DOCUMENT RESUME

ED 273 983 CS 210 057

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TITLE An Exploratory Study of Spelling Errors of Grade Three Students.
SPONS AGENCY Natural Sciences and Engineering Research Council, Ottawa (Ontario).
PUB DATE Apr 86
NOTE 27p.; Paper presented at the Annual Meeting of the American Educational Research Association (67th, San Francisco, CA, April 16-20, 1986).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Cognitive Processes; Comparative Analysis; Educational Research; *Error Analysis (Language); *Error Patterns; Foreign Countries; Grade 3; Microcomputers; Primary Education; *Spelling; Test Validity
IDENTIFIERS Canada

ABSTRACT

Noting that while the number of errors gives a general indication of spelling ability, it may represent an oversimplification of the spelling process, a study examined the spelling ability of 40 Canadian third grade students of average ability. Subjects were divided into low and high spelling ability groups on the basis of the Edmonton (Alberta) Public Schools Spelling Achievement Test. Subjects completed achievement tests, cognitive processing tasks, and a computerized spelling test, which consisted of 30 words selected on the basis of familiarity and predictability. After hearing each word orally and used in a sentence, subjects spelled the word on the computer, then rated their familiarity with the word and perceived spelling of the word. Scores on the spelling tests were analyzed as a function of spelling ability, general cognitive processing, and more global spelling factors. Low versus high ability group analyses did not demonstrate differences in general cognitive processing. Group analyses did, however, reveal differences in patterns of correct spelling and phonetic errors as a function of word familiarity and predictability. Regression analyses also revealed that correct spelling by high ability spellers was best predicted by variables measuring use of phonetic and sequential segmentation strategies. Correct spelling by low ability spellers was best represented by memory for whole words and for letter sequences. (HTH)

An Exploratory Study of Spelling Errors of Grade Three Students

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Paper presented at the annual meeting of the American Educational Research Association, San Francisco, California, April, 1986.
The research was supported by a grant to Dr. J. P. Das, Director, Centre for the Study of Mental Retardation, from the Natural Sciences Engineering Research Council of Canada. We are indebted to the Edmonton Public School Board for their cooperation and especially to Janice L. C. Kowal for her assiatance in administering the research.

Abstract

This paper reports an exploratory study of spelling in three third grade classrooms for average ability students. Scores on a computerized version of a dictated words spelling test were analyzed as a function of spelling ability, general cognitive processing, and more global spelling factors. Low versus high ability group analyses did not demonstrate differences in general cognitive processing. Group analyses did, however reveal interesting differences in patterns of correct spelling and phonetic errors as a function of word familiarity and predictability. Regression analyses also revealed interesting predictors of spelling ability: Correct spelling by high ability spellers was best predicted by variables measuring use of phonetic and sequential segmentation strategies. Correct spelling by low ability spellers was best represented by memory for whole words and for letter sequences. Results are discussed in terms of developmental trends in spelling ability.

In the classroom, spelling is typically scored and interpreted in terms of the number of incorrectly spelled words on an oral spelling test. It is assumed that number of errors is a sufficient measure of spelling ability. While number of errors made may be an easy measure to collect, giving a general indication of spelling ability, it may represent an oversimplification of the spelling process. In addition, the number of spelling errors does not give any indication of where spelling strengths and/or weaknesses may lie, nor how close the student may be to learning the correct spelling of a particular word.

Personkee and Yee (1966), Simon (1976), and others have theorized that multiple cognitive processes likely take place within an individual while spelling different words. For example, Personkee and Yee theorize that for most words, the correct spelling is known by rote. Little intentional cognitive processing is necessary to spell the word and it is likely that little or no thought occurs about whether the word is spelled correctly. Intentional cognitive processing occurs when rote recall is not possible or when the certainty of the correct spelling is questioned. When this happens, other cognitive methods to spell the words are needed. Different methods may be available to a student to determine or check the spelling of the word. These processes that are thought to be of importance include phoneme-grapheme correspondence (Frith, 1980; Gerber & Hall, 1982; Treiman, 1985), phonemic analysis (Baron, Treiman,

Wilf, & Kellman, 1980; Gerber & Hall, 1982), etc.

In addition, the methods that are available to an individual, and therefore the type of errors made, may be developmentally related (cf, Frith, 1980; Gentry, 1984; Bookman, 1984; Read, 1971). In general, these authors claim that the stages or levels of spelling ability progress from precommunicative forms of spelling in which letter sequences only slightly reflect correct spelling, to memorization of a few sight words through constant exposure, to the application of increasingly complex grapheme-phoneme correspondence - or phonetic - rules to spell unknown words, to automatic, correct spelling. The type of errors made in the classroom may therefore reflect differing developmental levels. Gerber and Hall (1982) found that these stages are still followed with learning disabled students, though at a much slower rate than normal. It may be, therefore, that different ability levels in the classroom may be expected to be following different types of spelling procedures. Given this, an understanding of spelling errors can be very important in effectively helping students.

For example, Frith (1980, 1984) has extensively studied individual and developmental spelling differences in children of varying reading and spelling ability, particularly comparing children who are good readers-good spellers, good readers-poor spellers, and poor readers-poor spellers. Her findings generally demonstrate that more sophisticated spellers tend to make spelling errors that are phonetically consistent with the pronunciation of the word while less sophisticated spellers do

not. This suggests that the quantity of spelling errors is insufficient, in and of itself, to determine the nature of the spelling problem because, even though two students may have made the same number of errors, the type of errors and the spelling process used to spell the word may be very different.

In addition, within an individual, spelling errors can be caused by a variety of related factors. It is possible that the student is inappropriately using some spelling rule or is not sensitive to the need to use an appropriate spelling rule. It is also possible that the student has learned by rote the wrong spelling. This type of error may be very difficult to change because it is unlikely that the student is aware that an error exists.

Understanding the cognitive processes of spelling is important not only for learning spelling words (which can often be memorized with little understanding of any rules that might apply), but for the ability to proofread words and recognize when the words may not be spelled correctly. Therefore, understanding the processes students are using when spelling words incorrectly are important not just for learning a specific word, but being able to recognize at some point in the future whether a particular spelling is correct.

Studies such as Frith's (1980, 1984), Gerber & Hall's (1982), etc. have generally examined differences between sub-populations taken from much larger pools defined on specific criterion. This methodology allows direct comparisons between separate homogeneous samples on the variables of interest, but does little to increase our understanding of how spelling

differences effect the less homogeneous, intact classroom. In order to better understand the heterogeneity of spelling ability, the present study examined intact classrooms. Third graders, developmentally most likely to be in transition between using different spelling strategies, such as using phonetic rules as an aid to spelling, were selected (cf. Frith, 1980, 1984). In addition, even within the intact classrooms, students are not necessarily homogeneous with respect to spelling ability, especially while at a transitional stage of spelling. Therefore, we divided the students into low and high spelling ability groups on the basis of scores on a standardized spelling achievement test.

An additional concern was to attempt to develop a better understanding of spelling in relation to the general cognitive processes posited to underlie spelling behavior. In particular, the ability to access long term memory has been implicated as an important cognitive process underlying spelling ability, as has memory for the order in which the letters occur in the spelling word (Luria, 1973). Thus, a measure of long term memory access for letters and memory for letter order, respectively, were used to examine the relationships between these cognitive processes and spelling. In addition, as spelling requires the sequential ordering of letters, according to the information integration model developed by Das (cf. Das, Kirby, & Jarman, 1979), successive processing measures, should be related to spelling ability whereas simultaneous processing measures should not. For this reason, auditory serial recall and memory for designs tasks,

marker tasks for successive and simultaneous processing, respectively, were included in the present study.

Groff (1982, 1984) has examined the relationship between word familiarity and spelling difficulty. It is generally held that the more familiar the word is to the student, the better the spelling (cf. Cahen Craun, & Johnson, 1971). However, Groff's findings suggest that this relationship, although existing, does not exist at a very strong or practically useful level. In order to more closely examine the controversy over the familiarity effect, familiar and unfamiliar words, defined in terms of word frequency, were included in the present study.

In addition, in order to more closely examine the developmental and ability-related hypotheses proposed by Frith (1980, 1984) and others, predictable and unpredictable words were also included in the study. Predictable words were defined as words that could be spelled by the application of common phonetic rules whereas unpredictable words were irregular in that they violated one or more phonetic rules. Depending on developmental or ability level, the third graders in the present study may be expected to show different patterns of correctness and type of errors for words with phonetically predictable and unpredictable spellings.

Method

Subjects.

Forty third grade students (average age = 8 years, 9 months) from three classrooms for average ability students in two public elementary schools in Edmonton, Alberta, Canada participated. There were 15 females and 25 males. Two students did not

adequately complete the computerized spelling portion of the study and were not included in the analyses. Subjects were divided into two groups on the basis of a median split of performance on the Edmonton Public Schools Spelling Achievement Test (EPSB, 1981). The low spelling ability group was comprised of 18 students and averaged the 23rd percentile in spelling achievement. The high spelling ability group consisted of 20 students averaging the 76th percentile in spelling achievement.

Tasks and design.

The subjects were administered achievement tests, cognitive processing tasks, and the computerized spelling test.

The achievement tests consisted of the Edmonton Public Schools Spelling Achievement Test (EPSB, 1981), a dictated words spelling test which was used to determine high and low ability groups, and the Schonell Word Reading Test (Schonell, 1963).

The cognitive processing tasks consisted of a task designed to obtain a measure of lexical access time for letters (based on the Posner task - see Varnhagen, Das, & Varnhagen, 1986), recall for the order in which letters are presented (Das, 1985), auditory serial recall for words (Das, Kirby, & Jarman, 1979), and memory for designs (Graham & Kendall, 1960). These tasks comprised a subset of a large battery of cognitive processing tasks administered as part of a separate study.

The computerized spelling test consisted of thirty words presented via a tape recorder interfaced with an Apple IIe microcomputer. The words were selected on the basis of familiarity and predictability. Familiarity was determined by

frequency of occurrence in the Carroll, Davies, & Richman (1971) American Heritage word frequency book. Words that had a spelling frequency of less than 10 and a third grade frequency of less than 50 were operationally defined as unfamiliar words. Words that had a spelling frequency of greater than 125 and a third grade frequency of greater than 500 were defined as familiar words. Predictability was determined by ratings of the authors and two elementary school teachers as to the ease with which phonetic rules could be used to spell the words. Predictable words were words that could be spelled by application of common phonetic rules. Unpredictable words were words with irregular spellings in that they violated one or more phonetic rules. There were 11 familiar words with predictable spellings, 4 familiar words with irregular or unpredictable spellings, 11 unfamiliar words with predictable spellings, and 4 unfamiliar words with unpredictable spellings.

The computerized spelling test procedure (Varnhagen & Gerber, 1984) was adapted from the commonly used dictated words procedure: For each word in the spelling test, the word was orally presented via tape recorder, used in context in a sentence, and repeated. The subject then typed his or her spelling of the word on the Apple IIe keyboard. Following typing the spelling of each word, the subject rated his or her familiarity with the word (1 = not familiar, 5 = very familiar) and perceived spelling of the word (1 = did not spell correctly, 5 = spelled correctly). The questions were presented on the computer monitor, along with the student's spelling of the word and the student entered his or her ratings using the keyboard.

The Schonell Word Reading Test, auditory serial recall, and memory for designs tasks were administered during the first session; the lexical access and order recall tasks were presented via microcomputer during the second session; the computerized spelling test was administered during the third session; and the Edmonton Public Schools Spelling Achievement Test was administered in the fourth session. Subjects were seen individually for the first three sessions which were separated by approximately one day; the intact class participated in the fourth session.

Scoring

Word reading scores (max. = 100 words) and reading ages were obtained from the Schonell Word Reading Test. Spelling achievement scores (max. = 45 words) and achievement percentiles were obtained with the Edmonton Public Schools Spelling Achievement Test. The lexical access measure was obtained according to the procedures described by Varnhagen, et al. (1986); time to access long term lexical memory for letters was determined as the difference in time to make a Name Match versus a Physical Match decision on a Posner (1978) task using letters as stimuli. The order recall measure consisted of the greatest number of letters that could be placed in the correct serial order (max. = 7 letters). Auditory serial recall consisted of the longest list of words (max. = 7 words) recalled in correct serial order. The memory for designs score consisted of the total number of points (max. = 77) awarded for correct reproduction of the geometric figures from memory.

Several measures were obtained from the computerized spelling test. The total spelling test score consisted of the total number of correctly spelled words (max. = 30). Percent correct was also determined as a function of familiarity and predictability. Errors made on the incorrectly spelled words were first classified as to whether they were phonetic or non-phonetic in nature. Phonetic errors were acceptable spellings given the incorrect application of some phonetic rule. For example, spelling the word, tight, as tite was classified as a phonetic error because of the phonetic rule for spelling a one syllable words with a long vowel sound in the middle with a silent e at the end. Non-phonetic errors consisted of all incorrectly spelled words that did not represent incorrect application of phonetic rules, e.g., tihgt. Both authors independently classified the errors as to whether they were phonetic or non-phonetic; interrater reliability was .99. From this analysis, percentage of phonetic errors as a function of familiarity and predictability was obtained.

Errors were also scored as to whether they represented substitutions (e.g., tyght for tight or enouf for enough), omissions (e.g., tigt), extra letters (e.g., tiight), and reversals (e.g., tihgt). Both authors independently classified the errors according to type; interrater reliability for scoring the four types of errors was .95. The total number of errors made on each word was averaged across words and comprised the errors per word measure.

Time to spell each word from the subject's first keystroke until typing [RETURN] was divided by the number of letters in the

final typed version of the word. Time per letter to spell words correctly was then determined as a function of predictability and familiarity. Similarly, time per letter to spell words incorrectly and to make phonetic errors was also determined as a function of predictability and familiarity.

Initial examination of the subject's self-reports of familiarity and correctness showed that most subjects' self-ratings were "5", indicating that they were very familiar with the word or very confident that the word was spelled correctly. Very few subjects provided any variance in their self-ratings. As a result, the self-reports were not analyzed in any detail and will not be considered here.

Results and Discussion

Means and standard deviations for performance on the various tasks by the high and low ability spelling groups are found in Table 1. As expected, the high ability spellers performed significantly better on the computerized spelling test than the low ability spellers, $t_{(38)} = 4.11$, $p < .05$. The high ability spellers were also significantly better word readers (average Schonell word reading age = 9.1) than the low ability spellers (average word reading age = 8.1), $t_{(38)} = 4.88$, $p < .05$. Thus, the high and low ability spelling groups resemble Frith's (1980) good reader-good speller and poor reader-poor speller groups, respectively. The two ability groups did not differ on any of the cognitive processing tasks, ie., lexical access time for letters, order recall for letters, auditory serial recall (successive processing), and memory for designs (simultaneous

processing). These nonsignificant findings rule out any general cognitive processing differences between the two groups that might account for differences in spelling ability.

The more global spelling factors, including word predictability and familiarity and phonetic rule use, do differentiate between the two ability groups. Percentage of words spelled correctly on the computerized spelling test was analyzed by a one-between groups (ability), two-within groups (familiarity and predictability) analysis of variance. In addition to the main effect of ability as described above, $F(1, 36) = 17.37$, $p < .05$, there were significant main effects of familiarity and predictability, $F(1, 36) = 44.96$ and 137.58, $p < .05$, respectively. For the familiar words, 56% were spelled correctly, whereas only 39% of the unfamiliar words were spelled correctly. This finding contradicts Groff's (1982, 1984) findings that word familiarity is only a minimally important factor accounting for correct spelling, but supports the widely held contention (cf. Cahen, Craun, & Johnson, 1971) that familiarity does play a key role in spelling.

Considering the predictable words, 63% were spelled correctly whereas 33% of the unpredictable words were spelled correctly. With unpredictable words, phonetic rules are not useful. Other, more complicated rules or outright memorization are required for correct spelling. This finding demonstrates that at least some of the third graders are relying on phonetic rules to guide their spelling.

There was also an interaction of familiarity and predictability, $F(1, 36) = 38.41$, $p < .05$. Although not of

particular interest to the present study, simple effects tests revealed that although familiar words with predictable and unpredictable spellings were spelled equally well (correct spelling was 64% for familiar words with predictable spellings and 61% for familiar words with unpredictable spellings), unfamiliar words with unpredictable spellings were spelled much more poorly than unfamiliar words with predictable spellings (18% and 48% of the unfamiliar words with unpredictable and predictable spellings, respectively, were spelled correctly). Familiar words by definition are more likely to have been memorized and therefore spelled automatically, without reliance on phonetic rules. With the unfamiliar words, the subjects may be more likely to rely upon phonetic rules wherever possible, leading to the difference in correct spelling for the predictable and unpredictable unfamiliar words.

A somewhat more interesting finding was the marginally significant interaction between ability and familiarity, $F(1, 38) = 3.83$, $p = .055$. This interaction is shown in Figure 1. The high ability spellers are much more likely than the low ability spellers to correctly spell familiar words; correct spelling was 69% for high ability spellers compared with 42% correct for low ability spellers. Possibly the familiar words were more familiar to the high ability spellers and therefore more likely to be spelled automatically. Due to the lack of variance in the self-reports of familiarity, however, this hypothesis cannot be directly tested. On the other hand, both the high and low ability spellers are unlikely to spell

unfamiliar words correctly; correct spelling was 47% and 30% for the high and low ability spellers, respectively.

Percent phonetic errors made was also submitted to a one-between groups (ability), two-within groups (familiarity and predictability) analysis of variance. There was a significant main effect of ability, $F_{(1,38)} = 6.04$, $p < .05$. As with Frith's (1980) good reader-good speller versus poor reader-poor speller comparisons, the high spelling ability students made a greater proportion of phonetic misspellings (58%) than the low ability spellers (45%). Interestingly, although the two ability groups had different patterns of misspellings, they demonstrated comparable number errors per word; the average number of misspellings per word was 1.64 and 1.69 for the high and low ability groups, respectively. It might have been expected that the low ability spellers would make more errors per word, but this was not the case. In addition, if more errors per word are being made, one would expect the proportion of phonetic errors would decrease, because with each error the odds increase that the phonetic similarity to the correct spelling will be lost. However, the constant number of errors per word adds support to the hypothesis that the spelling processes of the two ability groups differ.

There were also main effects of familiarity and predictability, $F_{(1,38)} = 14.61$ and 18.90, $p < .05$, respectively. A greater percentage of phonetic errors were made with the unfamiliar words (53%) than with the familiar words (44%). This supports our earlier hypothesis that the familiar words are more likely to have been memorized and spelled automatically than the

unfamiliar words. Thus, we would expect more nonphonetic errors, or errors likely due to typographical errors or incorrect memorizations, with the familiar words. On the other hand, we would expect more phonetic errors with the unfamiliar words to which more conscious attention must be paid in order to spell.

There were also a greater percentage of phonetic errors made with words that had phonetically predictable spellings (52%) than unpredictable (44%) spellings. These findings make intuitive sense; words that are easier to spell phonetically may be more likely to contain phonetic errors than words with irregular spelling. It is also possible that the subjects were able to discriminate words for which phonetic rules are appropriate and words for which they are inappropriate.

This ability to discriminate when and where phonetic rules may be most appropriate seems to be especially important for spelling familiar words. Given this, the errors made with familiar words with predictable spellings may be expected to be phonetic in nature whereas the errors for familiar words that do not have predictable spellings may be more likely to be non-phonetic. It may be less easy for the students to discriminate when and where to use phonetic rules with the unfamiliar words, however. This is exactly what the results demonstrated. The interaction of familiarity and predictability, $F(1,38) = 4.64$, $p < .05$, demonstrated comparable percentages of phonetic errors with predictable and unpredictable unfamiliar words (53% for each type of word) but a relatively large discrepancy between predictable and unpredictable familiar words (54% and 36%,

respectively).

There were no interactions between ability and familiarity or predictability. An examination of the data did, however, show that although both high and low ability spellers made comparably low percentages of phonetic errors on the familiar words, the high ability spellers were slightly more likely than the low ability spellers to make phonetic errors on the unfamiliar words. These findings, though statistically nonsignificant, demonstrate that the high ability spellers are either more sensitive to or more reliant upon phonetic rules to guide their spelling for words they do not automatically know how to spell by sight.

We examined time per letter to spell each word in an attempt to begin to make inferences about processing differences between high and low ability spellers as a function of phonetic rule use. However, the time measures were too unstable to demonstrate any group differences and will not be considered in any further detail here.

In summary, the analysis of group differences revealed that the high ability spellers were particularly better than the low ability spellers in terms of spelling familiar words. More interestingly, the high ability spellers were more likely than the low ability spellers to make phonetic errors, particularly with unfamiliar words. This greater reliance by the high ability spellers on phonetic rules was also demonstrated in the regression analyses.

Stepwise multiple regression procedures were used to predict total spelling test scores for the two ability groups. The original predictor variables entered for predicting total

spelling score consisted of the cognitive processing measures (lexical access time, order recall, auditory serial recall, and memory for designs), the Schonell word reading measure, and the more global spelling processes measures (time per letter to spell the word, number of errors per word, and percentage of phonetic errors). Total spelling test score for the high ability spellers was best predicted by the percentage of phonetic errors and order recall measures, accounting for 72% of the variance. These results indicate that the high ability spellers were using more mature phonetic and sequential segmentation strategies (Frith, 1980). Total spelling score for the low ability spellers was best predicted by Schonell word reading and order recall measures, accounting for 74% of the variance. According to these results, the spelling performance of lower ability third grade spellers can best be represented by their memory for whole words and for letter sequences.

Several conclusions can be made, even from this exploratory study. First, in opposition to Groff's (1982, 1984) arguments, word familiarity does appear to be an important factor in spelling. Familiar words were more likely to be spelled correctly than unfamiliar words, particularly by high ability spellers. The error patterns suggest that many of the familiar words were memorized or sight words; errors, when they were made, tended to be of the form of letter reversals or omissions representative of typographical errors or incorrect memorization rather than phonetic. One might expect that these familiar, memorized words would take less time per letter to spell.

Unfortunately our time measure was too unreliable to analyze. It is also possible that for familiar words, even when the correct spelling is not known, the students are aware of when and where to use phonetic rules as a guide to spelling the word correctly.

The low ability spellers were less successful than the high ability spellers in terms of spelling familiar words. Possibly the familiar words (operationally defined as high frequency words in third grade) were not as familiar to the low ability spellers as they were to the high ability spellers. Certainly, the reading scores demonstrate less facility with printed words. However, the lack of variance in the familiarity self-ratings makes this hypothesis untestable in the current study.

The group differences in spelling scores and types of errors and the regression analysis support the notion of a developmental or ability-related trend from non-phonetic to phonetic forms of spelling. The group analyses suggest little reliance by the low ability spellers on phonetic strategies for spelling. The regression analyses demonstrate that this ability group is more dependent upon whole or sight word memorization for spelling. On the other hand, the group differences and regression analyses suggest that the high ability speller were relying more on phonetic strategies to guide their spelling. These findings demonstrate a more mature level of spelling ability.

The discovery of two different ability groups demonstrating different patterns of spelling within intact classrooms for average achieving students may have important implications for instruction. The low ability students may benefit from phonics instruction to teach them phonetic spelling rules and/or help

them become more aware of the need to use these rules in spelling. This type of instruction may help them to progress to a more mature phonetic level of spelling ability. The high ability students, on the other hand, may benefit more simply from additional practice and spelling experiences in order to help them develop automatic spelling for increasingly complex words.

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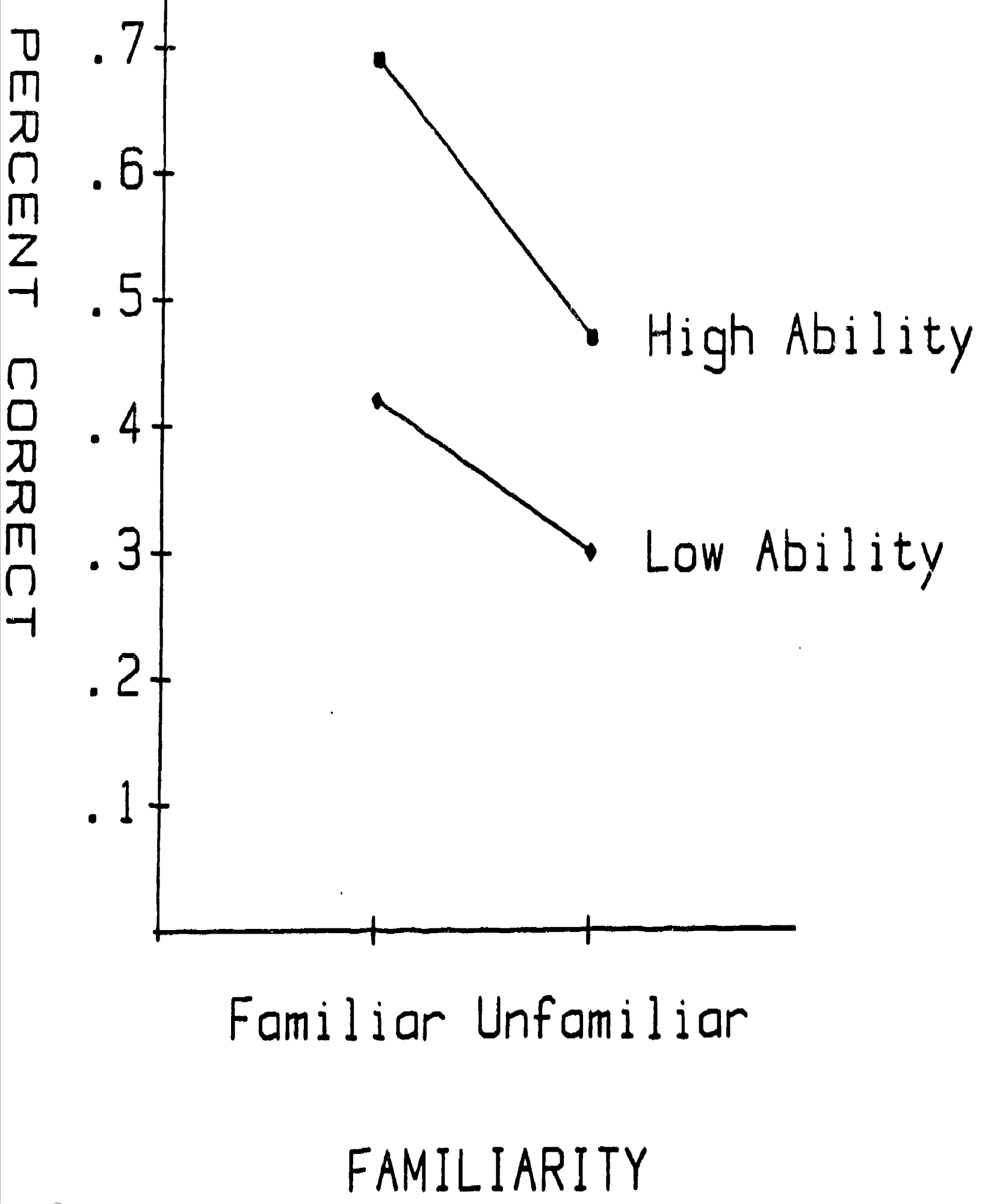
Table 1

Means (and standard deviations) for performance by the high and low ability spellers

	Ability Group	
Task	High (N=20)	Low (N=18)
Computerized Spelling Test	19.00	12.50
	(4.96)	(4.77)
Schonell Word Reading Test	41.00	30.83
	(7.08)	(5.59)
Lexical Access	0.282	0.304
	(0.15)	(0.21)
Order Recall	4.55	4.06
	(0.69)	(1.06)
Auditory Serial Recall	4.25	4.44
	(0.79)	(0.51)
Memory for Designs	53.50	48.22
	(8.36)	(12.22)

Figure Caption

Figure 1. Percent correct spelling as a function of familiarity for the high and low ability spellers.


PERCENT CORRECT
.7
.6
.5
.4
.3
.2
.1
High Ability
Low Ability
Familiar Unfamiliar
FAMILIARITY