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Impact of music on the quality of life of cochlear implant users: a focus group study

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Common.SubmissionDetails.Abstract:	Objective: To study the aspects of the quality of life (QoL) on which music has an impact in adult cochlear implant (CI) users. Methods: Thirty adult CI users aged between 18 and 81 years old with a wide range of patient characteristics and musical backgrounds participated in the study. Six focus group discussions about music in everyday life were conducted and data were analysed using template analysis based on the QoL model of the World Health Organisation Quality of life BREF questionnaire (WHOQOL-BREF). Results and discussion: A theoretical framework of the impact of music on the QoL was developed. Music was reported to contribute to many aspects of physical, psychological, and social well-being in adult CI users. These positive effects of music on QoL were similar to what has been reported in the literature for NH adults. However, difficulties in music perception and enjoyment were found to have a negative impact on CI users' QoL, especially by causing unpleasant feelings and limited participation in music-related or routine daily activities. Conclusions: These findings suggest that an improvement in music experiences of CI users may lead to improvements in QoL and therefore support the need for music rehabilitation. However, the relative importance of music overall and of specific aspects of music for each individual should be measured for an accurate assessment of the impact of music on the QoL of CI users.
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used, please see the first sentence in section 2.1. Recruitment: ‘Convenience and volunteer sampling was used with the aim to recruit as many CI users as possible within the timescale of the study.’

The authors note that 22 of the 30 participants were over the age of 58 and that this had implications for the findings, but no further discussion was given in the remaining document.

- Authors’ response:
We have rephrased this sentence in paragraph 1 of section 2.2 Participants: ‘Twenty-two of the 30 participants were over 58 years old, which may suggest that the findings can generalise more to older CI users.’

Did those individuals under the age of 40 (n=3) differ from those above 40, or even those below 58 from those above 58?
Of the 30 participants, 17 had used their implant for 1-2 years. It may be important to tease apart the early users from the responses of the later implanted.
It may be important to address whether those who had their implant longer (and were those who were younger in age) viewed their music and concurrent QoL higher than the older adults with shorter duration.
Were there any differences between those who were unilateral, bilateral, or bimodal (CI+HA) in terms of their experience and QoL?

- Authors’ response:
We agree that duration of implant use, age and CI configuration are crucial parameters and may impact music experience and therefore the effects on the QoL. As this is the first study looking at the impact of music on the QoL of CI users, our aim was to explore this relationship for the CI population overall and look at differences and similarities with NH adults but not to look at the role of CI-related factors. In the discussion we have highlighted this limitation and the potential differences between participants (and CI adults in general) due to such factors (paragraph 4 of ‘Discussion’): ‘The relationship of CI users with music and the impact of music on the QoL is likely to depend on individual factors, such as age, duration of implant use, CI configuration or expectations based on prior music experiences. Although the effects of these factors were not examined ...’

REVIEWER 2
GENERAL

The discussion is lacks in terms of how the current work relates to music and QoL among older adults. Specifically, how does music enjoyment change as we age, and how does that existing work relate to the results from the current study.

- Authors’ response:
There was a brief discussion of this in ‘Discussion’ paragraph 8. We have now added the following at the end of the paragraph: ‘The effect of age on music experiences was not looked at in the present study.’, which acknowledges the limitation that the study did not address the role of age.

The discussion also needs more information on how other demographic factors impact music enjoyment. Specifically, music experience and duration of deafness are skimmed over yet deserve more discussion.

- Authors’ response:
We have acknowledged the role of these factors and that the present study did not look at this (paragraph 4 of ‘Discussion’): ‘The relationship of CI users with music and the impact of music on the QoL is likely to depend on individual factors, such as age, duration of implant use, CI configuration or expectations based on prior music experiences. Although the effects of these factors were not examined ...’

	Regarding recruitment, was there any compensation for the participants? Were the participants offered money, parking passes, or other forms of compensation? Please make this clear. - Authors' response: We have explained this at the end of section 2.1. Recruitment: 'Potential participants were informed that they would receive a fee and have their travel expenses covered.' LINE-BY-LINE Methods, 2.3 The focus groups, line 37 The reference should be van Besouw instead of Van Besouw. Methods, 2.4 Data analysis, line 29 Avoid using back-to-back parentheses. Modify this line to (WHOQOL-BREF; The WHOQOL Group 1998). Section 3. Results, line 39. You are missing the table number; (Table ?). Results, Psychological Domain, Page 14, line 46 The word "through" is mis-spelled as "throught". References, line 24 The Chin & Rickard reference is in all caps. Please revise. - Authors' response: All the above-mentioned line-by-line errors were corrected. Please see original document with tracked changes. Please note: In addition to the responses to the editor's and reviewer's comments, other minor changes (e.g. changes in the wording, phrases added for clarification) were also made to the manuscript. These changes can be found in the uploaded copy of the original manuscript with tracked changes.

Impact of music on the quality of life of cochlear implant users: a focus group study

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Key Words: cochlear implant, music, quality of life, focus group

Abbreviations:

CI: cochlear implant

NH: normal-hearing

QoL: Quality of Life

WHO: World Health Organisation

WHOQOL-BREF: World Health Organisation Quality of Life instrument short version

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Abstract

Objective: To study the aspects of the quality of life (QoL) on which music has an impact in adult cochlear implant (CI) users.

Methods: Thirty adult CI users aged between 18 and 81 years old with a wide range of patient characteristics and musical backgrounds participated in the study. Six focus group discussions about music in everyday life were conducted and data were analysed using template analysis based on the QoL model of the World Health Organisation Quality of life BREF questionnaire (WHOQOL-BREF).

Results and discussion: A theoretical framework of the impact of music on the QoL was developed. Music was reported to contribute to many aspects of physical, psychological, and social well-being in adult CI users. These positive effects of music on QoL were similar to what has been reported in the literature for NH adults. However, difficulties in music perception and enjoyment were found to have a negative impact on CI users' QoL, especially by causing unpleasant feelings and limited participation in music-related or routine daily activities.

Conclusions: These findings suggest that an improvement in music experiences of CI users may lead to improvements in QoL and therefore support the need for music rehabilitation. However, the relative importance of music overall and of specific aspects of music for each individual should be measured for an accurate assessment of the impact of music on the QoL of CI users.

1. Introduction

Cochlear implants (CIs) have been successful in providing significant improvements in speech understanding for many severely or profoundly deaf adults, especially in favourable listening environments (Leigh et al. 2016). However, most CI recipients still achieve poor outcomes for speech recognition in noise and for the perception of music (Sladen & Zappler 2015). Overall, CI users perceive the fundamental elements of music less accurately and report poorer music enjoyment and limited participation in musical activities compared to their normal-hearing (NH) peers (Drennan et al. 2014). There is no firm evidence to suggest that this pattern is different between postlingually deafened and prelingually deaf adult CI users (Moran et al. 2016).

On the other hand, there is evidence that music is important, especially for the postlingually deafened CI users who have prior NH exposure to music. For example, sixteen out of 53 respondents to a music questionnaire reported that they would have undergone implantation just to be able to listen to music (Migirov et al. 2009) and 27 out of 40 respondents reported that they would choose a CI that transmits music perfectly, if it was available (Philips et al. 2012). Despite these findings, there has been little investigation into the impact of music on the quality of life (QoL[1]) of CI users, and only indirectly through correlation analyses. In two studies, improvements in QoL after implantation have been positively correlated with improvement in music enjoyment, perceived music sound quality and time spent listening to music for postlingually deafened adult CI users (Lassaletta et al. 2008; Zhao et al. 2008). Also Calvino et al. (2015) found a positive correlation between self-reported music

[1] The World Health Organisation (WHO) has defined QoL as "an individual's perception of their position in life" and as a concept that is affected "by the person's physical health, psychological state, level of independence, social relationships, and their relationship to salient features of their environment" (WHOQOL 1993). This definition is adopted throughout the article.

perception and QoL (Calvino et al. 2015). However, it remains unclear if improved music sound quality and more hours listening to music result in an improvement in QoL or vice versa. No such correlation was found for a group of prelingually deaf adults implanted in adolescence, possibly due to their limited exposure to music before implantation (Fuller et al. 2013). This suggests that the impact of music on QoL may vary depending on factors such as hearing background and should not be assumed but explicitly measured.

Studies with NH adults offer more evidence for the effects of music on QoL. Various types of evidence (e.g. from interviews or neuropsychology) suggest that music can have positive effects on aspects of the lives of adults of different ages, whether they are healthy or have mental or physical impairments, or whether they are musicians or non-musicians, with psychological effects being the most commonly reported (Forsblom et al. 2009; Salimpoor et al. 2011). Music has the power to induce positive feelings and reduce negative feelings, and can also be used for entertainment and relaxation (Laukka 2007; Wall & Duffy 2010). Laukka (2007) used questionnaire data to show that music can bring pleasure, improve mood and help relaxation in adults aged 65 to 75 years old. Another way that music benefits psychological well-being is by promoting self-awareness (Schäfer et al. 2013). People can engage with music for cognitive or intellectual purposes too, using music as a source of knowledge (Chin & Rickard 2012). There is also evidence that music can support action and social interaction (Erkkilä et al. 2011; Cooke et al. 2010). For instance, Erkkilä et al. (2011) showed that providing music therapy to adults diagnosed with depression can increase general functioning scores. Finally, benefits of music have been reported for physical health, especially for people with physical impairments, for example through supporting movement and rehabilitation in individuals with Parkinson's disease (de Dreu et al. 2012).

To date, it has not been investigated how the difficulties experienced by CI users to perceive, enjoy music and engage with musical activities affect their QoL and if CI users can benefit from music in the same way as NH adults given the challenges that they face with music. The aim of the present study was to directly investigate dimensions of QoL on which music has an impact in adult CI users.

2. Methods

2.1 Recruitment

Convenience and volunteer sampling was used in order to recruit as many CI users as possible within the timescale of the study. One-hundred and three postal and 181 email invitations were sent to CI users of the University of Southampton Auditory Implant Service (USAIS) who satisfied the inclusion and exclusion criteria (Table 1). Nine CI users who attended a music workshop at the USAIS were invited separately. A study advert was also sent to the National Cochlear Implant Users Association (NCIUA) for circulation to their members. No special interest in music or music experience was required. Potential participants were informed that they would receive a fee and have their travel expenses covered.

(Table 1 around here)

2.2 Participants

Thirty adult CI users (12 male, 18 female, mean age= 49.5 years, age range: 18-81 years) participated in one of six focus groups about music in everyday life (four to six participants per focus group). Five CI users were prelingually[2] deaf and nine had received some music training (Table 2). Seventeen had a CI in one ear, two had bilateral implants and 11 had a HA contralateral to the implant. Twenty-two of the 30 participants were over 58 years old, which may suggest that the findings can generalise more to older CI users. Twenty-eight of the participants were USAIS patients. One participant was recruited through the NCIUA and another indicated an interest to participate in the study directly to the first author. Significant others (partners or friends) of the participants were allowed to be present in the focus groups. Although they were not asked to participate in the discussion, they sometimes made useful and relevant comments that were coded. Significant others are referred to as 'focus group visitors' hereafter.

There is no agreement in the literature about the ideal sample size of a focus group. The amount of data that is generated and whether the range of the sample is appropriate for the topic of interest are perhaps more important than the sample size itself (Kitzinger 2006). The sample size of the present study was considered sufficient and representative for the study of the relationship of adult CI users with music, because of the amount of data collected, the diversity of the groups in terms of demographic characteristics (Table 2) and the repetition of certain patterns across sessions. A group size of 5 - 6 participants per focus group has been recommended for topics considered important by the participants and where participants are expected to be willing to share their opinion and feelings (Krueger & Casey 2009: 67).

[2] Congenitally deaf or went deaf < 3 years old

The study was approved by the UK National Research Ethics Committee (14/EM/0140), the University of Southampton Ethics Committee and the University of Southampton Research Governance Office (8264).

(Table 2 around here)

2.3 The focus groups

'Focus groups' are small discussion groups where participants focus on a specific topic by interacting with each other (Kitzinger 2006). The interaction between the participants is the advantage of focus groups over individual and group interviews where no communication between participants exists. Interaction can highlight participants' attitudes, facilitate the expression of ideas and experiences, and shed light on various perspectives (Kitzinger 2006). For these reasons, focus groups are particularly popular among the different qualitative research methods in health sciences. In the present study, focus groups were thought to be the most appropriate method because it was anticipated that interaction between participants would encourage them to share personal experiences and feelings about music more than in an interview setting. van Besouw et al. (2014) demonstrated that music focus groups with CI users can improve understanding of their challenges with music (van Besouw et al. 2014). Participants themselves can benefit too, from realising that their problems are common among CI users, understanding their own abilities better and giving each other support and advice (Plant 2012; van Besouw et al. 2014).

Six focus groups were held in a quiet seminar room at the University of Southampton between June and July 2014. The first author, who had no relationship with the participants,

acted as the focus group facilitator by asking broad open-ended questions to stimulate discussion and ensure that issues relevant to the role of music in life were covered. The focus group discussions lasted approximately 45 minutes each and were audio-recorded with participants' consent. The recordings were transcribed verbatim and anonymised by the first author.

2.4 Data analysis

The data were analysed by the first and the third author based on the theory of template analysis (King 2012). Template analysis is a particular type of thematic analysis of qualitative data where themes are organised into a coding template. The analysis often starts with a priori themes, reflecting areas that are expected in advance to be important for the analysis. This allowed both for the analysis to be based on a QoL model and for new themes to arise. The QoL subdomains (specific facets included within the main domains) of the World Health Organisation Quality of Life BREF questionnaire (WHOQOL-BREF; The WHOQOL Group 1998) were used as a priori themes to identify areas of QoL on which music has an impact (Table 3). The WHOQOL-BREF is a reliable QoL measure that has been cross-culturally validated in 23 countries (Skevington et al. 2004). A license to use the WHOQOL questionnaire and related materials was granted to the first author by the WHO.

(Table 3 around here)

The transcript of the first focus group was coded first. Participants' comments relating to effects of music on the QoL domain that corresponded to one of the a priori WHOQOL-BREF domains were coded as such. The transcript was read again to identify comments that did not correspond to any of the a priori categories (i.e. the WHOQOL-BREF subdomains). An initial template was then developed and used for coding the remaining five transcripts. During this process, the template was modified to better describe the new data; for example the theme *relaxation* (thought to be comparable to the WHOQOL-BREF 'Rest' subdomain under the 'Physical health' domain) was moved to the psychological domain because in the context of music it referred rather to a calming effect. The template was also discussed with an expert in music and CIs who critically assessed to what extent the themes were appropriate and distinct from each other. Critical comparison between researchers is among the quality checks that have been used with template analysis (King 2012). After all the necessary changes were made, the final template was developed.

(Table 4 around here)

3. Results

Music was found to have an impact on various facets of the physical, psychological and social domains of the QoL of adult CI users (Table 4). Selected themes are presented below for each of the three QoL domains.

Physical domain

Music benefits the physical health of CI users by supporting physical indoor or outdoor exercise and it also has a therapeutic function. Use of music for fitness generated positive feelings and promoted participation in leisure activities:

> *"Well, I've joined a Zumba class and that music is fine to me. I can get all the beats to join and all the extra stuff. And that music is real pleasure for me." (P20)*

Another example of the use of music to support physical exercise was dancing:

> *"I can't remember what theme was it, I could still dance even though I couldn't hear it because I could feel the beat and that was what I needed, it was the beat to dance so I used to dance even though I couldn't hear the music so relying purely on the beat so you know that's another form of appreciation now." (P16)*

Music was also used as a therapy in meditation and was also used to alleviate tinnitus, a problem commonly experienced by CI users:

> *"…and of course now since I've had the tinnitus it's a therapy as well, because you know I don't know how I cope, it does take my mind off it, listening to music as well as other sounds but sometimes I will sit there listening to the radio and reading and that's goes it's like it's not there, the tinnitus, so it does help me that way as well." (P17)*

Music can also have a physical impact as it is perceived by CI users to help with memory, possibly as a result of trying to follow or remember a familiar song.

> *"But I think I'm fine on the radio. It sort of helps my memory working." (P6)*

However, negative effects on physical health can be caused by the poor music sound quality and mismatch in frequency information that CI users receive. For example, high notes can cause physical discomfort to CI users:

> *"But especially with music I needed to go a bit like this "can it be turned down?" That has been really quite difficult, the high frequencies. I mean the very high ones." (P1)*

The discomfort together with the listening effort required for music listening were also reported to cause dizziness. For one individual, this occurred when the acoustics of the theatre made the music uncomfortably echoey:

> *"But it was too echoey and I said, I came out, I came to the friends of my husband 'did you hear it?'. And then they said it is ok. Is it ok? That can't be that perfect. That's why I switched it off cause I think it's worse with the hearing aid on. I felt dizzy in some ways cause I thought 'my brain keeps going stupid'." (P6)*

Psychological domain

Most of the effects of music on QoL were identified in this domain. The benefits of music for the psychological functioning of CI users could be categorised into: positive emotions, negative emotions and impact on self-esteem. Music was described as a source of happiness in life:

> *"And it's just the beat to it and the way they are singing. I just love it. I just really, it gets me smiling again." (P7)*

Similar to pleasure were the functions of music as a source of energy or as a mood enhancer:

"And so everyday I have to go on Youtube and find those songs that move me so much and connect with those songs which move me so much you know. And it really cheers me up." (P8)

Music also had a calming effect and was used for relaxation and as a relief from anxiety:

"…also like it's relaxing, you know sitting indoors with the iPad going or the radio, it's not radios on or music on the CD player, is always some form of music in our house. And it is relaxing." (P16)

In fact, the ability of music to induce (positive or negative) emotions on its own was perceived by participants as having a positive impact, which can be associated with the ability of music to improve mood and generate energy, described above:

"It makes me feel happy, it can make me feel sad. […] It just releases a lot of emotion, different emotions and listening to music can make me 'Ohh, so many changes in my life'. It can inspire me to make decisions. It just touches me somewhere." (P28)

The ability of music to bring memories of significant past events, occasions or loved ones was particularly important especially for postlingually deafened CI users with prior NH experience of music; reminiscence induced feelings of nostalgia:

"But music means a lot to me because certain pieces immediately take me back to a situation in life, you know. So right in from even before the war. Stuff that was on the radio, if I hear it immediately takes me back to my childhood or a situation. And that applies to music. All the way through it takes me back to a place. And that way I love it." (P16)

In addition to creating positive feelings, music was also reported to reduce negative feelings, such as isolation and loneliness and was described as a companion, especially for those who lived alone. This effect of music is likely to result in less psychological distress, higher confidence and more social interaction.

> *"Classic FM in my car radio. I can't always hear it. But to me it's companionship because I'm by myself now and it's just something else in my life. I can't just say I don't know what they are saying in between tapes but it's something there for me." (P21)*

Being able to hear music again after deafness had a positive effect on the self-esteem of CI users, by creating confidence to participate in social activities as well as a feeling of normality and not missing out or feeling separated from others:

> *"But I just think, I think music makes you happy or can make you sad sometimes but it's just a power of enjoying life like other people do. Not being different from everybody else." (P1)*

The feeling of normality that music gives to CI users, in addition to the ability of music to bring memories from the past, is also relevant to the use of music to form or strengthen identity (Laiho 2004).

In contrast to the positive effects of music for psychological health, the difficulties experienced by CI users to recognise familiar music and follow new music, in combination with poor sound quality were reported to cause unpleasant emotions and negatively affect their self-esteem. Many participants stated that they no longer enjoyed listening to music and avoided social events because they were disappointed with how music sounds through the implant. Not being able to keep in tune in order to sing in public, in particular, caused

feelings of disappointment and embarrassment, which are associated with confidence and self-esteem. Embarrasment with singing also resulted in activity limitations:

> *"But I realise there are a lot of people who know the songs and we know, we would love a chance to do it but we have to keep quiet because it's not in tune. Embarrassment, I feel embarrassment." (P8)*

Following music in a public venue with a poor acoustic environment, such as the theatre, was reported to cause frustration, resulting in avoidance of participation in these activities:

> *"So when I tried all this I said and I got so demoralised because I put it on and whether it was such a big church or what I've done it now but I did not enjoy that concert. In the end to get out of my predicament I just switched completely the thing off. I switched it off completely, I could not sit there or stand there"*

Another frustrating situation reported by CI users was the presence of background music (in restaurants or pubs) masking speech and making communication very challenging. Although background music in public places is generally intended to create ambience and atmosphere, CI users experienced the opposite effect:

> *"I shouldn't have music with other noise, with speech or whatever, I find that incredibly tiring and upsetting that you go in to a restaurant and there's background noise. No-one is listening to it I want to say: "One in six people have a hearing deficit. Why are you playing it when no-one is listening to it?" It doesn't give ambience to me. It actually causes me a lot of distress." (P19)*

Although the perception of the beat by CI users is generally considered good, this is not always the case in more challenging listening environments such as fitness and dance classes,

where moving in time with the beat is necessary. Difficulty to follow the beat in such an environment and in the presence of others resulted in feelings of lack of confidence:

> *"I still stand at the back of my gym class when the music is playing and people are doing the you know sort of keep fit stuff and there's Zumba dancing because I need to watch everybody else, I'm not confident enough to… I hear it but I'm not sure I'm hearing exactly the same as everybody else. And so I stand at the back as I've done for quite a lot of years now and just make sure that I can follow everybody else." (P27)*

Social domain

The impact of music on social relationships and activities was perceived as overlapping, in the sense that CI users used music to strengthen their personal relationships through participation in social activities. For that reason, the WHOQOL-BREF domains 'Social relationships' and 'Environment' were merged here into a broad *social* domain (Table 4).

CI users discussed how music promoted participation in social activities, such as at the theatre or live music shows:

> *"I love going to anything to do with music. We've been to a couple of concerts since I've had the, and it's been a magic experience. We went to the opera - that was absolutely splendid." (P1)*

In addition to public social activities, music also helped to strengthen relationships within the family through participation in daily activities at home:

> *"I've got a 7 and a 4 year old, they quite like watching the music channels on the tv - and because now that I'm starting to hear the beat, I will be mucking about with them,*

just starting to, not really dancing, but just mucking about with them, and that's now becoming part of our weekend and stuff, and there's laughing and "mummy's being silly", but yeah I think that's quite good though." (P5)

On the other hand, social interaction was limited by factors such as the difference in music experience between CI users and their NH peers, as a consequence of poor percpeption of music through the implant:

"But that's something we could have talked about, it was lovely to talk about it after, to go to have a drink, we can talk…" (P6)

"You know I'm enjoying it but then I'm not enjoying it because he is not enjoying it and then I think well it's, it's sad. We can't converse on it, we can't discuss it together because he's heard any of it, do you know what I mean?" (focus group visitor)

In addition to causing annoyance due to masking, background music also negatively affected social interaction:

"That's the only time I won't appreciate the music on is if it's, if I am you know having dinner or trying to talk to my friends, we're just at the table and they've got like normal people do they might have put a CD on and then I don't like it because its over-powering the speech and I want to, to converse". (P7)

Generally, CI users reported avoiding public events and situations where they felt unable to follow or enjoy the music:

"But I did not enjoy that Carol service. And it put me off and I was a bit reluctant to go" (P9)

CI users commonly reported a difficulty to keep in tune while singing, as a result of not being able to hear the pitch well. This caused embarrassment when singing in public (reported in the psychosocial domain above) and prevented CI users from singing in choirs and other groups:

"What I can't do is sing with somebody. You know I couldn't sing. I keep my mouth shut if there are people who are singing around me because I wouldn't be with them." (P16)

Apart from public events, music also accompanied everyday activities such as housework, and was used to make driving less boring:

"I listen to it in the car all the time, how to pass the journey. (P18)"

However, daily activities such as shopping were sometimes negatively affected by background music, which was described as annoying and uncomfortably loud:

"And the shop is worse, clothes shop and that popped me off and I can't buy a dress cause I'm out horrendous loud music, it needs to be cut. I think it's too loud. I think it's above the limit. And then you don't need listen, I want to go in to relax in the shop, in a quieter environment. It doesn't encourage you to buy clothes in such a really loud music." (P6)

The concentration and listening effort required for music listening can also lead to avoidance of everyday music listening at home. In particular, use of music as background to other activities is limited by the need to focus on the music in order to enjoy it.

"But I just want to, you want to listen to music and do other things. But you can't if you are connected with the headphones. You just have to sit there and listen to it. As

you said, we don't just want to sit there. And I would like to just turn the radio on and do other things and be listening to them" (P4)

CI users also reported engagement with music at a more cognitive level. Music was brought up as a source of education or an opportunity to learn new skills:

"But also I listen to music because I find it educational as well. Like I was saying learning the different languages you know in music." (P18)

Use of music for education may stop, though, as a result of poor music listening skills. This was described as *unfortunate* by participants:

"But the one unfortunate thing about losing one's hearing and the music is that your musical education stops at that point so you remember all the tunes you used to know but you can't educate yourself anymore to learn more hearing new things." (P26)

Importance of music

The focus group discussion also revealed strong differences between CI users in terms of the overall importance of music in life. Some participants reported that music played a very important role in their life, while for others it was less important:

"So music plays a big part in my life, a very big part. Without music it's not the same." (P2)

"I'm just say here listening taking it all in. Music's never been the part of my life." (P10)

The importance of music in life depends on preferences and other personal characteristics, but it is also associated with the ability to perceive and enjoy music according to expectations. Therefore, for some individuals music becomes less important when it is poorly perceived:

> *"But to be quite honest I could live in a world without music. It wouldn't worry me at all because I don't get the pleasure and the beauty that I used to." (P15)*

4. Discussion

To the knowledge of the authors, this is the first study to demonstrate the effects of music on the QoL of adult CI users and the specific aspects of QoL on which music impacts. Previous studies had found positive associations between music and QoL scores measured with different questionnaires (Lassaletta et al. 2008; Zhao et al. 2008; Fuller et al. 2013; Calvino et al. 2015), but they had not explored the way music affects the QoL of CI users.

The present study supported previous findings and further identified hearing-specific benefits of music for the QoL that had received little attention to date. These benefits are: the ability of music to relieve tinnitus, to strengthen memory (physical domain) and to induce a sense of normality (psychological domain, 'self-esteem' subdomain), and the use of music as education (social domain). This study also confirmed that uses of music previously reported for NH adults are applicable to CI users but in a way that is related to the deafness. For instance, music as a source of reminiscence is particularly important for postlingually deafened CI users, because it links to the period in time before deafness. Other functions of music that were found are comparable to those previously reported for NH adults, such as the use of music to improve mood, to relax, or for socialising (Schäfer et al. 2013). This suggests

that to some extent CI users use music in their everyday life and derive benefits from music in aspects of their QoL similarly to NH adults, despite difficulties in perceiving and enjoying it as a result of the physical limitations of the implant.

On the other hand, poor perception and enjoyment of music do not allow CI users to benefit from music to the extent that they would like to and therefore they experience a number of negative effects on their QoL, such as low confidence as a result of not being able to sing in tune with others. Some of these effects had been reported previously; for example, Migirov et al. (2009) and Plant (2015) found that many CI users are unhappy with the quality of music through the implant and often express feelings of frustration and disappointment.

The relationship of CI users with music is likely to depend on individual factors, such as age, duration of implant use, CI configuration or expectations based on prior music experiences. Although the effects of these factors were not examined, many of the functions of music were common for prelingually deaf and postlingually deafened CI users, especially in the physical and social domains. For example, participant 24 (prelingually deaf) and participant 16 (postlingually deafened) both reported using music for relaxation. However, other effects of music on QoL, such as the (positive or negative) effect on confidence, were more relevant to postlingually deafened CI users. In the following example participant 22, a postlingually deafened CI user discusses this with a prelingually deaf participant:

> *"But because you've been deaf from birth you have no way of knowing whether what you are hearing is the same as somebody else's hearing who hasn't got a hearing loss. This is my problem at the moment, I don't know whether I'm…, I'm not hearing what other people are hearing…." (P22)*

This may explain to some extent the findings of Fuller et al. (2013), who reported no relationship between music and QoL for prelingually deaf CI users implanted in adolesence. That music plays a more important role for CI recipients with prior music experience has also been suggested elsewhere (Migirov et al. 2009; Bartel et al. 2011).

Music was found to affect some facets of QoL as defined in the WHOQOL-BREF. For example, music as a relief from tinnitus and high notes sounding uncomfortably loud correspond to the WHOQOL-BREF facet of 'Pain and discomfort'. Yet, music was not found to have an effect on other WHOQOL-BREF facets (e.g. 'bodily image and appearance', 'sexual activity' or 'financial resources'), which suggests that even though music plays a role in life other aspects of the QoL may be more important than music.

Besides, the importance of music varies among individuals. For example, it has been previously reported that NH young adults (18-21 years old) spend significantly more money each month on music than on any other of the nine activities (computer games, TV, films, books, sports, radio, newspapers/magazines and favourite hobby) investigated (Lonsdale & North 2011). In the same study, adults >30 years old reported music to be significantly less important and spent less time with music than younger adults. However, social interaction was still an important reason for listening to music for participants up to 50 years old. The effect of age on music experiences was not looked at in the present study.

Whatever the reasons for variation with regard to the impact of music on QoL, the strong differences in the importance of music among the participants suggest that the relative importance of the different aspects of the music experience, QoL and music in general need to be assessed to evaluate the contribution of music to an individual's QoL.

5. Conclusions

Adult CI users use music and benefit from it in similar ways to adults with NH. However, the difficulties that CI users have perceiving and enjoying music prevents them from participating in music activities to the extent that they would like to and this therefore has a negative impact on CI users' physical, psychological and social well-being. An implication of these findings is that the optimization of music listening and enjoyment for CI users has the potential to result in significant benefits for their QoL. This way, the findings are of clinical significance as they stress the value of improving the music experience of adult CI users through new music-focused CI technologies or music auditory training. Future work should explore further the importance of music compared to other aspects of the lives of CI users and hearing-impaired adults in general, the relative influence of music on each of the different dimensions of the QoL and what this influence depends on.

Data access statement: The transcripts of the focus group discussions are available online: http://dx.doi.org/10.5258/SOTON/377895. The data have been anonymized and there are no ethical issues associated with or restrictions to making the data available.

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Declaration of interest

The authors report no declarations of interest.

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Tables

Table 1. Inclusion and exclusion criteria of the focus groups.

Inclusion criteria	Exclusion criteria
• >18 years old • CI users • 50% or higher in the BKB sentences speech test or any other test of speech perception in noise used or self-reported ability to communicate in a focus group setting	• Communicating with British sign language or need of an interpreter

Table 2. Demographics of the focus group participants.

N_o	**Age**	**Gender**	**Implant type**	**Type of deafness**	**Duration of CI use (years, months)**	**Implant manufacturer**	**Music training**	**Participated in music focus group before**
P1	75	Female	Bimodal	Postlingual	1 year	AB	Yes	Yes
P2	60	Female	Unilateral	Postlingual	1 year	AB	Yes	No
P3	66	Male	Bimodal	Undefined	15 months	Med-El	No	Yes
P4	80	Female	Bimodal	Postlingual	1 year	AB	No	Yes
P5	37	Female	Bimodal	Prelingual	1 year	AB	No	No
P6	53	Female	Unilateral	Prelingual	4 years	AB	No	Yes
P7	42	Female	Unilateral	Postlingual	4 years	Cochlear	No	Yes
P8	64	Male	Unilateral	Postlingual	8 years	AB	Yes	No
P9	63	Male	Unilateral	Postlingual	2 years	Med-El	No	No
P10	68	Female	Unilateral	Postlingual	2 years	AB	No	No
P11	71	Female	Unilateral	Postlingual	6 years	Cochlear	Yes	Yes
P12	67	Male	Bimodal	Postlingual	2 years	Med-El	Yes	Yes
P13	64	Female	Unilateral	Postlingual	18 years	Not reported	No	No
P14	57	Male	Bimodal	Postlingual	1 year	AB	No	No

P15	81	Male	Bilateral	Postlingual	4 years	Cochlear	No	Yes
P16	81	Male	Bimodal	Postlingual	1 year	AB	No	No
P17	66	Male	Bimodal	Postlingual	1 year	AB	No	No
P18	26	Male	Unilateral	Prelingual	13 years	Cochlear	No	No
P19	68	Female	Unilateral	Postlingual	2 years	Med-El	No	No
P20	67	Female	Unilateral	Postlingual	2 years	Med-El	Yes	Yes
P21	80	Female	Unilateral	Postlingual	1 year	AB	No	No
P22	67	Female	Bimodal	Postlingual	2 years	Med-El	No	No
P23	62	Female	Unilateral	Prelingual	1 year	Cochlear	No	No
P24	18	Male	Bimodal	Prelingual	7 years	Cochlear	Yes	No
P25	68	Male	Unilateral	Postlingual	3 year	Med-El	No	No
P26	77	Male	Unilateral	Postlingual	2 years	Neurelec	Yes	No
P27	67	Female	Bimodal	Postlingual	1 year	Med-El	Yes	No
P28	43	Female	Unilateral	Postlingual	5 years	Med-El	No	Yes
P29	76	Female	Bilateral	Postlingual	3 years	Neurelec	No	No
P30	48	Female	Unilateral	Postlingual	7 years	AB	No	Yes

Table 3. The conceptual framework of the WHOQOL-BREF questionnaire (reproduced from The WHOQOL Group (1998). Development of the World Health Organization WHOQOL-BREF quality of life assessment. *Psychological medicine*. 28 (3). p.pp. 551–558.).

Domain	**Facets incorporated within domains**
1. Physical health	Activities of daily living Dependence on medicinal substances and medical aids Energy and fatigue Mobility Pain and discomfort Sleep and rest Work Capacity
2. Psychological	Bodily image and appearance Negative feelings Positive feelings Self-esteem Spirituality / Religion / Personal beliefs Thinking, learning, memory and concentration
3. Social relationships	Personal relationships

	Social support Sexual activity
4. Environment	Financial resources Freedom, physical safety and security Health and social care: accessibility and quality Home environment Opportunities for acquiring new information and skills Participation in and opportunities for recreation / leisure activities Physical environment (pollution / noise / traffic / climate) Transport

Table 4. The final template of the focus group data analysis describing the impact of music on the QoL of adult cochlear implant users.

Impact of music on the quality of life of cochlear implant users				
Physical health	**Psychological health**			**Social interaction & activities**
	Positive emotions	**Negative emotions**	**Self-esteem**	
• Supporting exercise • Music as therapy • Strengthens memory • Listening effort • Discomfort • Dizziness	• Pleasure • Arousal of emotions • Mood enhancement • Reminiscence • Relaxation • Reducing isolation and loneliness • Vitality	• Frustration • Disappointment	• Confidence • Embarrassment • Feeling normal	• Participation in social activities • Social interaction • Activities of daily living • Music as education

Impact of music on the quality of life of cochlear implant users: a focus group study

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Key Words: cochlear implant, music, quality of life, focus group

Abbreviations:

CI: cochlear implant

NH: normal-hearing

QoL: Quality of Life

WHO: World Health Organisation

WHOQOL-BREF: World Health Organisation Quality of Life instrument short version

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Abstract

Objective: To study the aspects of the quality of life (QoL) on which music has an impact in adult cochlear implant (CI) users.

Methods: Thirty adult CI users aged between 18 and 81 years old with a wide range of patient characteristics and musical backgrounds participated in the study. Six focus group discussions about music in everyday life were conducted and data were analysed using template analysis based on the QoL model of the World Health Organisation Quality of life BREF questionnaire (WHOQOL-BREF).

Results and discussion: A theoretical framework of the impact of music on the QoL was developed. Music was reported to contribute to many aspects of physical, psychological, and social well-being in adult CI users. These positive effects of music on QoL were similar to what has been reported in the literature for NH adults. However, difficulties in music perception and enjoyment were found to have a negative impact on CI users' QoL, especially by causing unpleasant feelings and limited participation in music-related or routine daily activities.

Conclusions: These findings suggest that an improvement in music experiences of CI users may lead to improvements in QoL and therefore support the need for music rehabilitation. However, the relative importance of music overall and of specific aspects of music for each individual should be measured for an accurate assessment of the impact of music on the QoL of CI users.

1. Introduction

Cochlear implants (CIs) have been successful in providing significant improvements in speech understanding for many severely or profoundly deaf adults, especially in favourable listening environments (Leigh et al. 2016). However, most CI recipients still achieve poor outcomes for speech recognition in noise and for the perception of music (Sladen & Zappler 2015). Overall, CI users perceive the fundamental elements of music less accurately and report poorer music enjoyment and limited participation in musical activities compared to their normal-hearing (NH) peers (Drennan et al. 2014). There is no firm evidence to suggest that this pattern is different between postlingually deafened and prelingually deaf adult CI users (Moran et al. 2016).

On the other hand, there is evidence ~~to suggest~~ that music is important, especially for the postlingually deafened CI users who have prior NH exposure to music. For example, sixteen out of 53 respondents to a music questionnaire reported that they would have undergone implantation just to be able to listen to music (Migirov et al. 2009) and 27 out of 40 respondents reported that they would choose a CI that ~~would~~ transmits music perfectly, if it was available (Philips et al. 2012). Despite these findings, there has been little investigation into the impact of music on the quality of life (QoL[1]) of CI users, and only indirectly through correlation analyses. In two studies, improvements in QoL after implantation have been positively correlated with improvement in music enjoyment, perceived music sound quality and time spent listening to music for postlingually deafened adult CI users (Lassaletta et al. 2008; Zhao et al. 2008). Also Calvino et al. (2015) found a positive correlation between self-

[1] The World Health Organisation (WHO) has defined QoL as "an individual's perception of their position in life" and as a concept that is affected "by the person's physical health, psychological state, level of independence, social relationships, and their relationship to salient features of their environment" (WHOQOL 1993). This definition is adopted throughout the article.

reported music perception and QoL (Calvino et al. 2015). However, it remains unclear if improved music sound quality and more hours listening to music result in an improvement in QoL or vice versa. No such correlation was found for a group of prelingually deaf adults implanted in adolescence, possibly due to their limited exposure to music before implantation (Fuller et al. 2013). This suggests that the impact of music on QoL may vary depending on factors such as hearing background and should not be assumed but explicitly measured.

Studies with NH adults offer more evidence for the effects of music on QoL. Various types of evidence (e.g. from interviews or neuropsychology) suggest that music can have positive effects on aspects of the lives of adults of different ages, whether they are healthy or have mental or physical impairments, or whether they are musicians or non-musicians, with psychological effects being the most commonly reported (Forsblom et al. 2009; Salimpoor et al. 2011). Music has the power to induce positive feelings and reduce negative feelings, and can also be used for entertainment and relaxation (Laukka 2007; Wall & Duffy 2010). Laukka (2007) used questionnaire data to show that music can bring pleasure, improve mood and help relaxation in adults aged 65 to 75 years old. Another way that music ~~can also~~ benefits psychological well-being is by promoting self-awareness (Schäfer et al. 2013). People can engage with music ~~also~~ for cognitive or intellectual purposes too, using music as a source of knowledge (Chin & Rickard 2012). There is also evidence that music can support action and social interaction (Erkkilä et al. 2011; Cooke et al. 2010). For instance, Erkkilä et al. (2011) showed that providing music therapy to adults diagnosed with depression can increase general functioning scores. Finally, benefits of music ~~for physical health~~ have ~~also~~ been reported for physical health, especially for people with physical impairments, for example through supporting movement and rehabilitation in individuals with Parkinson's disease (de Dreu et al. 2012).

To date, it has not been investigated how the difficulties experienced by CI users to perceive, enjoy music and engage with musical activities affect their QoL and if CI users can benefit from music in the same way as NH adults given the challenges that they face with music. The aim of the present study was to directly investigate dimensions of QoL on which music has an impact in adult CI users.

2. Methods

2.1 Recruitment

Convenience and volunteer sampling was used in order to recruit as many CI users as possible within the timescale of the study. One-hundred and three postal and 181 email invitations were sent to CI users of the University of Southampton Auditory Implant Service (USAIS) who satisfied the inclusion and exclusion criteria (Table 1). Nine CI users who attended a music workshop at the USAIS were invited separately. A study advert was also sent to the National Cochlear Implant Users Association (NCIUA) for circulation to their members. No special interest in music or music experience was required. Potential participants were informed that they would receive a fee and have their travel expenses covered.

(Table 1 around here)

2.2 Participants

Thirty adult CI users (12 male, 18 female, mean age= 49.5 years, age range: 18-81 years) participated in one of six focus groups about music in everyday life (four to six participants per focus group). Five CI users were prelingually[2] deaf and nine had received some music training (Table 2). Seventeen had a CI in one ear, two had bilateral implants and 11 had a HA contralateral to the implant. Twenty-two of the 30 participants were over 58 years old, which may suggest that the findings can generalise more to older CI users ~~had implications for the representativeness of the findings~~. Twenty-eight of the participants were USAIS patients. One participant was recruited through the NCIUA and another indicated an interest to participate in the study directly to the first author. Significant others (partners or friends) of the participants were allowed to be present in the focus groups. Although they were not asked to participate in the discussion, they sometimes made useful and relevant comments that were coded. Significant others are referred to as 'focus group visitors' hereafter.

There is no agreement in the literature about the ideal sample size of a focus group. The amount of data that is generated and whether the range of the sample is appropriate for the topic of interest are perhaps more important than the sample size itself (Kitzinger 2006). The sample size of the present study was considered sufficient and representative for the study of the relationship of adult CI users with music, because of the amount of data collected, the diversity of the groups in terms of demographic characteristics (Table 2) and the repetition of certain patterns across sessions. A group size of 5 - 6 participants per focus group has been recommended for topics considered important by the participants and where participants are expected to be willing to share their opinion and feelings (Krueger & Casey 2009: 67).

[2] Congenitally deaf or went deaf < 3 years old

The study was approved by the UK National Research Ethics Committee (14/EM/0140), the University of Southampton Ethics Committee and the University of Southampton Research Governance Office (8264).

(Table 2 around here)

2.3 The focus groups

'Focus groups' are small discussion groups where participants focus on a specific topic by interacting with each other (Kitzinger 2006). The interaction between the participants is the advantage of focus groups over individual and group interviews where no communication between participants exists. Interaction can highlight participants' attitudes, facilitate the expression of ideas and experiences, and shed light on various perspectives (Kitzinger 2006). For these reasons, focus groups are particularly popular among the different qualitative research methods in health sciences. In the present study, focus groups were thought to be the most appropriate method because it was anticipated that interaction between participants would encourage them to share personal experiences and feelings about music more than in an interview setting. ~~Van~~ van Besouw et al. (2014) demonstrated that music focus groups with CI users can improve understanding of their challenges with music (van Besouw et al. 2014). Participants themselves can benefit too, from realising that their problems are common among CI users, understanding their own abilities better and giving each other support and advice (Plant 2012; van Besouw et al. 2014).

Six focus groups were held in a quiet seminar room at the University of Southampton between June and July 2014. The first author, who had no relationship with the participants,

acted as the focus group facilitator by asking broad open-ended questions to stimulate discussion and ensure that issues relevant to the role of music in life were covered. The focus group discussions lasted approximately 45 minutes each and were audio-recorded with participants' consent. The recordings were transcribed verbatim and anonymised by the first author.

2.4 Data analysis

The data were analysed by the first and the third author based on the theory of template analysis (King 2012). Template analysis is a particular type of thematic analysis of qualitative data where themes are organised into a coding template. The analysis often starts with a priori themes, reflecting areas that are expected in advance to be important for the analysis. This allowed both for the analysis to be based on a QoL model and for new themes to arise. The QoL subdomains (specific facets included within the main domains) of the World Health Organisation Quality of Life BREF questionnaire (WHOQOL-BREF~~);~~ ~~(~~The WHOQOL Group 1998) were used as a priori themes to identify areas of QoL on which music has an impact (Table 3). The WHOQOL-BREF is a reliable QoL measure that has been cross-culturally validated in 23 countries (Skevington et al. 2004). A license to use the WHOQOL questionnaire and related materials was granted to the first author by the WHO.

(Table 3 around here)

The transcript of the first focus group was coded first. Participants' comments relating to effects of music on the QoL domain that corresponded to one of the a priori WHOQOL-BREF domains were coded as such. The transcript was read again to identify comments that did not correspond to any of the a priori categories (i.e. the WHOQOL-BREF subdomains). An initial template was then developed and used for coding the remaining five transcripts. During this process, the template was modified to better describe the new data; for example the theme *relaxation* (thought to be comparable to the WHOQOL-BREF 'Rest' subdomain under the 'Physical health' domain) was moved to the psychological domain because in the context of music it referred rather to a calming effect. The template was also discussed with an expert in music and CIs who critically assessed to what extent the themes were appropriate and distinct from each other. Critical comparison between researchers is among the quality checks that have been used with template analysis (King 2012). After all the necessary changes were made, the final template was developed.

(Table 4 around here)

3. Results

Music was found to have an impact on various facets of the physical, psychological and social domains of the QoL of adult CI users (Table 4). Selected themes are presented below for each of the three QoL domains.

Physical domain

Music benefits the physical health of CI users by supporting physical indoor or outdoor exercise and it also has a therapeutic function. Use of music for fitness generated positive feelings and promoted participation in leisure activities:

> *"Well, I've joined a Zumba class and that music is fine to me. I can get all the beats to join and all the extra stuff. And that music is real pleasure for me." (P20)*

Another example of the use of music to support physical exercise was dancing:

> *"I can't remember what theme was it, I could still dance even though I couldn't hear it because I could feel the beat and that was what I needed, it was the beat to dance so I used to dance even though I couldn't hear the music so relying purely on the beat so you know that's another form of appreciation now." (P16)*

Music was also used as a therapy in meditation and was also used to alleviate tinnitus, a problem commonly experienced by CI users:

> *"…and of course now since I've had the tinnitus it's a therapy as well, because you know I don't know how I cope, it does take my mind off it, listening to music as well as other sounds but sometimes I will sit there listening to the radio and reading and that's goes it's like it's not there, the tinnitus, so it does help me that way as well." (P17)*

Music can also have a physical impact as it is perceived by CI users to help with memory, possibly as a result of trying to follow or remember a familiar song.

> *"But I think I'm fine on the radio. It sort of helps my memory working." (P6)*

However, negative effects on physical health can be caused by the poor music sound quality and mismatch in frequency information that CI users receive. For example, high notes can cause physical discomfort to CI users:

> *"But especially with music I needed to go a bit like this "can it be turned down?" That has been really quite difficult, the high frequencies. I mean the very high ones." (P1)*

The discomfort together with the listening effort required for music listening were also reported to cause dizziness. For one individual, this occurred when the acoustics of the theatre made the music uncomfortably echoey:

> *"But it was too echoey and I said, I came out, I came to the friends of my husband 'did you hear it?'. And then they said it is ok. Is it ok? That can't be that perfect. That's why I switched it off cause I think it's worse with the hearing aid on. I felt dizzy in some ways cause I thought 'my brain keeps going stupid'." (P6)*

Psychological domain

Most of the effects of music on QoL were identified in this domain. The benefits of music for the psychological functioning of CI users could be categorised into: positive emotions, negative emotions and impact on self-esteem. Music was described as a source of happiness in life:

> *"And it's just the beat to it and the way they are singing. I just love it. I just really, it gets me smiling again." (P7)*

Similar to pleasure were the functions of music as a source of energy or as a mood enhancer:

"And so everyday I have to go on Youtube and find those songs that move me so much and connect with those songs which move me so much you know. And it really cheers me up." (P8)

Music also had a calming effect and was used for relaxation and as a relief from anxiety:

"…also like it's relaxing, you know sitting indoors with the iPad going or the radio, it's not radios on or music on the CD player, is always some form of music in our house. And it is relaxing." (P16)

In fact, the ability of music to induce (positive or negative) emotions on its own was perceived by participants as having a positive impact, which can be associated with the ability of music to improve mood and generate energy, described above:

"It makes me feel happy, it can make me feel sad. […] It just releases a lot of emotion, different emotions and listening to music can make me 'Ohh, so many changes in my life'. It can inspire me to make decisions. It just touches me somewhere." (P28)

The ability of music to bring memories of significant past events, occasions or loved ones was particularly important especially for postlingually deafened CI users with prior NH experience of music; reminiscence induced feelings of nostalgia:

"But music means a lot to me because certain pieces immediately take me back to a situation in life, you know. So right in from even before the war. Stuff that was on the radio, if I hear it immediately takes me back to my childhood or a situation. And that applies to music. All the way through it takes me back to a place. And that way I love it." (P16)

In addition to creating positive feelings, music was also reported to reduce negative feelings, such as isolation and loneliness and was described as a companion, especially for those who lived alone. This effect of music is likely to result in less psychological distress, higher confidence and more social interaction.

> *"Classic FM in my car radio. I can't always hear it. But to me it's companionship because I'm by myself now and it's just something else in my life. I can't just say I don't know what they are saying in between tapes but it's something there for me." (P21)*

Being able to hear music again after deafness had a positive effect on the self-esteem of CI users, by creating confidence to participate in social activities as well as a feeling of normality and not missing out or feeling separated from others:

> *"But I just think, I think music makes you happy or can make you sad sometimes but it's just a power of enjoying life like other people do. Not being different from everybody else." (P1)*

The feeling of normality that music gives to CI users, in addition to the ability of music to bring memories from the past, is also relevant to the use of music to form or strengthen identity (Laiho 2004).

In contrast to the positive effects of music for psychological health, the difficulties experienced by CI users to recognise familiar music and follow new music, in combination with poor sound quality were reported to cause unpleasant emotions and negatively affect their self-esteem. Many participants stated that they no longer enjoyed listening to music and avoided social events because they were disappointed with how music sounds through the implant. Not being able to keep in tune in order to sing in public, in particular, caused

feelings of disappointment and embarrassment, which are associated with confidence and self-esteem. Embarrasment with singing also resulted in activity limitations:

> *"But I realise there are a lot of people who know the songs and we know, we would love a chance to do it but we have to keep quiet because it's not in tune. Embarrassment, I feel embarrassment." (P8)*

Following music in a public venue with a poor acoustic environment, such as the theatre, was reported to cause frustration, resulting in avoidance of participation in these activities:

> *"So when I tried all this I said and I got so demoralised because I put it on and whether it was such a big church or what I've done it now but I did not enjoy that concert. In the end to get out of my predicament I just switched completely the thing off. I switched it off completely, I could not sit there or stand there"*

Another frustrating situation reported by CI users was the presence of background music (in restaurants or pubs) masking speech and making communication very challenging. Although background music in public places is generally intended to create ambience and atmosphere, CI users experienced the opposite effect:

> *"I shouldn't have music with other noise, with speech or whatever, I find that incredibly tiring and upsetting that you go in to a restaurant and there's background noise. No-one is listening to it I want to say: "One in six people have a hearing deficit. Why are you playing it when no-one is listening to it?" It doesn't give ambience to me. It actually causes me a lot of distress." (P19)*

Although the perception of the beat by CI users is generally considered good, this is not always the case in more challenging listening environments such as fitness and dance classes,

where moving in time with the beat is necessary. Difficulty to follow the beat in such an environment and in the presence of others resulted in feelings of lack of confidence:

> *"I still stand at the back of my gym class when the music is playing and people are doing the you know sort of keep fit stuff and there's Zumba dancing because I need to watch everybody else, I'm not confident enough to… I hear it but I'm not sure I'm hearing exactly the same as everybody else. And so I stand at the back as I've done for quite a lot of years now and just make sure that I can follow everybody else." (P27)*

Social domain

The impact of music on social relationships and activities was perceived as overlapping, in the sense that CI users used music to strengthen their personal relationships through participation in social activities. For that reason, the WHOQOL-BREF domains 'Social relationships' and 'Environment' were merged here into a broad *social* domain (Table 4).

CI users discussed how music promoted participation in social activities, such as at the theatre or live music shows:

> *"I love going to anything to do with music. We've been to a couple of concerts since I've had the, and it's been a magic experience. We went to the opera - that was absolutely splendid." (P1)*

In addition to public social activities, music also helped to strengthen relationships within the family through participation in daily activities at home:

> *"I've got a 7 and a 4 year old, they quite like watching the music channels on the tv - and because now that I'm starting to hear the beat, I will be mucking about with them,*

just starting to, not really dancing, but just mucking about with them, and that's now becoming part of our weekend and stuff, and there's laughing and "mummy's being silly", but yeah I think that's quite good though." (P5)

On the other hand, social interaction was limited by factors such as the difference in music experience between CI users and their NH peers, as a consequence of poor percpeption of music through the implant:

"But that's something we could have talked about, it was lovely to talk about it after, to go to have a drink, we can talk…" (P6)

"You know I'm enjoying it but then I'm not enjoying it because he is not enjoying it and then I think well it's, it's sad. We can't converse on it, we can't discuss it together because he's heard any of it, do you know what I mean?" (focus group visitor)

In addition to causing annoyance due to masking, background music also negatively affected social interaction:

"That's the only time I won't appreciate the music on is if it's, if I am you know having dinner or trying to talk to my friends, we're just at the table and they've got like normal people do they might have put a CD on and then I don't like it because its over-powering the speech and I want to, to converse". (P7)

Generally, CI users reported avoiding public events and situations where they felt unable to follow or enjoy the music:

"But I did not enjoy that Carol service. And it put me off and I was a bit reluctant to go" (P9)

CI users commonly reported a difficulty to keep in tune while singing, as a result of not being able to hear the pitch well. This caused embarrassment when singing in public (reported in the psychosocial domain above) and prevented CI users from singing in choirs and other groups:

> *"What I can't do is sing with somebody. You know I couldn't sing. I keep my mouth shut if there are people who are singing around me because I wouldn't be with them." (P16)*

Apart from public events, music also accompanied everyday activities such as housework, and was used to make driving less boring:

> *"I listen to it in the car all the time, how to pass the journey. (P18)"*

However, daily activities such as shopping were sometimes negatively affected by background music, which was described as annoying and uncomfortably loud:

> *"And the shop is worse, clothes shop and that popped me off and I can't buy a dress cause I'm out horrendous loud music, it needs to be cut. I think it's too loud. I think it's above the limit. And then you don't need listen, I want to go in to relax in the shop, in a quieter environment. It doesn't encourage you to buy clothes in such a really loud music." (P6)*

The concentration and listening effort required for music listening can also lead to avoidance of everyday music listening at home. In particular, use of music as background to other activities is limited by the need to focus on the music in order to enjoy it.

> *"But I just want to, you want to listen to music and do other things. But you can't if you are connected with the headphones. You just have to sit there and listen to it. As*

you said, we don't just want to sit there. And I would like to just turn the radio on and do other things and be listening to them" (P4)

CI users also reported engagement with music at a more cognitive level. Music was brought up as a source of education or an opportunity to learn new skills:

"But also I listen to music because I find it educational as well. Like I was saying learning the different languages you know in music." (P18)

Use of music for education may stop, though, as a result of poor music listening skills. This was described as *unfortunate* by participants:

"But the one unfortunate thing about losing one's hearing and the music is that your musical education stops at that point so you remember all the tunes you used to know but you can't educate yourself anymore to learn more hearing new things." (P26)

Importance of music

The focus group discussion also revealed strong differences between CI users in terms of the overall importance of music in life. Some participants reported that music played a very important role in their life, while for others it was less important:

"So music plays a big part in my life, a very big part. Without music it's not the same." (P2)

"I'm just say here listening taking it all in. Music's never been the part of my life." (P10)

The importance of music in life depends on preferences and other personal characteristics, but it is also associated with the ability to perceive and enjoy music according to expectations. Therefore, for some individuals music becomes less important when it is poorly perceived:

> *"But to be quite honest I could live in a world without music. It wouldn't worry me at all because I don't get the pleasure and the beauty that I used to." (P15)*

4. Discussion

To the knowledge of the authors, this is the first study to demonstrate the effects of music on the QoL of adult CI users and the specific aspects of QoL on which music impacts. Previous studies had found positive associations between music and QoL scores measured with different questionnaires (Lassaletta et al. 2008; Zhao et al. 2008; Fuller et al. 2013; Calvino et al. 2015), but they had not explored the way music affects the QoL of CI users.

The present study supported previous findings and further identified hearing-specific benefits of music for the QoL that had received little attention to date. These benefits are: the ability of music to relieve tinnitus, to strengthen memory (physical domain) and to induce a sense of normality (psychological domain, 'self-esteem' subdomain), and the use of music as education (social domain). This study also confirmed that uses of music previously reported for NH adults are applicable to CI users but in a way that is related to the deafness. For instance, music as a source of reminiscence is particularly important for postlingually deafened CI users, because it links to the period in time before deafness. Other functions of music that were found are comparable to those previously reported for NH adults, such as the use of music to improve mood, to relax, or for socialising (Schäfer et al. 2013). This suggests

that to some extent CI users use music in their everyday life and derive benefits from music ~~for~~ in aspects of their QoL similarly to NH adults, despite difficulties in perceiving and enjoying it as a result of the physical limitations of the implant.

On the other hand, poor perception and enjoyment of music do not allow CI users to benefit from music to the extent that they would like to and therefore they experience a number of negative effects on their QoL, such as low confidence as a result of not being able to sing in tune with others. Some of these effects had been reported previously; for example, Migirov et al. (2009) and Plant (2015) found that many CI users are unhappy with the quality of music through the implant and often express feelings of frustration and disappointment.

~~Overall, the results of the present study support previous findings that show positive associations between music and QoL (e.g. Calvino et al. 2015).~~ The relationship of CI users with music is likely to depend on individual factors, such as age, duration of implant use, CI configuration or expectations based on prior music experiences. Although the effects of these factors were not examined, many of the functions of music were common for prelingually deaf and postlingually deafened CI users, especially in the physical and social domains. For example, participant 24 (prelingually deaf) and participant 16 (postlingually deafened) both reported using music for relaxation. However, other effects of music on QoL, such as the (positive or negative) effect on confidence, were more relevant to postlingually deafened CI users. In the following example participant 22, a postlingually deafened CI user discusses this with a prelingually deaf participant:

> *"But because you've been deaf from birth you have no way of knowing whether what you are hearing is the same as somebody else's hearing who hasn't got a hearing loss. This is my problem at the moment, I don't know whether I'm…, I'm not hearing what other people are hearing…." (P22)*

This may explain to some extent the findings of Fuller et al. (2013), who reported no relationship between music and QoL for prelingually deaf CI users implanted in adolesence. That music plays a more important role for CI recipients with prior music experience has also been suggested elsewhere (Migirov et al. 2009; Bartel et al. 2011).

Music was found to affect some facets of QoL as defined in the WHOQOL-BREF. For example, music as a relief from tinnitus and high notes sounding uncomfortably loud correspond to the WHOQOL-BREF facet of 'Pain and discomfort'. Yet, music was not found to have an effect on other WHOQOL-BREF facets (e.g. 'bodily image and appearance', 'sexual activity' or 'financial resources'), which suggests that even though music plays a role in life other aspects of the QoL may be more important than music.

Besides, the importance of music varies among individuals. For example, it has been previously reported that NH young adults (18-21 years old) spend significantly more money each month on music than on any other of the nine activities (computer games, TV, films, books, sports, radio, newspapers/magazines and favourite hobby) investigated (Lonsdale & North 2011). In the same study, adults >30 years old reported music to be significantly less important and spent less time with music than younger adults. However, social interaction was still an important reason for listening to music for participants up to 50 years old. The effect of age on music experiences was not looked at in the present study.

Whatever the reasons for variation with regard to the impact of music on QoL, the strong differences in the importance of music among the participants suggest that the relative importance of the different aspects of the music experience, QoL and music in general need to be assessed to evaluate the contribution of music to an individual's QoL.

5. Conclusions

Adult CI users use music and benefit from it in similar ways to adults with NH. However, the difficulties that CI users have perceiving and enjoying music prevents them from participating in music activities to the extent that they would like to and this therefore has a negative impact on CI users' physical, psychological and social well-being. An implication of these findings is that the optimization of music listening and enjoyment for CI users has the potential to result in significant benefits for their QoL. This way, the findings are of clinical significance as they stress the value of improving the music experience of adult CI users through new music-focused CI technologies or music auditory training. Future work should explore further the importance of music compared to other aspects of the lives of CI users and hearing-impaired adults in general, the relative influence of music on each of the different dimensions of the QoL and what this influence depends on.

Data access statement: The transcripts of the focus group discussions are available online: http://dx.doi.org/10.5258/SOTON/377895. The data have been anonymized and there are no ethical issues associated with or restrictions to making the data available.

Acknowledgments

We are grateful to all the CI users who participated in the focus groups for their time, feedback and enthusiasm. We would also like to thank Dr Helen Cullington from the USAIS for her help with the recruitment of participants and Dr Kim Bull from the Faculty of Medicine of the University of Southampton for revising the article. This work was supported

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Declaration of interest

The authors report no declarations of interest.

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Tables

Table 1. Inclusion and exclusion criteria of the focus groups.

Inclusion criteria	Exclusion criteria
• >18 years old • CI users • 50% or higher in the BKB sentences speech test or any other test of speech perception in noise used or self-reported ability to communicate in a focus group setting	• Communicating with British sign language or need of an interpreter

Table 2. Demographics of the focus group participants.

N_o	**Age**	**Gender**	**Implant type**	**Type of deafness**	**Duration of CI use (years, months)**	**Implant manufacturer**	**Music training**	**Participated in music focus group before**
P1	75	Female	Bimodal	Postlingual	1 year	AB	Yes	Yes
P2	60	Female	Unilateral	Postlingual	1 year	AB	Yes	No
P3	66	Male	Bimodal	Undefined	15 months	Med-El	No	Yes
P4	80	Female	Bimodal	Postlingual	1 year	AB	No	Yes
P5	37	Female	Bimodal	Prelingual	1 year	AB	No	No
P6	53	Female	Unilateral	Prelingual	4 years	AB	No	Yes
P7	42	Female	Unilateral	Postlingual	4 years	Cochlear	No	Yes
P8	64	Male	Unilateral	Postlingual	8 years	AB	Yes	No
P9	63	Male	Unilateral	Postlingual	2 years	Med-El	No	No
P10	68	Female	Unilateral	Postlingual	2 years	AB	No	No
P11	71	Female	Unilateral	Postlingual	6 years	Cochlear	Yes	Yes
P12	67	Male	Bimodal	Postlingual	2 years	Med-El	Yes	Yes
P13	64	Female	Unilateral	Postlingual	18 years	Not reported	No	No
P14	57	Male	Bimodal	Postlingual	1 year	AB	No	No

P15	81	Male	Bilateral	Postlingual	4 years	Cochlear	No	Yes
P16	81	Male	Bimodal	Postlingual	1 year	AB	No	No
P17	66	Male	Bimodal	Postlingual	1 year	AB	No	No
P18	26	Male	Unilateral	Prelingual	13 years	Cochlear	No	No
P19	68	Female	Unilateral	Postlingual	2 years	Med-El	No	No
P20	67	Female	Unilateral	Postlingual	2 years	Med-El	Yes	Yes
P21	80	Female	Unilateral	Postlingual	1 year	AB	No	No
P22	67	Female	Bimodal	Postlingual	2 years	Med-El	No	No
P23	62	Female	Unilateral	Prelingual	1 year	Cochlear	No	No
P24	18	Male	Bimodal	Prelingual	7 years	Cochlear	Yes	No
P25	68	Male	Unilateral	Postlingual	3 year	Med-El	No	No
P26	77	Male	Unilateral	Postlingual	2 years	Neurelec	Yes	No
P27	67	Female	Bimodal	Postlingual	1 year	Med-El	Yes	No
P28	43	Female	Unilateral	Postlingual	5 years	Med-El	No	Yes
P29	76	Female	Bilateral	Postlingual	3 years	Neurelec	No	No
P30	48	Female	Unilateral	Postlingual	7 years	AB	No	Yes

Table 3. The conceptual framework of the WHOQOL-BREF questionnaire (reproduced from The WHOQOL Group (1998). Development of the World Health Organization WHOQOL-BREF quality of life assessment. *Psychological medicine*. 28 (3). p.pp. 551–558.).

Domain	**Facets incorporated within domains**
1. Physical health	Activities of daily living Dependence on medicinal substances and medical aids Energy and fatigue Mobility Pain and discomfort Sleep and rest Work Capacity
2. Psychological	Bodily image and appearance Negative feelings Positive feelings Self-esteem Spirituality / Religion / Personal beliefs Thinking, learning, memory and concentration
3. Social relationships	Personal relationships

	Social support Sexual activity
4. Environment	Financial resources Freedom, physical safety and security Health and social care: accessibility and quality Home environment Opportunities for acquiring new information and skills Participation in and opportunities for recreation / leisure activities Physical environment (pollution / noise / traffic / climate) Transport

Table 4. The final template of the focus group data analysis describing the impact of music on the QoL of adult cochlear implant users.

Impact of music on the quality of life of cochlear implant users				
Physical health	**Psychological health**			**Social interaction & activities**
	Positive emotions	**Negative emotions**	**Self-esteem**	
• Supporting exercise • Music as therapy • Strengthens memory • Listening effort • Discomfort • Dizziness	• Pleasure • Arousal of emotions • Mood enhancement • Reminiscence • Relaxation • Reducing isolation and loneliness • Vitality	• Frustration • Disappointment	• Confidence • Embarrassment • Feeling normal	• Participation in social activities • Social interaction • Activities of daily living • Music as education

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2 February 2017

John Graham
Cochlear Implants International Editor

Manuscript title: 'Impact of music on the quality of life of cochlear implant users: a focus group study'
Authors: Dritsakis et al.

Dear Mr Graham,

We would like to thank our reviewers for their extremely helpful and constructive feedback and suggestions.

We have addressed the issues raised by the reviewers and have submitted the revised manuscript as well as a copy of the original manuscript with tracked changes as requested. We have also given our point-by-point response to the comments below.

We look forward to hearing from you.

Very best wishes,

Mr Giorgos Dritsakis
PhD candidate
ISVR, University of Southampton
e-mail: G.Dritsakis@soton.ac.uk

Responses to comments

Reviewer 1

-Less than 10% of the individuals contacted/invited agreed to participate.

Authors' response: This was not a concern due to the nature of the study and the sampling techniques used, please see the first sentence in section 2.1. Recruitment: 'Convenience and volunteer sampling was used with the aim to recruit as many CI users as possible within the timescale of the study.'

-The authors note that 22 of the 30 participants were over the age of 58 and that this had implications for the findings, but no further discussion was given in the remaining document.

Authors' response: We have rephrased this sentence in paragraph 1 of section 2.2 Participants: 'Twenty-two of the 30 participants were over 58 years old, which may suggest that the findings can generalise more to older CI users.'

-Did those individuals under the age of 40 (n=3) differ from those above 40, or even those below 58 from those above 58?

-of the 30 participants, 17 had used their implant for 1-2 years. It may be important to tease apart the early users from the responses of the later implanted.

-It may be important to address whether those who had their implant longer (and were those who were younger in age) viewed their music and concurrent QoL higher than the older adults with shorter duration.

-Were there any differences between those who were unilateral, bilateral, or bimodal (CI+HA) in terms of their experience and QoL?

Authors' response: We agree that duration of implant use, age and CI configuration are crucial parameters and may impact music experience and therefore the effects on the QoL. As this is the first study looking at the impact of music on the QoL of CI users, our aim was to explore this relationship for the CI population overall and look at differences and similarities with NH adults but not to look at the role of CI-related factors. In the discussion we have highlighted this limitation and the potential differences between participants (and CI adults in general) due to such factors (paragraph 4 of 'Discussion'): 'The relationship of CI users with music and the impact of music on the QoL is likely to depend on individual factors, such as age, duration of implant use, CI configuration or expectations based on prior music experiences. Although the effects of these factors were not examined ...'

Reviewer 2

General

The discussion is lacks in terms of how the current work relates to music and QoL among older adults. Specifically, how does music enjoyment change as we age, and how does that existing work relate to the results from the current study.

Authors' response: There was a brief discussion of this in 'Discussion' paragraph 8. We have now added the following at the end of the paragraph: 'The effect of age on music experiences was not looked at in the present study.', which acknowledges the limitation that the study did not address the role of age.

The discussion also needs more information on how other demographic factors impact music enjoyment. Specifically, music experience and duration of deafness are skimmed over yet deserve more discussion.

Authors' response: We have acknowledged the role of these factors and that the present study did not look at this (paragraph 4 of 'Discussion'): 'The relationship of CI users with music and the impact of music on the QoL is likely to depend on individual factors, such as age, duration of implant use, CI configuration or expectations based on prior music experiences. Although the effects of these factors were not examined ...'

Regarding recruitment, was there any compensation for the participants? Were the participants offered money, parking passes, or other forms of compensation? Please make this clear.

Authors' response: We have explained this at the end of section 2.1. Recruitment: 'Potential participants were informed that they would receive a fee and have their travel expenses covered.'

Line-by-line

Methods, 2.3 The focus groups, line 37

The reference should be van Besouw instead of Van Besouw.

Methods, 2.4 Data analysis, line 29

Avoid using back-to-back parentheses. Modify this line to (WHOQOL-BREF; The WHOQOL Group 1998).

Section 3. Results, line 39.

You are missing the table number; (Table ?).

Results, Psychological Domain, Page 14, line 46

The word “through” is mis-spelled as “throught”.

References, line 24

The Chin & Rickard reference is in all caps. Please revise.

Authors’ response: All the above-mentioned line-by-line errors were corrected. Please see original document with tracked changes.

Please note: In addition to the responses to the editor’s and reviewer’s comments, other minor changes (e.g. changes in the wording, phrases added for clarification) were also made to the manuscript. These changes can be found in the uploaded copy of the original manuscript with tracked changes.