Written language outcomes of deaf elementary students engaged in authentic writing

Kimberly A. Wolbers
University of Tennessee, Knoxville, kwolbers@utk.edu

Hannah Dostal
University of Connecticut - Storrs, hannah.dostal@uconn.edu

David Cihak
University of Tennessee, Knoxville, dcihak@utk.edu

Leala Holcomb
University of Tennessee, Knoxville, lholcom5@utk.edu

Recommended Citation
Wolbers, K., Dostal, H., Cihak, D. & Holcomb, L. (2020). Written language outcomes of deaf elementary students engaged in authentic writing. Journal of Deaf Studies and Deaf Education, 25(2), 224-238. https://doi.org/10.1093/deafed/enz047

Title: Written language outcomes of deaf elementary students engaged in authentic writing

Kimberly A. Wolbers
University of Tennessee
E-mail: kwolbers@utk.edu

Hannah M. Dostal
University of Connecticut

David Cihak
University of Tennessee

Leala Holcomb
University of Tennessee

Author's Note

Abstract

This study explores the impact of Strategic and Interactive Writing Instruction (SIWI) on six students' written language skills through the application of a multiple-baseline probe single case design with embedded condition. This was part of a larger Institute of Education Sciences (IES)-funded project focused on the development and feasibility of implementation of SIWI. For the majority of skills analyzed, there were improvements in the mean level of performance with the implementation of SIWI, as well as more consistent responding and positive trends in the data. The study also revealed that teachers are in need of additional tools to aid the systematic identification and tracking of syntax skills in children's written language development, and to distinguish these from other writing skills such as convention or handwriting.

Written language outcomes of deaf elementary students engaged in authentic writing

Within this study, we investigate the impact of Strategic and Interactive Writing Instruction (SIWI) on six students' written language skills, and explore support teachers need when identifying and monitoring their students' written language skills[i].

Review of Literature

The experience of learning to write among deaf and hard of hearing (d/hh) children is unique in that many are coming to the task of writing without a fully acquired first language. This reduces the linguistic resources needed to craft syntactically accurate sentences, and presents teachers of the deaf with the need to approach writing instruction in a way that accounts for language delay and deprivation that is not needed with other populations. Research on the language and literacy development of d/hh students suggests that language deprivation is common (Hall, Eigsti, Bortfeld, & Lillo-Martin, 2018; Humphries et al., 2016; Mitchell & Karchmer, 2004) and results in many d/hh children starting school without a language foundation to support academic learning (Mayberry, 2002). This creates difficulties in communication that can limit opportunities for learning in general, and for literacy development in particular (Hall et al., 2017).

In contrast, previous studies have found healthy cognitive and psychosocial development among d/hh children with early exposure to sign language across a range of measures, including: theory of mind (Hall et al, 2017; Schick, De Villiers, De Villiers, & Hoffmeister, 2007; Woolfe, Want, & Siegal, 2002), attention (Dye & Hauser, 2014), and working memory (Marshall et al., 2015). For example, in Hall and colleagues' (2017) study of d/hh students with and without early exposure to ASL, they found that Deaf native signers, who have had full access to language which served as a foundation for academic learning, had "mean scores indicative of healthy,

normative, age-typical Executive Function" (Hall et al., 2017, p. 14) Similarly, Dammeyer (2010) found that teacher-rated problems in psychosocial adjustment were related to language skills among d/hh students. Those with spoken or sign language proficiency were rated as having fewer behavioral problems. In addition, Marshall et al., (2015) found that deaf children who experienced a period of language deprivation scored significantly lower than hearing children or those with early sign language exposure on performance measures of working memory.

Just as many cognitive and psychosocial outcomes depend on early language development, literacy development also varies based on early exposure to and development of a full language, whether spoken or signed (Goldin-Meadow & Mayberry, 2001; Lederberg, Schick & Spencer, 2013). When comparing English L1 speakers, English L2 speakers, native ASL users, and late ASL learners, Mayberry (2007) found that those with early access to ASL perform at the same level as English L2 speakers across measures of grammar and syntax, while those who experienced a language delay performed significantly worse. This is similar to Mayberry and Lock's (2003) finding that when the age of language acquisition is held constant, no differences in syntactic processing arise between those who acquire a signed or spoken language as their L1. Mayberry (2007) similarly concluded that "despite these radical differences in both the linguistic structures and sensory–motor modality of the early language experience, the groups whose L1 language exposure began in early infancy showed similar performance on their L2 syntactic proficiency in English" (p. 542).

Studies of writing development among d/hh students have shown relatively stronger performance across more holistic measures of discourse and genre-specific writing features (Antia, Reed, & Kreimeyer, 2005; Arfe, 2015; Marschark et al., 1994; Musselman & Szanto,

1998; Yoshinaga-Itano, Snyder, & Mayberry, 1996), and lower levels of performance across measures of grammar and syntax (Antia, Reed, & Kreimeyer, 2005; Marschark, Mouradian, & Halas, 1994; Yoshinaga-Itano et al., 1996). Given that non-standard grammatical forms commonly appear in the writing of d/hh children, their writing tends to be less syntactically fluent and grammatically complex (Fabbretti, Volterra, & Pontecorvo, 1998; Marschark et al., 1994; Yoshinaga-Itano et al., 1996). For example, other studies have demonstrated that the writing of d/hh students often excludes the use of function words, includes subject-verb agreement errors, limits the use of complex sentences, and incorporates limited adjectives and adverbs (Antia, Reed, & Kreimeyer, 2005; Burman, Evans, Nunes, & Bell, 2008; Harrison, Simpson, & Stuart, 1991; Marschark, Mouradian, & Halas, 1994; Powers & Wilgus, 1983; Spencer, Barker, & Tomblin, 2003; Wilbur, 1977). This is in contrast to the majority of hearing students and some d/hh who have a strong language foundation, which includes developed syntax of their L1, upon which to build literacy skills. This contrast highlights the need for academic instruction to promote language development for d/hh children.

Despite the lack of research evidence supporting the use of stand-alone English grammar curriculum that is decontextualized from writing instruction (Graham & Perin, 2007; Hillocks, 1984), it is common practice with d/hh students who exhibit language delays (e.g., Anderson, Boren, Kilgore, Howard, & Krohn, 1990; Berent et al., 2007; Cannon & Kirby, 2013; Easterbrooks & Baker, 2002; Fitzgerald, 1949; Schneiderman, 1995). Strassman and Schirmer's (2013) review of research on writing instruction for d/hh students, found that only grammar instruction embedded within student writing seemed to yield positive results. They also suggested that strategy instruction and collaborative writing hold promise for improving the writing of d/hh students. SIWI takes an embedded approach to grammar instruction that

incorporates strategy instruction and interactive (collaborative) writing.

The approach to teaching written language skills, or grammar/syntax, in SIWI stands apart from other programs that have been implemented to teach d/hh students grammar and language skills (c.f., Anderson et al, 1999; Fitzgerald, 1949; Phelps-Teraski & Phelps-Gunn, 2000). Rather than being taught through a sequenced and decontextualized grammar curriculum, within SIWI, language skills are practiced naturally during collaborative guided writing, which may be more beneficial to language development. Teachers interactively guide students to construct an authentic text (which has a clear purpose for being shared with an intended reader) at a level just beyond what students are writing independently. This co-constructed text between teacher and students then serves as comprehensible and slightly advanced input (Krashen, 1994), since it stems from students' expressions and is meaningful to them. The comprehensible English text can be read and reread to support reading fluently for understanding, and it also serves as a model and scaffold for independent.

Teachers may also provide explicit grammar instruction as needs appear or as the teacher aims to target students' written language during the co-construction of text. In this way, grammar instruction is embedded in writing and given meaningful application. Attention to grammar during collaborative writing might occur in a number of ways; the teacher may illustrate the application of skills to the text through thinking aloud or modeling, or she may facilitate elaborate problem solving discussions with students about written language needs or use. These activities happen in the context of producing meaningful text with the intention of communicating with an audience, and the reader's perspective is often considered during the decision making. Thus, language instruction is always contextualized within purposeful written communication. Even when the teacher decides it is necessary to separately teach a writing or

language skill, she will thereafter contextualize practice of the skill into authentic guided writing. She does this by directing students' attention to places in the text where they might consider applying the new skill, and then guides their action. Visual scaffolds are often used during explicit instruction and guided practice, which support students in identifying needs for revision more independently. With time, they begin directing and self-regulating their actions during independent writing. Hence, we hypothesize that SIWI implemented with elementary d/hh students to target grammar and syntax will lead to gains in written language performance. Therefore, the purpose of this study is to examine the relationship between SIWI and students' written language (i.e., grammar) skills.

Method

A multiple-probe design across skills with an embedded condition (Kazdin, 2011) was used to establish the effectiveness of instruction on the independent word- and sentence-level writing skills of six d/hh students in which SIWI was systematically introduced for each skill. The procedure included assessing the initial level of performance for each written language skill and documenting change in each probe sequence after the SIWI intervention was implemented. When the performance criterion was met for the first writing skill, a second probe sequence was initiated. This procedure was repeated for the third probe sequence. The data provide information about the effect SIWI has on d/hh students' written language skills as they relate to each skill.

During SIWI students are engaged in discussion and writing in order to publish writing that purposefully and meaningfully communicates with an audience. Because of this, it is not possible to constrain the focus of instruction to an established set of skills. While the teacher will intentionally model, think aloud, or guide conversation in the targeted skill areas, students may still receive exposure to other skills. For this reason, the onset of SIWI with instruction for skill 1

(SIWI + I1) is an embedded condition that may impact skills 2 and 3, as SIWI with instruction for skill 2 (SIWI + I2) may impact skill 3 before targeted instruction for that skill was provided (SIWI + I3).

Writing (i.e., genre traits) and written language skills (e.g., grammar, syntax) were examined separately in order to track improvement in d/hh students' ability to organize and express ideas as well as use appropriate grammar and mechanics of writing. Researchers were interested in learning how both writing (i.e., genre traits) and written language (i.e., grammar, syntax) were impacted by the intervention. See Wolbers et al. (2015) for writing outcomes focused on genre traits.

Setting and Participants

This study took place in a residential school for the deaf in the southeastern part of the United States. For the purpose of writing instruction, four teacher participants divided their 3rd-5th grade students into three groups--low, mid and high performing. Grouping was primarily based on students' expressive and written language rather than grade level. Gabriella taught the lower-performing group, Vivian and Dana the mid-performing group, and Andrea the higher-performing group. Teacher and student participants (two from each group) are listed by pseudonyms and described below. Teacher data were drawn from a researcher-developed 19-item online survey of teachers' professional experience which included self-reported writing competencies and attitudes. Student participant data were drawn from teacher reports, researcher observations, and student academic/school records.

All four teachers identified as white hearing females who had between 3 and 7 years of teaching experience, and held a Master's Degree or equivalent in education. Vivian, with 6 years of experience, also held an Education Specialist (Ed.S.) degree. In addition, teacher participants

had between 4 and 11 years of experience with ASL, and reported being able to understand and express most or all concepts in ASL, with full or close to full comfort communicating in ASL. The school communication philosophy, however, was simultaneous communication (i.e., spoken English along with English influenced sign language), and because of this, teachers were limited in their use of ASL. This is considered a limitation of the study. It is not clear the extent to which all students had access to instruction through this form of communication, or whether there was sufficient modeling and interaction in ASL to grow students' expressive/receptive ASL abilities.

Two teachers rated their preparation to teach writing (survey item: My preparation to teach writing is...) as *minimal* and two rated it as *adequate* on the online survey. Yet, all four teachers reported being fully comfortable (5 on a scale of 1-5) and fluent expressing (5 on a scale of 1-5) themselves in writing (survey items: How fluent is your written English? How comfortable are you communicating in written English?). Related to attitude towards writing (survey item: I like to write.), the teacher with the least teaching experience (3 years), Andrea, gave a neutral rating (i.e., *neither agree nor disagree*) while the other three teachers *agreed* that they enjoyed writing.

Student 1, Jared. Jared was in Gabriella's class for writing instruction where simultaneous communication was used. He is an eight year old white male in the third grade. He has a severe hearing loss (71-90 dB) without amplification and a moderate hearing loss (41-55 dB) with the use of hearing aids, which his teacher reports he never wears. Jared has a severe language delay and difficulty expressing most ideas. His expressive communications with others includes basic vocabulary, and his writing at the beginning of the study primarily consisted of pictures. His grade equivalencies on the WJ III Broad Written Language and Broad Reading subtests were 1.1 and 1.1, and his grade equivalent SAT-HI score was 1.3 at the start of the

study. Jared scored 153 on the NWEA MAP[1] Language Usage subtest and 159 on the MAP

Reading subtest (below the 7th percentile).

Student 2, Shane. Shane was in Gabriella's class for writing instruction. Shane is a nine

years old white male in the fourth grade. He has profound hearing loss (91 dB+). He always

wears cochlear implants, and when he wears them, his hearing loss is mild (26-40 dB). He has

severe language delay and difficulty expressing most thoughts and needs. At the start of this

study, his writing included a few familiar words. His results on the WJ III Broad Written

Language and Broad Reading subtests were grade equivalents of 1.2 and 1.4. He received a

grade equivalent score of 1.2 on the SAT-HI, 163 on the MAP Language Usage subtest, and 156

on the MAP Reading subtest (below the 7th percentile).

Student 3, Nelly. Nelly was in Vivian and Dana's class for writing instruction. She is an

eight year old white female in the third grade. She has a profound hearing loss (91+ dB) without

amplification and a moderate to severe loss (56-70 dB) with the use of a cochlear implant, which

she wears regularly. During the time of the study, it should be noted that Nelly's right implant

was removed because of an infection, and her left implant was re-implanted near to the

conclusion of the study due to device failure. Nelly's communication with others is often in ASL

or in an English-influenced ASL. When writing, Nelly is able to generate many ideas but

struggles to spell and write those ideas on paper. On the WJ III Broad Written Language and

Broad Reading subtests, her grade equivalencies were 1.5 and 1.4 respectively, as well as 1.4 on

the SAT-HI. Nelly scored 155 on the MAP Language Usage subtest and 157 on the MAP

Reading subtest (below the 7th percentile).

Student 4, Tyra. Tyra was also in Vivian and Dana's class for writing instruction. She is

a nine year old African American female in the fourth grade. She has a profound hearing loss (91

dB+) without hearing aids and a moderate hearing loss (26-40 dB) with hearing aids, which she always wears. When communicating, Tyra is able to fluently express some ideas through ASL and English-influenced ASL. Tyra includes many ideas in her writing, yet often constructs incomplete sentences by only highlighting the major event. Her grade equivalencies on the WJ III Broad Written Language and Broad Reading subsets were 1.9 and 1.8, and her grade equivalent score on SAT-HI was 1.7. Tyra scored 158 on both the Language Usage and the Reading subtests of the MAP (below the 7th percentile).

Student 5, Barbara. Barbara was in Andrea's high performing class for writing instruction where simultaneous communication was used. Barbara is a nine year old Latina in the fourth grade. She has a profound hearing loss (91 dB+). With her cochlear implants, which she frequently uses, she has a mild hearing loss (26-40 dB). She can fluently express most anything through ASL and English-influenced ASL. Her home language is Spanish. When writing, Barbara notes her ideas using simple sentence structure that, at times, includes ASL syntax. On the WJ III Broad Written Language and Broad Reading subsets, her grade equivalencies were 2 and 2.1. On the SAT-HI, her grade equivalent score was 1.9. Barbara scored 172 on the MAP Language Usage subtest and 173 on the MAP Reading subtest (below the 7th percentile).

Student 6, Meg. Meg was also in Andrea's class for writing instruction. Meg is a 9 year old white female in the fourth grade. She has Waardenburg Syndrome and a profound hearing loss (91 dB+). She always uses hearing aids, which amplifies her hearing levels (26-40 dB). Her home language is ASL, and she can fluently express her ideas or thoughts in ASL. When writing at the beginning of this study, Meg was able to document many ideas but used simple sentences and rarely used punctuation to separate ideas. On the WJ III Broad Written Language and Broad Reading subsets, she received scores that were equivalent to grade levels 4.8 and 3.1. Her SAT-

HI score was equivalent to 3.5 grade. Meg scored 193 (~31st percentile) on the MAP Language Usage subtest and 185 (~16th percentile) on the MAP Reading subtest.

Independent Variable

The SIWI intervention was the independent variable. Instruction occurred two hours per week in a class that focused on writing. SIWI occurred across three genres in the following order: recount/personal narrative, information report, and persuasive. While students did not receive explicit writing and language instruction outside of the intervention, they did partake in various writing activities in other classes such as independent writing for 15 minutes daily in their homerooms.

SIWI professional development. Based on research on effective professional development that advances teacher knowledge and practice (e.g., Darling-Hammond & Richardson, 2009; Desimone, 2009; Thames & Ball, 2010; Wei, Darling-Hammond, Andree, Richardson & Orphanos, 2009), the SIWI year-long PD program consists of a summer institute, a fall workshop, and online coaching (see Wolbers et al., 2016 for more information about the impact of SIWI PD). Teachers involved in this study participated in a week-long workshop during the summer of 2014 to learn about the intervention. During the workshop, the teachers were introduced to SIWI principles, engaged in discussion after watching SIWI video models, and had hands-on experience co-constructing a newsletter with d/hh elementary students at a summer camp. At the time[ii], the summer workshop did not include a written language assessment tool. Teachers informally examined students' writing samples for writing and language strengths as well as areas of need. From this activity, they identified skills to incorporate into instruction at the individual and class level. Some examples include 1) simple sentences with a subject and predicate, 2) compound and complex sentences, and 3) use of a/the.

When the intervention was implemented during the school year, the researchers met with teachers online every other week to share and receive updates, provide instructional support, and discuss any issues from the previous two weeks. Teachers' implementation of SIWI in the classroom was video-recorded using a dual camera system that captured both teacher and student views in a single split-screen view. This footage was automatically uploaded to a secure server that researchers could access to guide coaching and support during bi-weekly meetings with teachers. In January of 2015, teachers attended a 3-day in-person workshop where they watched videos of their SIWI instruction and engaged in guided reflection and supportive discussions about their practice.

Instructional fidelity. To assess the fidelity of the intervention being administered in the classroom, researchers reviewed two SIWI units for each teacher. A unit contained all video recorded lessons across one co-construction, from planning to publication. The fidelity instrument has 57 instructional indicators and those that were unratable through observations were scored after a supplemental interview with the teacher. The degree to which teacher instruction was implemented as intended was marked as evident (1), somewhat evident (0.5), or not evident (0). There are four parts to the instrument: 1) curriculum and content (e.g., student's targeted skills are appropriate for the genre of writing), 2) strategic writing and visual scaffolds (e.g., strategies for writing processes are taught in the context of producing text), 3) interactive writing instruction (e.g., teacher asks and/or models metacognitive questioning often, such as why or how), and 4) metalinguistic knowledge and implicit competence (e.g., students are engaged in identifying, comparing and/or distinguishing grammatical features of ASL and English). An item remained unscored if, for example, students' language needs did not require a specific instructional strategy. A full copy of the SIWI fidelity instrument and how it was

developed can be found in Dostal and Wolbers (2015).

Instructional fidelity percentages for each teacher were averaged across two observed units (one in the fall, and one in the spring). The average instructional fidelity for Gabriella's units were 65%, Vivian's 74%, Dana's 76%, and Andrea's 54%. Previous findings indicate that first year SIWI teachers typically receive instructional fidelity percentages, on average, in the low 70's while teachers who continue with the SIWI sustained professional development program, which includes a summer workshop and regular coaching meetings throughout the year, reach 85% to 95%, on average, in their 2nd and 3rd years respectively (Wolbers et al., 2016). While the teachers in the study had been exposed to SIWI previously, this was their first time participating in research focused at the later elementary level, and receiving sustained professional development.

Dependent Variable

The dependent variables were word- and sentence- level language skills that teachers set based on students' current levels of performance. Therefore, language skills varied by class and student, as teachers observed students' use of language in their writing and determined the next most appropriate skills. Eleven different skills were identified by the teachers that spanned sentence awareness and complexity, grammar, and mechanics. The skills are defined below (Table 1, and presented for each student in Table 2). Teachers were encouraged to focus on one or two language skills at a time in order to direct the classroom dialogue around the targeted skills during SIWI as opposed to addressing all written language needs that surfaced during the construction of text. However, if a need surfaced that was outside of the skills being targeted but relevant to the text and appropriate for the student, the teacher would quickly address it by providing a short explanation, modeling, and/or asking a student to demonstrate its use. If, for

example, the class was co-constructing a sentence and students were confused about a language skill that was not their targeted skill such as when to use *a* or *the*, the teacher might quickly think aloud and model her approach rather than open a problem-solving discussion with students.

It should be noted that teachers were responsible for identifying the language skills of focus, and a number of these skills were related to conventions or mechanics more than language. Skills such as capitalization and punctuation, which were often set and monitored simultaneously, were likely easier for teachers to identify and instruct compared to syntax, or perhaps felt more immediate to teachers. While mechanics were not the original intent of the study, we continued the collection of data to determine the impact of SIWI on these skills along with language-related skills. The research team occasionally provided suggestions to teachers; one example of this is the use of words per T-unit to measure language complexity.

[Insert Table 1 and 2 here.]

Inter-rater agreement. Approximately 25% of the writing samples were scored by two researchers. Inter Class Correlation Coefficient (ICC) for scoring language skills was 0.964, demonstrating good internal consistency with scoring.

SCD Procedures

Baseline procedures. During the baseline phase, students were asked to write independent essays. A minimum of three data points, or three independent writing samples, were collected during baseline before SIWI was introduced, and another two data points were collected before SIWI instruction for skills 2 and 3. If stability in the baseline data was not present, we looked for visible downward trends before transitioning to intervention phase or overall low performance (e.g., never reaching more than 50%). Writing samples during baseline data collection were recounts--students wrote about something that happened in their lives.

Students were not required to write a set amount of text; therefore, their samples varied in length at each data point. On average, students completed writing samples in 15-20 minutes and were given more time as needed.

Intervention phase. During the intervention phase, the researchers introduced SIWI to the students targeting the first written language skill (SIWI + I1). Students were not explicitly introduced to SIWI targeting skills 2 and 3 until the established criteria were met (i.e., a stable pattern of 3 or more points above the mean of the baseline). That is, students remained in the baseline phase for skills 2 and 3. When the students reached the established criteria with skill 1, the researcher systematically introduced SIWI to students targeting skill 2 (SIWI + I2). When the students met the established criteria (i.e., 3 or more points above baseline mean), the researcher introduced SIWI targeting skill 3 (SIWI + I3), and continued until the established criteria were met.

Data points were scores from independent writing samples that were collected after each class co-construction was published, which occurred, on average, every week to two weeks. Students were given a picture and written prompt when collecting information report samples (e.g., What are characteristics of a good friend?) and persuasive writing samples (e.g., Do you feel there should be a no homework policy?). Prior to winter break, classes transitioned from recount writing to information report writing, and then transitioned to persuasive writing early spring. The independent writing samples collected during that time matched the genre being taught.

Maintenance. A maintenance probe was collected approximately every third writing sample after stopping instruction targeting the skill.

Social Validity

Near the end of the school year, we interviewed teachers using a semi-structured format. We asked them to reflect on a year of SIWI implementation--successes, struggles, and if they would continue using SIWI in the future. There were also questions about whether they believed SIWI contributed to students' writing and language progress.

Data Analysis

Visual analysis procedures are used to determine stability in baseline data and to assess level, trend, and variability in implementation and maintenance phases. A causal relationship between SIWI and language outcomes occurs when an effect is demonstrated at three different points in time. Descriptive data are also presented by student for mean levels, range of data, and number of sessions in each phase. Lastly, an improvement percentage was calculated for variables by comparing baseline mean with the final or maintenance phase mean. This calculation, however, was not performed for variables in which the baseline mean was 0, as 0 would become the denominator in the percentage calculation.

Results

Jared

See Figure 1 and Table 3, and the appendix for Jared's baseline and intervention phase writing samples. During baseline, Jared averaged 0.6 intelligible words for skill 1. His intelligible words increased to a mean of 3.9 during SIWI + I1, and he maintained intelligible words at a mean of 15. Jared wrote 25 times the amount of words in maintenance compared to baseline--a 2400% improvement. For skill 2a, Jared did not use any punctuation during baseline. His punctuation improved to a mean of 50% during the SIWI + I1 phase, and 71% during the SIWI + I2 phase. During maintenance, Jared consistently used punctuation 100% of time. Jared showed the same pattern of response with skill 2b. At baseline, he did not use capitalization. His

capitalization improved to a mean of 50% during SIWI + I1 and 98% during SIWI + I2. Jared maintained correct capitalization at 100%. It should be noted that writing sample number 13 during SIWI + I1 was one sentence in total that was correctly punctuated and capitalized while some writing samples during SIWI + I2 had several sentences. Jared went from 0% at baseline to 100% correct use at maintenance with both 2a and 2b skills. With skill 3, he demonstrated 0% verb variance at baseline, improved to a mean of 33% during SIWI + I2. During instruction targeting the skill, SIWI + I3, his data points showed considerable variability, ranging from 0% to 67% and averaging 27%.

[Insert Figure 1 and Table 3 here.]

Shane

See Figure 2 and Table 4. During baseline, Shane averaged 7.4 intelligible words for skill 1. His intelligible words increased to a mean of 12.7 during SIWI + I1, and he maintained intelligible words at a mean of 19. Shane demonstrated an overall intelligible words improvement of 157%. During baseline and SIWI + I1 phases for skill 2a, Shane showed great variability in correct punctuation (ranging from 0-100%) with means of 83% and 25% respectively. He showed increased consistency during the SIWI +I2 phase and improved his mean to 93%. During maintenance, Shane used correct punctuation 100% of time--an overall improvement of 20% from baseline. During baseline data for skill 2b, Shane demonstrated a range of correct capitalization from 50 to 100% and a mean of 72%. His capitalization improved to a mean of 100% during SIWI + I1 and 97% during SIWI + I2. Shane maintained correct capitalization at 100%. There was an overall improvement of 39% from baseline to maintenance with correct capitalization, even while Shane's writing samples were becoming increasingly longer. With skill 3, he demonstrated a mean of 1.7 T-units at baseline. He improved to a mean

of 3 during SIWI + I2 and a mean of 4.4 during SIWI + I3, with data points ranging from 3-6 T-units. Shane showed an overall improvement of 159% from baseline to final phase.

[Insert Figure 2 and Table 4]

Nelly

See Figure 3 and Table 5. During baseline, Nelly averaged 13% of varied sentence starters for skill 1. The variety of Nelly's sentence starters increased to a mean of 63% during SIWI + I1, and she maintained this writing skill at a mean of 85%. Nelly's varied sentence starters had improved by 554% from baseline. For skill 2, Nelly had an average of 11% of correct verb tense for baseline, and then with SIWI + I1, her average increased to 13%. She demonstrated considerable improvement when the teacher targeted the skill during SIWI + I2, increasing to a mean of 61% correct verb tense. Nelly maintained correct verb tense at 100%, and her overall improvement from baseline was 809%. Objective 3 was the number of words per T-unit. Nelly wrote a mean of 3.7 words per T-unit at baseline, and nearly doubled this after receiving SIWI + I2 and SIWI + I3 to a mean of 6.4 and 6.0 words per T-unit respectively--a 62% improvement from baseline. Nelly's baseline and intervention phase writing samples are included in the Appendix.

[Insert Figure 3 and Table 5]

Tyra

See Figure 4 and Table 6. For skill 1a, Tyra had a mean of 19% of correct punctuation in her writing baseline. Her use of correct punctuation went up to a mean of 74% during SIWI +1 and 89% during maintenance phase. Tyra showed an overall improvement in her correct punctuation from baseline to maintenance by 368%. In the meantime, Tyra worked on skill 1b, which was on capitalization. During baseline, she averaged 25% correct capitalization. After

receiving SIWI + I1, her use of correct capitalization rose to the mean of 76%. During

maintenance, Tyra used correct capitalization 100% of the time. Tyra's overall improvement

from baseline to maintenance phases was 300%. With skill 2, Tyra wrote complete simple

sentences at an average of 21% during baseline. SIWI + I1 did not show an impact, as she

continued to average a low 17% of complete simple sentences during this phase. With the onset

of instruction targeting the skill, SIWI + I2, her average percentage of complete simple sentences

jumped to 57%, and then continued steadily upward to 63% during the maintenance phase. From

baseline to maintenance, Tyra demonstrated an overall improvement of 200%. With skill 3, Tyra

wrote an average of 4.7 words per T-unit in baseline, which then increased to 6.5 during SIWI +

I2 and 7.2 during SIWI + I3 with an upward trend. This indicates an overall improvement in

Tyra's number of words per T-unit of 53% between baseline and final phases.

[Insert Figure 4 and Table 6]

Barbara

See Figure 5 and Table 7. For skill 1, Barbara had an average of 34% of correct

capitalization during her baseline. After receiving SIWI + I1, her average rose to 88%. She kept

steady at an average of 87% during the maintenance phase. Barbara's use of correct

capitalization showed an overall improvement from baseline to maintenance phase of 156%.

With skill 2, Barbara's mean baseline for the number of compound and complex sentences was

0. During SIWI + I1 and SIWI + I2, Barbara's average use of compound and complex sentence

increased to .5 and 1 respectively. At maintenance phase, she was able to produce compound and

complex sentences at a mean score of 3. Barbara averaged 5.6 words per T-unit at baseline for

skill 3. Her average number of words per T-unit increased during SIWI + I2 to 7.4. She

continued to progress during SIWI + I3 and was able to write a mean of 9.2 words per T-unit.

There was an increase of 64% in Barbara's number of words per T-unit from baseline.

[Insert Figure 5 and Table 7]

Meg

See Figure 6 and Table 8. During baseline, Meg received an average of 26% correct punctuation for skill 1a. After receiving SIWI + I1, her average went up to 73%. During the maintenance phase, she had an average of 100% accuracy on her usage of punctuation. This indicates an overall improvement of 285% in her ability to use correct punctuation. With skill 1b, Meg had a mean of 49% of correct capitalization at baseline that went up to 74% after receiving SIWI + I1 instruction. She maintained correct capitalization at 100% after the intervention for skill 1 concluded. From baseline to maintenance phases, Meg had an overall improvement of 104% for this skill. Objective two is the number of lowercase letter errors in Meg's writing. Meg had a mean of 11.3 lowercase letter errors at baseline. After receiving SIWI + I1 and SIWI + I2, her errors went down to an average of 3.5 and then 2.7, and she reduced her errors to two letters--F and E. At maintenance, she had no lowercase letter errors. This change from baseline to maintenance phases demonstrates that lowercase letter errors are no longer present in Meg's writing. With skill 3, Meg wrote a mean of 5.7 words per T-unit at baseline. Her average increased to 9 while receiving SIWI + I2 and decreased slightly to 8 during SIWI + I3. This demonstrates an overall improvement of 40%.

[Insert Figure 6 and Table 8]

Social Validity

In the end of year interviews, the teachers reflected on a year of SIWI implementation, including successes and struggles. Andrea remarked on the impact of SIWI on her students' writing performance: "There was improvement in all of them [students]. Their planning and

them noticing things about their own writing. It was a nice change." Other teachers commented about individual students. Vivian and Dana said, "Nelly has started transferring what she has learned about past tense verbs during group writing into her independent writing! I'm excited to see her so engaged and motivated during our group writing time!" Gabriella remarked:

> I'm really excited about the progress Shane and Jared have made. I worked with Shane last year, and it was a struggle to get him to draw a picture at the beginning of the year, and now he is writing short sentences that are very close to English. Jared is writing more words during his independent writing, and is so much more willing to participate and answer questions during group writing. [See Jared's writing samples in the Appendix.]

In terms of struggles, three of the four teachers said it was difficult to identify students' language skills. Andrea responded with the following when asked what needs to be improved: "Setting objectives. I think if there was some kind of chart. To know where to go next. You can pick them out of the air and Common Core has to be involved but how do you know what's next?" All teachers said they plan to continue using SIWI in the future.

Discussion

The purpose of this study was to examine the impact of SIWI on students' written language skills through the application of a multiple-baseline probe single case design with embedded condition. Data associated with six students and their individual language skills (3 each) were collected and analyzed. Written language skills were set by teachers with support from the research team. The skills varied across domains of grammar (e.g., percentage of complete sentences), language complexity (e.g., number of words per T-unit), conventions (percentage of correct end punctuation) and length (e.g., number of intelligible words). For

nearly all skills, there were demonstrated improvements in the mean level of performance with the implementation of SIWI, as well as more consistent responding and positive trends in the data. Across seventeen skills in which the improvement percentage from baseline to the final phase could be calculated, the median improvement was 157% and the mean improvement was 339%. While this indicates a marked improvement, a number of the skills teachers identified were letter- or word-level skills, or conventions, rather than grammar or syntax-related skills which was the original intent of the study. In this section, we first we discuss the changes in student performance that were documented within the context of SIWI instruction, and then highlight challenges teachers faced in assessing and identifying language skills for development. We follow this section with additional limitations and need for future research.

While it is clear that there was overall development in targeted skills, there were differences in terms of how and when students demonstrated improvement in the skills. With the inclusion of the embedded condition phase line, it was possible to differentiate language skills that were impacted by SIWI instruction in general from those that were impacted after implementation of SIWI with explicit instruction for the skills. For example, Jared's percentage of correct punctuation and capitalization improved from 0 to 50% during SIWI + I1--a phase when the teacher had not yet explicitly taught or emphasized the skills during SIWI. Performance continued to demonstrate an increase during the phase when the teacher provided targeted instruction, and into the maintenance phase. Similarly, Meg significantly reduced the number of lowercase letter errors in her writing after SIWI commenced but before the teacher had given specific attention to the skill during writing. This may suggest that students implicitly acquire some skills through repeated modeling of the composing process. While the teacher may not give particular emphasis to capitalizing the first letter of a new sentence, for example, she is

still modeling the practice when writing with students, and they may begin to infer the rule through repeated observation (cf., Dostal & Wolbers, 2016). These findings indicate that modeling and composing with students have potential to impact untargeted written language skills, and that SIWI may have some global influence on students' written language development. For example, words per T-unit was a skill that continually increased for students after the onset of SIWI and before the skill was given specific attention, which may illustrate SIWI's influence on language competency and complexity more broadly as compared to specific skills needing explicit instruction.

Conversely, there were language skills that were not impacted by the onset of SIWI until the skills were given attention during instruction. This is evident with Nelly's second skill, percentage of correct verb tense, and Tyra's second skill, percentage of complete simple sentences. In both cases, performance was not impacted by the onset of SIWI + I1 but did show marked improvement after teachers specifically directed students' attention toward the skills during SIWI + I2. For example, Tyra's use of complete sentences increased 57% during the phase in which her teacher provided instruction targeting this skill; however, during the prior phase in which the language skill was not targeted, her use of complete sentences dropped by 4%. Further, after the phase of instruction that focused on constructing complete sentences had ended, Tyra still demonstrated that she maintated this skill during the maintenance phase. In this way, targeted, explicit instruction did assist students in attaining even greater proficiency in skills that were not positively impacted by modeling and shared practice alone (Graham & Perin, 2007; Regan & Berkeley, 2012). Therefore, strategic instruction of written language skills during SIWI appears to be necessary to ignite some written language skills.

One challenge noted by the researchers was determining criterion levels for skills. For

example, at the beginning of the study Nelly started all of her sentences with "I" (see the Appendix for her baseline sample). Her teacher identified this as problematic and wanted her to begin using different sentence starters; however, there is no established level of optimal variability. In fact, with shorter essays, it may be possible to start each sentence differently; yet, this would become arduous and even unnecessary with longer pieces. Similarly, Barbara's teacher noticed that she was doing well with writing simple sentences and wanted to see her begin using compound and complex sentences. Yet, it was unclear how many complex and compound sentences would be needed to demonstrate she has met her skill. In reality, writers choose to use a variety of different sentence types for craft and to convey voice. In this case, the research team suggested using words per T-unit which has long been established in the literature as an indicator of sentence complexity (Hunt, 1965) and is a variable computed when using the The Structural Analysis of Written Language (SAWL; White, 2007). The SAWL is a tool that can be used to monitor language clarity and complexity, and SAWL variables, such as Word Efficiency Ratio, can be readily used in statistical analyses (see Bowers et al., 2018). While the SAWL is a useful research tool, the data do not easily inform instructional practice. In the case of words per T-unit, it was perhaps a valid measure but a more elusive skill for teachers and students.

In addition to measuring growth on language skills, another challenge experienced by teachers was selecting appropriate and necessary language skills for students. The vast majority of hearing children begin school having a foundation of a naturally acquired first language to build upon, and as such, there do not exist standards or a scope and sequence of language skills specifically for children who experience language delay. In this study, teachers had difficulty analyzing their students' writing samples for written language strengths and weaknesses, and

identifying appropriate skills. There was a tendency to gravitate toward conventions or entry-level skills such as punctuation or varied sentence starters, or to choose skills they reported feeling more prepared to teach such as subject-verb agreement. This arbitrary approach allowed teachers to select skills they were knowledgeable about and felt comfortable teaching, while perhaps sidestepping more critical needs for syntactic clarity and complexity. Thus, we recommend that future studies incorporate professional development for teachers targeting written language assessment and skill development, and that additional data are collected regarding the impact of SIWI on syntax-related skills.

As teachers indicated in their post-interviews, they requested tools that would provide a way of systematically assessing students' written language in order to select the appropriate skills, provide developmentally appropriate instruction, and monitor skills. Kilpatrick (See Kilpatrick, 2015 and Kilpatrick & Wolbers, 2019) has analyzed d/hh students' written language (of varying levels of proficiency) using a systemic functional grammar approach (Halliday & Matthiessen, 2014). Through her research, she was able to map a trajectory of written language features as they are typically demonstrated from less to more proficient d/hh writers. While she found there is variability across individuals in the development and use of written language features, an overall progression from less to more complex could be identified for noun phrases, verb phrases, and adverbial phrases. This research subsequently led to the development of the Kilpatrick Written Language Inventory (WLI) --a checklist inventory that provides teachers with a systematic way of identifying language constructions in students' writing. After using the WLI to evaluate writing, the teacher is able to describe which language features students are using with accuracy, which ones they are using inaccurately, and which ones have not been attempted, thus tracking development by student and class. This tool, we believe, can assist teachers with

the identification of appropriate written language skills and monitoring student growth, and it is now an incorporated element of the SIWI professional development program. Future studies are needed to examine teachers' use of the WLI as well as the impact it has on SIWI implementation.

Limitations

There were several limitations of the study. In some cases, the data were not well-suited for using single case design methodology. While there were demonstrated changes in mean levels of performance between baseline and instruction phases, and there were improvements in trends that could be observed, changes in written language skills were not consistently rapid. Some skills such as the number of intelligible words or the number of words per T-unit, by nature of being intertwined with language development, showed slower progression rather than quick behavioral changes, and continued growing during the maintenance phase. Secondly, scores were impacted by other uncontrolled variables. When students wrote shorter essays, for example, there were fewer opportunities to demonstrate the skills. This is illustrated with Jared's percentage of correct punctuation and capitalization. On sample 13, which occurred just before transition to SIWI + I2 (i.e., targeted instruction for the skills), Jared wrote a one-sentence sample that had capitalization and punctuation. With both data points at 100%, it appeared that Jared had mastered these skills; however, with the writing of longer essays later in the study, he demonstrated a lower overall percentage that gradually improved to full mastery at 100%. While we understand this to be a limitation to the study, we also recognize that the variation of length demonstrated in student writing samples represents development on the part of the student writers.

Data were also impacted by changes in genre. For example, the teacher identified a need

for Nelly's second skill, percentage of correct verb tense, while writing recounts, which requires mainly past tense verbs. Whereas she did show steady progress in this skill, the final data points at 100% were taken during information report and persuasive writing periods which require mainly present tense. Thus, these data may appear higher as a result of changing genres. The impact from changing genres can also be seen in Tyra's writing. While she was showing improvement with writing complete sentences during recount writing, she experienced difficulty again once the class switched to expository text. Often she struggled to include a second person subject pronoun (e.g., can't run at pool). Given that form and meaning are inextricably linked, grammar structures are used to create meaning and communicate ideas through writing (Derewianka, 1990). Thirdly, only two data points were collected for each student before switching skills, and a minimum of three are needed to detect trends prior to implementation. The discussed limitations presented challenges to the reliability of the data and to demonstrating a functional relationship between independent and dependent variables. It is recommended that the findings here be interpreted with caution, and that future research on the written language development of deaf writers use curriculum-based measurement data for single case design studies, as has been used in other studies (Walker, Shippen, Alberto, Houchins & Cihak, 2005), or use sample analysis tools such as the SAWL for group designed studies.

Conclusion

In this study, we used single-case design to examine the written language skills of d/hh students who were receiving Strategic and Interactive Writing Instruction. We can glean a few takeaways regarding the impact of the instruction and the needs of the teachers. The data suggest that providing students with strategic instruction of written language skills during collaborative and purposeful writing may positively impact their use of targeted writing conventions or

language skills. There is also building evidence that interactively writing with peers and teacher during SIWI leads to some global, untargeted language benefits, as students have multiple opportunities to see various language features modeled in the construction of an authentically communicated message. Additionally, we found that teachers need support with identifying and monitoring students' written language. Not only is there a need for teacher-friendly assessment tools to evaluate students' syntactic skills, there is also a need for future research on instructional experiences that support development of these language skills.

References

Anderson, M., Boren, J. J., Kilgore, J., Howard., & Krohn, E. (1999). *The apple tree curriculum for developing written language* (2nd Ed.). Austin, TX: PRO-ED, Inc.

Antia, S. D., Reed, S., & Kreimeyer, K. H. (2005). Written language of deaf and hard-of-hearing students in public schools. *Journal of Deaf Studies and Deaf Education, 10*(3), 244-255. doi: 10.1093/deafed/eni026

Arfe, B. (2015). Oral and written discourse skills in deaf and hard of hearing children: The role of reading and verbal working memory. *Topics in Language Disorders, 35*(2), 180-197. doi: 10.1097/TLD.0000000000000054

Berent, G., Kelly, R., Aldersley, S., Schmitz, K., Khalsa, B., Panara, J., & Keenan, S. (2007). Focus-on-form instructional methods promote deaf college students' improvement in English grammar. *Journal of Deaf Studies and Deaf Education, 12*(1), 8-24. doi: 10.1093/deafed/enl0

Bowers, L., Dostal, H., Wolbers, K., & Graham, S.C. (2018). The assessment of written phrasal constructs and grammar of deaf and hard of hearing students with varying expressive language abilities. *Education Research International, 2018,* 1-10. https://doi.org/10.1155/2018/2139626

Cannon, J., & Kirby, S. (2013). Grammar structures and deaf and hard of hearing students: A review of past performance and a report of new findings. *American Annals of the Deaf, 158*(3), 292-310. doi: 10.2307/26234898

Dammeyer, J. (2010). Psychosocial development in a Danish population of children with cochlear implants and deaf and hard of hearing children. *Journal of Deaf Studies and*

Deaf Education, *15*, 50-58. doi: 10.1093/deafed/enp024

Darling-Hammond, L., & Richardson, N. (2009). Teacher learning: What matters? *Educational*
   Leadership 66(5), 46-53. Retrieved from https://search-ebscohost-
   com.ezproxy.lib.uconn.edu/login.aspx?direct=true&db=aph&AN=37007620&site=ehost-
   live

Derewianka, B. (1990). *Exploring how texts work*. Rozelle, Australia: Primary English Teaching
   Association.

Desimone, L. M. (2009). Improving impact studies of teachers' professional development:
   Toward better conceptualization and measures. *Educational Researcher, 28*(3), 181-199.
   doi: 10.3102/0013189X08331140

Dostal, H. & Wolbers, K. (2015). Video review and reflection for ongoing inservice teacher
   professional development. In E. Ortlieb, L. Shanahan & M. McVee (Eds.), *Video*
   research in disciplinary literacies: Literacy research, practice and evaluation, Volume 6
   (pp. 329-352). Bingley, UK: Emerald Group Publishing Limited.

Dostal, H. & Wolbers, K. (2016). Examining student writing proficiencies across genres: Results
   of an intervention study. *Deafness & Education International, 18*(3), 159-169.
   https://doi.org/10.1080/14643154.2016.1230415

Dye, M. W., & Hauser, P. C. (2014). Sustained attention, selective attention and cognitive
   control in deaf and hearing children. *Hearing Research, 309*, 94–102. doi:
   10.1016/j.heares.2013.12.001

Easterbrooks, S. R., & Baker, S. K. (2002). *Language learning in children who are deaf and*
   hard of hearing: Multiple pathways. Boston, MA: Allyn & Bacon.

Fabbretti, D., Volterra, C., & Pontecorvo, V. (1998). Written language abilities of deaf Italians. *Journal of Deaf Studies and Deaf Education, 3*(3), 231-44. doi: 10.1093/oxfordjournals.deafed.a014353

Fitzgerald, E. (1949). *Straight Language for the Deaf: A system of instruction for deaf children.* Washington, DC: Alexander Graham Bell Association for the Deaf.

Goldin-Meadow, S. & Mayberry, R. (2001). How do profoundly deaf children learn to read? *Learning Disabilities Research and Practice*, *16*, 221-228. doi: 10.1111/0938-8982.00022

Graham, S. & Perin, D. (2007). *Writing next: Effective strategies to improve writing of adolescents in middle and high schools – A report to Carnegie Corporation of New York.* Washington, DC: Alliance for Excellent Education.

Hall, M., Eigsti, I., Bortfeld, H., & Lillo-Martin, D. (2017). Auditory deprivation does not impair executive function, but language deprivation might: Evidence from a parent-report measure in Deaf native-signing children. *Journal of Deaf Studies and Deaf Education, 22*(1), 9-21. doi: 10.1093/deafed/enw054

Halliday, M. A. K. & Matthiessen, C. M. I. M. (2014). *Halliday's Introduction to Functional Grammar* (4th ed.). New York, NY: Routledge.

Hillocks, G. (1984). What works in teaching composition: A meta-analysis of experimental treatment studies. *American Journal of Education, 93*(1), 133-170. doi: 10.1086/443789

Humphries, T., Kushalnagar, P., Mathur, G., Napoli, D.J., Padden, C., Rathmann, C., & Smith, S. (2016). Language choices for deaf infants: Advice for parents regarding sign languages. *Clinical Pediatrics, 55*(6), 513–517. doi: 10.1177/0009922815616891

Hunt, K. W. (1965). *Grammatical structures written at three grade levels* (NCTE Research

    Report No.3). Champaign, IL: NCTE. Retrieved from

    http://www.eric.ed.gov/PDFS/ED113735.pdf

Kazdin, A.E. (2011). *Single-case designs: Methods for clinical and applied settings* (2nd ed.).

    New York, NY: Oxford University Press.

Kilpatrick, J. R. (2015). *Developing a written language inventory for deaf and hard of hearing*

    students: A systemic functional grammar approach. Doctoral dissertation, University of

    Tennessee.

Kilpatrick, J. & Wolbers, K. (2019). Beyond the red pen: A functional grammar approach to

    evaluating the written language of deaf students. *Psychology in the Schools.* Advance

    online publication. https://doi.org/10.1002/pits.22289

Lederberg, A. R., Schick, B., & Spencer, P. E. (2013). Language and literacy development of

    deaf and hard-of-hearing children: Successes and challenges. *Developmental Psychology,*

    49(1), 15-30. doi: 10.1037/a0029558

MAP Assessment: Our scale and norms. (2017). Retrieved from

    https://www.nwea.org/assessments/map/scale-and-norms/

Marshall, C., Jones, A., Denmark, T., Mason, K., Atkinson, J., Botting, N., & Morgan, G.

    (2015). Deaf children's non-verbal working memory is impacted by their language

    experience. *Frontiers in Psychology, 6*, 527. doi:10.3389/fpsyg.2015.00527

Marschark, M., Mouradian, V., & Halas, M. (1994). Discourse rules in the language productions

    of deaf and hard of hearing children. *Journal of Experimental Child Psychology, 57*(1),

    89-107. doi:10.1006/jecp.1994.1005

Mayberry, R. I. (2002). Cognitive development of deaf children: The interface of language and

    perception in neuropsychology. In S. J. Segaolwitz, & I. Rapin (Eds.), *Handbook of*

    Neuropsychology (2nd ed., Vol. 8, Part II, pp. 71-107). Amsterdam, Netherlands:

    Elsevier.

Mayberry, R. I. (2007). When timing is everything: Age of first-language acquisition effects on

    second-language learning. *Applied Psycholinguistics, 28*, 537–549. doi:

    10.1017.S0142716407070294

Mayberry, R. I., & Lock, E. (2003). Age constraints on first versus second language acquisition:

    Evidence for linguistic plasticity and epigenesis. *Brain and Language, 87*, 369–383. doi:

    10.1016/S0093-934X(03)00137-8

Mitchell, R. E., & Karchmer, M. A. (2004). Chasing the mythical ten percent: Parental hearing

    status of deaf and hard of hearing students in the United States. *Sign Language Studies, 4*,

    138–163. doi: 10.1353/sls.2004.0005

Musselman, C. & Szanto, G. (1998). The written language of deaf adolescents: Patterns of

    performance. *Journal of Deaf Studies and Deaf Education*, 3, 245-257. doi:

    10.1093/oxfordjournals.deafed.a014354

Phelps-Terasaki, D., & Phelps-Gunn, T. (2000). *Teaching competence in written language: A*

    systematic program for developing writing skills. Austin, Texas: Pro-Ed Publishing.

Powers, A. R., & Wilgus, S. (1983). Linguistic complexity in the written language of hearing-

    impaired children. *Volta Review, 85*(4), 201-210.

Regan, K., & Berkeley, S. (2012). Effective reading and writing instruction: A focus on

    modeling. *Intervention in School and Clinic, 47*(5), 276–282. doi:

    10.1177/1053451211430117

Schick, B., de Villiers, P., deVilliers, J. & Hoffmeister, R. (2007). Language and theory of

    mind: A study of deaf children. *Child Development, 78*(2), 376-396.

    doi:10.1111/j.14678624.2007.01004

Schneiderman, E. (1995). The effectiveness of an interactive instructional context. *American*

    Annals of the Deaf, 140(1), 8-15. doi: 10.1353/aad.2012.0343

Spencer, L. J., Barker, B. A. & Tomblin, J. B. (2003). Exploring the language and literacy

    outcomes of pediatric cochlear impact users. *Ear and Hearing, 24*(3), 236-247. doi:

    10.1097/01.AUD.0000069231.72244.94

Strassman, B. K. & Schirmer, B. (2013). Teaching writing to deaf students: Does research

    offer evidence for practice? *Remedial and Special Education, 34*(3), 166–179. doi:

    10.1177/0741932512452013

Thames, M., & Ball, D. (2010). What math knowledge does teaching require? *Teaching Children*

    Mathematics, 17(4), 220-229. Retrieved from http://www.jstor.org/stable/41199946

Walker, B., Shippen, M., Alberto, P., Houchins, D. & Cihak, D. (2005). Using the expressive

    writing program to improve the writing skills of high school students with learning

    disabilities. *Learning Disabilities Research and Practice, 20*(3), 175-183. doi:

    10.1111/j.1540-5826.2005.00131.x

Wei, R. C., Darling-Hammond, L., Andree, A., Richardson, N., Orphanos, S. (2009).

    Professional learning in the learning profession: A status report on teacher development

    in the United States and abroad. Dallas, TX. National Staff Development Council.

White, A. (2007). A tool for monitoring the development of written English: T-unit analysis

    using the SAWL. *American Annals of the Deaf, 152*(1), 29-41. doi:

    10.1353/aad.2007.0016

Wilbur, R. (1977). An explanation of deaf children's difficulty with certain syntactic structures in English. *Volta Review, 79*, 85–92.

Wolbers, K., Dostal, H., Graham, S., Cihak, D., Kilpatrick, J., & Saulsburry, R. (2015). The writing performance of elementary students receiving Strategic and Interactive Writing Instruction. *Journal of Deaf Studies and Deaf Education, 20*(4), 385-398. https://doi.org/10.1093/deafed/env022

Wolbers, K., Dostal, H., Skerrit, P., & Stephenson, B. (2016). A three-year study of a professional development program's impact on teacher knowledge and classroom implementation of Strategic and Interactive Writing Instruction. *Journal of Educational Research, 110*, 61-71. https://doi.org/10.1080/00220671.2015.1039112

Woolfe, T, Want, S.C., & Siegal, M. (2002). Signposts to development: Theory of mind in deaf children. *Child Development, 73*(3), 768-778. doi: 10.1111/1467-8624.00437

Yoshinaga-Itano, C., Snyder, L. S. & Mayberry, R. (1996). How deaf and normally hearing students convey meaning within and between written sentences. *Volta Review, 98*(1), 9-38. Retrieved from https://search-ebscohost-com.ezproxy.lib.uconn.edu/login.aspx?direct=true&db=aph&AN=9706222521&site=ehost-live

Table 1

Description of Language Objectives

Objective	Description
Number of compound and complex sentences	A count of compound and complex sentences.
Number of intelligible words	A count of the number of intelligible written words.
Number of lowercase letter errors	A count of letters that were incorrectly capitalized.
Number of T-units	A count of T-units (main clause + subordinate clauses) written.
Number of words per T-unit	A count of T-units divided by the number of words written. A measures of sentence length and complexity.
Percentage of correct capitalization	Number of sentences beginning with a capital letter divided by total sentences.
Percentage of complete sentences	Number of sentences with a subject and predicate divided by total sentences.
Percentage of correct verb tense	Number of verbs with correct tense divided by total verbs.
Percentage of correct punctuation	Number of sentences ending with punctuation divided by total sentences.
Percentage of varied sentence starters	Number of sentences starting with unique first words divided by total sentences.
Percentage of verb variance	Number of unique verbs divided by total verbs.

Table 2

Student Objectives

Student	Objectives
Jared	(1) Number of intelligible words, (2) Percentage of correct capitalization and punctuation, (3) Percentage of verb variance
Shane	(1) Number of intelligible words, (2) Percentage of correct capitalization and punctuation, (3) Number of T-units
Nelly	(1) Percentage of varied sentence starters, (2) Percentage of correct verb tense, (3) Number of words per T-unit
Tyra	(1) Percentage of correct capitalization and punctuation, (2) Percentage of complete sentences, (3) Number of words per T-unit
Barbara	(1) Percentage of correct capitalization, (2) Number of compound and complex Sentences, (3) Number of words per T-unit
Meg	(1) Percentage of correct capitalization and punctuation, (2) Number of lowercase letter errors, (3) Number of words per T-unit

Table 3

Jared's Results Across Phases

Jared's Objectives	Phase	Mean	Range	Sessions
Objective 1: Number of intelligible words	Baseline	0.6	0-3	5
	SIWI + I1	3.9	0-9	8
	Maintenance	15	13-17	2
Objective 2a: Percentage of correct punctuation	Baseline	0%	0%	3
	SIWI + I1	50%	0-100%	2
	SIWI + I2	71%	50-90%	6
	Maintenance	100%	100%	1
Objective 2b: Percentage of correct capitalization	Baseline	0%	0%	3
	SIWI + I1	50%	0-100%	2
	SIWI + I2	98%	90-100%	6
	Maintenance	100%	100%	1
Objective 3: Percentage of verb variance	Baseline	0%	0%	3
	SIWI + I2	33%	33%	2
	SIWI + I3	27%	0-67%	9

Table 4

Shane's Results Across Phases

Shane's Objectives	Phase	Mean	Range	Sessions
Objective 1: Number of intelligible words	Baseline	7.4	5-9	5
	SIWI + I1	12.7	3-21	6
	Maintenance	19	17-25	3
Objective 2a: Percentage of correct punctuation	Baseline	83%	50-100%	3
	SIWI + I1	25%	0-50%	2
	SIWI + I2	93%	67-100%	5
	Maintenance	100%	100%	1
Objective 2b: Percentage of correct capitalization	Baseline	72%	50-100%	3
	SIWI + I1	100%	100%	2
	SIWI + I2	97%	83-100%	5
	Maintenance	100%	100%	1
Objective 3: Number of T-units	Baseline	1.7	1-2	3
	SIWI + I2	3	2-4	2
	SIWI + I3	4.4	3-6	7

Table 5

Nelly's Results Across Phases

Nelly's Objectives	Phase	Mean	Range	Sessions
Objective 1: Percentage of varied sentence starters	Baseline	13%	0-50%	5
	SIWI + I1	63%	0-100%	9
	Maintenance	85%	60-100%	4
Objective 2: Percentage of correct verb tense	Baseline	11%	0-33%	3
	SIWI + I1	13%	0-25%	2
	SIWI + I2	61%	0-83%	6
	Maintenance	100%	100%	2
Objective 3: Number of words per T-unit	Baseline	3.7	3.3-4	3
	SIWI + I2	6.4	6-6.8	2
	SIWI + I3	6.0	4.0-8.5	13

Table 6

Tyra's Results Across Phases

Tyra's Objectives	Phase	Mean	Range	Sessions
Objective 1a: Percentage of correct punctuation	Baseline	19%	0-50%	5
	SIWI + I1	74%	6-100%	6
	Maintenance	89%	80-100%	3
Objective 1b: Percentage of correct capitalization	Baseline	25%	11-50%	5
	SIWI + I1	76%	6-100%	6
	Maintenance	100%	100%	3
Objective 2: Complete simple sentences	Baseline	21%	17-27%	3
	SIWI + I1	17%	0-33%	2
	SIWI + I2	57%	29-100%	11
	Maintenance	63%	33-80%	3
Objective 3: Number of words per T-unit	Baseline	4.7	4-5.5	3
	SIWI + I2	6.5	6.3-6.7	2
	SIWI + I3	7.2	4.9-10.8	12

Table 7

Barbara's Results Across Phases

Barbara's Objectives	Phase	Mean	Range	Sessions
Objective 1: Percentage of correct capitalization	Baseline	34%	0-63%	5
	SIWI + I1	88%	67-83%	8
	Maintenance	87%	60-100%	3
Objective 2: Number of compound and complex sentences	Baseline	0	0	3
	SIWI + I1	.5	0-1	2
	SIWI + I2	1	1	5
	Maintenance	3	3	3
Objective 3: Number of words per T-unit	Baseline	5.6	4.8-6.6	3
	SIWI + I2	7.4	5.8-9.1	2
	SIWI + I3	9.2	8-10.3	6

Table 8

Meg's Results Across Phases

Meg's Objectives	Phase	Mean	Range	Sessions
Objective 1a: Percentage of correct punctuation	Baseline	26%	15-42%	5
	SIWI + I1	73%	54-100%	6
	Maintenance	100%	100%	3
Objective 1b: Percentage of correct capitalization	Baseline	49%	33-67%	5
	SIWI + I1	74%	53-100%	6
	Maintenance	100%	100%	3
Objective 2: Number of lowercase letter errors	Baseline	11.3	8-18	3
	SIWI + I1	3.5	1-6	2
	SIWI + I2	2.7	0-6	7
	Maintenance	0	0	2
Objective 3: Number of words per T-unit	Baseline	5.7	5.4-5.9	3
	SIWI + I2	9.0	7.8-10.3	2
	SIWI + I3	8.0	6.6-11.5	8

Appendix

Jared's Writing Sample from the Baseline Phase

Jared's Writing Sample from the Intervention Phase

I have cars.

I have blue.

I have red.

I have Yellow.

I cool like

Nelly's Writing Sample from the Baseline Phase

I liake {like} cat.

I PalY MY cat.

I Lstie {pet} cat.

I Love You!

Nelly's Writing Sample from the Intervention Phase

On Monday Jan 28. We

want {went} to Ut

baseketball. Lady VOse {Vols}

baseketball. I gat {got} a

snowet {poster}. I siad

shot {shout} go Ut. Ut

lady lates {lost}.

Figure 1. Jared's performance across language objectives for baseline, intervention and maintenance.

Baseline   SIWI + I 1   Maintenance

Number of Intelligible Words

Objective 1

Percentage Correct Punctuation

SIWI + I 2

Objective 2a

Percentage Correct Capitalization

Objective 2b

Number of T-units

SIWI + I 3

Objective 3

Writing Samples

Figure 2. Shane's performance across language objectives for baseline, intervention and maintenance.

Baseline   SIWI + I 1   Maintenance

Number of Intelligible Words

Objective 1

SIWI + I 2

Percentage Correct Punctuation

Objective 2a

Percentage Correct Capitalization

Objective 2b

SIWI + I 3

Objective 3

Percentage of Verb Variance
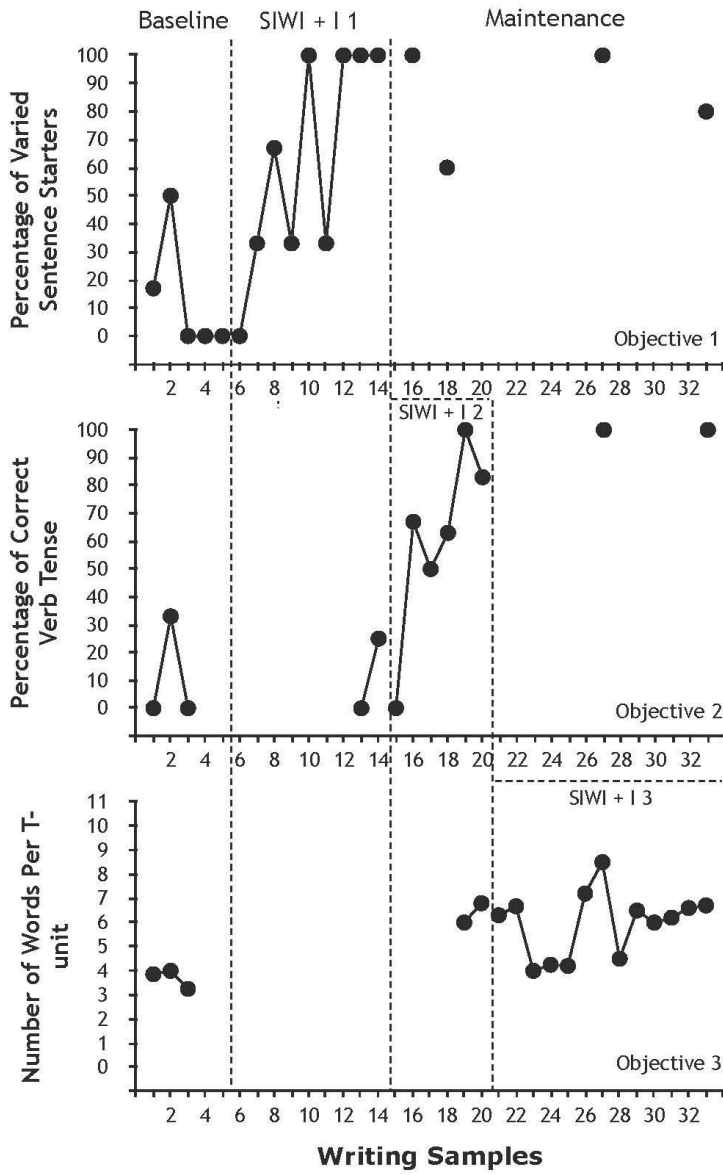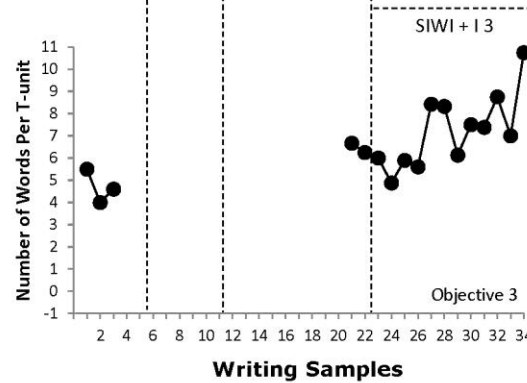
Writing Samples

Figure 3. Nelly's performance across language objectives for baseline, intervention and maintenance.

Baseline   SIWI + I 1   Maintenance

Objective 1

Percentage of Varied Sentence Starters

SIWI + I 2

Objective 2

Percentage of Correct Verb Tense

SIWI + I 3

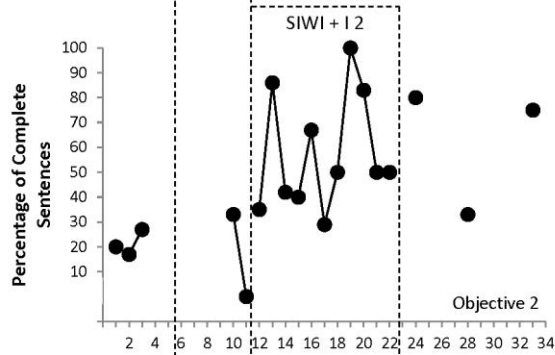Objective 3

Number of Words Per T-unit

Writing Samples

*Figure 4.*Tyra's performance across language objectives for baseline, intervention and maintenance.

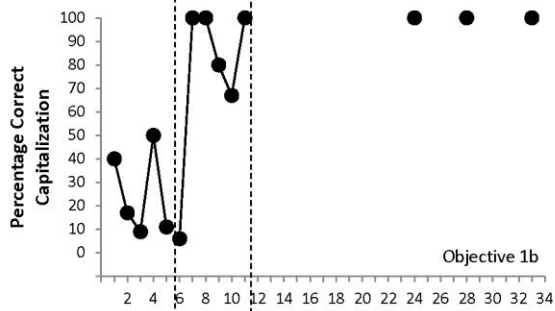Baseline   SIWI + I 1   Maintenance

Percentage Correct Punctuation

Objective 1a

Percentage Correct Capitalization

Objective 1b

SIWI + I 2

Percentage of Complete Sentences

Objective 2

SIWI + I 3

Number of Words Per T-unit

Objective 3

Writing Samples

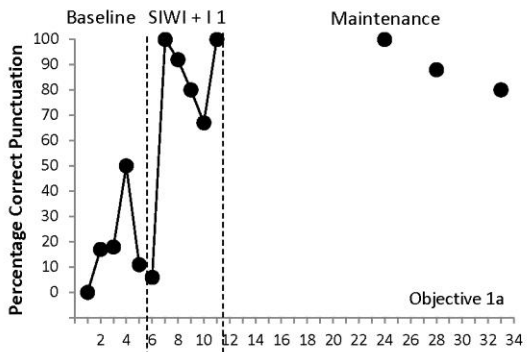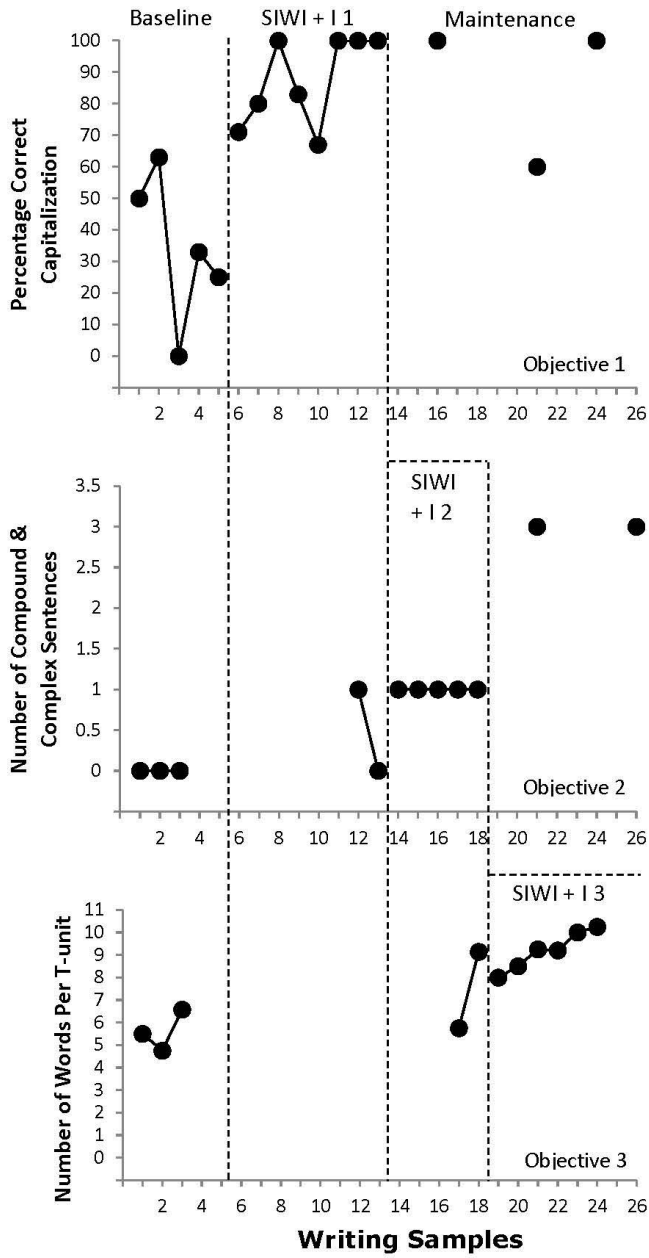*Figure 5.* Barbara's performance across language objectives for baseline, intervention and maintenance.

Baseline SIWI + I 1 Maintenance

Percentage Correct Capitalization

Objective 1

SIWI + I 2

Number of Compound & Complex Sentences

Objective 2

SIWI + I 3

Number of Words Per T-unit

Objective 3

Writing Samples

Figure 6. Meg's performance across language objectives for baseline, intervention and maintenance.