Critical Review: For Children with Hearing Loss, is Auditory-Verbal Therapy an Effective Intervention for Promoting Spoken Language?

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This review examined the evidence for the effectiveness of Auditory-Verbal Therapy (AVT) on promoting spoken language development in children with hearing loss. The articles included within this review consisted of prospective cohort studies, single-group designs or case series, and a systematic review. Although the articles all determine AVT to be an effective intervention for spoken language development, higher quality evidence is needed. Recommendations for further research and clinical practice are included.

Introduction

In Canada, more than a thousand children are born with hearing loss each year. There are multiple avenues of intervention that a family may choose, and the therapy program they take will largely depend on the family's communication goals for the child. The majority of children born with hearing loss are born to hearing parents, and spoken language is a goal for many families (Flexer, 2011). With an increasing awareness of a need for earlier amplification and aural (re)habilitation in Canada, there is an increasing potential for children with hearing loss to be successful in developing spoken language as their primary means of communication (Brennan-Jones, White, Rush, & Law, 2014).

Auditory-Verbal Therapy (AVT) is a relatively new approach for children with hearing loss whose goal is to develop spoken language as a primary means of communication. The approach is based on a defined set of principles. The program encourages earlier detection of hearing loss and it recommends that the child with hearing loss has optimal amplification. Unlike some other intervention programs for children with hearing loss, AVT puts an emphasis on the role of audition in developing spoken language and discourages clients from relying on visual cues, such as facial cues or gestures. The approach also emphasizes the role of the parents and caregivers. Parents participate within the sessions, where they are coached and guided by the certified AVT clinician, and they become the child's primary facilitator of spoken language development (Brennan-Jones, White, Rush & Law, 2014). The AVT approach also encourages the use of natural routines and environments to promote the development of listening skills and spoken language (Jackson & Schatschneider, 2014).

Objectives

The objective of this paper is to critically evaluate the current evidence for the effectiveness of AVT in promoting spoken language development in children with hearing loss.

Methods

Search Strategy

In order to find articles related to the topic of interest, two online databases (PubMed and Scopus) were searched using the key terms:

"Auditory-Verbal Therapy" AND "spoken language".

The search was limited to articles written in English and published between 2008 and 2016 to ensure the information was recent and the amount of studies was manageable.

Selection Criteria

Within the original search parameters, the titles and abstracts of the search results were scanned. Articles looking at the effectiveness of AVT were included if spoken language was assessed as an outcome. An additional inclusion criteria was that the study included children with hearing loss, ages 0 to 18 years, as participants. Articles were eliminated if the sample population included children with any other physical or developmental disabilities in addition to the hearing loss. Articles were also eliminated if they evaluated other therapies in addition to AVT, or if they compared AVT to other interventions.

Data Collection

The literature search yielded 5 articles that met the selection criteria. Within the five articles, there were two prospective cohort studies (Dornan, Hickson, Murdoch, & Houston, 2009; Dornan, Hickson, Murdoch, Houston, & Constantinescu, 2010), two studies with a single group or case-series design (Jackson & Schatschneider, 2014; Hogan, Stokes, White, Tyszkiewicz, & Woolgar, 2008), and one systematic review (Brennan-Jones, White, Rush, & Law, 2014).

Results

Prospective cohort studies:
Cohort studies allow for the collection of data on outcomes for a group of individuals with similar characteristics and is an appropriate study design to examine the effectiveness of AVT (Bondurant, Anastasi, Berman, Buhrmaster, Burrow, Chang, ... & Fishman, 2005). Having multiple cohort groups introduces a risk for confounding variables, which are factors that differ between the two groups and which may contribute to any observed associations (Pannucci & Wilkins, 2010). In addition, many cohort studies allow data to be collected at multiple points in time. One concern that may arise when participants are lost to follow up is transfer bias, which can have an impact on the reported outcomes (Mann, 2003).

The two cohort studies in this review are the second and third studies in a long-term clinical trial looking at the effectiveness of AVT on promoting the developmental progress of speech and language skills in children with hearing loss. The initial study, as well as the two studies being reviewed, had a matched-group, repeated measures design. The same participants were followed in all three studies. Participants (n=29) were between the ages of 2-6 years and had bilateral sensorineural hearing loss (PTA $\geq$ 40dB). Participants were recruited from centers of an AVT program. Clearly defined selection criteria included: moderate to high socioeconomic status (SES), monolingual English speakers, and no other significant physical or cognitive disabilities; these criteria limited the generalizability of the results. Participants in the comparison group received weekly individualized AVT for a minimum of 6 months, although the intervention procedure was not clearly defined in either of the studies (Dornan, Hickson, Murdoch, & Houston, 2007).

Participants in the control group were recruited from staff of the AVT centers, and they were matched to participants in the comparison group for total language age, receptive vocabulary, gender and SES. The participants in the control group did not have hearing loss and did not receive AVT. Since the comparison and control groups were matched for language-age, the comparison group was, on average, 10 months older than the control group, which gave the potential for a "cognitive advantage" (Dornan et al., 2007).

Qualified Speech-Language Pathologists completed testing in all studies using appropriate standardized procedures. There were potentially different testers at pre- and post-testing for each child. There was no indication of blinding during testing and tester reliability was not examined in either study (Dornan et al., 2007).

Dornan, Hickson, Murdoch & Houston (2009) reported the second study in the long-term clinical trial. The comparison group consisted of 25 of the original 29 participants and the reasons for fallout were indicated in the paper. Post-test measures were taken at the 21 month stage of the long term clinical trial for total language and receptive vocabulary, both of which were appropriate outcome measures, and they were compared to the pre-test measures taken in the initial study.

Appropriate statistical analysis for a cohort design revealed that within both groups, significant improvements were seen for total language and receptive vocabulary scores. Furthermore, between group t-tests revealed that for total language, there was no significant difference between the comparison and control group in the amount of change seen from pre- to post-test. However, for receptive vocabulary, the control group made significantly greater gains than the comparison group.

Dornan, Hickson, Murdoch, Houston & Constantinescu (2010) reported the third study within the series. 19 of the original participants remained, and reasons for fallout were indicated in the paper. The same outcome measures of total language and receptive vocabulary were taken at the 50 month stage of the study and were compared to the pre-test results from the initial study. Appropriate statistics revealed that within both groups, significant improvements were seen for total language and receptive vocabulary scores. Furthermore, between group analysis revealed that for both total language and receptive vocabulary, there was no significant difference between the comparison and control group in the amount of change seen from pre- to post-test.

Despite some weaknesses in the methodology, both cohort studies provide suggestive evidence that AVT does improve spoken language in children with bilateral sensorineural hearing loss.

Single group design
Single group designs consist of a single group who receives the intervention and from which outcomes are assessed over a period of time. They do not contain a comparison which can reduce the level of evidence, however, there are often explicit or implicit comparisons made. Comparisons are often limited if the sample is not representative of the population being studied, if participants drop out of the study, if there is a small sample size or if there are confounding variables.

Case series are one type of single group design (Ip, Paulus, Balk, Dahabreh, Avendano, & Lau, 2013).

Hogan, Stokes, White, Tyszkiewicz & Woolgar (2008) reported a single group design study investigating whether, in children with hearing loss, AVT is effective at accelerating spoken language development. Participants (n = 37) were self-referred to an AV program, which made this a convenience sample. All participants had permanent bilateral hearing loss, ranging from moderate to profound, and were between the ages of 0 and 5 years. Participants attended AVT sessions at least twice a month for a minimum of 12 months; although, the operational details of the intervention were not clearly defined. Heterogeneity within the group was attributed to the degree of hearing loss, the age at which the hearing loss was diagnosed, the age at the start of AVT, and the type of amplification device used.

Pre-programme measures of total language were taken using appropriate standardized assessments and were used to calculate the predicted rate of language development (RLD) in the absence of AVT. The method by which the predicted RLD was calculated assumed a linear growth of language development, whereas, development is typically not linear. Further testing was completed at six-month intervals to calculate the observed RLD for each individual and for the group as a whole. No blinding during testing was indicated. The observed RLD, an appropriate outcome measure, was then compared to the predicted RLD, as well as to the expected RLD in typically hearing children.

The individual data were grouped based on the type of amplification used, including a group for participants who only used hearing aids (HA), a group for participants who only used cochlear implants (CI), and a group for participants who began the study with hearing aids but transitioned to cochlear implants at some point during the study (HA-CI). Appropriate statistical analysis revealed that, for all three groups, the observed RLD was significantly greater than the predicted RLD, and greater than expected for typically hearing children. For the individuals in the CI and HA-CI groups, the growth observed in their RLD was confounded by the change in hearing technology. To account for this, the data from the HA-CI group were further analyzed. Appropriate statistical analysis revealed that there was a significant difference in the RLD both when the child used the hearing aids and when they used the cochlear implants.

Further statistical analysis was done to account for the heterogeneity in the group. The data were grouped according to the age at which the participants started AVT, including a group for those who began AVT at < 2 years, 2-3 years, and >3 years. Appropriate statistical analysis revealed that, within each age band, there was a significant difference in the predicted and observed RLD. In addition, across the age groups, there was no significant difference in the predicted RLD or in the observed RLD.

Based on the study design and weaknesses in the method, this study provides equivocal evidence that AVT does accelerate the development of spoken language development in children with hearing loss.

Jackson & Schatschneider (2014) reported a case series design study investigating whether enrolment in an early intervention program that emphasizes spoken-language and listening development (i.e. AVT) is effective for promoting the development of spoken language in children with hearing loss. Participants (n=24) were between the ages of 3 months and 6.5 years, and had hearing loss ranging from mild to profound. They were all recruited retrospectively from an individual clinician's caseload, which made this a convenience sample. This allowed for heterogeneity within the group but also limited the generalizability of the results. Additional inclusion criteria, including consistent use of an amplification device, only English spoken at home, and no other cognitive or physical disabilities, further limited generalizability.

Participants participated in weekly AV therapy sessions for a minimum of 12 months, although operational details of the sessions were not included. Testing was done upon entry to the program using appropriate standardized procedures, and then every 6 months, by the same tester and with the same test. Tester reliability was not examined and there was no indication of blinding. Appropriate outcome measures included: spoken language and auditory comprehension. Duration of therapy and type of sensory device used were also investigated to determine if these variables had an effect on language growth.

Appropriate statistical analysis showed that with time as a fixed effect, there was a significant improvement in the raw scores for both expressive and receptive language for the group as a whole, and there were no significant differences between individuals. Standard scores were also included to compare the participants' performance to that of typically hearing children. For expressive and receptive language, there was not a significant upward trend over time. Between individuals, there was a significant difference in the amount of expressive language growth but there was no

significant difference in the amount of receptive language growth.

Further statistical analysis indicated that there was no main effect for sensory device used on the rate of language development. The authors recognized that the effects of sensory device used could not be isolated due to the co-varying influence of the degree of loss. In addition, the analysis revealed that there was a main effect for duration of intervention on both the expressive and receptive raw scores. Furthermore, there was a significant interaction between the sensory device used and the duration in therapy for auditory comprehension raw scores only. The rate of change was greater for children with hearing aids who had mild to moderate degrees of hearing loss and had received AVT longer.

This study provides equivocal evidence to support the effectiveness of AVT on promoting spoken language development.

Systematic Reviews:
A systematic review is an accumulation of the existing evidence which can be used to look at the effectiveness of a particular intervention or therapy. It is an appropriate design to look at the effectiveness of AVT on the development of spoken language in children with hearing loss. Systematic reviews include a defined search strategy, and specific inclusion and exclusion criteria. One risk with systematic reviews is publication bias, which occurs because studies with positive results are more likely to be published than studies with negative results (Kitchenham, 2004).

Brennan-Jones, White, Rush, & Law (2014) reported a systematic review that looked at the effectiveness of AVT in promoting receptive and expressive spoken language development in children with permanent hearing impairments. Clearly defined inclusion criteria for articles included: randomized control trials (RCTs) or quasi-RCTs, articles looking at children 0-18 years with bilateral hearing loss, and comparisons to a control group consisting of children with bilateral hearing loss who were on the waitlist for AVT or receiving treatment as usual.

An electronic search of 18 different databases and clearly defined search strategies were used to find articles. Two authors independently screened titles and abstracts and selected relevant articles. Authors expanded their search by scanning reference lists of relevant articles and contacting several study authors. The method used to search for articles was appropriate given the study design. Review authors were not blinded to author names or institutions, nor to journals of publication. 13 articles from the original search seemed to match the inclusion criteria; however, all 13 articles were excluded from the study.

Since there were no studies included in the review, Brennan-Jones et al. (2014) were unable to assess the effects of AVT on spoken language development. This study provides no evidence in support of AVT as an effective intervention for kids with hearing loss, although it demonstrates a need for higher quality studies.

Discussion

Collectively, the articles in this review provide suggestive evidence that AVT is effective for promoting the development of spoken language in children with hearing loss. Weaknesses in the study designs, as well as in the methods and samples, reduce the overall level of evidence provided by the studies and the overall confidence in the findings.

Based on inherent weaknesses in the study designs, the studies included in this review are classified as representing lower levels of evidence. Some specific weaknesses in the designs included:

- The cohort studies occurred over a period of time. In the more recent of the two studies, there was a fallout of 6 participants from the earlier study. Dornan et al. (2010) identified reasons for the fallout, although, the loss of participants still introduced the potential for transfer bias. The study did not include the participants who left in the analysis, which could have had an impact on the outcomes (Pannucci & Wilkins, 2010).
- The single group studies had no control group which limited the comparisons that could be made.
- In the study reported by Jackson & Schatschneider (2014), participants were selected retrospectively which made the study vulnerable to confounders.

There were also weaknesses related to the sample of participants that were used within the studies.

- One area of weakness was the way in which participants were recruited for the studies. In all four studies that had participants, participants for both the comparison and control groups were chosen out of convenience which introduced a risk for selection bias and limited the generalizability of the results (Mann, 2003).
- While the tight inclusion criteria used by the four studies increased the reliability of the results by reducing the amount of confounding variables, it also reduced the external validity of each of the studies (Pannucci & Wilkins, 2010).

- Additionally, all four studies had a small sample size which decreased the power of the study and reduced the certainty that the effects observed were true effects (Button, Ioannidis, Mokrysz, Nosek, Flint, Robinson, & Munafo, 2013).

There were also some problems with the methods used within the studies.

- All four studies indicated that the AV intervention used was consistent with the principles of AVT adapted by the AG Bell Academy for Listening and Spoken Language (Rhoades, E.A., 2006) although none of the studies indicated the specific operational details. This makes it difficult for other researchers looking to replicate the studies. Secondly, it makes it difficult to be certain that all of the AVT was implemented in the same way for all participants and to determine if there were differences in the application of the program that may have contributed to the results. (Pannucci & Wilkins, 2010).
- Furthermore, there was no indication of blinding in any of the four experimental studies during data collection or statistical analysis. Without blinding, there was an increased risk for bias and limited confidence in the association between the treatment and the observed effects (Karanicolas, Farrokhyar, & Bhandari, 2010; Pannucci & Wilkins, 2010).

An additional area of weakness in the studies was confounding variables. A confounder is a third variable which is associated with both the variable of interest and the observed outcome. Having confounders reduces the internal validity of the study. In the Hogan et al. study (2008) there was a confounder of a change in hearing technology that may have influenced the association observed between the RLD and the type of amplification device used. In the Jackson and Schatschneider study (2014), there was the confounder of degree of loss, which may have impacted the observed association between the type of sensory device used and the RLD.

Based on the concerns identified within the articles, some recommendations for future research include:

- Developing higher-quality studies, such as randomized control trials (RCTs). These studies are less likely to have bias, and as a result, there is a higher level of confidence in the results.
- Using control groups that consist of individuals who also have hearing loss and who are either waiting for AVT or who are receiving treatment as usual (Brennan-Jones et al., 2014). This will reduce a source of variability between the groups and will reduce the likelihood of seeing an effect when there isn't one.
- Using larger sample sizes to increase the power of the studies. This will provide clinicians with more confidence when basing clinical decisions on the study's conclusions.

Clinical Recommendations

Based on the current quality of evidence, I would recommend using caution when implementing the AVT approach in clinical practice until more research is done.

It is recommended that all approaches for spoken language outcomes are considered when providing treatment options to parents. In addition, the family's motivation level, their feelings and attitudes, and their particular needs, as well as the clinician's previous clinical experience, should also be considered when making recommendations about a particular approach for developing spoken language.

References

Bondurant, S., Anastasi, J. K., Berman, B., Buhrmaster, M., Burrow, G., Chang, M., ... & Fishman, A. (2005). *Complementary and alternative medicine in the United States*. Washington: The National Academies Press.

Brennan-Jones, C.G., White, J., Rush, R.W., and Law, J. (2014). Auditory-Verbal Therapy for Promoting Spoken Language Development in Children with Permanent Hearing Impairments (Review). *Cochrane Database of Systematic Reviews,* Issue 3. Art. No.: CD010100. DOI: 10.1002/14651858.CD010100.pub2.

Button, K.S., Ioannidis, J.P.A., Mokrysz, C., Nosek, B.A., Flint, J., Robinson, E.S.J., and Munafo, M.R. (2013). Power Failure: Why Small Sample Size Undermines the Reliability of Neuroscience. *Nature Reviews Neuroscience, 14,*365-376.

Dornan, D., Hickson, L., Murdoch, B., and Houston, T. (2007). Outcomes of an Auditory-Verbal Program for Children with Hearing Loss: A Comparative Study with a Matched Group of Children with Normal Hearing. *The Volta Review, 107,* 37-54.

Dornan, D., Hickson, L., Murdoch, B., Houston, T. (2009). Longitudinal Study of Speech Perception, Speech, and Language for Children with Hearing Loss in an Auditory-verbal

Therapy Program. *The Volta Review, 109*(2-3), 61-85.

Dornan, D., Hickson, L., Murdoch, B., Houston, T., and Constantinescu, G. (2010). Is Auditory Verbal Therapy Effective for Children with Hearing loss? *The Volta Review, 110*(3), 361-387.

Flexer, C. (2011). The Auditory Brain: Conversations for Pediatric Audiologists. Retrieved from http://www.audiologyonline.com/articles/auditory-brain-conversations-for-pediatric-817.

Hogan, S., Stokes, J., White, C., Tyszkiewicz, E., and Woolgar, A. (2008). An evaluation of Auditory Verbal Therapy Using the Rate of Early Language Development as an Outcome Measure. *Deafness and Education International, 10*(3), 143-167

Ip, S., Paulus, J. K., Balk, E. M., Dahabreh, I. J., Avendano, E. E., & Lau, J. (2013). Role of single group studies in Agency for Healthcare Research and Quality comparative effectiveness reviews. Rockville, MD: Agency for Healthcare Research and Quality.

Jackson, C.W. and Schatschneider, C. (2014). Rate of Language Growth in children with Hearing loss in an Auditory-Verbal Early Intervention Program. *American Annals of the Deaf, 158(5)*, 539-554.

Karanicolas, P.J., Farrokhyar, F., and Bhandari, M. (2010). Blinding: Who, What, When, Why, How? *Canadian Journal of Surgery, 53(5),* 345-348.

Kitchenham, B. (2004). Procedures for Performing Systematic Reviews. Retrieved from: file:///C:/Users/Sabrina/Downloads/Kitchenham-Systematic-Review-2004.pdf.

Mann, C.J. (2003). Observational Research Methods. Research Design II: Cohort, Cross Sectional, and Case-control Studies. *Emergency Medicine Journal, 20,* 54-60.

Pannucci, C.J. and Wilkins, E.G. (2010). Identifying and Avoiding Bias in Research. *Plastic and Reconstructive Surgery, 126,* 619-625.

Rhoades, E.A. (2006). Research Outcomes of Auditory-Verbal Intervention: Is the Approach Justified? *Deafness and Education International, 8*(3), 125-143.