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An Examination of the Spelling Patterns of Deaf and Hard of Hearing Elementary School Students

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Citation

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Abstract

Learning how to spell and applying knowledge from the five domains of language to

spelling (phonology, morphology, syntax, semantics, pragmatics) is an essential component of

academic success. In order to excel in school, all students need to learn how to spell. Students who are D/deaf and hard of hearing (d/hh) often struggle with spelling due to most methods of spelling education involving connecting spoken/heard sounds to letters, syllables, and words. There is limited research available regarding the methods deaf and hard of hearing students use to spell as well as error patterns typically made by this population.

The purpose of this research was to gain a better understanding of the changes in spelling as measured by a diagnostic assessment following a year of participation in Strategic and Interactive Writing Instruction (SIWI), a holistic approach designed to increase writing outcomes for students who are d/hh. Classroom teachers of D/deaf and hard of hearing students administered a spelling subtest taken from the Woodcock Johnson Tests of Achievement (3rd Edition; WJTA-3). The spelling test of fifty-nine words was administered twice, once at the beginning and once at the end of the year. This spelling test data was then scored, and students received either a 0 or 1 for each item scored. The pre-and post-test scores were then compared to see if there was any improvement throughout the school year when students participated in SIWI. Pre and post t-tests were used to analyze differences in the age equivalency and number of correct words on the spelling subtest.

Students made significant gains in their age equivalency, $t(51) = -3.649$, $p=.001$, and number of correct words $t(51) = -2.743$, $p=.008$. Mean scores for age equivalency increased from 90.75 months (SD=20.44) to 102.65 months (SD=32.94), a gain of 12 months during an 8-month time period. Number of correctly spelled words increased from a mean of 23 words (SD=8.9) to 26 words (SD=10.9). An analysis of each spelling error type was conducted using a one-way ANOVA and showed that the participants demonstrated significantly more PA errors (M= 3.37, SD= 2.81, range 0–12) than any other type of error defined by the MLC coding system. Overall,

students who participated in one year of SIWI demonstrated significant gains in their spelling as

measured by the spelling subtest of the WJTA-3. Additionally, the study found that students

made many more errors based on phonological awareness (PA) than any other error type defined

by the MLC.

An Examination of the Spelling Patterns of Deaf and Hard of Hearing Elementary School Students

Introduction

Spelling is a crucial part of elementary school course content, as academic work almost always involves spelling. It is necessary for all students to learn to spell, including deaf and hard of hearing (d/hh) students. According to previous research, when analyzed, deaf and hard of hearing students perform below the level of age matched peers with typical hearing on measures of reading, including decoding on orthographic learning (Wass et al., 2019). As of 2018, about 14.9 percent of children in the US have some degree of hearing loss (CDC, 2018). This is a significant percentage of the student population, yet there is limited information available about these students' patterns/skills in spelling. Therefore, the purpose of this research was to provide a better understanding of the strengths, weaknesses, and overall patterns of deaf and hard of hearing students' spelling in upper-level elementary grades.

Phonological Awareness

Phonological awareness, or the is the ability to identify and manipulate the sound structure of a language, is a necessary component of learning how to spell (ASHA, 2020). Although there is a strong connection between phonological awareness (PA) and spelling skills, there is some debate as to the extent that students who are deaf and hard of hearing use PA skills when spelling words. Research has documented that children use phonological awareness when spelling words (Bowers et al., 2015). The use of phonological awareness is generally seen as the foundation for reading and eventually spelling development, and is usually acquired through audition, or the process of hearing and manipulating the individual phonemes in words.

However, deaf and hard of hearing (d/hh) children struggle with this skill. For example, one study found most of the errors in the spontaneous writing samples of D/HH students were shown to be primarily phonologically based throughout the year the study was conducted (Bowers et al, 2015). The study also found that the students' errors in phonological awareness were consistent with previous studies showing that PA was the main spelling aspect d/hh students in grades 5-12 struggled with. Therefore, phonological awareness seems to be the most prevalent difficulty seen in middle school-high school d/hh children. However, one study conducted with deaf children who did not use cochlear implant technology demonstrated "visual errors", which included transposed letters and letter substitutions that were visually similar but differed in sound (Hayes, 2009). The presence of visual errors and the contradictory finding that phonological awareness errors are not the primary spelling error in deaf children indicates the need for further research in elementary aged children's spelling patterns.

Literacy Achievement in Deaf and Hard of Hearing Students

Children who are d/hh often struggle with literacy achievement (Hendricks et al., 2016). Many of these children have some sort of hearing assistance, such as cochlear implants, to access sound. In a recent study, researchers attempted to find out how d/hh children wearing cochlear implants performed on written storytelling exercises (Hendricks et al, 2016). The researchers found that compared to a group of typically hearing children, the d/hh children performed worse on these activities, spelling around 86% of familiar words correctly. This study emphasizes how d/hh children, even when accessing sound through the use of cochlear implants, struggle with written language expression and perform worse on spelling activities than children with normal hearing.

Spelling Patterns Among Early Education Students

While more research is clearly needed in the spelling of elementary aged d/hh students, scholars have attempted to find if the same patterns and differences (compared to typically hearing students) in middle and high school d/hh students apply to kindergarten children in a recent study. One study assessed the language, reading, and spelling skills of two groups of 20-22 children, one group with bilateral hearing loss and one with typical hearing (Aho & Werfel, 2020). Surprisingly, the researchers concluded that the examination did not show many differences between the two groups. This is contradictory to previous research done with older students, due to the fact that these older middle school students struggled with phonological awareness and made many errors in this category (Bowers et al, 2015). The study concluded that the errors that were shown in these older students' spelling had not yet emerged in Kindergarten (Aho & Werfel, 2020) leaving the question of when these errors do emerge in children.

Known Spelling Patterns of Deaf/Hard of Hearing Students

The errors usually made by d/hh students had seemed to emerge by middle school in one study which focused on this academic group. This group of students made many more PA errors than any other type of spelling error and had significant difficulty with spelling in general (Bowers et al, 2014). This was contradictory to the findings in the study with kindergarten students, which showed little to no difference in spelling skills of d/hh children compared to typically hearing children (Aho & Werfel, 2020). This could show that the errors typically made by d/hh children in spelling emerge after kindergarten and before middle school. This continues the question of when exactly these errors emerge during middle childhood. This research has served to provide a better understanding of the timeframe.

Summary

In summary, research conducted with d/hh children in kindergarten demonstrated no significant difference in their spelling abilities as compared to their hearing peers (Aho & Werfel, 2020). Students conducted with middle school age children show significant differences in spelling errors for d/hh students compared to their peers, including the types of linguistic errors that they make. To date, there is no published research on the spelling patterns of d/hh students in the elementary grades, specifically grades 3-5. The purpose of this research study was to examine the spelling skills of d/hh students participating in a year-long writing instruction intervention.

Research Questions

The research questions were as follows:

1. Does the percentage of spelling errors change over the course of one year?

    It is predicted that spelling accuracy will increase over the course of one year.

2. What spelling error patterns do d/hh children in grades 3-5 use on a spelling test?

    It was predicted that students demonstrate weak phonological awareness skills, with a high percentage of spelling errors consisting of errors of sound.

Methods

Participants

Fifty-two students who are deaf or hard of hearing were participants in a yearlong study to assess growth over time in different areas within writing, including spelling. Students were recruited from a wide range of classrooms using different types of communication modalities, including: listening and spoken language, total communication (TC) and bilingual-bicultural classrooms using both English and American Sign Language for instructional purposes. Parental consent was obtained by the IRB.

Procedures

Classroom teachers of D/deaf and hard of hearing students administered a spelling subtest taken from the Woodcock Johnson Tests of Achievement (3rd Edition; WJTA-3) (see Figure 1). The *Woodcock Johnson Tests of Achievement (Third Edition)* is a comprehensive academic assessment that tests skills ranging from oral and written language to mathematics. The assessment can be administered to individuals of all ages, from child to adolescent to adult. In this research study, students were only administered its Spelling subtest. The Spelling subtest of the Woodcock Johnson assessment is designed to test the spelling skills of individuals of all ages and is composed of a sample of 59 words to test spelling. Data collection was conducted by Elementary School teachers of the students. The spelling subtest was administered to students twice, once at the beginning and once at the end of the year. The average time between test administration was 8 months.

SIWI. Strategic and Interactive Writing Instruction (SIWI) was provided to the students by trained professionals for two hours per week for the academic year. Strategic and Interactive Writing Instruction (SIWI) uses guiding principles to provide authentic and meaningful writing experiences for students who are deaf and hard of hearing (d/hh). Spelling is a complex skill that is important to written composition; however, it is unclear how much, if any, explicit spelling instruction is required to improve spelling outcomes among d/hh students.

Figure 1. *WJTA-3 spelling subtest.*

Data Analysis

Student responses were compared to the target words on the spelling subtest and a

percent of spelling accuracy was calculated both for the beginning of the year and end of the year

samples. Students were given a score of (1) or (0) depending on if answers were spelled correctly

or not. Results were computed first using a raw score and students' scores were then compared to

age-based norms in months. Spelling samples were then coded using the Multi-Linguistic

Coding (MLC) system (see Table 1). Five error categories were defined for coding: phonological

awareness errors, orthographic pattern awareness errors, mental graphemic representation errors,

morphological awareness errors, and semantic awareness errors. A pair-samples t-test was used

to determine if there were any differences in pre-test to post-test spelling errors. A one-way

ANOVA was used to compare pre- and post- tests in order to determine if there was any

improvement throughout the school year when students participated in SIWI. It was predicted

that over one year of strategic and interactive writing instruction, students would demonstrate

statistically significant gains in spelling accuracy. Consistent with the literature, it was then

predicted that students would demonstrate more phonological errors than any other error defined

by the MLC system.

**Table 1.** *Multi-Linguistic Coding System for Spelling.*

Linguistic Category	Definitions, Defining Characteristics and Examples
Phonological errors (PA)	•**Errors of SOUND** •omission or addition of phonemes not in the word •maximally different incorrect representations of vowels ("o" for "a"; "u" for "e") •all letter reversals
Orthographic Pattern Awareness Errors (OPA)	•**Errors of regular PATTERNS** •incorrect consonant substitutions (d/t; n/m; s/tch) •rules for combining letters ("kry" for "cry"; "jrum" for "drum") •patterns that govern spelling ("ran" for "rain" ; "lader" for "ladder") •positional constraints on spelling patterns ("ckow" for "cow")
Mental Graphemic Representation Errors (MGR)	•**Errors of IRREGULARITY** (you just have to memorize the word) •correct "phonetic" spelling of non-phonetic words ("cidy" for "city") •incorrect spelling of unstressed syllables ("buckit" for "bucket") •incorrect vowels preceding –ng, r, l ("reng" for "rang" ; "whil" for "wheel") •incorrect spelling for repeated attempts (stopd, stopt, stoppd)
Morphological Awareness Errors	•**Errors of MODIFICATION** (i.e. prefix, suffix, tense change) •incorrect use of morphemes •wrong tense is represented ("walk" for "walked")
Semantic Awareness Errors (SA)	•**Errors of MEANING** •suffix modification errors represent another word ("fry" for "fried"; "drive" for drivers")

| •wrong word used ("cried" for "cries") |
| --- |

Results

The students' pre and post t-tests were analyzed using a one-way ANOVA for differences

in the age equivalency and in the number of correct words on the spelling subtest. The analysis

revealed that students made statistically significant gains in their age equivalencies in months

(see Figure 2), $t(51)= -3.649$, $p=.001$, as well as number of correct words (see Figure 3) $t(51)= -2.743$, $p=.008$. Mean scores for age equivalency increased from 90.75 months (SD=20.44) to

102.65 months (SD=32.94), a gain of 12 months over an 8-month time period. The number of

correctly spelled words increased from a mean of 23 words (SD=8.9) to 26 words (SD=10.9).

The analysis showed a general increase in students' spelling accuracy percentage, and indicated

that positive gains in age equivalencies were made over the course of the academic year.
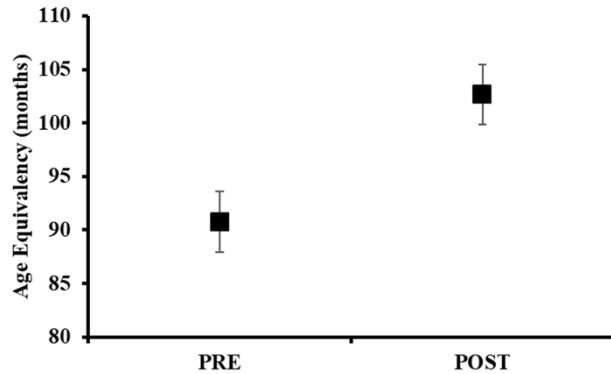
Figure 2. Age Equivalencies on Pre- and Post- Tests.
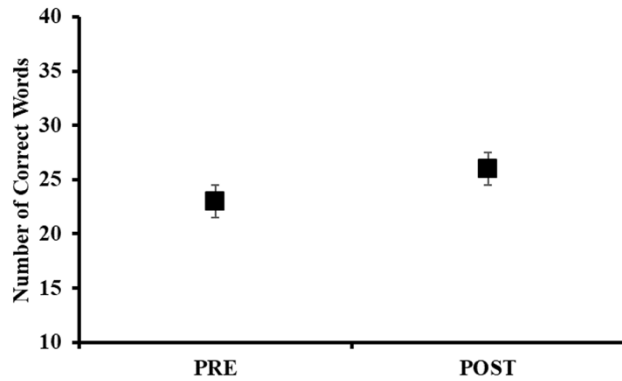
Figure 3. Number of Correct Words on Pre- and Post- Tests.

A one-way analysis of variance (ANOVA) was used, focusing on the variable of Error Type, which was composed of five major categories as stated on the MLC system (PA, OPA, MGR, SA, MA, VI) on students' spelling Pretests (see Figure 4). This analysis revealed that the participants in the study made significantly greater PA errors (M= 3.37, SD= 2.81, range 0–12) than any of the other four error types defined by the MLC coding system. Additionally, MGR errors (M=2.46, SD=3.13, range 0–11) and VI errors (M=2.38, SD=2.99, range 0-13) were the second most statistically significant error type categories determined through the analysis. The remaining error types were not demonstrated as often as PA, MGR, and VI errors and the analysis revealed the following results: OPA errors (M=1.58, SD=2.19, range 0–11), SA errors (M=0.94, SD=1.63, range 0–7), and MA errors (M=0.46, SD=0.70, range 0–3).
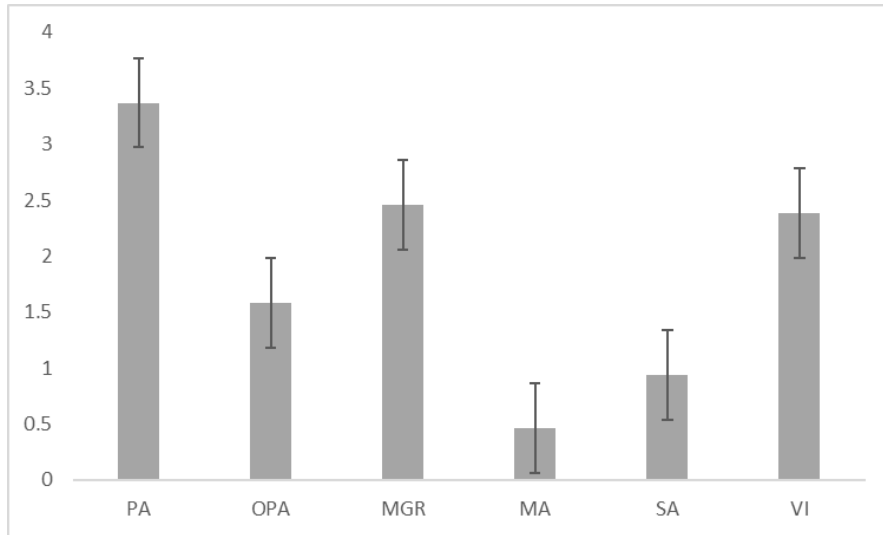
Figure 4. Error type from MLC System at Pre-test.

Discussion/Conclusions

Consistent with predictions and the literature, D/deaf and hard of hearing elementary school students made significantly more phonological awareness spelling errors (PA errors) as measured by their performance on the spelling subtest than any other type of error defined by the MLC coding system. As stated earlier, adolescent d/hh individuals struggled with the concept of Phonological Awareness in their spelling (Bowers et al, 2015), and this study indicated that the same finding may apply to younger students. Visual errors (VI) were made slightly less than PA errors, yet were still shown to be a significant category of errors. This type of error has previously been seen within D/deaf and hard of hearing populations (Hayes, 2009), and further research could be beneficial to see if this pattern remains consistent among different populations of d/hh individuals. These findings in error patterns are unique in that they are generally not what types of spelling errors are typically shown in elementary-aged students who have typical hearing. Furthermore, it was found that the d/hh students who participated in one year of Strategic and Interactive Writing Instruction (SIWI) demonstrated significant gains in their

spelling as measured by the spelling subtest of the WJTA-3. As shown by the results of analysis,

students in the study improved their age equivalencies as well as spelling accuracy (number of

words) significantly. Results demonstrate that d/hh students make gains in their spelling

outcomes during SIWI even though spelling is not explicitly taught as a part of direct instruction

(e.g., no spelling activities; spelling was discussed as a part of the writing process). Overall,

spelling outcomes improved within the authentic writing environment and guided support of

SIWI.

Limitations & Future Directions

There is limited research available that explores the spelling skills of children who are

deaf or hard of hearing. In this research study, there was no control group to compare the spelling

skills of children who are d/hh who did not participate in Strategic and Interactive Writing

Instruction (SIWI). In addition, further research is warranted to see if spelling outcomes also

improve in spontaneous writing samples during SIWI. Due to limited research on the

Multilinguistic Coding (MLC) system, it would be beneficial to research and analyze this system

and its components in order to make any necessary improvements and/or additions.

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