

# The 'Interactive Music Awareness Program' (IMAP) for Cochlear Implant Users

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## ABSTRACT

There is some evidence that structured training can benefit cochlear implant (CI) users' appraisal of music as well as their music perception abilities. There are currently very limited music training resources available for CI users to explore. This demonstration will introduce delegates to the 'Interactive Music Awareness Program' (IMAP) for cochlear implant users, which was developed in response to the need for a client-centered, structured, interactive, creative, open-ended, educational and challenging music (re)habilitation resource.

## Keywords

music, cochlear implants, perception, rehabilitation, auditory training, interactive learning, client-centred software

## 1. INTRODUCTION

CI technology has exceeded the early expectations of many with regard to providing severely or profoundly deaf people with the ability to perceive speech in quiet listening environments, yet current devices are poor at conveying the temporal and spectral cues that are necessary for the accurate perception of pitch and timbre, and have limited dynamic range [1]. Many CI users express a desire to hear music again but are dissatisfied by the sound quality of music as perceived through their implant [2, 3]. However, certain features of music are known to be more readily accessible to CI users; music with simple, repetitive structures and arrangements, a clear melody and strong beat is reported to be preferred post-implantation [2].

There is some evidence to suggest that structured training can benefit CI users' appraisal of music as well as their music perception abilities, particularly for melodic contour and timbre recognition [4, 5]. However, availability of aural rehabilitation, especially for adults, is patchy at best [6]. Computer-based perceptual training could provide a cost-effective solution, potentially leading to increased participation in music related activities and improvement in quality of life [7].

Evidence-based research into the efficacy and efficiency of musical (re)habilitation training is much needed [6]. In a review of issues relating to cochlear implantation, Zeng concluded that there were no structured (re)habilitation programs and protocols

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for cochlear implant recipients that have been field-tested and proven effective [8]. Since this review a number of computer assisted training programs for speech perception have been produced or further developed from existing materials [5]; however, there remains a particular need for music training programs [9].

The need for a structured music (re)habilitation resource aimed at CI users was the incentive for the development of the University of Southampton's 'Interactive Music Awareness Program' (IMAP). This demonstration will introduce delegates to the full functionality of the IMAP, allowing them to: experiment with specifically designed Max/MSP standalone applications; watch tutorial videos that introduce the bespoke software; and explore the HTML-based template used to structure the twenty-four half-hour sessions.

## 2. AURAL (RE)HABILITATION PROGRAM DESIGN CONSIDERATIONS

A number of recommendations relating to the development of aural rehabilitation programs have proved pertinent to the development of the IMAP. Sweetow and Sabes [10] propose that training should be interactive, practical and accessible, difficult enough to maintain interest and yet easy enough to minimize frustration and fatigue. They also advocate the use of a bottom up and top down approach to facilitate enhancement of both peripheral auditory and central processing, stating that performance 'must be measurable' with 'feedback provided on a [regular] basis'. With these criteria in mind the software applications developed for the IMAP employ accessible and clear GUI designs, and allow users with varying hearing experiences the opportunity for practical experimentation and interaction with music. Many of the applications provide immediate feedback to help users develop their own techniques and strategies for deciphering music through their CI.

In addition to Sweetow and Sabes' recommendations, we propose that a client-centered approach is essential to develop successful aural rehabilitation programs and protocols. This proposal is by no means new; Hull states that 'assessment of the impact of the hearing deficit on individual clients is ... critical for formulating a viable aural rehabilitation program based on the client's needs' [11]. In order to actively involve CI users in the development of the IMAP a series of consultation meetings and music exploration workshops were organized. The workshops involved a range of different musical activities including: practical music making; listening exercises; educational talks; and trialing of Max/MSP standalone application prototypes. Feedback from the consultation sessions and workshops suggested that the music rehabilitation program should be interactive, creative, open-ended, educational and challenging.

### 3. IMAP STRUCTURE AND CONTENT

The IMAP is housed on a USB stick that can be used at home on either Windows or Apple platforms. The user is guided through the twenty-four half-hour sessions by means of an HTML-template that links to the Max/MSP standalone applications. The software applications are introduced by text-based and video instructions, which provide tasks and challenges. Each session concludes with either an online listening task, which encourage users to discover music on YouTube, or a 'Test-Yourself' application focused on testing the users' abilities in: pulse detection; melodic contour perception; or instrument differentiation. These 'Test-Yourself' applications allow users to track their musical development by providing scores out of ten. The main bulk of the IMAP, however, is concerned with the interaction with six key interactive standalone applications, which encourage users to create, manipulate and play with music in creative and open-ended ways. The following overview of these applications describes the functionality and purpose of the software:

#### 3.1 The Timbre Player

'The Timbre Player' allows CI users to choose the melody and instrument they want to hear (from closed sets), with or without a rhythm track and with the ability to change the speed and pitch. The pitch controls are particularly important as they allow the user to find a pitch range that suits them. The melodies currently available are 'God Save the Queen', 'Somewhere over the Rainbow' and a new melody, 'Ben's Tune'. 'Ben's Tune' features large pitch jumps in order to try and stimulate different CI electrodes, affording the possibility of experiencing a more perceptible difference in pitch. A range of visual cues are provided to help decipher the melodic contour including: videos of the performers; a piano-roll; stave notation; and graphic representations of the sound ('goat animation' and a spectrogram). It is hoped that this software will help CI users to discover which instruments they can perceive better through their implant.

#### 3.2 The Tapsters

'The Pulse Tapster' and 'The Rhythm Tapster' help users develop their sense of pulse and ability to replicate rhythms through challenging rhythm tasks. Rhythm is one of the most accessible aspects of music through a CI, so it is hoped that rhythm-based activities will prove encouraging and motivating for users. The applications provide immediate feedback about how successfully the user is able to use the QWERTY keyboard to tap a pulse of a musical extract or replicate a short rhythmic pattern. It is hoped this software will lead to a tangible improvement in the user's musical skills, and to further understanding of the accessibility of rhythmic structures.

#### 3.3 The N-Machines

The 'N-Machines' are simple graphical mixers that allow the user to control the instrumental/vocal mix, pitch and speed of songs. Artists currently featured include Philip Selway (Radiohead); Robin Grey; Madelaine Hart; and Blueswerver. It is hoped that allowing CI users to piece together the different instrumental/vocal lines will aid the appreciation of the music, assist in the understanding of how musical textures are constructed, and help users work out which particular combinations of instruments sound best.

#### 3.4 The AVP

Many CI users have reported to us that they find background music in television program and films distracting and even annoying. 'The AVP' (Audio Visual Player) allows CI users to work creatively by controlling and combining various video and audio fragments in order to see how the different pieces of

music change the emotion, drama, sense of time or setting, or mood of short films. This software allows CI users to use music creatively and expressively, combining systematic and creative thinking to create something new.

#### 3.5 The ERM

Some CI users avoid listening to music, or find it off-putting because they feel a pressure to be able to differentiate particular musical instruments or sounds, which can be rather difficult through a CI. 'The ERM' (Environmental Rhythm Machine) aims to alleviate this pressure by allowing users to interact musically and playfully with everyday sounds; sounds that they will have most likely have become used to hearing through their CI already. This may help avoid the disappointment that can stem from finding it problematic to recognize traditional musical instruments. 'The ERM' is a simple environmental sound drum machine, which encourages users to adapt preset rhythmic loops, and to compose new rhythmic structures. It allows CI users to take control of what they are hearing, and to work creatively with sound.

### 4. THE FUTURE

A controlled, randomized crossover trial of the IMAP is currently underway at the South of England Cochlear Implant Centre in the UK. Measures of music perception and appreciation at the beginning, half way through and end of the trial will be used establish the efficiency and efficacy of the materials. Following feedback from the trial the IMAP will be made available online in order to enable CI users worldwide to benefit from the program.

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### 6. ACKNOWLEDGMENTS

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