ABBI Project Newsletter

January 2017

Research and Development

by The ABBI team

Introduction

In 2014 the number of blind children below the age of 15 years was estimated to be 19 million. Scientific evidence suggests that some tactile and audio skills in congenital blind individuals result enhanced, such as the ability to localize a sound source in the horizontal plane or discriminate between different sounds. Studies of animals confirm this view by suggesting that sound processing by neurons in auditory cortical areas can be enhanced following visual deprivation. On the other hand, recent scientific works have pointed out that some forms of auditory perception in visually impaired individuals is compromised, raising some doubts about the degree and the limits of how well the brain can compensate sensory loss. Indeed blind individuals seem to be impaired in complex skills related to auditory spatial perception, such as the ability to relate multiple sounds.

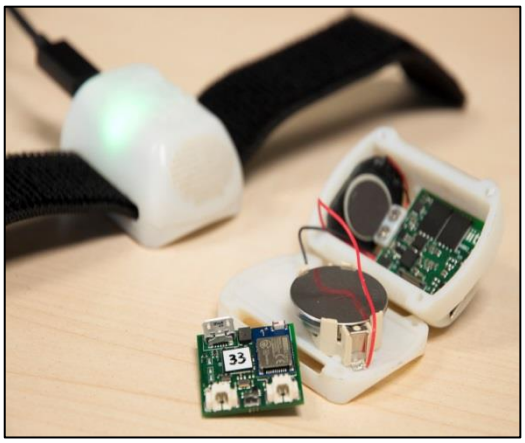
For this reason,a great effort has been put in the development of new technological devices to to assist visually impaired individuals but available technologies are still not fulfilling this purpose. Indeed, despite the huge improvement of technological devices specifically designed for visually impaired users, we found that many of these solutions are neither widely accepted by adults nor easily suitable for young children because they are not developed for rehabilitation purposes. For instance, they are too complex because they imply the need of learning a new language following long training programs and integrating multiple sensory signals.

Innovation

The project started from the necessity of developing a new rehabilitation device for young children with visual impairment. For this reason, we developed ABBI (Audio Bracelet for Blind Interactions) which is an audio bracelet meant to improve spatial and social skills in visually impaired children (Figure 1). The device is composed of a bracelet that can connect to a smartphone application wirelessly via a Bluetooth link. The basic operation of the bracelet is to produce a sound when a movement is occurring, thus providing an auditory feedback of body movements that can convey spatial information related to the position of the body in the space.

The innovation of ABBI mainly consists in its potential to help children experiencing the correspondences between auditory and motor information, thus improving their ability to perceive and act towards auditory stimuli. This approach is innovative because it does not require extensive learning

trainings and it can be introduced early in rehabilitation protocols, thus it is more adaptable compared to existing sensory-substitution devices. Moreover by exploiting the natural ability to process sensory signals, this system is not intrusive as it would enhance perceptual functions without overwhelming individual sensory and cognitive resources. Finally, it has been proved that the use of ABBI is particularly powerful in rehabilitation contexts, as it provides benefits by enhancing functional capabilities instead of merely substituting typical properties of the visual modality.



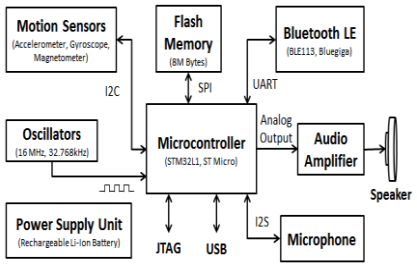


Figure 1.
The ABBI device with its main components and their communication protocols

Summary of the project

Over three years, the ABBI device has been developed and validated together with more than 50 children from 3 to 17 years of age. Co-design workshops, where researchers, trainers and children have collaborated to create and improve ABBI designs, have been an integral part of the development. Validation has been carried out by performing longitudinal three months rehabilitation trainings based on the use of the bracelet (Figure 2). During this period, children performed spatial and social rehabilitation games specifically designed for the use of ABBI. **Results suggest that ABBI helps rehabilitating the sense of space and improving social skills in visually impaired children, and that beneficial effect are maintained one year later the end of the training.** Indeed no improvement in spatial and social skills has been reported for the control group of visually impaired children following a classical rehabilitation training without the use of ABBI. These findings indicate that an audio-motor training can be helpful to compensate for the lack of visual experience with long lasting effects on spatial, motor and social skills of children.

Social impact

In order to evaluate the ABBI system we used a double approach. The first evaluation consisted of observations during the training sessions at Istituto Chiossone (7 visually impaired children aged 3-5 years and 4 visually impaired children aged 6-8 years plus 2 trainers – in total 13 persons). To complement this, we performed a final usability evaluation of the ABBI social rehabilitation app, and the ABBI end user app (ABBI XP). In this evaluation we asked the test person to go through a series of tasks that tested the different control functions available in the two apps (See Figure 3). After the test, the person rated the usability of the app using a standardised questionnaire.

In total, 7 trainers evaluated the ABBI social app and the ABBI end user app, 8 visually impaired children, 8 additional trainers and 4 sighted adults evaluated the ABBI end user app. All in all, these evaluations involved **40 potential end users.** The results indicate that the ABBI itself is quite easy to use, and the apps also get good results – the average usability score for the ABBI social app is 79 (good) and the ABBI end user app gets almost the same average rating: 78 (good). **Thus, the ABBI and the apps form a working and usable system.**

Future development

The ABBI team is currently working on the development of an **ABBI KIT** addressed to rehabilitation centers for visually impaired children interested in using this technology in therapeutic contexts.

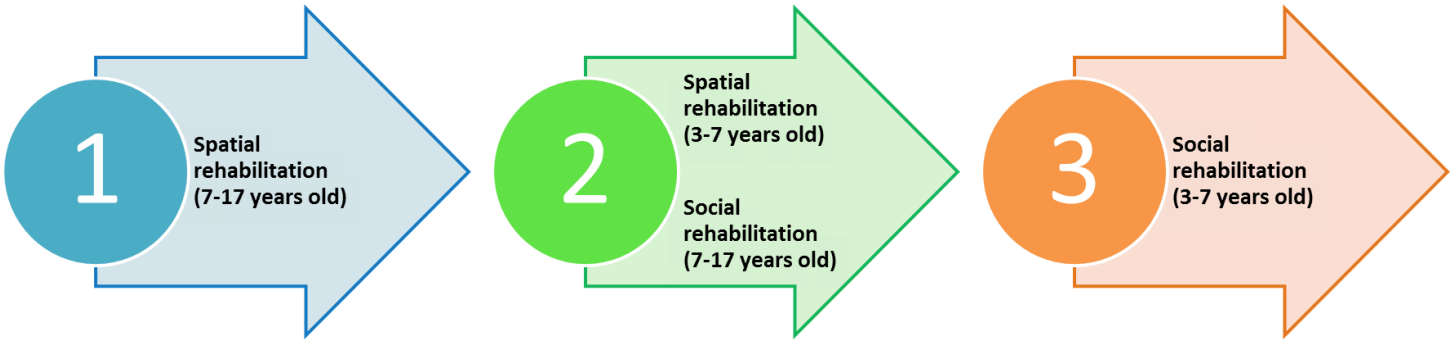


Figure 2. Longitudinal rehabilitation trainings carried out to validate the ABBI bracelet

Dissemination activities

by The ABBI team

Links and selected references

Website: https://www.abbiproject.eu/

Gori Monica et al. (2016). Devices for visually impaired people: high technological devices with low user acceptance and no adaptability for children Neuroscience and Biobehavioral Reviews, 69, pp. 79-88.

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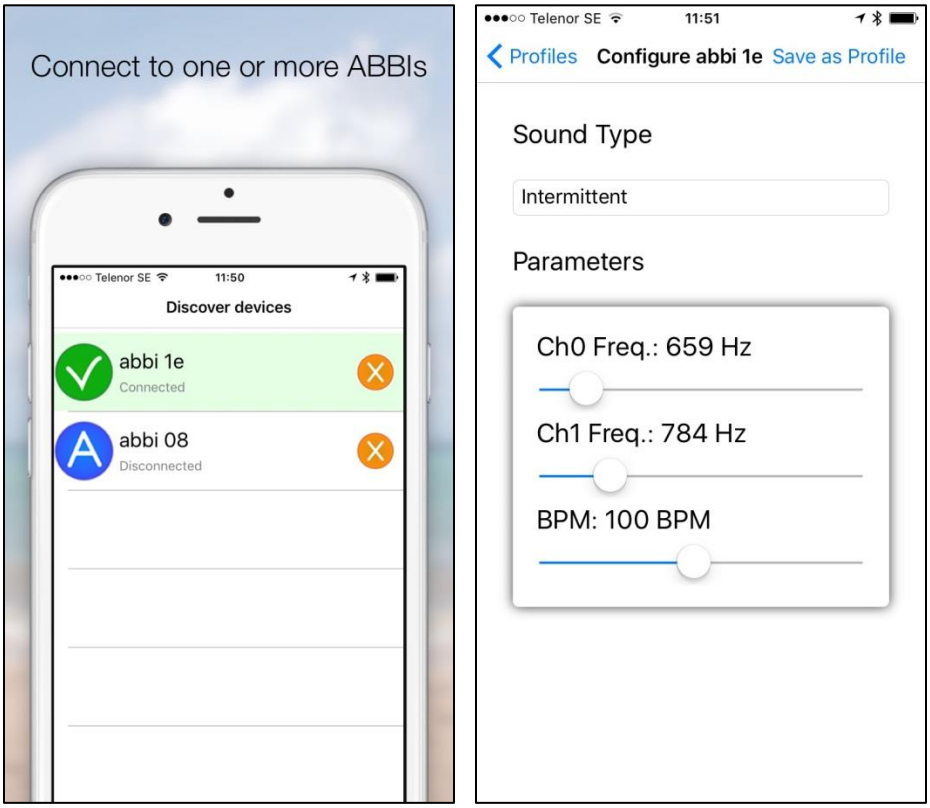
Cappagli Giulia et al., (2016). Multisensory rehabilitation improves spatial impairments in visually impaired children. Frontiers in Integrative Neuroscience (in press).

Wilson Graham et al., (2015). In the Heat of the Moment: Subjective Interpretations of Thermal Feedback During Interaction. ACM CHI2015, Korea.



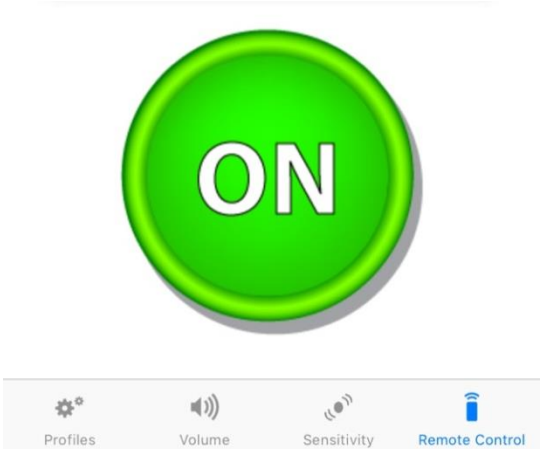


Figure 3. Examples of screenshots for the final evaluation test to test the different control functions available in the two appss