
Spatial hearing training in CI users: stakeholder involvement in the development of virtual reality games

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Abstract

Older children and teenagers with bilateral cochlear implants (CIs) often have poor spatial hearing which jeopardizes speech and language development, education, and social well-being. The lack of protocols for bilateral CI fitting and resources for spatial-hearing training contributes to these difficulties. A large body of research demonstrates that sound localisation can improve with training, underpinned by plasticity-driven changes in the auditory pathway. The aim of the BEARS (Both EARS) project is to develop a package of virtual-reality games to train spatial hearing in young people with bilateral CIs and evaluate their effectiveness.

To develop the BEARS games we have followed a participatory design whereby stakeholder participants are also co-creators. Children aged 8-16 years old with bilateral CIs attended cycles of workshops assessing aspects of the 3 BEARS applications (localisation, spatial speech-in-noise and spatial music) and reflecting on their experiences which in turn informed changes in the game implementations. The cycles were customised to focus on the elements that the participants considered important. CI users have had the opportunity to give feedback on visual elements of the apps or configuration and settings. Clinicians have also played a key role in the project by assessing the BEARS games and advising on the usual care pathway across UK CI centres in preparation for the clinical trial.

Workshop participants have agreed that the games are appropriate and ready to be used. The main areas of modification have been: the variety of scenarios to cover age range and interests, the number of levels of complexity to ensure small improvements were measurable,

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feedback and reward schemes to ensure positive reinforcement and an additional implementation on an iPad for those who had difficulties with the headsets (Vickers et al 2021). Participants have also provided feedback on different types of headphones which informed our decision on the equipment to be purchased and have helped us examine communication issues in online settings. The effectiveness of the BEARS training suite will be evaluated in a large-scale clinical trial to determine if using the games lead to improvements in speech-in-noise, quality of life, perceived benefit, and cost utility compared to usual care. Workshops and feedback with CI audiology and rehabilitation clinicians have helped us define ‘usual care’ for the trial and what additional information should be collected as part of the trial. Upcoming workshops will focus on the virtual spatial speech in noise test, quality of life questionnaire and guide of qualitative interviews that will be used in the trial.

Computer-based interactive interventions allow patients to take control of their own management reducing the reliance on outpatient-based rehabilitation. For young people in particular, a virtual-reality implementation is more engaging than traditional rehabilitation methods. Patient-centred research is being used more and more in audiological research as it ensures that any intervention or material developed is relevant to the intended user and the participatory design used here is improving the BEARS games and measures and makes us confident that children with bilateral CI users find them appropriate and entertaining.