

BAR-ILAN UNIVERSITY

**Improvement of Sequential Time Perception and  
Storytelling Ability, Using Virtual Reality,  
among Deaf and Hard of Hearing Children with  
and without a Cochlear Implant**

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## Abstarct

The cochlear implant has created a major medical revolution in the field of audiology by allowing children with a severe to profound hearing loss to gain access to sounds and voices for the first time in their lives (O'Donoghue, 2013). Research has shown a vast improvement in linguistic (Akmese & Acarlar, 2016; Boons et al., 2013a, 2013b; Le Maner-Idrissi et al., 2010) and cognitive (Eden & Ingber, 2014a; Kronenberger, Colson, Henning, & Pisoni, 2014) abilities among children with cochlear implants. Linguistic and cognitive abilities such as sequential time perception and storytelling ability have been researched among deaf and hard of hearing children. However, there is no research to my knowledge comparing children with and without cochlear implants on these topics. The aim of the present study was to improve deaf and hard of hearing childrens' sequential time perception and storytelling ability with and without chochlear implants by administering an intervention plan using virtual reality technology.

The study included 55 children ages 7-10 years who were divided into three groups:

- a. deaf and hard of hearing children with cochlear implants
- b. deaf and hard of hearing without cochlear implants
- c. a control group of hearing children

The participants completed pretest and posttest measures. The following tests were administered: The test "A series of pictures" out of the Kaufman test for children (Kaufman & Kaufman, 1996), A Screening language test for Hebrew speaking children (Goralnik, 1982). The study also included a demographic questionnaire with relevant background information about the participants and their parents. All of the deaf and hearing impaired children underwent two months of technology intervention which included three scenerios: "Baking a cake", "Making hot chocolate" and "Planting a tree". The intervention plan used virtual reality technology (VR Desktop) which allowed a combination of 3-D interactive content and active learning.

The research hypothesis were partially confirmed. Our first hypothesis prior to intervention was that deaf and hard of hearing children have lower sequential time perception and storytelling ability than hearing children. This hypothesis was confirmed. The second hypothesis was that prior to intervention, children with a cochlear implant will have a higher sequential time perception and storytelling ability than children who use hearing aids. This hypothesis was not confirmed. The third hypothesis was that deaf and hard of hearing

children without a cochlear implant will show a larger improvement in sequential time perception and storytelling ability than deaf and hard of hearing children with a cochlear implant. This hypothesis was partially confirmed. Results showed that the two study groups (deaf and hard of hearing children with and without a cochlear implant) showed a significant improvement in sequential time perception as a result of the intervention. However, children without a cochlear implant showed a much more significant improvement in this measure compared to children with a cochlear implant. This finding is consistent with the direction suggested in the research hypothesis. In regard to the measure of storytelling ability, while both study groups showed a significant improvement following intervention, there was no significant difference between the groups with regard to the extent of improvement. In other words, the improvement seen in storytelling ability following intervention was not significantly different between deaf and hard of hearing children with and without a cochlear implant, a finding which is not consistent with the research hypothesis.

Finally, the fourth hypothesis was that children using a cochlear implant from age of language acquisition or after (postlingual) will show greater progress in sequential time perception and storytelling ability than children who started using a cochlear implant before the age of language acquisition (prelingual). This hypothesis was also partially confirmed. It was found that both groups (children who were implanted before and after the age of language acquisition) showed a significant improvement in sequential time perception following intervention. However, children who were implanted after the age of language acquisition showed a larger improvement in this measure compared to children who were implanted prior to age of acquisition. This finding is consistent with the direction suggested in the research hypothesis. In addition, while both study groups showed a significant improvement in storytelling ability following intervention, there was no significant difference between the groups with regard to the extent of improvement. In other words, the improvement seen in storytelling ability following intervention was not significantly different between children who were implanted before and after the age of language acquisition, a finding which is not consistent with the research hypothesis.

In conclusion, the findings of this research showed a significant improvement in sequential time perception and storytelling ability following intervention. These findings highlight the importance of technological intervention plans to improve linguistic and cognitive abilities among deaf and hard of hearing children with and without a cochlear implant. The present research suggests an easy and convenient research tool, which tests the sequential time

perception and storytelling ability of deaf, hard of hearing and hearing children all together. Moreover, it seems that there is a need to examine in depth the way the cochlear implant influences these abilities, in light of the findings indicating significant differences between deaf and hard of hearing children with and without a cochlear implant, in the improvement of sequential time perception and storytelling ability following a technological intervention plan. This research leaves an opening for other researchs to examine these abilities with a larger sample, and for a more extended period of time.