

## **Critical Review: Does a literacy program with Visual Phonics improve phonological awareness and phonics skills in d/Deaf or hard of hearing children aged 3-9?**

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Children who are d/Deaf or hard of hearing (DHH) are at risk of having poorer reading skills than their hearing peers (Trezek & Wang, 2006). Research shows that having limited access to sound can make development of phonemic and phonological skills challenging (Tucci & Easterbrooks, 2015). Research into methods to teach these skills to DHH students early on is important to decrease this gap either by school entry and shortly after. This critical review examines current literature on the effects of literacy programs combined with Visual Phonics (VP) on phonological awareness (PA) and phonics skills in DHH children between the ages of 3-9. The results of the computerized database search found seven articles meeting the inclusion criteria. Study designs included; single subject study design, single group pre-posttest design, single group posttest design and case study design. Overall, results showed that DHH children aged 3-9 improve their early literacy skills related to PA and phonics following a literacy program with VP.

### ***Introduction***

Phonological awareness (PA) skills have been found to be a strong predictor of later reading skills (Tucci & Easterbrooks, 2015). PA is one of the five key components of reading, along with phonics, reading comprehension, vocabulary and reading fluency. PA involves activities such as rhyming, alliteration, and syllabication (Narr, 2008). It also includes phonemic awareness, which is the awareness of sounds in words and the ability to manipulate them (Tezek & Wang, 2006). Phonics is the understanding of letter-sound correspondences (grapheme-phoneme correspondences, GPCs) – i.e. the relationship between letters and sounds. All of which are essential for development of strong reading skills (Tucci & Easterbrooks, 2015).

It is well documented that d/Deaf or hard of hearing (DHH) students have poorer reading skills than their hearing peers (Trezek & Wang, 2006). Research shows that having limited access to sound can make development of phonemic and phonological skills challenging (Tucci & Easterbrooks, 2015).

Visual Phonics (VP) is a teaching tool that has been developed and used in classrooms for over 30 years, however, only recently has it started to appear in the literature (Narr, 2008). VP is a multisensory approach (auditory, visual, tactile, and kinesthetic) to teach the relationship between sounds and written symbols (Beal-Alvarez & Easterbrooks, 2011; Trezek, Wang, Woods, Gampp & Paul, 2007). It is composed of 45 handshapes and movements that resemble the way sounds are articulated, allowing it to also be used to teach children how to orally produce phonemes correctly. The approach also portrays links between one grapheme and multiple phonemes and one phoneme with multiple grapheme combinations (Beal-Alvarez & Easterbrooks,

2011). VP is not a communication system, but rather a tool to complement literacy programs and provide phonemic information in a different way to students who are DHH (Narr, 2008; Trezek et al., 2007).

Phonological and phonemic awareness skills are developed at a very early age; therefore, it is imperative that methods of teaching these skills to DHH students are developed and researched to decrease the gap between DHH students and their peers.

### ***Objectives***

The primary objective of this paper is to critically analyze the available evidence on the effects of literacy programs with VP on emergent literacy skills, specifically PA and phonics skills, in DHH children aged 3-9. The secondary objective is to provide recommendations for future research and clinical implications.

### ***Methods***

#### Search Strategy

Articles related to the topic of this review were found using the following computerized databases: Scopus, PubMed, PsychINFO and ProQuest. Keywords used to search the databases were:

(Visual Phonics) AND (children) AND  
(Hard of Hearing) OR (Deafness)

Articles were limited to ones written in English.

#### Selection Criteria

The following inclusion criteria was used to select articles for this review: use of VP in combination with a literacy program, measured outcomes related to

emergent literacy skills, participants had some degree of hearing loss and participants were between the age of 3 to 9 at the start of the study.

#### Data Collection

Results of the above database search revealed seven studies included in this review. Two studies employed a single subject study design, two used a single group pre-posttest design, one used a single group posttest design and two were case studies.

### *Results*

#### Single Subject Design

Single subject design studies are commonly used with rarer populations, such as DHH populations. The use of multiple probes across the study allows for participants to be their own controls, providing high levels of evidence. By nature of the design these studies may be subject to selection bias, and the small sample sizes limits generalizability of the results.

**Beal-Alvarez, Lederberg, and Easterbrooks (2011)** conducted two single subject design studies (n=1, n=3) examining acquisition of GPCs in DHH preschoolers who received supplemental VP with their emergent literacy program. Acquisition of GPCs is an important early reading skill that leads to later reading success. Standardized tests available from the child's file were reported for descriptive purposes, as well as language spoken and device use. Only GPCs unknown at baseline were taught during four 30-minute sessions each week for ten weeks (Study 1) or four one-hour sessions each week for 23 weeks (Study 2). Outcome measures included probes of GPC knowledge completed at baseline and appropriate intervals throughout the intervention. Both studies completed a baseline probe immediately prior to teaching of a GPC. Study 1 also conducted probes for all GPCs on days 8, 20, 33 and 37 of instruction. Study 2 separated GPCs into two sets of nine. Baseline probes for set one was conducted during the first week of instruction as well as on days 14, 34, and 48. Baseline probes for set two were conducted during the 11<sup>th</sup> week of instruction as well as on days 60 and 71.

Results of visual inspection and statistical analyses revealed all participants learned all taught GPCs as a direct result of the intervention and showed maintenance of the learning throughout the study.

Strengths of this study included a sound rationale, appropriate detail regarding methods, consistent measurement of targeted and untargeted GPCs, appropriate statistical analysis, use of treatment fidelity and acceptable reliability. Neither study described

participant selection criteria in detail, however participant characteristics were described clearly. There was also a potential for a bias in that outcome measures were collected by the authors.

Overall this study provides a high level of evidence in relation to GPC acquisition in DHH preschoolers.

**Tucci and Easterbrooks (2015)** used a multiple baseline across content design with three DHH preschoolers to measure the effectiveness of an emergent literacy program on identification of letter-sound correspondence, initial-sound identification and syllable segmentation. VP was used when teaching letter-sound correspondences and initial-sound identification. Knowledge of these skills relates to the later reading success of all children. Intervention occurred an hour a day, four days a week for 25+ weeks (about one school year). Outcome measures included probes of the above skills at baseline and evenly spaced time points throughout the intervention.

Results of visual inspection and statistical analysis indicated that by the end of the study participant one mastered syllable segmentation, participant two showed improvements and participant three was unable to sustain progress. All three participants mastered all taught letter-sound correspondences; and participants one and three mastered initial sound identification while participant two showed improvements.

Strengths of this study involved solid rationale, detailed description of methods, consistent probes throughout the intervention, suitable statistical analysis and reliability, use of treatment fidelity checks and discussion of social validity. While there was no description of participant selection, appropriate details of participant characteristics were provided. Limitations included participant two receiving inconsistent instruction due to change in schools and potential for bias as some outcome measures were completed by the researcher.

Overall this study provides a high level of evidence that DHH preschoolers can acquire the early literacy skills of letter-sound correspondences, syllable segmentation and initial sound identification.

#### Single Group Pre-Posttest Design

These studies lack controls or comparison groups, lowering internal validity. They often cannot control for all possible contributors to outcomes, posing questions to whether the outcomes were due to the intervention or another factor.

**Trezek et al. (2007)** used a single group pre-posttest design to determine if 90 minutes of daily instruction during one school year from a phonics-based reading curriculum supplemented with VP improved reading skills in DHH kindergarten and first grade students (n=10). Results will contribute to if DHH students are able to gain phonological and phonemic information and contribute it to their reading abilities. A standardized assessment was administered pre- and posttest to determine changes in the following skills for all participants: sentence writing phoneme, sentence writing spelling, phonemic awareness segmentation; and the following for the grade one participants; phonemic awareness deletion, phonics onsets and phonics rimes.

Statistical analysis revealed statistically significant differences between the pre- and posttest scores on all the above measures as well as large effect sizes. Stanine scores for the kindergarten students revealed a decrease on the sentence writing phoneme subtest compared to pretest, however scores on all three measures indicate average performance. The first-grade students showed a decrease in stanine scores at posttest, with below average performance for the sentence writing spelling, phonemic awareness segmentation and phonics onsets subtests, even though significant gains were noted on all six measures.

Strengths of this study include strong rationale and well formulated question, detailed description of methods, use of pre- and posttest measures and reports of social validity. Appropriate statistical analysis was utilized, however there was no correction for multiple comparisons. Although there was no description of selection criteria and convenience sampling was used, detailed population demographics of the area and individual characteristics of the participants was provided. Further limitations of the study included a small sample size and the potential for bias as the teachers provided the intervention and administered the assessments.

Overall this study provides a moderate level of evidence in relation to improvement of reading skills in DHH kindergarten and first grade students.

**Trezek and Wang (2006)** discuss findings of their study asking whether one school year instruction of a phonics-based reading program supplemented with VP improves beginning reading skills in DHH kindergarten and first-grade students (n=13). Results will contribute to evidence showing if improvement in phonemic awareness and phonics skills contributes to improvements in reading comprehension. Standardized assessments were used at pre- and posttest to measure word reading, pseudoword decoding, and reading

comprehension. On average the participants were taught 48 lessons from the literacy program throughout the eight-month school year.

Statistical analysis found there was a statistically significant difference between pre- and posttest for word reading, improved performance at posttest for pseudoword decoding and reading comprehension, better average annual gain by participants on word reading and pseudoword decoding than the national population of DHH students, and no statistically significant difference between degree of hearing loss and performance on word reading.

Strengths of this study included clear rationale, discussion of social validity and use of appropriate reliability. A detailed description of methods was included, however does not specify frequency of intervention. Appropriate statistical analysis was used, however, the small sample size prevented the use of statistical tests beyond descriptive statistics for the pseudoword reading and reading comprehension tests. Limitations included loss of three participant at follow up, small sample size inhibiting generalization of effect of hearing loss to the larger population, and potential for bias as the author administered and scored tests.

Overall this study provides a moderate level of evidence in relation to improvement of reading skills in DHH kindergarten and first grade students.

#### Single Group Posttest Design

Single group posttest designs pose the same limitations as pre-posttest designs. They have an additional limitation in that there is no pre-test to allow for comparison of results.

**Narr (2008)** investigated the relationship between performance on a PA task, decoding task, reading ability, and length of time instructed with VP for DHH students in kindergarten to grade three (n=10). Knowledge of these skills may assist in enhancing reading skills of this population. This study occurred in a classroom where teachers already utilized VP and had their own literacy activities taught for one hour every day. Outcome measures included curriculum-based measures for reading level and previously developed tasks for research for PA and decoding.

Statistical analysis revealed better than chance accuracy and large effect sizes for the decoding and PA tasks, age and length of time instructed with VP did not impact performance on either task, there was no pattern between performance on the tests and reading level had an impact on the decoding task but not on the PA task

(students at grade level performed better than students below grade level).

Strengths of this study include strong rationale and appropriate expansion on previous research, detailed description of methods, appropriate use of statistical analysis including error analysis and reliability. Selection criteria was not described, and convenience sampling was utilized, however clear participant descriptions were provided. Limitations included not controlling for independent variables (e.g. lack of attendance) and failure to assess other concomitant factors that could influence performance.

Overall this study provides a moderate level of evidence regarding the relationship between reading ability, length of time instructed with VP and performance on PA and decoding tasks in DHH students.

#### Case Study

Case studies can be useful to use with interventions new to research, such as VP, and rarer populations, such as DHH populations. They can provide informative and detailed information, both quantitatively and qualitatively, of the effects of an intervention. A limitation is having only one participant with no control, resulting in limited generalizability.

**Wang, Sychala, Harris, and Oetting (2013)** reported on early reading skills of three DHH preschoolers immediately following 40 (n=2) or 50 (n=1) weeks of phonics-based instruction supplemented with VP as well as in early elementary school. Early teaching of these skills can work to improve later reading skills. Participants received group instruction for 20 minutes daily and individual instruction one hour weekly. Three standardized tests were administered to measure phonemic awareness and phonics skills and compare participants early reading skills to hearing peers.

Overall participants showed improvements in all subtests, except for three subtests between two participants. At follow up all participants retained skills learned and were age-equivalent or ahead of hearing peers.

Strengths of this study included strong rationale for question and study design, detailed description of methods, comprehensive report of participant characteristics, collection of qualitative and quantitative data, use of fidelity checks and outcome measures assessed at four different time points, including a follow up time point. Standard scores and percentages correct were reported for assessments. Limitations included no use of statistical tests, baseline data was not collected for every subtest due to noncompliance, and

modifications were used when administering and scoring the assessments; affecting validity of results.

Overall this study provides a low level of evidence in relation to improvement of reading skills in DHH preschoolers.

**Smith and Wang (2010)** present findings on improvements in phonemic awareness, phonics, word-learning and sounds in speech in a deaf preschooler after six weeks of instruction of a phonics curriculum with VP. Intervention occurred four or five days per week for 15-20 minutes each session. Five outcome measures relating to the above skills were assessed prior to the start and at the end of intervention.

Analysis of qualitative data and comparison of pre- and posttest scores revealed the participant showed significant improvements on four of the outcome measures and remained stable at 100% on the fifth measure. It also showed he transferred skills to classroom instruction and showed most improvements in phonemic awareness.

Strengths of this study included strong rationale, detailed description of participant characteristics, and sufficient description of methods. Limitations included no use of statistical analysis, weak pre- and posttest measures, weak discussion section and a potential for bias as author administered pre- and posttest measures.

Overall this study provides a low level of evidence regarding improvement of phonemic awareness, phonics, word learning and sounds in speech in deaf preschoolers.

#### *Discussion*

Overall findings show that DHH children aged 3-9 showed improvements in early literacy skills related to PA and phonics following a literacy program with VP.

Due to the lack of comparison groups in all the studies, it is not possible to determine if the use of VP enhances the outcomes from the literacy programs or if the outcomes would remain the same even if VP was not used. Qualitative data from two studies provides subjective data on improvements of the participants and how the participants used VP to support their own learning.

As a result of the differences in literacy programs between the studies; a maximum of two studies used the same literacy program; and the different outcome measures; conclusions cannot be made regarding the effectiveness of specific literacy programs with VP. In

Tucci and Easterbrook's (2015) study VP was not used to teach one of their outcome measures; syllable segmentation. Visual analysis of the data shows syllable segmentation was not as consistently learned and mastered as the other outcome measures. This raises the question as to whether use of VP could have enhanced the participants learning. Future research is needed to determine the efficacy of VP as an addition to a literacy program.

This review revealed gaps in the literature and provides suggestions for future research. Future studies should address these gaps through the use of study designs that include comparison groups to determine if the addition of VP is helpful as well as determine which literacy programs are most effective. Larger sample sizes without use of convenience sampling would be helpful in generalizability of results to the larger population. If possible, studies should also separate children who wear hearing aids from children who wear cochlear implants to determine if there is an effect of the different ways of processing sound.

### *Clinical Implications*

Despite inconclusive conclusions and lack of high-level evidence study designs, this research does provide useful information for practicing clinicians. It is clear that DHH students require some direct teaching of PA and phonics skills. This research shows that this population can show improvements following literacy instruction with VP. It is recommended clinicians provide support in this area, however the best program or combinations of strategies is unclear. Based on the findings of the research it is recommended that if using VP, use it in conjunction with a literacy program as a tool to provide additional support to students.

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