repeated twice in exactly the same form is based on a flawed internal representation of the word, or that it is generated by a faulty internal rule system. If this was the case, though, the child would not be expected to make correct choices in a recognition task involving this same word. Instead, he or she would tend to choose the misspellings that matched the flawed internal representations, or that conformed to their faulty internal system of rules. However, subjects did not do this in the majority of instances. This outcome shows that the children did have relevant spelling information about these words available in long-term memory, that they did not use or were unable to use in

the initial production of their written spelling attempts.

Although it is possible that subjects learned some of the correct spellings between the second and third sessions, it is doubtful that they could have mastered a sufficient number of words to account for their very strong performance on the recognition test. Comparison of the two dictation tests showed that the mean number of correct spellings did not increase significantly over the one week period between tests ($\bar{X}_1 = 27.13$, $\bar{X}_2 = 28.23$; $t_{(29)} = 1.34$, $p > .20$). It seems unlikely that much more learning would have taken place between the second and third sessions than occurred between the first and second sessions. The large number of words presented to each subject (a mean of 48.5 words, s.d. 7.3) and the fact that children were not told that they would be returning for a third session are factors which further limit the possible amount of learning between sessions.

Another potential explanation of the results is that subjects simply rejected any spelling that they recognized in the recognition test as being one of their own. Children might have assumed that the experimenter was giving them an alternative to their own spelling because their spelling was wrong, and therefore rejected their own version of the word. However, even if children were able to remember how they had spelled the words a week previously, adoption of this strategy would lead them to reject some of their own correct spellings. In fact, this almost never happened. Even when children were 'not sure' about correct spellings when they first produced them, they virtually always

chose these correct spellings in the recognition task. Therefore, this explanation does not account for the data.

In summary, the results of this experiment confirm that children are able to differentiate between correct and incorrect spellings for words they cannot spell correctly to dictation. The findings support Simon's argument that children have accurate information about words available in memory storage that they are unable to use in the production of initial spelling attempts.

CHAPTER IV

Experiment 2

The purposes of this next experiment were to replicate and extend the findings from Experiment 1, using a different type of recognition task, and to provide a further test of Simon's contention that children are able to recognize the correctness or incorrectness of spellings for words they cannot spell to dictation.

This experiment consisted of two parts, as did Experiment 1. In the first part of the study, subjects were given two spelling dictation tests, using the same words on both occasions. In both tests, subjects wrote the words and then immediately rated the correctness of each of their own spelling attempts, using a four-point rating scale. The two spellings produced by each child for each word were compared, and these comparisons were used to classify the spellings into four categories: correct spellings, 'lapse' misspellings, 'inconsistent' misspellings, and 'consistent' misspellings (as defined in Experiment 1). The procedures in the first part of the experiment were identical to those used in Experiment 1, and similar results were expected. That is, it was expected that subjects would give significantly higher correctness ratings to their own correct spellings than to their misspellings, regardless of the type of misspelling.

In the second part of the study, subjects were required to complete a spelling recognition task. The subjects returned for a third session in which they examined and evaluated various spelling

alternatives for the same words they had earlier attempted to spell to dictation. This recognition task was different from that used in Experiment 1. Three alternative spellings were provided for each word: the correct spelling, a common misspelling, and the subject's own misspelling of the word. If a child spelled a word correctly on both dictation tests, a second common misspelling of the word was supplied as the third alternative. In this experiment, subjects did not compare the alternative spellings for a word directly and choose among them, as they did in Experiment 1. Instead, they examined the alternatives one at a time, and gave a correctness rating for each one.

This type of recognition task is more difficult than the forced-choice recognition task used in the previous experiment. When alternative spellings are compared directly, the child's attention may be focussed on the particular part of the word where the two alternatives differ (e.g. beautiful vs. beautaful) and the decision facing the child is quite clear. However, when spellings are examined in isolation (for example, when a child evaluates an initial spelling attempt, or when he or she writes, evaluates, and erases a number of 'possible' spellings for a word) the entire word must be searched for errors.

If Simon's analysis is correct, then children should be able to discriminate between correct and incorrect alternative spellings for words that they cannot spell correctly to dictation, even under these demanding task conditions. That is, subjects should give significantly higher correctness ratings to the correct spellings

of words than to either common misspellings or to their own misspellings of these words. They should do so for all three categories of misspellings described earlier ('lapses', 'inconsistent' misspellings, and 'consistent' misspellings).

Method

Subjects. Twenty-five children served as subjects in this experiment. All were grade-four pupils at John Dearness Public School in London, Ontario. Twelve of these children were males, and thirteen were females. Their ages ranged from 106 to 123 months, with a mean of 115.4 months (9.6 years) and a standard deviation of 4.3 months.

Word materials. The spelling words used in this study were the same as those used in the previous experiment. They were selected from Thomas's list of the words used most often by Canadian elementary school children in their written compositions (Thomas, 1979).

Procedures. All subjects participated in three separate sessions, conducted about one week apart. The subjects were tested individually in a small room close to their own classroom. The specific procedures followed in the three sessions are described below.

A. Dictation tests. A spelling dictation test was given in the first session, and the same test was re-administered one week later. In both tests, the experimenter dictated words by pronouncing them and using them in short phrases or sentences. The child was required to write each word on a lined data sheet, and to

immediately make a judgement about the correctness of each spelling attempt. The child indicated his or her response by circling one of four symbols (✓ : ✓? : X? : X) printed next to the word on the data sheet. The child was told to circle the '✓' if he was sure that his spelling was right, or the '✓?' if he was not sure but thought that it was right. He was told to circle the 'X' if he was sure the spelling was wrong, or the 'X?' if he was not sure but thought it was wrong. This procedure was demonstrated by the experimenter, and practised by the subject on several sample words. The test itself was not administered until the subject was able to give an adequate explanation of the meaning of each of the symbols.

The basal and ceiling procedure described in Experiment 1 was used for the first dictation test, so each child was given words that were neither too easy for them nor far too difficult. All words that were between the child's basal and ceiling on the first dictation test were presented to him again in the second dictation test. Exactly the same procedures were followed in these two tests.

As stated earlier, the purpose of the re-testing was to differentiate between different types of spelling errors. The two spellings produced by each child for each word were later compared, and these comparisons were used to classify the spellings into four categories: correct spellings; 'lapse' misspellings (when the word was misspelled on only one of the two dictation tests); 'inconsistent' misspellings (when the word was misspelled twice, in two different ways); and 'consistent' misspellings (when the word

was misspelled twice in exactly the same way).

B. Recognition test. All subjects returned for a third and final session, one week after the second dictation test. Each subject was given typewritten lists of correct and incorrect spellings for the words between his or her basal and ceiling. The child was required to look at these spellings one at a time and to rate the correctness of each of them, using the four-point rating scale. Different lists of spelling alternatives were prepared in advance for different subjects. Each child's list contained all of the words he or she had misspelled in one or both of the dictation tests. For each of these words, there were three alternative spellings: the correct spelling, a common misspelling, and the child's own misspelling of the word. (If the child had produced two different misspellings for the word in the two dictation tests, then only the more recently produced misspelling was used.) Ten words that the child had spelled correctly on both dictation tests were also included in the list, to control for the possibility that subjects would simply reject any spelling that they recognized as being one of their own. The three alternatives for these words consisted of the correct spelling and two common misspellings supplied by the experimenter.

The three different spellings for each word were typed on separate pages. (The assignment of spellings to pages was counter-balanced, so for some words the correct spelling appeared on the first page, and for other words the correct spelling appeared on the second or third page). These three pages were

presented to the subject one at a time. The child evaluated all of the spellings on the first page before beginning the next, and therefore he or she never had the opportunity to make a direct comparison of the three alternatives for any given word.

The experimenter began the session by giving these instructions:

> "I'm going to show you a list of words. Some of them are spelled correctly and some are not. As I read each word, look carefully at the spelling. If you are sure it is the correct spelling, circle the check-mark next to the word. If you are not sure, but think it is correct, circle the check-question mark (✓?). Sometimes the spelling will not be correct. If you are sure it is wrong circle the 'X' next to the word. If you are not sure, but think it is wrong, circle the 'X'-question mark (X?)."

The experimenter then presented the subject with the first page of spellings and misspellings. He dictated each word and prompted the child to look at the spelling. The child indicated his or her evaluation of each spelling by circling one of the four symbols (✓ : ✓? : X? : X) printed next to the word. This procedure was repeated with the other two pages. These pages contained the same words as the first list but different spellings. (The procedures for Experiment 2 are summarized and illustrated with examples in Appendix C.)

Results

A. Correctness ratings on the dictation tests. The data in Table 3 replicate the findings from the first part of Experiment 1. That is, they show that immediately after the subjects wrote the words to dictation, they gave significantly higher correctness ratings to their own correct spelling attempts

Table 3

Subjects' ratings of the correctness of their own written spelling attempts (pooled data from two dictation tests).

Type of Spelling	Number Produced per Subject per Test	Mean Correctness Ratings (4 = ✓ : 3 = ✓? : 2 = X? : 1 = X)
[a] Correct Spellings	28.5	3.65
'Consistent' Misspellings	4.8	3.02
'Lapse' Misspellings	8.6	2.72
'Inconsistent' Misspellings	8.0	2.43

[a] Correct spellings of 'lapse' words (misspelled on one of the two tests) are included with the correct spellings produced on both tests.

than to their own misspellings. They did so for all three types of misspellings.

Table 3 shows the mean correctness ratings as a function of the four categories of spellings described earlier: correct spellings, 'lapse' misspellings, 'inconsistent' misspellings, and 'consistent' misspellings. As in Experiment 1, the mean ratings given to the different types of spellings and misspellings were compared by analysis of variance, and the overall differences among means were found to be significant ($F_{(3,72)} = 64.68$, $p < .001$). Pairwise comparisons between means, based on Tukey's HSD test, indicated that subjects gave significantly higher correctness ratings to their own correct spellings than to their misspellings, regardless of the nature of the error. Even 'consistent' misspellings were rejected as errors in about one out of four instances (24.1%) and the mean correctness ratings given to the 'consistent' misspellings were significantly lower than the ratings given to correct spellings (Tukey's HSD test, $p < .01$).

Although subjects rejected a substantial proportion of the misspellings in all three categories, the ratings did vary as a function of the error type (see Table 3). Significantly higher correctness ratings were given to 'consistent' misspellings than to 'lapse' misspellings (Tukey's HSD test, $p < .05$).) 'Lapse' misspellings, in turn, were given significantly higher ratings than 'inconsistent' misspellings ($p < .05$). Although the ratings given to 'consistent' misspellings were higher than the ratings for the other types of errors, they were still significantly lower than the ratings given to correct spellings.

B. Correctness ratings on the recognition test. The ratings given to the typed spellings in the recognition task (in the final session) showed that the children were able to differentiate between correct and incorrect spellings for words they had not been able to spell correctly to dictation. The results of the recognition test were analyzed by comparing the mean correctness ratings given to the three different types of spelling alternatives (correct spellings, common misspellings, and the subjects' own misspellings) for words in three different categories: 'lapse' words (words that were misspelled only once), 'inconsistent' words (words that were misspelled twice, but in two different ways), and 'consistent' words (words that were misspelled twice in exactly the same way). These data were subjected to a 3 x 3 analyses of variance with Type of Spelling Alternative and Word Category both serving as within-subjects factors. Significant main effects were found for Type of Spelling Alternative ($F_{(2,192)} = 268.773$, $p < .001$) and for Word Category ($F_{(2,192)} = 6.434$, $p < .05$). The interaction between these two factors was also found to be significant ($F_{(4,192)} = 11.330$, $p < .01$). The data for this analysis are summarized in Table 4, and the interaction is illustrated in Figure 2.

Tests of simple main effects for Type of Spelling Alternative (correct spellings vs. common misspellings vs. subjects' own misspellings) were significant within all three Word Categories. Subjects gave significantly higher correctness ratings to the actual correct spellings than to their own misspellings of the same words (Tukey's HSD test, $p < .01$). The subjects' own misspellings,

Table 4

Subjects' ratings of the correctness of printed spellings, as a function of the Type of Spelling Alternative and the Word Category.

Word Categories	Mean Correctness Ratings (4 = ✓ : 3 = ✓? : 2 = X? : 1 = X)		
	Correct Spellings	Subjects' Own Misspellings	Other Common Misspellings
Lapse Words	3.687	2.130	1.719
Inconsistently Misspelled Words	3.436	2.259	1.859
Consistently Misspelled Words	3.402	2.925	1.902

Note: Within rows, all pairwise differences between means are significant at $p < .01$ (Tukey's HSD test). Within columns, only the bracketed means differ significantly, at $p < .01$.

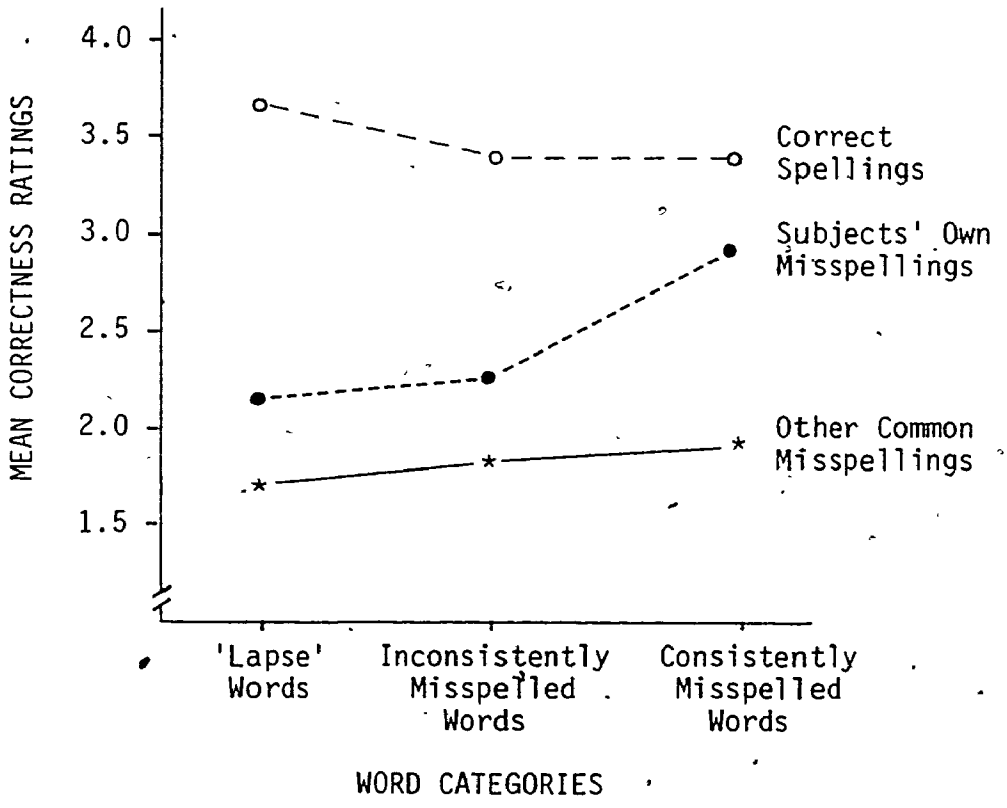

Figure 2. The interaction between Type of Spelling Alternative (correct spellings vs. subjects' own misspellings vs. other common misspellings) and Word Categories (lapse words vs. consistently misspelled words vs. inconsistently misspelled words).

in turn, were given significantly higher ratings than the other common misspellings of these words (see Table 4). The significant interaction between Type of Spelling Alternative and Word Categories is accounted for by the fact that subjects gave higher correctness ratings to their own 'consistent misspellings than to either their 'lapse' misspellings or their 'inconsistent' misspellings (see Figure 2).

These results confirm the major hypothesis in this study. That is, they show that the children were able to accurately evaluate plausible alternative spellings for many words they could not recall to dictation. Even when subjects misspelled words twice in exactly the same way, they were more likely to accept the actual correct spelling as being correct than they were to accept their own version of the word. These findings provide additional support for Simon's contention that children have some form of memory representation for words they fail to spell correctly. The results indicate that visual 'testing' of possible spelling alternatives allows children to retrieve and apply spelling information that is available but otherwise inaccessible in long-term memory.

Discussion

These results provide further evidence that grade-four children are able to detect their own spelling errors and to evaluate plausible alternative spellings for words they cannot recall directly. As in the first study, the children's immediate judgements about their own written spelling attempts were quite accurate. False rejections of correct spellings were rare, but over one-third of all misspellings were recognized as errors

immediately after they were produced. 'Lapse' misspellings and 'inconsistent' misspellings were more easily detected than 'consistent' misspellings, but even 'consistent' misspellings were rejected in a substantial number of instances. These data suggest that children are indeed capable of making effective use of a recognition test applied to their own initial spelling attempts.

The results of the recognition test provided further support for Simon's assumption that " ... the correctness or incorrectness of a spelling may be recognized in situations where we cannot recall the correct spelling (Simon and Simon, 1973; p. 117)". All subjects showed a bias toward accepting spellings as correct more often than warranted, and accepted more than one spelling for many words in the list. In spite of this, they gave significantly higher correctness ratings to the correct spellings than to the incorrect alternatives, even when the incorrect spellings were ones that they had produced themselves on two previous occasions.

The recognition task used in this study was more difficult than the recognition task used in Experiment 1. The subjects were required to examine spelling alternatives in isolation and to make a judgement about the correctness of each one, rather than to compare the alternatives directly and choose between them. Although the recognition decisions required in this task were more difficult than in Experiment 1, subjects were still able to demonstrate under these very demanding conditions that they could differentiate between correct and incorrect spellings for words they could <u>not</u> spell correctly to dictation.

The children could not have achieved this outcome by simply rejecting any spelling that they recognized as one of their own making. If they had used such a strategy, they would have judged their own correct spellings to be 'incorrect' as well as their own misspellings. In fact, the children gave very high correctness ratings to their own correct spellings of 'lapse' words (see Table 4). The correct spellings of 'lapse' words were judged 'correct' 94.2% of the time. The children also gave very high ratings ($\bar{X}$ = 3.79) to correct spellings that they had produced themselves on both of the earlier dictation tests. These correct spellings were judged 'correct' 94.7% of the time. It should be noted, as well, that the children rejected misspellings supplied by the experimenter even more often than their own misspellings. These data show clearly that the subjects' ratings were based on correctness and not simply their recollection of how they had spelled the words earlier.

Subjects could have learned the correct spellings of some words between sessions, and this might account for their ability to recognize correct spellings for words they could not spell to dictation. However, subjects were given a large number of words to spell and they were not told that they would be returning for a third session. A comparison of the dictation tests showed, as in Experiment 1, that there was no significant improvement between the first and second sessions (mean number correct on test #1 = 27.72, and on test #2 = 29.24; t_{24} = 2.007. $p > .05$). It is unlikely that much more learning would have taken place between the second

and third sessions than occurred between the first and second sessions.

In this chapter, we did not address the question of why children are more successful in recognizing correct spellings than in spelling words to dictation. The opportunity to see potential alternatives in written form may be a critical factor in spelling decisions. For example, a child might consider whether to use one 'l' or two in the word 'until' before attempting to write the word, and find that he or she is unable to resolve the uncertainty. Once these potential spellings are seen in writing, though, the correct spelling may be easily recognized. On the other hand, children may have difficulty delimiting the possible options for a given word. A child who writes 'untill' may not have considered the possibility of using one 'l' instead of two. In this situation, it may be sufficient to provide the child with 'possible' alternatives, even if one does not allow him or her to see the alternatives in printed form. Given a choice, the child may readily identify the correct spelling.

Simon has argued that visual cues <u>are</u> important in spelling recognition decisions, and that some information about words can only be retrieved from memory when written spellings are available to serve as retrieval cues. This hypothesis will be tested in the next experiment by comparing children's recognition decisions for visually presented and orally presented spelling alternatives.

CHAPTER V

Experiment 3

In the previous two chapters, evidence was presented which showed that fourth-grade children were able to make quite accurate judgements about the correctness of their own initial spelling attempts. They were also able to discriminate between correct and incorrect spellings of words which they could not spell to dictation. These findings support Simon's contention that children may recognize the correctness or incorrectness of spellings even when they cannot recall the correct spellings. The results of both experiments indicate that children have spelling information available in memory which they are unable to use in the initial production of written spellings. They <u>are</u> able to use this information, however, in the evaluation of written spellings.

Simon contends that children's judgements about their own spelling attempts and about other alternative spellings are influenced by visual cues. Her model is based on the hypothesis that the "word-recognition information" that children acquire through reading " ... can be retrieved <u>only</u> on presentation of an appropriate visual stimulus--that is, of the appropriate word, perhaps not quite correctly spelled (Simon and Simon, 1973; p. 103)." Although the subjects in the previous experiment were able to make quite accurate decisions about written spellings, those decisions may not have depended upon the opportunity to see the spellings in written form. It is quite possible that they

would have made equally accurate judgements about their own oral spellings, without any opportunity to use visual cues. Also, children may be able to choose among orally presented alternatives for words they cannot recall to dictation.

In this experiment, my purpose was to test the hypothesis that spelling recognition decisions are enhanced by the opportunity to see spellings in printed form. I tested this hypothesis by comparing the accuracy of children's decisions about the correctness of orally presented and visually presented spelling alternatives.

Method

Subjects. The twenty-six children who served as subjects in this experiment included 14 males and 12 females. All were grade-four pupils at Glen Cairn Public School in London, Ontario. Their ages ranged from 114 to 125 months, with a mean of 117.9 months (9.8 years) and a standard deviation of 3.1 months.

Materials. The spelling words were taken from Thomas's list (Thomas, 1979) of the words most frequently misspelled by Canadian schoolchildren. The words in this list represent quite a wide range of difficulty, since some are very common words that tend to be troublesome, and others are less frequently used but more difficult words. The 25 most troublesome words from each of the third, fourth, and fifth grades were used for this experiment. Because of overlap between the lists for the three grades, the list contained 50 words altogether. It was discovered in pilot work that some of the better spellers in grade four classes misspelled

only a few of the words on this list. Therefore, 10 more words were added to the list. These additional words were selected from Thomas's list of the 3000 words most frequently used by Canadian school children in their written compositions, and they were approximately equal in difficulty to the most difficult words on the original list. The 60 words on the final list were arranged in order from the least to the most difficult, based on Greene's spelling-difficulty norms (Greene, 1954).

Pre-test. All subjects were pre-tested as a group on the 60-word spelling list described above. The children's teacher dictated the words in order of difficulty, pronouncing each one and using it in a short sentence. Children were not allowed to erase errors but were told that if they made a mistake they could draw a line through the word and write it again. When the tests were marked later, only the first attempts at the words were evaluated. Pre-test results were used in selecting an appropriate starting point for each subject for a second dictation test. This second dictation test was administered during individual experimental sessions, a few days after the pre-test.

Experimental session. After the pre-test, subjects were divided into two groups by random assignment, and then tested individually. When subjects entered the testing room they were greeted and given a brief explanation of the purpose of the testing. Once the child seemed at ease, the procedures were explained and demonstrated and the testing was begun.

All subjects began the session by spelling a list of words

orally to dictation. The procedures on this dictation test were identical for all subjects. The dictation test was followed by a 'recognition' test, in which the subjects had to choose between two alternative spellings for words they had just spelled to dictation. The spelling alternatives were shown in printed form to one group of subjects, and they were presented orally to the other group. The procedures are described further below.

A. Dictation test. All subjects completed the spelling dictation test under the same conditions. This test was based on the same list of words that was used for the pre-test. Rather than have all subjects spell all 60 words, though, the experimenter started each subject on the first word he or she had misspelled on the pre-test. Since the words were arranged in order of difficulty, this procedure allowed words that were too easy for a particular subject to be eliminated from his or her list.

The experimenter dictated each word by pronouncing it and using it in a short sentence or phrase. The child was asked to spell each word "out loud" and the experimenter recorded the child's spelling by printing it on a data sheet. The spellings produced by the subjects in this dictation test were recorded so that they could be used later as 'possible' spellings in the recognition task. Whenever a child misspelled a word that he or she had also misspelled in the pre-test, the experimenter printed the correct spelling of that word on the data sheet as well as the child's orally-produced misspelling. Whenever the child spelled a word correctly in both the pre-test and the oral dictation test the

experimenter printed a common misspelling of that word on the data sheet as well as the child's correct spelling. The two alternatives for each word were printed side-by-side, with the relative positions of the correct and incorrect alternatives varying randomly from word to word.

B. Recognition task. When the dictation test was completed, the experimenter administered the recognition test. Only the first eight words misspelled on both dictation tests, and the last eight words spelled correctly on both tests were used. (Of the eight misspelled words, some had been misspelled and then correctly spontaneously by the subject in the pre-test. On average, 0.75 words per subject were of this type.) The child was presented with the two 'possible' spelling alternatives for each word, and he or she was required to identify the one that he or she thought was correct. Half of the subjects were allowed to see the spellings in printed form, and half of them had the alternatives described to them orally. The specific procedures are described further below.

(i) Visual presentation condition. In this condition, the two spelling alternatives for each word were shown to the subject in printed form. The two alternatives were presented in succession rather than simultaneously, so that the visual and oral presentation conditions would be equivalent in this respect. The data sheet containing the printed spellings was placed before the child, and it was covered by a cardboard template with a small 'window' cut out of it. The experimenter dictated each word and

used it in a short sentence or phrase (e.g. "Wait. Wait for me."). He then said, "This is the first choice," and he moved the template so that only the first spelling alternative was exposed (e.g. 'wait'). He then said, "This is the second choice," and he moved the template again so that only the second alternative was exposed (e.g. 'wate'). Each spelling was exposed only long enough for the experimenter to recite the spelling silently to himself, letter by letter, at a rate slightly faster than one letter per second). Both spellings were then covered and the subject was asked to indicate his choice. If he or she did not respond immediately, the spellings were presented a second time. The subject indicated his or her choice by repeating the 'correct' spelling aloud.

(ii) Oral presentation condition. In this condition, the two spelling alternatives for each word were described orally. For example, the experimenter would say: "Wait. Wait for me. The first choice is W-A-T-E. (The child was asked to repeat this aloud, as check that he or she had heard the experimenter correctly). The second choice is W-A-I-T. (The child was asked to repeat this, as well.) Which is the correct spelling?" The spellings were presented at a rate slightly faster than one letter per second. If the subject did not respond immediately, the two choices were repeated. Subjects indicated their choice by repeating the correct spelling aloud. (The procedures for Experiment 3 are summarized and illustrated with examples in Appendix E.)

Results

The results support the hypothesis that spelling decisions are facilitated by the opportunity to see potential spelling alternatives in printed form. The data were subjected to a 2 X 2 analysis of variance, with one between-subjects factor (mode of presentation) and one within-subjects factor (type of word). A significant main effect for 'mode of presentation' was found ($F_{1,24}$= 7.384, $p < .05$). That is, subjects were able to identify a significantly greater number of correct spellings in the 'visual presentation' condition (a mean of 13.92 correct out of 16 words) than in the 'oral presentation' condition (a mean of 12.38 correct out of 16 words). As one would expect, subjects in both groups were much more successful with words that they had themselves spelled correctly to dictation than with words they had misspelled to dictation (the means are presented in Table 5). This difference was also statistically significant ($F_{1,24}$= 59.309, $p < .001$). The interaction between these two factors was not significant ($F = 1.302$; $p > .20$). This indicates that visual cues facilitated spelling decisions for both types of words.

Ancillary findings. The results show that visual cues can facilitate the process of making spelling decisions, but it should be noted that subjects in both groups chose the experimenter-provided correct spellings over their own spellings of the words in the majority of instances. They did so in spite of the fact that they had misspelled these words in both the written pre-test and the oral dictation test, and therefore appeared genuinely unable to

Table 5

Number of correct spellings chosen in a two-alternative recognition task, for two types of words, under visual presentation and oral presentation conditions.

	Mean Number Correct Out of Eight Words	
	Visual Presentation Condition	Oral Presentation Condition
Words spelled correctly in both the pre-test and the oral dictation test	7.85	7.38
Words misspelled in both the pre-test and the oral dictation test	6.08	5.00

produce the correct spellings. These results are consistent with the findings from the first two experiments. They indicate that when a child cannot recall a spelling in response to a spoken word, he or she may still be capable of choosing between correct and incorrect spellings for that word, even when the alternatives are presented orally.

The degree of accuracy achieved by the children in the recognition task could not have been achieved by random guessing. Subjects in the 'visual presentation' group identified the correct spellings for 6.08 out of the 8 words they had misspelled to dictation, on the average. This is a significantly better than 50% accuracy ($t_{12} = 5.965$, $p < .001$). Subjects in the 'oral presentation' group did not do as well, but they did identify an average of 5.00 correct spellings out of the 8 words they had misspelled to dictation. Again, this is significantly better than 50% accuracy ($t_{12} = 2.944$, $p < .05$).

Subjects in either group could have achieved this outcome by simply rejecting any spelling that they recognized as being one of their own making. Such a strategy would lead them to reject some of their own correct spellings, however, and this rarely occurred. Subjects chose their own correct spellings over the experimenter-provided misspellings in 7.85 out of 8 instances in the 'visual presentation' condition, and in 7.38 out of 8 instances in the 'oral presentation' condition. These results indicate that the subjects' decisions were based on their judgements about the correctness of the alternative spellings and not simply on their

recollection of how they had spelled the word earlier in the dictation test.

Discussion

The results support the hypothesis that spelling recognition decisions are facilitated by the opportunity to see potential alternative spellings in printed form. As predicted, subjects were more successful in choosing between the two alternative spellings for each word when the alternatives were presented visually rather than orally. This suggests that it would indeed be useful to generate and 'test' a list of possible alternatives for a word when one is uncertain about its spelling.

The performance of the subjects in this experiment on the recognition task was also consistent with findings from Experiments 1 and 2. Even when the children misspelled words twice to dictation (once in writing and once orally) they often knew that their spellings were wrong. When the children were given alternatives to their own spellings they usually accepted their own correct spellings over incorrect alternatives, but they rejected their own misspellings in favour of the correct alternatives in the majority of instances. This was true even in the 'oral presentation' condition, although the degree of accuracy was not as high as in the 'visual presentation' condition.

This outcome suggests that the most difficult step in spelling a word may be generating or delimiting the possible options. Once the alternatives are clear (even if the alternatives are not seen in written form) the final choice may be relatively easy. The

implications of these findings will be examined further in the General Discussion.

Although the results show that visual cues contribute to spelling decisions, recognition testing is not necessarily mediated by 'visual memory', at least in the usual sense of that term. Children may 'test' written spellings by looking for letter patterns that violate orthographic rules. Visual cues could be helpful in this process. Children could also 'test' written spellings by reading them and trying to match the symbols with sounds in auditory memory. Simon noted that this latter strategy could be used to detect unpronounceable or 'non-phonetic' misspellings, but it could not be used to choose between plausible graphemic options (e.g. wait vs. wate). We will return to this issue as well in the General Discussion.

CHAPTER VI

Experiment 4

As a practical application of their theory, Simon and Simon suggested that:

> "It may be effective to make children explicitly aware of the generate-and-test technique, and to encourage them to try out alternatives, rather than arriving immediately at the 'one correct spelling' (Simon and Simon, 1973; p. 136)."

This suggestion was based on the hypothesis that recognition testing would allow children to retrieve and apply spelling information that was otherwise inaccessible in long-term memory. They provided no empirical evidence to support this suggestion, however. The purpose of the experiment to be described in this chapter was to test the hypothesis that children are able to improve their spelling performance by using a 'generate-and-test' spelling strategy.

Although no-one has yet demonstrated that writing out and 'testing' spelling alternatives has any effect on children's spelling accuracy, a study by Blumberg (1976) dealt with a related issue. Blumberg tested the effectiveness of a word-study technique based on the generate-and-test model, using sixth-grade children as subjects. When new words were introduced in spelling lessons, some students were required to generate trial spellings for each word before viewing the correct version and comparing it to their own attempts. Control subjects were shown the correct spelling first,

and then practised spelling the words from memory.

Contrary to expectations, experimental group subjects did no better than control subjects on a long-term retention test. There was some indication, however, that their initial acquisition of the spellings was more rapid. Blumberg's study was designed to test the effects of a generate-and-test procedure on the acquisition of new spelling knowledge, rather than to test Simon's suggestion that writing and testing alternatives should facilitate the retrieval and application of previously learned spelling information.

The experiment to be described in this chapter will test the hypothesis that children's spelling accuracy can be enhanced by the use of a generate-and-test spelling strategy. The fourth-grade children who served as subjects were divided by random assignment into one experimental group and two control groups. The subjects in the experimental group were prompted to write out 'possible' alternative spellings for a word, and to visually inspect the alternatives before making their final decision and writing out the spelling they considered correct. Subjects in an 'attention control' group were prompted to generate possible spelling alternatives orally before making a final decision about the word and writing the 'correct' spelling. These subjects, like those in the experimental group, had to think about the possible ways of spelling each word, but they had no opportunity to use visual recognition testing. Subjects in a 'direct recall' control group simply wrote each word once to dictation. If the recognition testing mechanism described by Simon and others is in fact viable,

then the subjects in the experimental group should spell more words correctly on their final attempts than the subjects in either control group.

Method

Subjects. Thirty-nine children, including 16 males and 23 females participated as subjects in this study. The subjects were grade four pupils from Lord Elgin and Manor and Highland Park Public Schools in London, Ontario. Their ages ranged from 112 to 132 months, with a mean of 119.2 months (9.9 years) and a standard deviation of 4.9 months.

Materials. The 60 words used in this experiment were the same as those used in the previous study. The list is based on Thomas's compilation of the words most frequently misspelled by Canadian schoolchildren in their written compositions (Thomas, 1979).

Pre-test. All subjects were pre-tested as a group on the list of 60 words described above, using a standard dictation test format. The words were presented in order of increasing difficulty. Subjects were not allowed to erase errors on this test, but were told that if they made a mistake they could draw a line through the word and write it again. When the tests were marked, only the first attempt at each word was evaluated.

The results of the pre-test were used to select appropriate words for each subject, to be dictated again in a later experimental session. The first 12 words misspelled by a subject and the last 12 words spelled correctly were entered on a list. (Of the 12 misspelled words, an average of 1.23 words per subject

had been corrected spontaneously in the pre-test.) This list of 24 words was then used in an individual session with the subject, a few days after the pre-test.

Experimental conditions. After the pre-test, the subjects were divided by random assignment into three groups. These consisted of the experimental group and the two control groups mentioned earlier. When the child entered the testing room he or she was greeted and given a seat across the corner of the table from the experimenter. The purpose of the test was explained briefly. The child was re-assured that he or she would not be graded on the test, but was urged to do his or her best to spell the words correctly. The test procedures were explained and demonstrated with a few sample words before the 24-word list was administered. The specific procedures followed in each of the three conditions are described below.

A. Experimental group. Subjects in the experimental group were prompted to generate and 'test' a number of spelling alternatives for each word before making their final spelling attempts. When a word was dictated, the subject was told to write it on a 'practice' sheet of paper. After this first attempt, he or she was asked to think of " ... at least two other possible ways to spell the word", and to write these spellings on the practice sheet. Finally, the child was asked to decide which was the correct spelling and to write it on the 'test paper'. Subjects who failed to write at least three alternatives for a word were prompted to "Try to think of another way that this word could be spelled." This prompt was

given regardless of whether the initial attempts were correct, of course, and no other prompts or assistance were given. The experimenter demonstrated this procedure with a few sample words, first writing out alternatives himself and choosing among them, and then asking the child to try this with a few sample words. Once the child understood the procedure, the 24-word list was administered.

B. Attention-control group. In this condition, subjects were prompted to think of alternative spellings for each word before making their final spelling attempt, but they produced these alternatives orally. They had no opportunity, therefore, to use visual recognition testing before making their final decisions about how to spell the words.

When a word was dictated, the subject was asked to 'practice' by spelling it out loud. After the first attempt, he or she was asked to think of " ... at least two other possible ways to spell the word", and to report these orally. Subjects who stopped before giving at least three alternative spellings for a word were prompted to "try to think of another way that this word could be spelled." The experimenter recorded the child's oral spellings, out of the child's sight. Finally, the experimenter asked the child to decide on the correct spelling of the word and to write it on the 'test paper'. This procedure was demonstrated with a few sample words before the test itself was administered.

This condition was designed to control for the effects of structured effort and attention on spelling accuracy. These

control subjects were required to think about spelling alternatives for each word--a task that required concentration and sustained effort. In this respect, it was equivalent to the experimental condition. Because the spelling alternatives were produced orally, however, these subjects had no opportunity to use visual recognition testing before making their final attempts at spelling the words.

C. Direct recall group. In the 'direct recall' condition the words were dictated and the subjects were simply required to write them on the 'test paper' provided. Each word was attempted only once, and therefore subjects in this group had no opportunity to use visual recognition testing in making their spelling decisions. (The procedures for Experiment 4 are summarized and illustrated with examples in Appendix G).

Results

The results show that the recognition testing strategy did have a significant positive effect on spelling decisions. Table 6 shows the average number of correct final spelling attempts produced by the subjects in each of the three groups. Overall differences among the means are significant ($F_{(2,36)} = 10.837$, $p < .01$). Pairwise comparisons between means showed that subjects in the experimental group produced a significantly greater number of correct spellings than subjects in either of the control groups (Tukey's HSD test, $p < .01$). The mean number of correct spellings was slightly higher in the 'attention control' condition than in the 'direct recall' condition, but this difference was not

Table 6

Comparison of the final spelling attempts of subjects in the Experimental Group, the Attention Control Group, and the Direct Recall Control Group.

Condition	Mean Number Correct on Final Attempt	Differences Between Means		
		$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$
Experimental Group	$\bar{X}_1 = 16.38$	-	2.62 *	3.85 **
Attention Control Group	$\bar{X}_2 = 13.77$		-	1.23 n.s.
Direct Recall Control Group	$\bar{X}_3 = 12.54$			-

Overall differences among means are significant ($F_{2,36} = 10.84$, $p < .01$).

* Pairwise comparison is significant (critical HSD = 2.064; $p < .05$).

** Pairwise comparison is significant (critical HSD = 2.631; $p < .01$).

statistically significant. These results support the hypothesis that the use of a 'generate-and-test' spelling strategy enhances children's spelling accuracy.

The oral and written spelling alternatives produced by the experimental subjects and attention control subjects were also examined. The purpose of this analysis was to determine whether the opportunity to see written spellings affected the process of generating alternative spellings, or only the subjects' final choices among the 'possible' spellings.

Subjects in both groups had difficulty generating as many as three alternative spellings for each word. The experimental subjects were able to produce only 2.52 written alternatives per word, on the average, and the attention-control subjects produced only 2.32 oral alternatives per word. The difference between these means is not statistically significant (t_{24}= 1.124, $p > .20$). Some subjects in both groups were consistently unable to think of more than two 'possible' spellings for any of the words. Others seemed to have particular difficulty 'inventing' incorrect spellings when their initial attempt at spelling the word was correct. They produced only one 'practice' spelling for some words, therefore.

The accuracy of the 'practice' spellings was also compared across the two conditions. The experimental group subjects, who produced written 'practice' spellings, spelled 12.31 out of 24 words correctly on the <u>first</u> attempt, on the average. The attention control subjects, who produced oral 'practice' spellings,

spelled 12.15 out of 24 words correctly on the first attempt. The difference between these means is not statistically significant (t_{24}= 0.112, p > .20). (The direct recall control group made only one attempt at each word, and spelled an average of 12.54 out of 24 words correctly.)

Although initial practice attempts were equally accurate under the two conditions, subsequent practice attempts were not. The experimental subjects produced a mean of 5.54 correct spellings in their second, third, or later written 'practice' attempts. The attention-control subjects produced only 3.61 correct spellings in their later oral 'practice' attempts. The difference between these means is statistically significant (t_{24}= 2.385, p <.05).

These results confirm that the performances of the two groups did not differ until after the experimental subjects had produced at least one written spelling and had their first opportunity to apply a visual recognition 'test'. This suggests that after the first spellings were written out in the experimental condition, the visual cues provided by the initial spelling attempt facilitated the generation of other 'possible' alternatives. The decision process itself also appeared to be affected by the opportunity to look at written spellings. When the generated list of 'possible' alternatives actually included the correct spelling, experimental group subjects were able to identify the correct spelling 90.7% of the time, on the average. The attention-control subjects were able to identify the correct spelling 80.2% of the time when their generated list of alternatives actually included the correct

spelling. This difference between conditions is significant ($t_{24} = 2.839$, $p < .05$).

Discussion

The generate-and-test strategy resulted in greater spelling accuracy by the experimental subjects, and the results therefore support Simon's claim that spelling difficulties may be resolved by writing out and testing possible alternatives. The generate-and-test strategy allowed for visual inspection of written spellings, but it may also have encouraged subjects to pay greater attention to the task and simply to think more carefully about each word before making a final decision. These latter factors, rather than visual recognition testing per se, might account for the superiority of the experimental group over the 'direct recall' control group. However, this would not explain the differences in performance between the 'experimental' and 'attention-control' groups. In both of these conditions, subjects were encouraged to think about possible alternatives for each word, and similar degrees of concentration and sustained effort were required. The only difference was that experimental subjects wrote out the alternatives, while 'attention control' subjects generated them orally. Therefore, only the experimental subjects had an opportunity to apply a visual recognition 'test' to their own output.

As mentioned, experimental subjects generated a relatively small number of alternatives for most words. When the first alternative was incorrect it was usually corrected on the second

attempt, if at all. This suggests that it may be unnecessary to generate and directly compare several alternatives. The visual cues provided by a partially correct initial spelling may be sufficient to 'bring to mind' the correct spelling in many instances. This possibility will be examined in the next experiment.

CHAPTER VII

Experiment 5

The experiment to be described in this chapter is similar in design and purpose to the previous one. The primary objective was to test the effects of a simplified recognition testing procedure on spelling accuracy. A second objective was to further assess the effects of visual cues on children's judgements about the correctness of their own initial spelling attempts.

Simon described two ways in which a speller might approach the task of re-writing a misspelled word, once he or she had detected the error. "It may be necessary to activate processes similar to the generate-phoneme processes to try different optional spelling patterns from the 'optional pattern lists' for ambiguous phonemes. (Simon, 1976, p. 294)." That is, the child might generate possible alternatives to the original misspelling by applying phoneme-grapheme correspondences, and continue doing this until the correct spelling was 'hit upon' and recognized. It may not be necessary, however, to generate and compare several alternatives. Simon assumes that a visual stimulus in the form of a partially correct spelling can facilitate the retrieval of a previously inaccessible internal representation of a word. If this is so, then a relatively simple test-rewrite strategy may be effective. The child might simply examine the spelling and attempt to identify the incorrect letter(s) by comparing the misspelling to the model found in memory. The child could then " ... make the corrections

indicated by the internal model (Simon, 1976, p. 293-294)."

In the experiment to be described below, subjects were divided by random assignment into three groups, consisting of one experimental group and two control groups. Subjects in the experimental group were prompted to use the generate-test-rewrite strategy described above. That is, they were required to write a practice spelling for each word, and to make a judgement about the accuracy of the practice spelling before attempting the word a second time. Subjects in an 'attention control' group were prompted to give an oral 'practice' spelling, and to judge the accuracy of that spelling before making a written spelling attempt. Thus, they were encouraged to attend to and think about their spelling of the word prior to their final decision, but they had no opportunity to use visual recognition testing. Subjects in a 'direct recall' group simply made one attempt at writing each word. If the generate-and-test strategy is effective in providing access to encoded spelling information, then subjects in the experimental group should spell more words correctly on their final attempts than subjects in either control group. The subjects' judgements about the correctness of their initial spelling attempts (practice spellings) will also be examined, to further test the hypothesis that visual cues facilitate spelling decisions.

Method

Materials. The words used in this study were the same as those used in the previous two experiments. The 60-word list was based on Thomas's compilation of the words most frequently misspelled by

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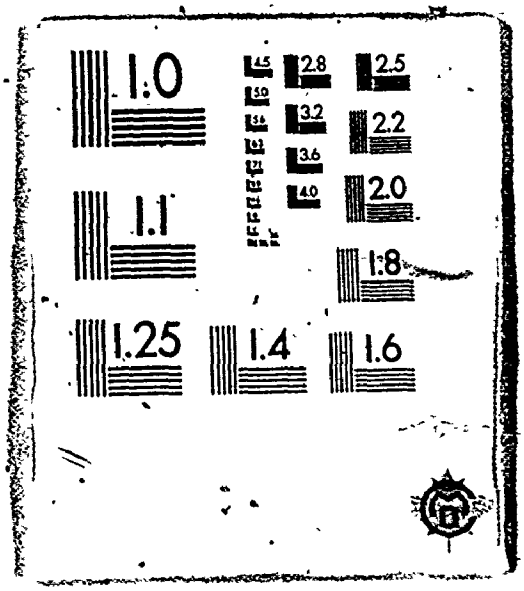

Canadian schoolchildren in their written compositions (Thomas, 1979).

Subjects. The forty-two children who served as subjects were all grade-four children from the Brick St. and C. C. Carrothers Public Schools in London, Ontario. The ages of the subjects ranged from 114 to 128 months, with a mean age of 119.0 months (9.9 years), and a standard deviation of 4.1 months.

Pre-test. The subjects were pre-tested as a group on the list of 60 words described above. The words were dictated by the teacher in order of increasing difficulty, using a standard dictation test procedure. That is, each word was pronounced and used in a short sentence or phrase. The children were not allowed to erase errors in this test, but were told that if they made a mistake they could put a line through the word and write it again. When the tests were marked later, only the first attempt at each word was scored. The first 12 words misspelled by a subject were entered on a list and this list was used for that subject in the experimental session, a few days later. (Of the 12 misspelled words, an average of 1.13 per subject had been corrected spontaneously in the pre-test.) The last 12 words spelled correctly by a subject on the pre-test were also entered on the list to be used in the experimental session.

Experimental conditions. Following the pre-test, the subjects were divided by random assignment into three groups, consisting of an experimental group and two control groups. All subjects were tested individually. When a child entered the testing room the

experimenter explained the purpose of the testing in very general terms. The child was re-assured that he or she would not be graded on the test, but was urged to do his or her best to spell the words correctly. Once the child seemed at ease, the specific procedures were explained and demonstrated with a few sample words. The procedures used in the three conditions are described below.

A. Experimental group. In this condition, subjects were given an opportunity to use a generate-test-rewrite strategy. That is, they were asked to write a trial or practice spelling for each word, and to 'test' this spelling for recognition before making a final written spelling attempt. When a word was dictated, the child was told to write a 'practice' spelling on the left side of the page. The experimenter then asked the child to look at the practice spelling and say whether he or she thought it was 'right' or 'wrong', and whether they were 'sure' or 'not sure' about that judgement. The child gave his or her response orally. Finally, the child was asked to write the "correct" spelling on the right side of the page.

B. Attention-control group. In the attention-control condition, subjects were required to 'practise' by spelling each word orally, and to evaluate their oral spelling before trying to write the word. When a word was dictated, the child was told to spell it out loud. The experimenter recorded the child's spelling on a data sheet (out of the child's sight), and then asked him or her to "listen carefully". The experimenter repeated the child's spelling orally, and asked whether the child thought the spelling

was 'right' or 'wrong' and whether he or she was 'sure' or 'not sure' about that judgement. Finally, the child was asked to write the correct spelling on the sheet of paper provided.

This condition was designed to control for the effects of structured effort and attention on spelling accuracy. These control subjects, like those in the experimental group, were required to practice each word and to think about whether their spelling was correct before making a final decision about how to write the word. However, their practice spellings were given orally. They had no opportunity, therefore, to use visual recognition-testing before making their final spelling attempts.

C. Direct recall group. In the direct recall condition, each word was dictated in the usual manner. The child was asked to think carefully about the word and to write the correct spelling on the paper provided. Only one attempt was allowed for each word, and therefore these subjects had no opportunity to use visual recognition-testing before making their decision about how to write the word. Subjects were asked to look at each of their spelling attempts, after writing them, and to say whether they thought it was 'right' or 'wrong', and whether they were 'sure' or 'not sure' about that evaluation. (The procedures for Experiment 5 are summarized and illustrated with examples in Appendix I.)

Results

The results show that subjects were able to improve their spelling accuracy significantly by writing out and 'testing' practice spellings for the words. Table 7 shows the average number

Table 7:

Comparison of the final spelling attempts of subjects in the Experimental Group, the Attention Control Group, and the Direct Recall Control Group.

Condition	Mean Number Correct on Final Attempt	Differences Between Means		
		$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$
Experimental Group	$\bar{X}_1 = 16.14$	-	2.35 **	2.64 **
Attention Control Group	$\bar{X}_2 = 13.79$		-	0.29 n.s.
Direct Recall Control Group	$\bar{X}_3 = 13.50$			-

Overall differences among means are significant ($F_{2,39} = 13.12$, $p < .01$).

** Pairwise differences between means are significant (critical HSD = 1.754; $p < .01$).

of correct final spelling attempts by subjects in the three groups. The overall differences in accuracy among the three groups are significant ($F_{(2,39)} = 13.120$, $p < .001$). Pairwise comparisons between means show that the experimental group did significantly better than either of the control groups (Tukey's HSD test, $p < .01$). The 'attention-control' and 'direct recall' groups did not differ significantly from each other.

The practice spellings produced by the subjects in the experimental and attention-control groups were also compared. The purpose of this comparison was to determine whether there were differences between the groups before the experimental subjects had an opportunity to apply a visual recognition 'test'. In fact, the practice spellings produced by the subjects were about equally accurate under the two conditions. On average, the experimental subjects produced 13.64 correct written practice spellings out of the 24 words attempted. The 'attention-control' subjects produced an average of 13.71 correct oral practice spellings out of the 24 words attempted. The difference between these means is not statistically significant. (The direct recall control group made only one attempt at each word, and spelled an average of 13.50 out of 24 words correctly.) Since differences between the written practice and oral practice groups did not emerge until after the practice spellings had been produced, those differences may reasonably be attributed to the different opportunities for visual recognition testing provided by the different practice conditions.

These results show that the opportunity to 'test' written

spellings can enhance children's spelling performance. Spelling accuracy is improved when children are given the opportunity to 'test' their initial written spelling attempts before making final spelling decisions. Direct comparison between the 'possible' alternatives for a given word appears to be unnecessary.

Ancillary findings. The subjects' judgements about the accuracy of their practice spellings were also examined. The purpose of this analysis was to determine whether the misspellings were more easily detected when they were written out then when they were produced orally. Such a finding would give further support for the hypothesis tested and confirmed in Experiment 3--namely, that visual cues facilitate spelling decisions. The data show that false rejections of correct spellings were infrequent in both conditions. The 14 subjects in the 'written practice' group together rejected a total of only 5 correct practice spellings. The oral practice subjects together rejected only 2 correct spellings. These 'false alarm' rates are too low to allow meaningful comparison between the two groups. Subjects were significantly more successful in detecting errors in the written practice condition than in the oral practice condition. The mean 'error detection rate' (the proportion of misspellings judged 'wrong') was .464 for the written practice spellings, and .260 for the oral practice spellings. This difference is statistically significant ($t_{26} = 3.567$, $p < .005$). (The 'direct recall' control subjects also evaluated their only written attempt at each of the words. The mean 'error detection rate' for this group was .405).

The ability to detect misspellings may also be expressed in terms of d', which is based on both the 'error detection rate' and the 'false rejection rate'. Unfortunately, many of the subjects judged all of their correct spellings to be correct, and no d' can be calculated with a 'false rejection rate' of zero. (When $p(Y|n) = 0$, Z_{sn} and $d' = \infty$). The fact that subjects used a 4-point rating system provided a partial solution to this problem. Each word was rated as: 'correct-sure'; 'correct-not sure'; 'incorrect-not sure'; or 'incorrect-sure'. For this analysis, only a 'correct-sure' rating was counted as an acceptance of a spelling. All other ratings (including 'correct-not sure') were treated as rejections of the spelling. Theoretically, this provides an unbiased estimate of the d' for each subject (Swets, 1964). Using this method, the mean d' for the 'written practice' subjects (1.699) was compared to the mean d' for the 'oral practice' subjects (1.578) and the difference between groups was found to be significant ($t_{26} = 2.070$, $p < .05$). (The mean d' for the 'direct recall' subjects was 1.674.) The difference between the 'written practice' and 'oral practice' conditions indicates that subjects were better able to differentiate between correct and incorrect initial spelling attempts when they had an opportunity to see their spelling attempts in printed form. This supports the hypothesis that visual cues facilitate spelling recognition decisions.

Discussion

The results show that the experimental subjects were able to apply visual recognition testing effectively to their own written

spelling output. Those subjects who had an opportunity to see their initial spelling attempts in written form before making their final attempts produced significantly more correct spellings than subjects who had no such opportunity. Their judgements about their initial attempts were also more accurate when these attempts were written rather than oral.

As in the previous study, experimental subjects may have attended more closely to the task than 'direct recall' subjects, or they may have been encouraged to simply think more carefully about the words. These factors would not explain the differences in performance between the experimental and 'attention-control' groups, however. In both conditions, the children were required to think of a possible spelling for each word and to evaluate that spelling before making a final attempt at writing the word. This required as much concentration, time, and effort in the oral practice condition (attention-control group) as in the written practice condition (experimental group). Therefore, the superior performance of the experimental subjects can be attributed to the opportunity to use visual recognition testing.

This experiment provides further empirical evidence that visual recognition testing is a viable strategy and a useful supplement to direct recall. The findings support Simon's analysis, and indicate that visual cues can enhance the retrieval and application of spelling knowledge.

CHAPTER VIII

General Discussion

The results of these five experiments, taken together, provide strong empirical support for Simon's model of spelling strategies and processes. The findings indicate that when children misspell words, they often have accurate information about those words available in memory. Some of this information is inaccessible during the production of initial spelling attempts, but it still may be used to evaluate written spellings or to choose between possible alternatives for words the child cannot recall directly. These findings have important implications for applied spelling research. The results also support the hypothesis that spelling recognition decisions are facilitated by the availibility of visual cues. This hypothesis is the basis for Simon's suggestion that children might resolve uncertainties about words by writing out and 'testing' trial spellings. Finally, the results show that the visual recognition testing strategy is viable in the sense that the use of this strategy has a positive effect on children's spelling performance.

Retrieval Problems and Spelling Errors

One of the important assumptions in Simon's analysis is that retrieval difficulties are an important factor in children's spelling errors. Simon contends that children acquire spelling knowledge through reading and that they retain in memory at least partial representations of most words in their reading

vocabularies. Even when the information in memory is accurate, however, the child may be unable to produce a correct spelling because ...

> " ... much of the 'visual' information about words ... remains inaccessible for recall until a written version of the word is available as a retrieval cue (Simon and Simon, 1973; p. 131)."

Simon predicted on the basis of this theoretical analysis that children would be able to recognize whether or not their own written spelling attempts were correct, and that they would be able to differentiate between correct and incorrect spellings of words that they could not spell correctly to dictation.

Simon's explanation of spelling errors is very similar to Tulving and Pearlstone's interpretation of recall failures in other types of memory tasks (Tulving and Pearlstone, 1966). These authors pointed out that failure to recall an item did not necessarily mean that the item was unavailable in memory storage. They argued that ...

> " ... a substantial part of non-recall of familiar words [in verbal learning experiments] is attributable to inaccessibility of otherwise intact memory traces."

Tulving and Pearlstone cited the discrepancy between recall and recognition and the superiority of cued recall over uncued recall to support their hypothesis.

Other writers have taken positions contrary to Simon's, attributing spelling errors primarily to deficiencies in spelling knowledge or in word-analysis skills (e.g. Nelson, 1980; Boder, 1967). If learning, retention, and perceptual problems are the

causes of most spelling errors, then one would not expect children to be able to evaluate their own spelling attempts successfully or to be able to choose between alternative spellings for words they cannot spell to dictation.

The findings clearly supported Simon's position. The fourth-grade subjects in Experiment 1 were able to make quite accurate judgements about the correctness of their own written spelling attempts. They recognized their correct spellings as being correct in virtually all instances, and they detected a substantial number of their own spelling errors. The errors detected by the children included misspellings that they themselves had repeated twice in two earlier attempts to spell the words to dictation. These were not just carelessly produced misspellings for words the children actually knew quite well. These findings were replicated in Experiment 2.

The results of the 'recognition tests' used in Experiments 1 and 2 also confirmed Simon's predictions. In Experiment 1, subjects were required to choose between spellings that they had produced themselves and alternative spellings of the same words. They almost always chose their own correct spellings over incorrect alternatives. However, they rejected a significant majority of their own misspellings in favour of correct spellings provided by the experimenter. Subjects even rejected a majority of the misspellings that they had repeated twice in the same form in the two dictation tests, and that they had initially considered 'correct'. Some pertinent information about the misspelled words

must have been available in memory to enable the children to make these correct recognition decisions.

The 'recognition' task used in Experiment 2 provided a more stringent test of Simon's hypothesis, and the predictions were again confirmed. The children spelled words to dictation, attempting each one twice. Later they were presented with three alternative spellings for each of the words used in the dictation tests. They evaluated these alternatives one at a time, rather than comparing them directly and choosing between them. The subjects gave significantly higher correctness ratings to correct spellings than to misspellings of the same words, even when they had produced the same misspellings themselves in both of the dictation tests.

The superiority of recognition over recall in these first two experiments may have been partly due to learning between sessions but this did not appear to be an important factor. In Experiment 3, when the recognition task was given immediately after the recall task, the children still were able to choose between spelling alternatives for words they could not recall directly. The subjects' success in evaluating alternatives for words they had earlier misspelled to dictation suggests that they had some knowledge of these words which they did not use during the production of their initial spelling attempts.

It is possible that the abstract nature of the encoded information used in recognition, rather than its inaccessibility, makes it unsuitable for use in the production of spellings.

Henderson and Chard (1980) have argued that written spellings might be recognized on the basis of vague characteristics such as overall shape, for example, whereas the correct production of a spelling requires detailed letter-by-letter knowledge of the word. Readers may indeed respond to the overall configurations of words (the word 'el__ph__nt' is easily decoded, for example), but spelling recognition decisions are quite different from 'reading recognition'. Choosing between alternative spellings (e.g. elephant vs. elephent) or evaluation of the correctness of a single spelling attempt does require attention to details and quite specific knowledge of ~~the letter-by-letter~~ structure of the word.

The results of Experiments 4 and 5 were consistent with Simon's 'inaccessibility' explanation of recall failures. In both experiments, subjects were able to produce correct spellings for words that they were initially unable to recall by using the recognition testing technique. One might describe the strategy of writing out and testing potential spellings as a 'self-cueing' device, which enhances retrieval of otherwise inaccessible spelling information. The success of this strategy indicates that information about the initially unrecalled words was not only available in memory, in many cases, but also was sufficient for written production of correct spellings.

These findings suggest that greater attention should be given to retrieval and output processes in applied spelling research. Pedagogical studies have tended to focus on methods of enhancing the acquisition and retention of spelling knowledge. Researchers

have compared the effects of direct and incidental approaches to the teaching of spelling rules and generalizations (Horn, 1937; 1944; Reid, 1966); various methods of grouping words on spelling lists (Osburn, 1954); visual, oral, and kinesthetic modes of word presentation (Fernald, 1943), and a variety of word-study techniques (Blumberg, 1980). They have given relatively little attention to the act of spelling itself, or to methods for enhancing the retrieval and application of previously acquired spelling knowledge.

The literature on spelling disabilities has also focussed on learning problems and perceptual deficits and the methods that are used in remedial programming reflect this orientation. Programs are frequently designed to facilitate the initial learning of words and spelling principles (e.g. Allred, 1977, Peters, 1967), to strengthen mental images of words (Fernald, 1943; Radaker, 1963), or to develop word-analysis skills. Further research is needed to develop methods of maximizing children's use of their existing spelling knowledge. Relatively simple approaches such as reinforcing attention to the task and encouraging proof-reading may be effective. On the other hand, it may be necessary to train children in specific retrieval strategies and to program for generalization beyond the training environment.

Visual Cues and Spelling Decisions

An important assumption in Simon's analysis is that some spelling information can only be retrieved from memory storage when a visual stimulus is available--that is, when the child has an

opportunity to look at a written version of the word, " ... perhaps not quite correctly spelled (Simon and Simon, 1973; p. 130)." The findings supported this hypothesis. In Experiment 3, the children were required to spell dictated words orally. Later, they were required to choose between the spellings they had produced themselves and alternative spellings of the same words. The subjects were more successful in choosing between the alternatives when they were presented visually rather than orally.

The results of Experiments 4 and 5 also supported this hypothesis. In both experiments, subjects were able to improve their recall performance by writing out and examining potential spellings before their final attempts at writing the words. Generating and testing oral spelling alternatives had no significant effect on recall performance. In Experiment 5, as well, judgements about the correctness of written practice spellings were more accurate than judgements about oral practice spellings. These results indicate that visual cues do have a positive effect on spelling decisions.

A study by Fisher and Craik (1977) suggests a possible interpretation of these findings. These authors presented subjects with lists of words for later recall, and induced them to attend to either the sounds or the meanings of words. Recall of the words was tested under semantic cueing and phonemic cueing conditions. Recall was improved when the retrieval cue was compatible with the encoding condition. A similar principle may apply to spelling. That is, retrieval of visually encoded spelling information might

depend upon the availability of visual cues, whereas information about sound-letter relationships and spelling rules might be retrieved in response to sound cues alone (as in a dictation test).

Henderson and Chard (1980) have suggested an alternative explanation of the superiority of visual presentation over oral presentation of spellings. They argue that visual presentation "... owes its superiority not to its allowing more efficient access to the visual lexicon ... " but rather to the greater ease of extracting information from a parallel display rather than a serial presentation of spelling information.

To support this argument, Henderson and Chard tested children's ability to recall dictated words after six seconds of interpolated activity, under three different word presentation conditions. One group of children had complete words presented to them visually for six seconds (parallel visual display). A second group had each word presented visually one letter at a time (serial visual display) and a third group had each spelling presented auditorally one letter at a time (serial auditory presentation). Performance was significantly better with parallel visual display than with either visual or auditory serial presentation. The performance of the latter two groups did not differ significantly.

Henderson and Chard concluded that the parallel-serial distinction was more important than the sense modality. A similar explanation might account for the findings in Experiments 3 and 5, where children were found to be more successful in evaluating spellings when those spellings were presented visually rather than

orally. It should be noted, however, that Henderson and Chard used a short-term recall task in their study, and this is quite different from asking children to make judgements about the correctness of spellings, as in the present research. It remains to be seen whether the parallel vs. serial presentation effect found by Henderson and Chard can be obtained in both types of spelling tasks.

Although the evidence indicates that visual cues facilitate spelling recognition decisions it does not necessarily follow that such decisions are based upon visually encoded mental representations of words. Children could evaluate their written spelling attempts by comparing them to visually encoded representations or mental images of specific words. If a match was obtained between a visual stimulus (i.e. a written word) and an internal representation, the spelling would be accepted as correct.

This might be referred to as a 'visual' checking strategy, but the term could be misleading. Frith (1980) has pointed out that one does not have to see a word in a particular type-face or handwriting style in order to recognize it. If 'visual' representations are used at all, therefore, they may be quite abstract in nature. Some authors avoid the implication of 'mental snapshots' by using the terms 'lexical' or 'word-specific' to refer to spelling strategies which are based upon letter-by-letter knowledge of the spelling patterns of specific words.

Children could also evaluate written spellings by using their knowledge of grapheme-phoneme correspondences. Spellings could be

'sounded out' letter-by-letter and if the obtained pronunciations matched the stimulus words the spellings would be accepted as correct. This strategy, which could be called 'phonetic recoding', would have the disadvantage of allowing 'phonetic' misspellings to pass undetected.

Children might also use rule-based strategies to check their written spelling attempts. This process might also be facilitated by visual cues. The written spelling could serve as a kind of processing aid, allowing the child to focus attention on difficult parts of words, search for illegal letter sequences, check for rule violations, and so on.

The primary purpose of this thesis was to test the viability of the recognition testing strategy described by Simon, rather than to determine the nature of the encoded spelling information used by children in 'testing' their own spelling output. However, this latter issue is an important subject for further study. Of course, it is quite possible that children combine more than one strategy, or they may use different approaches according to the demands of the particular situation. A child might tend to use a phonetic' recoding strategy in proofreading a paragraph, for example, but use a 'visual' or rule-based strategy to check the spelling of an isolated word on a spelling test.

There may also be significant individual differences in the tendency to use one strategy or another. Baron, Treiman, Wolf, and Kellman (1980) have shown that adults differ in terms of their reliance on rules and correspondences in reading and spelling.

Some people make extensive use of letter-sound relationships, and Baron et al. refer to these individuals as "Phoenicians" (after the inventors of the alphabet). They describe individuals who rely on word-specific memory as "Chinese" readers (in reference to the ideographic Chinese writing system). They attribute these individual differences to deficits in the ability to analyze the phonemic structure of words in "Chinese" readers. Corresponding differences may be found in the way that individuals evaluate their own spelling output.

Practical Implications

Although this research has shown that the visual recognition testing strategy is available and functional, caution is required in generalizing from these results and drawing conclusions about classroom applications. The children did improve their spelling performance by using the recognition testing strategy in Experiments 4 and 5, but they did so under rather artificial circumstances. They worked under the close scrutiny of an adult, they were prompted to use the strategy on every word, and they were highly motivated to do well. These conditions may not apply in the everyday situations where children are expected to apply their spelling skills. It should be remembered, as well, that the recognition-testing strategy is included in Simon's model as an optional 'route' to a correct spelling and it may not be used on all words or by all spellers. The present research shows only that the recognition testing strategy can have an effect on spelling performance, but further studies are needed to define the

circumstances under which children actually use the strategy. In spite of these limitations, it is useful to speculate about the practical implications of the research.

The findings indicate that visual recognition testing is useful as supplement to direct recall, and that fourth-grade children are capable of applying a generate-and-test spelling strategy quite effectively. It may be worthwhile, therefore, to develop and test methods of teaching this strategy and encouraging its use in the classroom.

Previous studies of the effects of systematic training in proofreading have produced mixed results. Oswalt (1962) gave twenty-minute lessons in proofreading each day over a period of six weeks to a group of fifth-grade pupils. Control subjects did not receive this instruction. After training, experimental subjects did significantly better than control subjects in detecting misspellings in a prepared paragraph. Only male experimental subjects showed any improvement on a spelling achievement test. This improvement may have been due to the greater exposure to words gained through proofreading instruction, rather than any improvements in proofreading skills per se.

In a similar study, Bishop (1965) compared a conventional textbook-based spelling program to a program which emphasized proofreading skills. No significant differences between groups were found on a standardized spelling test given after the training period, but experimental subjects did significantly better in spelling unstudied words on a test prepared by the experimenter.

The two spelling programs involved several components and Bishop presented no direct evidence that the use of proofreading accounted for the obtained differences in performance.

Yudkovitz (1979) has described a remedial program to develop the recognition-testing abilities of children with spelling disorders. Yudkovitz makes no reference to Simon's model, but her "error scanning approach" to remediation is based on a similar rationale. She hypothesizes that while ...

> " ... these children [may] have difficulty with word production, it is not always true that their recognition skills are at the same level. They often seem to be able to detect their own or other children's spelling errors; that is, despite their own poor visual imagery during attempts at word reproduction, error recognition is possible (Yudkovitz, 1979; p. 55)."

Yudkovitz's "error-scanning" program involves three steps. At the first stage, the teacher writes out sentences containing spelling errors. The child scans these sentences and circles misspellings. When an error is circled the teacher writes out three alternatives (including the correct spelling, the original misspelling, and another misspelling). The child chooses one and feedback is given immediately. When a certain level of proficiency is reached, the next stage is begun. The child now scans his or her own written sentences, circles the errors, and then is given practice in choosing among alternatives provided by the teacher. Later, the child generates and tests his or her own alternative spellings for misspelled words. At the final stage, the child is encouraged to use visual imagery in correcting misspellings. No evidence has

been presented by Yudkovitz to demonstrate that this program is effective, but the assumptions on which the program is based appear valid, at least for some grade-four children. The findings of the present research suggest that this may be a useful approach to the remediation of spelling problems and to the improvement of the spelling performance of normal children.

Individual differences in recognition testing ability are another important topic for further research. Little or nothing is known about the relationship between recognition testing ability and spelling achievement, but it has been suggested that deficiencies in the visual checking mechanism or simple failure to use visual recognition testing may be factors in spelling disabilities. Deschler, Ferrell, and Kass (1978) have speculated that learning disabled adolescents may be particularly deficient in the ability to monitor their own responses in academic tasks.

Deschler et al. compared the performances of learning disabled and normal high school students in a number of 'monitoring' tasks. The students were required to: (a) choose between correct and incorrect spellings for a list of words; (b) judge the correctness of spellings presented one at a time; and (c) check a typed 150-word passage for errors of spelling, grammar, punctuation, and capitalization. The normal group out-performed the learning disabled group on all three tasks.

The material used in these tasks was not produced by the subjects, so the results do not reveal anything about the self-monitoring capabilities of the two groups. They may simply

indicate that learning disabled students are less knowledgeable about correct spellings and grammatical structures, rather than showing any specific deficiency in their ability to monitor their own responses.

Deschler et al. tested these subjects on one self-monitoring task, as well. Each student was required to write a 100-word story and to check his or her work for grammatical, punctuation, and spelling errors. Learning disabled students were not as successful as normal students in detecting their own errors. This study was not concerned with spelling errors alone, and the data are too limited to conclude that recognition testing deficits are a significant factor in spelling disabilities. Nevertheless, further research comparing the recognition testing abilities of good and poor spellers appears warranted.

In summary, the data presented in this thesis indicate that children have spelling information available in memory that they are unable to retrieve and apply during the production of their initial spelling attempts. They are able to use this information to evaluate their own written spellings or to choose among 'possible' spelling alternatives for some words that they cannot recall directly. Visual cues are helpful in making these spelling decisions.

The findings show that children can overcome their retrieval difficulties to some degree by using the 'generate-and-test' spelling strategy described by Simon and Simon--that is, by writing out and 'testing' trial spellings before making their final

attempts at writing words. Whether this strategy can be applied effectively in the classroom is still open to question. Yudkovitz's approach to the training of recognition skills appears promising, but it has yet to be tested.

In future applied studies, it will be particularly important to determine whether recognition-testing skills developed through training can be transferred beyond the training environment. Attention must also be given to the problem of how children may be trained to generate plausible spelling alternatives for difficult words. Simon and Yudkovitz both imply that this is a rather straightforward matter of applying phoneme-grapheme correspondences rules. However, the findings of the present research suggest that this may be the most difficult step in the generate-and-test process. It is possible to generate a very large number of 'phonemic' spellings for most English words by applying phoneme-grapheme correspondences, and it would be hopelessly inefficient for a child to test all 'possible' options in an unsystematic way. It may be more effective to train children to define the most plausible options for a given word by using their knowlege of the higher-order patterns in the English spelling system.

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APPENDIX A

Summary of Procedures for Experiment 1

First Session

(a) The child writes each word as it is dictated by the experimenter.

(b) Immediately after writing each word, the child rates the correctness of the attempt, using a four-point rating scale.

(c) The experimenter continues dictating words until he establishes a 'basal' of six consecutive correct spellings and a 'ceiling' of six consecutive errors (as described in the procedures section).

Second Session

(a) All words that were between the child's basal and ceiling on the first test are dictated again.

(b) The child writes each word as it is dictated by the experimenter.

(c) Immediately after writing each word, the child rates the correctness of the attempt, using the four-point rating scale.

Third Session

(a) All words that were between the child's basal and ceiling on the first dictation test are presented again. The experimenter dictates each word and shows two typed spelling alternatives to the child.

(b) The child circles the spelling for each word that he or she thinks is the correct version.

Appendix A. Example illustrating the procedures used in Experiment 1.

Stimulus Words	Child's Spelling of Each Word		Alternatives Given for Each Word
	First Session Dictation Test #1	Second Session Dictation Test #2	Third Session Two-Alternative Recognition Task
scream	screem	screem	scream vs. screem
needle	needle	needle	nedle vs. needle
engine	enjin	engin	engin vs. engine
beautiful	beautful	beautiful	beautful vs. beautiful
important	importent	important	importent vs. important
salad	saled	saled	saled vs. salad
etc.	etc.	etc.	etc.

APPENDIX B

Summary of Statistical Analyses

for Experiment 1

ANOVA Summary Table

Comparison of the mean correctness ratings given by subjects to their own correct spellings, 'lapse' misspellings, 'inconsistent' misspellings, and 'consistent' misspellings (see Table 1).

Source	SS	df	MS	F	p
Type of Spelling	22.05	k-1 = 3	7.35	65.275	$p < .001$
Subjects	13.05	n-1 = 29	0.45	3.996	$p < .01$
Residual	9.80	(k-1)(n-1) = 87	0.113		
Total	44.90	N-1 = 119			

ANOVA Summary Table

Comparison of the proportion of correct choices in a two-alternative recognition task, for four categories of words (correctly spelled words, 'lapse' words, 'inconsistent' words, and 'consistent' words). (See Table 2)

Source	SS	df	MS	F	p
Type of Word	2.274	k-1 = 3	0.758	90.238	$p < .001$
Subjects	1.436	n-1 = 29	0.049	5.893	$p < .001$
Residual	0.728	(k-1)(n-1) = 87	0.008		
Total	4.438	N-1 = 119			

Comparison of subjects' performances on the two-alternative recognition task to chance performance (50% correct) for three categories of words (see Table 2).

Word Category	Mean Proportion Correct	Standard Deviation	$t = \frac{\bar{x} - \mu}{S_x/\sqrt{N-1}}$	p
'Lapse' Words	.915	.088	25.39	$p < .001$
'Inconsistent' Words	.825	.155	11.30	$p < .001$
'Consistent' Words	.684	.211	4.70	$p < .001$

APPENDIX C

Summary of Procedures for Experiment 2

First Session

(a) The child writes each word as it is dictated by the experimenter.

(b) Immediately after writing each word, the child rates the correctness of the attempt, using a four-point rating scale.

(c) The experimenter continues dictating words until he establishes a 'basal' of six consecutive correct spellings and a 'ceiling' of six consecutive errors (as described in the procedures section).

Second Session

(a) All words that were between the child's basal and ceiling on the first test are dictated again.

(b) The child writes each word as it is dictated by the experimenter.

(c) Immediately after writing each word, the child rates the correctness of the attempt, using the four-point rating scale.

Third Session

(a) The experimenter presents three pages of typed spellings to the child. For each word, there are three different spellings: the correct spelling, the child's own misspelling of the word, and another common misspelling of the word. The three alternatives for a given word appear on separate pages. The child examines all of the spellings on the first page and rates the correctness of each one, using the four-point rating scale. This procedure is repeated with the second page, which contains different spellings of the same words, and then it is repeated again with the third page.

Appendix C. Example illustrating the procedures used in Experiment 2.

Stimulus Words	Child's Spelling of Each Word		The three pages are presented consecutively. Child rates the correctness of each spelling.		
	First Session Dictation Test #1	Second Session Dictation Test #2	Third Session - Recognition Task Page 1	Page 2	Page 3
scream	screem	screem	screem	screm	scream
needle	needle	needle	nedle	needle	neddle
engine	enjin	engin	engine	engen	engin
beautiful	beautful	beautiful	beutiful	beautful	beautiful
important	important	importent	important	important	importent
salad	saled	saled	saled	salad	salid
etc.	etc.	etc.	etc.	etc.	etc.

APPENDIX D

Summary of Statistical Analyses for Experiment 2

ANOVA Summary Table

Comparison of mean correctness ratings given by subjects to their own correct spellings, 'lapse' misspellings, 'inconsistent' misspellings, and 'consistent' misspellings (see Table 3).

Source	SS	df	MS	F	p
Type of Spelling	20.453	k-1 = 3	6.818	64.684	$p < .001$
Subjects	8.173	n-1 = 24	0.340	3.223	$p < .01$
Residual	7.587	(k-1)(n-1) = 72	0.105		
Total	36.213	N-1 = 99			

ANOVA Summary Table

Comparison of the mean correctness ratings given by subjects for three Types of Spelling Alternatives (Factor B) for three Categories of Words (Factor A). (See Table 4).

Source	SS	df	MS	F	p
Subjects	9.657	n-1 = 24	.402	1.988	$p < .01$
Treatments	119.461	pq-1 = 8			
A	2.602	p-1 = 2	1.301	6.434	$p < .05$
B	108.693	q-1 = 2	54.346	268.773	$p < .001$
A X B	8.166	(p-1)(q-1) = 4	2.291	11.330	$p < .01$
Residual	38.826	(n-1)(pq-1) = 192	.2022		
Total	167.944	npq-1 = 224			

APPENDIX E

Summary of Procedures for Experiment 3

Pre-test

A list of 60 words is dictated to the children as a group. The child writes each word as it is dictated. Only the child's first attempt at each word is considered.

Experimental Session

(a) Beginning with the first word misspelled by the child in the pre-test, the experimenter dictates the words and the child spells each one orally.

(b) Eight words misspelled in both the pre-test and the oral dictation test and eight words spelled correctly in both tests are selected. The experimenter provides an alternative to the child's spelling for each of these words.

(c) Subjects are divided randomly into two groups:

(i) In the visual presentation condition, the two alternatives for each word are shown in printed form, one after the other, and the child is required to identify the correct version.

(ii) In the oral presentation condition, the two alternatives for each word are presented orally and the child is required to identify the correct version.

Appendix E. Example illustrating the procedures used in Experiment 3.

Stimulus Words	Child's Spelling of Each Word		Alternatives Given for Each Word
	First Session (Pre-Test) Words are Written to Dictation	Second Session Words are Spelled Orally to Dictation	Second Session - Recognition Task Alternatives are Presented Consecutively Visually to Grp. 1 Orally to Grp. 2 Subjects Identify Correct Spellings
laid	layed	layed	layed vs. laid
package	pacage	pakage	package vs. pakage
safely	safely	safetly	not presented
further	ferther	ferther	further vs. ferther
problems	problems	problems	problems vs. problums
cousin	cosin	cosen	cosen vs. cousin
planning	planning	planning	planing vs. planning
etc.	etc.	etc.	etc.

APPENDIX F

Summary of Statistical Analysis

for Experiment 3

ANOVA Summary Table

Comparison of the number of correct spellings chosen in a two-alternative recognition task, for two types of words, under visual presentation and oral presentation conditions (see Table 5).

Source	SS	df	MS	F	p
Between Subjects	32.692	np-1 = 25			
A (visual vs oral presentation)	7.692	p-1 = 1	7.692	7.384	$p < .05$
Subjects within Grps.	25.000	p(n-1) = 24	1.042		
Within Subjects	80.000	np(q-1) = 26			
B (word type)	56.077	q-1 = 1	56.077	59.309	$p < .001$
A X B	1.	(p-1)(q-1) = 1	1.231	1.302	n.s.
B X Subjs. w. Groups	22.693	p(n-1)(q-1) = 24	.945		
Total	112.693	npq-1 = 51			

APPENDIX G

Summary of Procedures for Experiment 4

Pre-test

A list of 60 words is dictated to the children as a group. The child writes each word as it is dictated. Only the child's first attempt at each word is considered.

Experimental Session

(a) Twelve words misspelled in the pre-test and twelve words spelled correctly in the pre-test are selected for each subject.

(b) The subjects are divided randomly into three groups.

(i) In the Experimental Condition, the words are dictated to the child and he or she is required to think of three alternative spellings for each word and to write these on a 'practice sheet'. The child then decides which is the correct version and writes it on the 'test paper'.

(ii) In the Attention Control Condition, the words are dictated to the child and he or she is required to think of three alternative spellings for each word and to give these spellings orally. The child then decides which is the correct version and writes it on the 'test paper'.

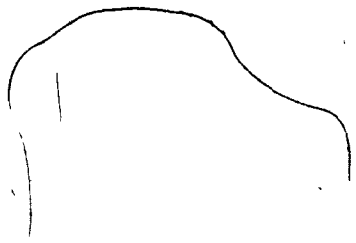
(iii) In the Direct Recall Control Condition, the words are dictated to the child. He or she is asked to think carefully about the word and then to write the correct spelling on the 'test paper'.

	Pre-Test	'Practice' Spellings	Final Attempts
	Words are written to dictation.	24 selected words are dictated to each child.	Subjects write the 'correct' spellings on the 'test paper'.
Experimental Group	friend saide first apon again etc.	These subjects write out three 'practice' spellings for each word. friend, frend, freind siad, saide, sed frist, first, ferst apon, aupon, upon agen, agane, agin etc.	friend saide first upon agane etc.
Attention Control Group	freind said first apon again etc.	These subjects give three oral 'practice' spellings for each word. frend, freand, freind said, siad, sed first, ferst, furst apon, apone, apoun again, agane, agan etc.	freind said first apon agan etc.
Direct Recall Control Group	freind said frist upon again etc.	These subjects do not generate 'practice' spellings.	freind said frist apone again etc.

APPENDIX H

Summary of Statistical Analysis

for Experiment 4



ANOVA Summary Table

Comparison of the number of words spelled correctly on final attempts by subjects in the Experimental Group, the Attention Control Group, and the Direct Recall Control Group (see Table 6).

Source	SS	df	MS	F	p
Between Groups	100.308	k-1 = 2	50.154	10.837	$p < .01$
Within Groups	166.615	N-k = 36	4.628		
Total	266.923	N-1 = 38			

APPENDIX I

Summary of Procedures for

Experiment 5

Pre-test

A list of 60 words is dictated to the children as a group. The child writes each word as it is dictated. Only the child's first attempt at each word is considered.

Experimental Session

(a) Twelve words misspelled in the pre-test and twelve words spelled correctly in the pre-test are selected for each subject.

(b) The subjects are divided randomly into three groups.

(i) In the Experimental Condition, the words are dictated to the child. He or she is asked to write a 'practice spelling' for each word and to rate the correctness of the practice attempt, using a four-point rating scale. The child then makes a final attempt at writing the correct version of the word.

(ii) In the Attention Control Condition, the words are dictated to the child and he or she is asked to practice each one by spelling it aloud. The child is required to rate the correctness of the oral practice spelling, using a four-point rating scale. The child then makes a final attempt at writing the correct version of the word.

(iii) In the Direct Recall Control Condition, the words are dictated to the child and he or she makes one attempt to write the correct spelling. The child is required to rate the correctness of the spelling attempt, using the four-point rating scale.

	Pre-Test	'Practice' Spellings	Final Attempts
	Words are written to dictation	24 selected words are dictated to each child.	Subjects write the 'correct' spellings on the 'test paper'.
Experimental Group	friend saide first apon again etc.	These subjects write and evaluate a 'practice' spelling for each word. friend siad frist apon agen etc.	friend saide first upon agane etc.
Attention Control Group	freind said first apon again etc.	These subjects give and evaluate an oral 'practice' spelling for each word. frend said first apon again etc.	freind said first apon agan etc.
Direct Recall Control Group	freind said frist upon again etc.	These subjects do not generate 'practice' spellings.	freind said frist apone again etc.

APPENDIX J

Summary of Statistical Analysis for Experiment 5

ANOVA Summary Table

Comparison of the number of words spelled correctly on final attempts by subjects in the Experimental Group, the Attention Control Group, and the Direct Recall Control Group (see Table 7).

Source	SS	df	MS	F	p
Between Groups	58.91	k-1 = 2	29.455	13.120	$p < .001$
Within Groups	87.57	N-k = 39	2.245		
Total	146.48	N-1 = 41			

END

1 3 1 0 1 1 8 3

FIN