12-2011

Impact of Computerized "Sounding out" on Spelling Performance of a Child Who Uses AAC: A Preliminary Report

Jillian H McCarthy
University of Nebraska - Lincoln

David R. Beukelman
Institute for Rehabilitation Science and Engineering at Madonna Rehabilitation Hospital

Tiffany Hogan
University of Nebraska - Lincoln, thogan2@unl.edu

Perspectives on Augmentative and Alternative Communication, December 2011, vol. 20, no. 4, pp. 119-124
doi: 10.1044/aac20.4.119

Impact of Computerized "Sounding out" on Spelling Performance of a Child Who Uses AAC: A Preliminary Report

Jillian H. McCarthy

Department of Special Education and Communication Disorders, University of Nebraska-Lincoln
Lincoln, NE
Department of Audiology and Speech Pathology, University of Tennessee
Knoxville, TN

David R. Beukelman

Tiffany P. Hogan

Department of Special Education and Communication Disorders, University of Nebraska-Lincoln
Lincoln, NE

Abstract

Spelling is a vital skill for people who rely on augmentative and alternative communication (AAC). The ability to spell words provides an opportunity to create novel and spontaneous communication and increases educational, social, and employment opportunities for children and adults. However, many children and youth who rely on AAC struggle to gain functional spelling skills and written language. The purpose of this preliminary investigation was to develop a strategy to provide auditory letter-sounds using commercially available computer equipment and to evaluate how such a computerized "sounding out" strategy influences spelling accuracy for one child who required AAC support. The spelling accuracy of both consonants and vowels increased during intervention sessions when individual sounds associated with target words were provided compared to the baseline session when individual sounds were not provided. Future directions are discussed.

The ability to spell provides a means to generate spontaneous, novel utterances using augmentative and alternative communication (AAC) technology for individuals with limited or no verbal speech (Schlosser & Blischak, 2004). This, in turn, increases independence in daily activities, such as social communication, educational participation, volunteer/employment opportunities, and management of care providers. Several studies have examined factors that appear to be critical for the spelling development of children with complex communication needs (CCN) who rely on AAC (Hart, Scherz, Apel, & Hodson, 2007; Peeters, Verhoeven, de Moor, & van Balkom, 2009). One factor that has been previously explored is how one's ability to produce subvocal articulation affects or influences the ability to accurately spell words. Although researchers have investigated the ability to subvocally articulate, it remains unclear how influential subvocal articulation is on spelling performance and development.

Subvocal Articulation

Subvocal articulation has been defined as mouthing speech silently (Keeney, Cannizzo, & Flavell, 1967), whispering, vocalizing speech that is barely audible to others (Murray & Roberts, 1968), or speaking that occurs within the brain (i.e., individuals hear and practice the target sounds without any form of overt articulation; Baddeley, 2001). Researchers have reported that, when subvocal articulation is suppressed, the ability to recall phonological information decreases significantly. In other words, the ability to rehearse information using subvocal articulation affects the ability to recall phonological information from memory for both children and adults.

Children with severe motor speech impairments, such as cerebral palsy, are not able, in theory, to manipulate subvocal articulation in the same manner as typically developing children. Bishop and Robson (1989) explored this idea with a group of children who had cerebral palsy and varying levels of dysarthria (severe to mild). The results of the study revealed that one adolescent who used AAC was able to spell nonwords with high accuracy. On the basis of this individual's performance, Bishop and Robson concluded that, for some individuals, subvocal articulation was not necessary for accurate spelling. However, in a more recent study, Hart and colleagues (2007) examined the types of spelling errors made by 4 individuals with CCN (ages 9–23) who used AAC. The results suggested that those with CCN consistently made more spelling errors than did their spelling-matched typically developing peers. Significant to this study was the observation that the spelling-matched peers vocally rehearsed the sounds of the target words, whereas the participants with CCN did not overtly practice sounds. Hart and colleagues concluded that subvocal articulation or vocal rehearsal could be used as a strategy to facilitate accurate spelling.

Purpose

The purpose of this preliminary investigation was to develop a strategy to provide auditory sound sequences using commercially available computer equipment and to evaluate how this computerized provision of sound sequences influenced spelling accuracy for a child who required AAC support.

In this study, we provided individual sounds and blends for each target word using conventional computer technology. For example, if the target nonword was "nooth," the computerized provision of individual sounds included /*n*/, /*u*/, and /*θ*/. We created and used nonwords throughout this examination to control for previous spelling and writing experiences of the participant. We recorded the target nonwords using the first author's voice, acoustically normalized them for intensity, and cut them into a sequence of individual sounds using Adobe Audition software. We presented all target nonwords on a laptop computer using the experimental software program Direct RT. We presented computerized sound sequences audibly through external speakers attached to the computer. For this study, the examiner released target words and individual sounds. However, we designed the system such that this information can be released by using the right click on a computer mouse or by a jellybean switch.

In this preliminary evaluation, we examined the use of the computerized provision of sound sequences (sounding out) with one participant, Sam, an 8-year old boy who had just completed the first grade. He demonstrated normal vision and hearing and had a diagnosis of cerebral palsy. Sam relied on a Dynavox V with direct selection to communicate. At the time of the evaluation, he primarily used iconic symbols to communicate, but had begun working toward spelling messages with word prediction. He started using AAC technology at age 6. Prior to that, his intervention emphasized increasing speech intelligibility.

An ABAB research design was used for this study. During the three baseline (A) sessions and the single return-to-baseline session, Sam spelled the target words presented

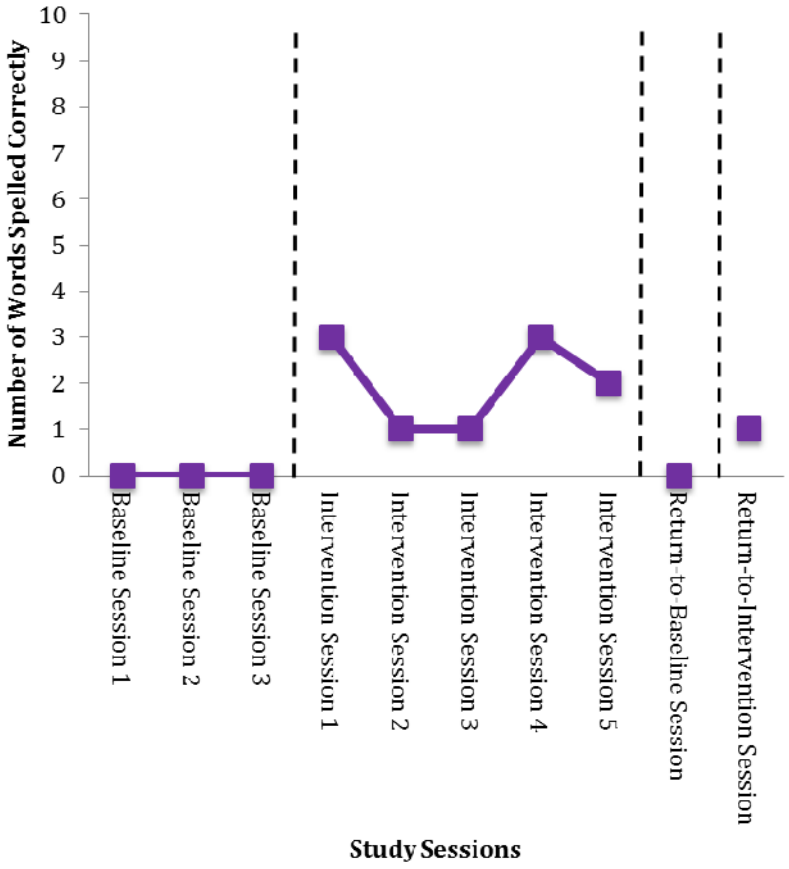
without individual sound information. During the three intervention (B) sessions and the single return-to-intervention session, he was instructed to listen to the target nonwords followed by the computerized provision of individual sound sequences, but was given the opportunity to listen to this information up to six times. On average, Sam listened to the computerized sound sequences 2.1 times (range 2 to 3 times) per target nonword. Sam spelled target words during the baseline and intervention sessions using his Dynavox V.

We completed reliability of spelling accuracy measurement for 20% of all spelling sessions. Reliability between the first judge (the first author) and a graduate student who served as the second judge was 98.8%.

Preliminary Results

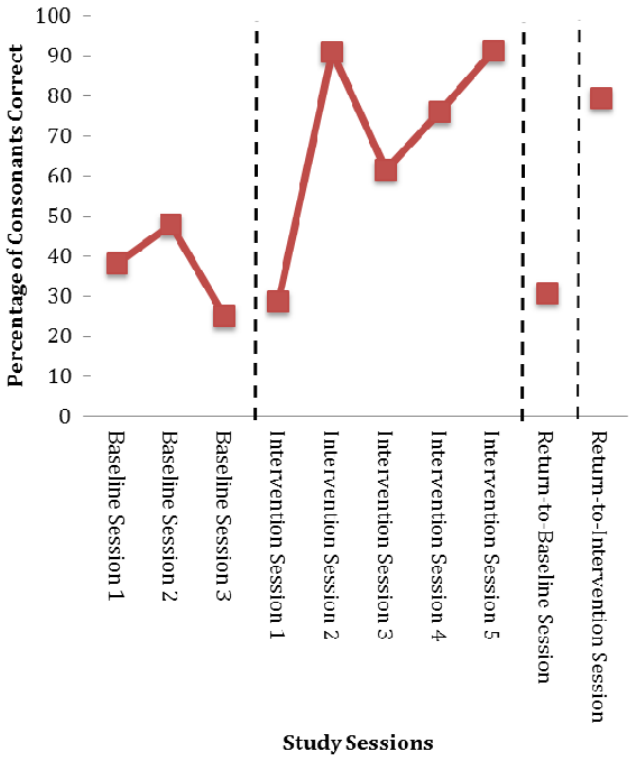
Overall, Sam increased his spelling accuracy of nonwords slightly during intervention (Figure 1) compared to the baseline sessions when no words were correctly spelled. During the intervention sessions, Sam spelled a range of 1 to 3 of the 10 target words correctly.

Figure 1. Overall Spelling Accuracy for Sam.



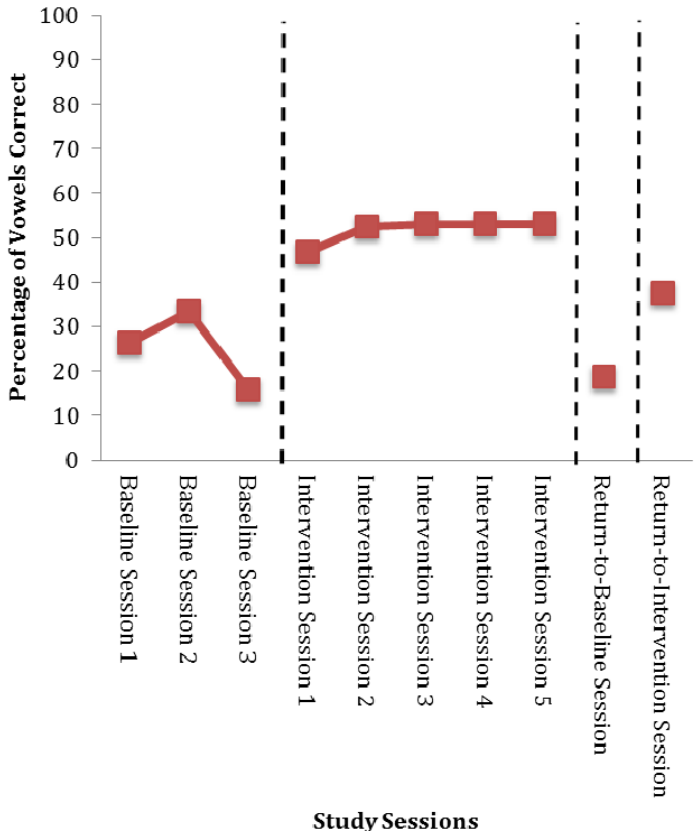
At the orthographic level, Sam's consonant accuracy was greater during the intervention sessions than it was during the baseline sessions (Figure 2).

Figure 2. Overall Correct Consonant Orthography for Sam.



Subsequent analyses of Sam's vowel production at the orthographic level revealed that Sam's vowel accuracy during the intervention sessions showed increased accuracy over his performance during the baseline sessions. Sam produced approximately half of the vowels correctly when he heard the target vowel sound with the computerized sound sequence, compared to 25% accuracy that he achieved during baseline sessions (Figure 3).

Figure 3. Overall Correct Vowel Orthography for Sam.



Summary

A review of these preliminary results revealed that, when the investigator acoustically provided the sound information of each target nonword through computerized sounding out (auditory sounding out of nonwords), a single participant was able to increase his spelling accuracy scores over those he achieved during the baseline session. More specifically, the computerized sounding out enabled Sam to increase his percentage of success for both consonants and vowels, although consonants were produced with more accuracy than vowels. It also should be noted that short vowels were produced with more accuracy than long vowels. Thus, the findings of this study provided preliminary support for the use of an auditory compensation, specifically computerized sounding out, to increase spelling accuracy of children with CCN. As with previous studies on providing letter names during spelling activities (Raghavendra & Oaten, 2007; Schlosser & Blischak, 2004), the current study demonstrated that provision of letter sounds showed potential as an effective strategy to increase the spelling accuracy of children who use AAC.

Future Research

Ongoing future research will include larger numbers of participants representing different types and degrees of impairment. Specifically, the study will examine how computerized sounding out influences the spelling accuracy of children with cerebral palsy who require AAC to meet their communication needs compared to children with cerebral palsy who are able to meet their communication needs using intelligible dysarthric speech. These two participant groups will allow researchers to further explore and understand how speech

intelligibility influences spelling accuracy with and without the use of computerized sounding out strategy.

Acknowledgments

This research project was supported in part by the Barkley Trust, Nebraska Speech-Language-Hearing Endowment (NSLHE) Fund Grant 2010, and the National Institutes of Health (NIH) National Institute for Deafness and Communication Disorders (NIDCD) Ruth L. Kirschstein National Research Service Pre-doctoral Fellowship (NIH F31 *DC010965-02*). The authors alone are responsible for the content and writing of the article. The opinions contained in this article are those of the authors and do not necessarily reflect those of the National Institutes of Health

References

Baddeley, A. D. (2001). Is working memory still working? *American Psychologist, 56,* 851-864.

Bishop, D. V. M., & Robson, J. (1989). Accurate non-word spelling despite congenital inability to speak: Phoneme-grapheme conversation does not require subvocal articulation. *British Journal of Psychology, 80,* 1-13.

Hart, P., Scherz, J., Apel, K., & Hodson, B. (2007). Analysis of spelling error patterns of individuals with complex communication needs and physical impairments. *Augmentative and Alternative Communication, 23,* 16-29.

Keeney, T. J., Cannizzo, S. R., & Flavell, J. H. (1967). Spontaneous and induced verbal rehearsal in a recall task. *Child Development, 38,* 953-966.

Murray, D. J., & Roberts, B. (1968). Visual and auditory presentation, presentation rate, and short-term memory in children. *British Journal of Psychology, 59,* 119-125.

Peeters, M., Verhoeven, L., de Moor, J., & van Balkom, H. (2009). Importance of speech production for phonological awareness and word decoding: The case of children with cerebral palsy. *Research in Developmental Disabilities, 30,* 712-726.

Raghavendra, P., & Oaten, R. (2007). Effects of speech and print feedback on spelling performance of a child with cerebral palsy using a speech generating device. *Disability and Rehabilitation: Assistive Technology, 2*, 299-308.

Schlosser, R. W., & Blischak, D. M. (2004). Effects of speech and print feedback on spelling in children with autism. *Journals of Speech, Language, and Hearing Research, 47,* 848-862.