Use of Remote Microphone Accessories with Young Children who have Cochlear Implants. An Investigation of Professionals' Opinions and Experiences

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Abbreviations

BATOD	British Association of Teachers of the Deaf
CRIDE	Consortium for Research into Deaf Education
ICToD	Implant Centre Teacher of the Deaf
NDCS	National Deaf Children's Society
NHSP	Newborn Hearing Screening Programme
QToD	Qualified Teacher of the Deaf
RMS	Remote Microphone System
ToD	Teacher of the Deaf

A note on terminology:

The terms "deaf children" and "children with a hearing loss" are used to represent the entire spectrum of hearing loss from Mild to Profound.

The word "parent" is used to imply all primary caregivers.

Acknowledgements

There is an apocryphal story that has a traveller in Ireland stopping to ask directions.
"How do I get to Cork?" asks the traveller.
"Well," says the local. "I wouldn't start from here."

Studies such as this are only possible thanks to the respondents who are willing to take time out of their lives and complete the questionnaires thoughtfully and in detail. I appreciate every contribution.

I am indebted to my colleagues who have been endlessly encouraging of my endeavours this year. It is a joy to work with a team whose commitment to evidence-based practice exemplifies Lenin's dictum:
Theory without practice is sterile. Practice without theory is blind.

However, especial gratitude is due to the *triumfeminate* who have provided support as I persisted along my circuitous, tortuous and entirely metaphorical journey to Cork. Thank you for your professional generosity and extraordinary patience.

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I am grateful to my husband who continues to be the rock that my life is built upon.

And finally, for my dad. Because language. Innit.

Abstract

Children who are born profoundly deaf have their access to spoken language almost fatally compromised. Research has demonstrated delays in interaction with caregivers, language development, academic progress and higher-order thinking skills including Theory of Mind.

Cochlear implants allow profoundly deaf children to experience sound at a level close to normal limits but technological limitations of cochlear implants mean that children have access to an auditory signal which is distorted and which is less accessible at a distance from the speaker or in complex auditory environments. The early years is a time when young children are establishing the linguistic foundations needed to become lifelong language users and good auditory access is essential.

The use of Remote Microphone Systems (RMS) has been demonstrated to improve access to speech which has concomitant benefits for language development, maintaining attention and social engagement with caregivers. Organisations working with deaf children recommend that RMS should be offered to all children with cochlear implants but this is not yet universal.

A survey was circulated to Teachers of the Deaf, exploring their beliefs about language development and the use of assistive listening devices with young children together with their experiences of working with different RMS available in the UK.

The design and the limitations of the survey are described. Responses indicated that, while Teachers of the Deaf display a high degree of commonality in beliefs about language development, there is a spectrum of opinions about the use of RMS together with variable levels of confidence in using them. The majority of respondents reported a need for further training in order to support the development of evidence-based practice.

1. Introduction

Wolfe (2020) suggests that "[the] multiple channel cochlear implant is the most successful sensory prosthetic device in the history of medicine." [p1]. Cochlear implants have allowed children with a severe to profound hearing loss to have auditory access to speech with a clarity beyond that offered by traditional hearing aids. The delivery of a robust electronic signal directly to a functional auditory nerve offers a means to bypass the damaged cochlea and avoids the issues of distortion and feedback which are often associated with amplification through hearing aids. This improved access to sound impacts upon the children's ability to develop spoken language and can have consequent positive effects upon their educational attainments and social/emotional development. (Iler Kirk & Hudgins, 2016; Dettman, 2016; McMahon et al, 2012)

However, numerous studies demonstrate that children with cochlear implants continue to show language development which is delayed by comparison with their hearing peers and which may follow an atypical path. Educational outcomes of children with a hearing loss continue to be at a lower level than those of children with normal hearing and there is evidence that there is also a deficit in cognitive skills including those falling under the umbrella of Executive Function (Jones & Mason, 2017). Further, children who use cochlear implants may have social skills which are atypical and less developed than might be expected. (Mellon et al, 2016; Quittner et al, 2016; Nittrouer & Caldwell-Tarr, 2016)

Children learning to speak require access to good models of speech. Cochlear implants do not restore normal hearing and there is an increasing awareness of the need to improve the quality of the auditory signal which children receive in order to overcome the effects of distance from the speaker and background noise. The use of a remote microphone system (RMS/radio aid) can improve the signal to noise ratio and mitigate some of these effects. Within the field of deaf education, there is a growing imperative to increase the use of radio aids as evidenced by the statement in the Quality Standards for the Use of Personal Radio Aids that:

"Every deaf child should be considered as a potential candidate for a personal radio aid as part of their amplification package, at first hearing aid fitting" (NDCS, 2017, p11)

Radio aid systems have hitherto typically been issued to children who are at school, in order to mitigate the effects of the *"*hostile acoustic environment" of the classroom (NDCS, 2017, p4) thus falling within the professional responsibilities of Qualified Teachers of the Deaf and the funding purview of Education services. The provision of radio aids to children who are not yet at school may prove a challenge to funding (NDCS, 2018) and, while the Quality Standards identify a need to establish models of funding shared between education and health, these are not widespread.
Both academic research (eg Allen et al, 2017) and the relevant professional guidance indicate that the use of a remote microphone to improve access to spoken language should be universal practice but provision remains "inconsistent and inequitable" (NDCS, 2017 p3).

Within the UK, Qualified Teachers of the Deaf (QToD) are the professionals who would typically support and encourage the use of equipment designed to improve auditory access. This study aims to investigate the beliefs and opinions of QToDs with respect to the value of remote microphone systems for children under 5 who have cochlear implants and identify potential barriers to implementation.

2. Literature Review

2.1 Cumulative Language Experience

Following a longitudinal study of over 300 children with hearing loss, Moeller, Tomblin et al (2015) posited a model of the relationship between deaf children and their developmental outcomes, especially their speech and language. They suggested that many of the factors which affected outcomes could be grouped within a mechanism which they termed Cumulative Language Experience. Within this, they identified three sub-processes: Hearing Aid Use, Linguistic Input and Audibility.

2.2 Hearing

2.2.1 The genesis of hearing

"It's all about the brain. We hear with our brain. The ears are just the way in… Listening happens in the brain, not in the ears." (Flexer, quoted in Wolfe & Smith, 2016, p14)

The foetus is able to detect sound from 19 weeks gestation. Initially responsive only to sounds around 500Hz, the foetal auditory system responds to stimuli across the range 100Hz-3KHz by 35 weeks gestation (Hepper & Shahidullah, 1994). Kral & Sharma (2012) argue that the development of the cortex proceeds as episodes of stimulation cause the brain to form neural pathways based on connections between neurons. This process of synaptogenesis continues throughout infancy to its peak at 2-4 years from which point synaptic density declines as less used pathways are pruned. The localisation of function within the cortex proceeds as part of this process with the primary auditory cortex located within the temporal lobe. Stimulation of the auditory cortex is a vital component of this process (O'Neil & Ryugo, 2011) and, without it, the brain will develop in an atypical fashion with the visual system colonising the putative secondary auditory cortex. (Cole & Flexer, 2007; Lartz & Meehan, 2012; Wolfe & Smith, 2016b).

2.2.2 The baby who is deaf

The child who is born with a hearing loss has, by the time of birth, already missed 20 weeks of auditory stimulation and development by comparison with the child with normal hearing. Without access to the full range of speech sounds in his auditory

environment, the baby who is deaf will continue to find it difficult to extract the patterns of sound which form distinctive units of meaning (ie words) and thus the capacity to map these phonological patterns onto events and objects in order to derive meaning (Iler Klerk & Hudgins, 2016, Blaiser et al, 2015). Nittrouer & Caldwell-Tarr (2016) identify clear sensory input and adequate auditory experience as being key to facilitating language learning in order to avoid long term consequences. Quittner et al (2016) note that children with a hearing loss may have delayed learning and socioemotional development consequent upon their reduced language levels.

2.2.3 Identification and Amplification

The Newborn Hearing Screening Programme (NHSP) endeavours to identify children who are deaf with a view to early intervention through the provision of hearing aids together with specialist professional support for families. Moeller, Tomblin et al (2015) identify early and consistent hearing aid use as a key component of the Cumulative Language Experience necessary for age appropriate language to develop. Early fitting of hearing devices is associated with improved speech, language and psychosocial outcomes (Ching et al, 2018; McCreery & Walker, 2017, Walker, 2015).

Nonetheless, for the baby with a severe to profound loss, hearing aids may not offer optimal access to speech sounds, particularly at the higher frequencies.

2.2.4 Cochlear implants

Available in the UK to children with a severe to profound hearing loss (defined as hearing only sounds louder than 80dBHL at two frequencies 500Hz-4KHz without acoustic hearing aids; NICE 2018) cochlear implants can offer access to speech at close to normal limits.

Iler Kirk & Hudgins (2016) state that cochlear implants have allowed children with significant hearing loss to achieve “unprecedented levels of speech recognition and spoken language processing”.

Nonetheless, Eisenberg (2015) notes, since paediatric implantation started in the 1980s, there has been an awareness of the wide disparity in the outcomes for children who have been implanted; this variation has been ascribed to factors such

as age at implant, mode of communication and maternal level of education although Wolfe (2020) reflects that, while a number of factors have been shown to affect cochlear implant results (eg socio-economic status, parental sensitivity to children's needs) no single factor confines the child to a particular outcome.

2.2.5 The effect of age at implant

Nicholas & Geers (2006) suggest that cochlear implants make age-appropriate language before the child starts school a realistic possibility. Yawn et al (2017) report that patients who received cochlear implants before the age of 12 months developed babbling patterns similar to typically developing peers and reached age-appropriate speech and language development sooner than those implanted later. Ching & Dillon (2013) identified a global outcome delay of 0.5 standard deviations for each 6m delay in implantation. The delays were evident in expressive and receptive language, speech production, social development and auditory function.
Thus, there is compelling evidence that there are benefits to implanting children under 5 (Dettman,2016; Govaerts et al, 2002) and, as Yawn (2017) notes, very few contraindications.

2.2.6 Communication

Debate about the role of sign language in the lives of deaf children and their families continues (eg Karmiloff & Karmiloff-Smith, 2001; Humphries et al, 2012). Nonetheless, 90% of deaf children are born to hearing parents (NICE, 2020) and, as Daboo (2017) notes, it is possible to argue that "Parents want their child to be like them, they want their child to listen, speak and be as normal as possible!" [p93] Following a longitudinal study, Geers et al (cited in Iler Kirk & Hudgins, 2016) identified the key factor for the development of good speech perception was placement in provision which emphasises the use of spoken language.

2.3 Linguistic Experience

2.3.1 The genesis of language

"Communication grows out of a relationship" (Coupe & Goldbart, 1988)

The centrality of interaction between infant and caregiver is emphasised by many authors. Joint engagement starts with the infant and adult entirely focused on one another, sharing mutual gaze (Fagan, Bergeson & Morris, 2014). Throughout the first three years of life, the characteristics of joint attention change as the child grows and he begins to look out towards objects in his environment. (Adamson et al 2004; Quittner et al, 2016). Initially he may direct the adult's attention to his object of interest and invite interaction through what Baron-Cohen (1989) terms proto-declarative pointing. Tomasello (2003) suggests that this is "…the purest expression of the uniquely human social-cognitive motivation to share attention with others." [p34].

The adult-child dyad shares attention for longer periods of time and these episodes begin to focus on an object, action or event which, increasingly, may be outside the immediate spatiotemporal context. As the child becomes more mobile, he may be at a greater distance from his caregiver as they interact but he continues to listen, co-constructing the activity through behaviour and response (Adamson et al, 2004).

2.3.2 The language environment

Hart & Risley (1995) in a seminal study of the language environments of young children in the USA, found that the key predictive factor for vocabulary size was the amount of language which the child had heard; the more parents spoke to their children, the larger was the child's vocabulary. By 2 years of age, children who have heard less talk have smaller vocabularies and slower language processing speeds (Layng 2016). Rinderman & Baumeister (2015) emphasise parental educational behaviour" as the driver for language development. Bayliss (2015) quotes Suskind's comment that "Language exposure is what feeds early brain development".

LoRe, Ladner & Suskind (2018) note the development of around 1million neuronal links per second during early childhood and identify the importance of responsive caregivers and a rich language environment as equally fundamental to this development.

2.3.3 Parental sensitivity

Hirsh-Pask et al (2015) suggest that the child and caregiver co-create the communicative space which lays the foundations for later language. Both *quantity* of

language input (eg Grieb, 2010) together with the *quality* of parental sensitivity (Ching & Dillon,2013; Quittner et al, 2016) affected language outcomes in children from low-income families. Vygotskian theory (1962) suggests that the adult identifies the child's level of understanding and then works within his Zone of Proximal Development, modelling language just beyond the current level of complexity thereby scaffolding his development to the next stage. Dave et al (2018) note that the interaction between child and caregiver is a dynamic process, changing as the child develops and with the adult sensitively matching her input to the child's current development. Maternal responsiveness has been shown to be a greater predictor of a child's vocabulary use than the mother's own vocabulary (Fagan, Bergeson & Morris, 2014).

2.3.4 Infant-Directed Speech

Interaction is at the heart of communication development. The infant-adult dyad shares communicative space as the adult contingently responds to the child's gaze and vocalisations as though they were communicative (Fagan, Bergeson & Morris, 2014).

Adults adjust their speech patterns to hold attention (Gallaway, 1998) and promote parent/child bonding (Kondaurova et al, 2015). Infant Directed Speech has prosodic features which distinguish it from the language more typically used within that linguistic community. Stress patterns are exaggerated and there are more question-like formulations with their attendant rising intonation (Dave et al, 2018). Moeller & Tomblin (2015) report that access to child-directed speech positively influences the efficiency of language processing leading to increased language growth.

2.3.5 The deaf child learning language

As noted above, most children who have a diagnosed hearing loss are born to hearing parents (NICE, 2020). The interaction between the deaf child and his hearing parents is compromised by the mismatch between the parents' preferred communication mode and the child's access to that information (Karmiloff & Karmiloff-Smith, 2001; Fagan, Bergeson & Morris, 2014; Morgan et al, 2014; Quittner et al 2016).

McCreery & Walker (2017) identify the need for deaf children to have access to high quality linguistic experiences but suggest that parents may find it harder to engage in communicative behaviours with their deaf baby as they find it difficult to judge the child's Zone of Proximal Development. Faced with a baby who is less responsive to sound play and less spontaneously vocal, parents can become increasingly directive in their speech (Fagan, Bergeson & Morris, 2014) and may use linguistic strategies which are less helpful for developing expressive language (Cruz, 2013).

2.3.6 Expanding the lexicon

Learning a new word involves mapping "…a consistent phonetic form onto a conceptual referent" (Blaiser et al, 2015 p25). Ambrose et al (2015) suggest that infants start to identify patterns in the stream of auditory input from their caregivers; stable phonological boundaries are extracted through frequent exposure within familiar contexts. Later, existing knowledge of words is used to support word recognition; identifying familiar vocabulary highlights new words as they are encountered and allows the novel sound pattern to be mapped onto a likely referent. Ma'ayan (2018) notes the importance of repeated exposures to new words, allowing a robust cognitive link between word and referent to be established.

Studies of word learning in children consistently identify difficulties for children who have a hearing loss (Blaiser et al, 2015). Children with a reduced lexicon find it harder to learn new vocabulary (Walker & McGregor, 2013 ; Shannan et al, 2010). As Layng (2016) notes, the additional delay in processing a distorted signal in order to recognise a familiar word can be enough to ensure that the following words are missed completely.

Further, opportunities to "overhear" vocabulary in a wider social environment is reduced by the limitations of hearing technology (Cole & Flexer, 2011, cited by Ma'ayan 2018).

2.3.7 Beyond words

While the need to develop a vocabulary and to understand syntactic and morphological rules is an essential part of being a successful user of language, communication also depends upon understanding the social environment. Children

who are deaf are often described as being less aware of others' emotions and beliefs.

Taumoepeau & Ruffman (2006) suggest that early shared linguistic experiences form the basis for developing the child's understanding of other people's mental states whilst Morgan et al (2014) report that deaf children experience less talk about the mind and their interaction with caregivers includes fewer mental state words as the adult adjusts to child's reduced language level.

2.3.8 Towards a Theory of Mind

Theory of Mind is the individual's understanding that they have mental states (beliefs, opinions, emotions) of their own which may differ from others' (Baron-Cohen et al, 1985). Siegel & Varley (2002) speculate that it is an innate skill in humans which requires environmental stimulus in the shape of early conversational experience, proposing that "conversational experience serves as a gateway to others' beliefs" [p469].

This would suggest that children who are deaf may miss out on opportunities to develop the precursor skills for Theory of Mind as a result of their reduced early interaction. Proceeding from early interaction and joint attention, Sundqvist et al (2014) identify a developmental pathway of increasing complexity noting that only 40% of children who had cochlear implants performed at an age appropriate level on cognitive Theory of Mind tasks. Similarly, Remmel & Peters (2009) state that exposure to mental state language predicts later Theory of Mind understanding whilst Chilton & Beazley (2014) report a number of studies showing that Theory of Mind is delayed or restricted in some children who are deaf and suggest that the mismatch of hearing status between parent and child leads to a communication barrier. Moeller & Schick (2006) note that families of deaf children with deaf parents have more advanced talk about mental states than deaf children of hearing parents. They hypothesise that a shared language competence leads to more discussion of mental states with a consequent benefit for the child's development of Theory of Mind.

2.4 Audibility

"…the routine provision of radio aid technology to early years deaf children represents the biggest change to deaf education provision in the UK since the introduction of newborn hearing screening"
Webster & Maiden (2018)

2.4.1 The auditory environment

The world of the young child is typically acoustically complex. (Nelson et al, 2013; Blaiser et al, 2015; NDCS, 2017). Friedman & Morgulis (2017) note that listening takes place in a variety of sub-optimal situations whilst brain growth and development is contingent upon access to consistent auditory input.
Mulla (2011) observed that homes are not acoustically friendly with a variety of background noises; young children in his study could spend approximately 5 hours per day in conditions identified as further than 2m from the speaker or in competing noise. Language is maximally developed through natural interaction in familiar routines but many of these take place in situations such as cars, supermarkets and playgrounds.

2.4.2 The limitations of cochlear implants

Whilst cochlear implants can offer the deaf child the experience of sound, they do not restore normal hearing. Wolfe (2020) suggests that it is important to make this explicit to families as part of the implantation process, further observing that the use of hearing assistance technology should be discussed at an early stage as this "…implicitly reiterates the fact that the cochlear implant alone may not sufficiently address the candidate's communication difficulties across every conceivable situation" [p184].
Cole & Flexer (2016) emphasise the need for families to be fully informed about the effects of distance and noise on brain development and language. Processing strategies used by cochlear implants deliver spectrally broad signals which lack the fine detail that would be perceived by the listener with natural hearing within normal levels (Caldwell & Nittrouer, 2013) and this contributes to the difficulty which children with cochlear implants have in listening at a distance, in complex environments, discriminating speech sounds and segregating a target signal from background noise

(Spratford, McCreery & Walker, 2017; Allen et al, 2017; NDCS, 2017). Reduced access to the prosodic features of speech may leave children who use cochlear implants both less able to discriminate vocal tone and less motivated to attend to the voices of caregivers (Kondaurova et al, 2015).

Nelson et al (2013) emphasise the importance of ensuring an optimal auditory signal as children attempt to learn new vocabulary and concepts, noting that children with a hearing loss may not have full access to phonemic information in running speech and will therefore face a higher cognitive burden when sustained attention is needed. Children with a hearing loss need a better SNR to understand speech (Walker et al, 2019). McMillan & Saffran (2016) suggest that a signal-to-noise ratio (SNR) of at least +20dB is necessary when toddlers are learning new vocabulary. Walker & McGregor (2013) suggest that children who have cochlear implants are recipients of distorted input which affects the ability to fast-map the sound to the referent and causes delays in word learning. It is also noted that retention of new vocabulary causes especial difficulty.

2.4.3 Remote Microphone Systems

It may be argued that the greatest challenge for children with cochlear implants is speech perception in noise (Caldwell & Nittrouer, 2013; Iler Kirk & Hudgins, 2016). McMillan & Saffran (2016) note the impact which noise has on all young children; chronic noise pollution may cause the child to become less attuned to auditory information and less able to discriminate phonemes. Children with cochlear implants are adversely affected by 2 key issues:

- distance from the speaker (eg inverse square law: sound intensity at source reduces in proportion to the square of the distance) and
- reverberation (sound waves are reflected off surfaces in a room and cause signals to overlap at the ear) (Nelson et al, 2013, McCreery & Walker, 2017).

Children's acoustic environments are often complex (eg Mulla, 2011, Blaiser et al, 2015). Shannan et al (2010) note that children require a better quality signal than adults as they are less able to make use of their existing lexicon in order to support comprehension while Nelson et al (2013) recommend a SNR of at least +20dB. This is substantially greater than a typical SNR in real world environments which might be +5dB. (Wolfe, 2020) It is noted that the reduced access to phonemic information

places a higher cognitive burden on deaf children trying to listen than for children with normal hearing (see also Mulla, 2011).

The use of radio aids to overcome the issues of distance and reverberation is well established (eg McCreery & Walker, 2017; Wolfe, 2020) although Ambrose et al (2014) caution that they do not normalise the child's auditory experience.

Cole & Flexer (2016) propose that "The purpose of technology is to efficiently, effectively and consistently channel auditory information to the brain" [p187] and argue that a RMS should be offered to families soon after first fitting of amplification.

2.4.4 The use of Remote Microphone Systems in the Early Years

The use of Remote Microphone Systems is increasingly recommended for young children at home (Mulla & McCracken, 2014; NDCS, 2017; Allen et al, 2017; Curran et al, 2019).

Children using RMS show more consistent response to speech (Allen et al, 2017) and improved attention (Mulla, 2011; Nelson et al 2013). Benitez-Barrera et al (2018) observed that there was an increase in the quantity of adult-child interactions at a distance, hypothesising that the improved audibility offered by the RMS increased the child's responsiveness which encouraged the adult to communicate more often. Similarly, Friedman & Morgulis (2017) reported increased auditory awareness and verbal interaction in young children using RMS.

Mulla (2011) found that parents recognised the improved access offered by the RMS and appreciated the increased engagement with their children. Allen et al (2017) report improved social engagement with both adults and peers while Walker et al (2019) report increased feelings of security in complex environments.

Concerns about families' willingness to engage with another layer of technology have been cited as barriers to use with children at home; evidence suggests that careful introduction and on-going support are key (Statham & Cooper, 2009; Friedman & Morgulis, 2017, Allen et al , 2017) with Walker et al (2019) noting that technical issues can be a barrier to implementation and recommends training on trouble-shooting.

2.4.5 Professionals' beliefs and confidence

Bevington (2016) comments that a significant number of professionals are reluctant to use a RMS unless the child is capable of reporting back about sound quality.
Wolfe & Schafer (2015) suggest that there is no evidence that a correctly fitted RMS will be detrimental to the language development of a child with cochlear implants and note that the inability to report difficulties is not a bar to receiving cochlear implants themselves.
Cole & Flexer (2016) note with regret that some professionals suggest a value to children "learning to listen" in noise. NDCS (2018) are forthright in their rejection of this belief, commenting that it is critical for the child to develop good language skills; listening in noise simply hampers this.
Teachers of the Deaf are typically experienced in fitting and supporting radio aids to children in schools who use hearing aids. In most cases, the radio aid will be a system which makes use of a transmitter worn by the speaker whose voice is transmitted by means of a digital audio signal to the child's hearing devices to which a receiver has been fitted. The same system can be used with many types of hearing equipment.
Boddy & Datta (2018) observe that, until recently, the expertise to fit RMS to speech processors was "housed firmly within Cochlear Implant teams" [p35] and local QToDs did not feel empowered to manage systems.
Allen et al (2017) note that rapid changes in technology require Teachers of the Deaf to constantly update their skills. Increasingly, manufacturers of implantable hearing devices are offering a proprietary RMS as part of the package (eg Cochlear MiniMic 2+). These accessories are given directly to the family via the implant clinic and levels of manufacturer support are low.

2.5 The current study

The Quality Standards for the use of personal radio aids (NDCS, 2017) outlines the expectation that children of all ages should routinely be considered as candidates for the fitting of a RMS.
The 2018 CRIDE Survey asked authorities with the UK if they made radio aids available to children under 4.

Number of services providing radio aids to families of children under 4 for use in the home	Yes 56%	No 44%
Number of services providing radio aids to families of children under 4 for use in early years settings	Yes 81%	No 19%

Table 1: Services making radio aids available to children under 4 *(*Source: CRIDE, 2018*)*

Only slightly over half of all authorities make radio aids available to children for use in the home. While more will offer a RMS system to children attending an early years setting, there remain just under 20% who do not. Further, the CRIDE report notes that this is a statement of policy and may not reflect whether children under 4 are actually issued with radio aids.

However, CRIDE data is unable to capture the degree to which the device-specific RMS are being used by families and supported by ToDs as a means of extending access to radio aids for children under 5.

2.5.1 Themes underlying the present study

This study aims to explore the beliefs of the professionals who work with deaf children with respect to:

- Audition and the development of spoken language
- Understanding and experience of different radio aid systems
- Current practice
- Experience of training / Continuing Professional Development.

It is hoped to elucidate what underlies current practice with respect to young children who use cochlear implants and their access to both standalone radio aid systems and those which are provided by a manufacturer of cochlear implants.

3. Methodology

3.1 Purpose of the study

Newby (2014) suggests 3 reasons which should underlie educational research:

- To explore issues of interest
- To shape policy by identifying goals and the means to attain them
- To improve practice.

This study is set within a context in which the use of Radio Aids with children who have cochlear implants is of current interest within the profession. The bodies which seek to guide practice for Teachers of the Deaf (eg BATOD, NDCS) have evidence-based policies that encourage the use such equipment. However, as noted above (CRIDE, 2018), practice varies across the UK and many local authorities do not make systems available to children under 4. This study hopes to establish why these goals have been identified but not met and whether there is a means by which practice could be improved.

3.2 The survey

Questionnaires are amongst the most commonly used data collection methods used for social research. It is possible to collect a large data set in return for relatively little cost (Newby, 2014). However, as Artino (2014) notes, time must be invested in the design of the questionnaire to ensure both validity (Do the items address the constructs under investigation?) and reliability (Would results from the instrument be the same on a different day?) Ary et al (2014) outline a possible route to planning a successful survey.

3.2.1 Define the population

There were approximately 1300 Teachers of the Deaf working in the UK in 2018 (CRIDE, 2018) of whom 83% had the appropriate Mandatory Qualification and a further 16% were in training.

3.2.2 Population census

With a relatively small population size and a methodology which typically has low response rates (Ary, 2014; Dillman et al, 2014; Newby, 2014) it was decided to circulate the survey to as many members of the population as possible rather than to identify a representative sample. However, as a means to increase an expected low response rate, it was also decided to introduce an element of snowball sampling.

3.2.3 The snowball sample

Snowball sampling occurs when one interviewee suggests the name of the next possible respondent (Ary et al 2014). Newby (2014) suggests that it can be a way to contact otherwise difficult to reach groups and is based on the expectation that one member of a population is likely to know others.

3.2.4 Construct the instrument

Surveys are useful for gathering data which are hard to quantity or observe such as opinions and beliefs but, as Artino (2014) notes, that there are "…many ways to get flawed data from a survey" [p1464]. A number of authors suggest procedures to design a satisfactory instrument (Cohen, 2011; Ary et al, 2014; Dillman et al, 2014; Newby, 2014) and there are many commonalities.

Artino (2014) suggests that the first step should be to investigate the way in the which the target audience conceptualises the construct under investigation. However, Djazoul (2019) argues that, where the researcher is part of the relevant professional group, it is not necessary to do this formally, using instead the knowledge gained through professional practice.

The questionnaire should be based on a thorough literature search to identify the domains which may measure the tool's construct (Artino, 2014). Paragraph 2.5.1 (above) identifies the themes which this author derived from the Literature Review and which form the basis of the questionnaire.

3.2.4.1 Formulate the question items

Newby (2017) suggests that there is no compelling evidence that either closed or open questions are more effective at collecting good quality data. A mix of the two offers the opportunity to gather data which is amenable to quantitative analysis

(Cohen, 2011) together with "…a sense of the respondent's own voice" (Newby, 2017, p300). Artino et al (2014) suggest that poor wording, confusing layout and inadequate response options can reduce the reliability and validity of the resultant data.

Dillman (2014) differentiates between:

- factual questions which can easily be recalled, such as age, and
- questions about attitudes and opinions which require the participants to consider their response.

Dillman (2014) argues that the researcher should "get into a respondent state of mind" in order to write questions which participants will be willing to answer and able to answer accurately. The questions within this survey are predominantly about the respondents' professional practice and the beliefs and knowledge which underpin it. As such, they will require consideration but not research and, hopefully, relate to a topic of some interest to them (Ary 2014). It is possible that responses may be biased by the respondents' desire to give a socially acceptable answer but this may be offset by the promise of confidentiality (Ary, 2017).

Questions should be clear as respondents will need to complete the survey without support (Bolorinwa, 2015) and written in the language of the target population (Artino et al, 2014). As a researcher working within her own professional paradigm, it can be argued that the author shares a common language with the census population and should be able to judge the language level that will be understood. This will, in any case, be checked during the expert validation stage (*paragraph 3.2.3.3 below*).

Closed questions, which offer a forced choice of response options, are relatively easy for the respondent to answer but it is essential to ensure that answers are mutually exclusive (Dillman, 2014) and that either all possible responses are available (Cohen, 2011) or that the respondent has the opportunity to add an alternative. Within this survey, they are used to gather data about demographic factors (eg qualifications, hours of recent training) and experiences (Which transmitters have you worked with?). They offer a snapshot of the respondents' professional lives but do not address the beliefs and opinions.

Attitude scales are used to differentiate the intensity of an individual's response to a stated dimension.

Ary et el (2017) note that, for ease of completion, there should be consistency when assigning numbers to response categories with “positive” dimensions consistently at one end of the scale. Respondents may not notice if the poles are reversed leading to inaccurate responses (Dillman, 2015).

When using a *simple linear scale*, a dimension is proposed and the respondent is required to indicate on a line the extent to which they agree with it. As each respondent will have a different interpretation of the dimension, Newby argues that a numerical scale can add a “spurious sense of accuracy” [p 307]. In this study, only 2 questions make use of this type of scale; respondents are asked to indicate their degree of agreement with a statement.

A *numerical scale* uses words to define the end points but uses numbers to indicate a progression between the two. Equal gaps between the points are implicit but not measurable. In this study, this type of question is used to investigate respondents’ understanding and beliefs about technology.

A *Likert scale* uses words rather than numbers to denote the respondent’s position along a continuum of belief. There is no imputation of equal interval between the points on the scale and, typically, a scale will consist of 5-7 points (eg strongly agree/agree/neither agree nor disagree/disagree/strongly disagree). In this study, this type of question is mostly used to assess the respondents’ beliefs about language development.

Open questions

While closed questions have the parameters of response set by the researcher, the open question may offer the respondent the opportunity to offer her own perspective. Open questions can be a useful way to add richness to the response to a closed question; Newby notes that direct quotes from respondents can offer insights not easily gained otherwise. This approach is used for the follow up to a number of closed questions in this survey. However, as Foster & Cue (2009) note, this “bottom-up” analysis of responses requires the researcher to interpret responses in order to code them.

3.2.4.2 Ordering the question items

Dillman (2014) notes that the respondent can, at any time, simply stop the process of completion; the order of questions within a survey can encourage higher completion

rates (Ary et al, 2014; Newby, 2014; Artino, 2014). Through offering easier questions of high interest at the start, the respondent's commitment is engaged before introducing more difficult open-ended questions towards the end. (Newby, 2014; Artino, 2014),

In this survey, questions are thematically grouped (Ary et al, 2014), starting with a forced choice Likert-type scale focusing on the language development of deaf children: a topic likely to be of interest to and relevant to the target audience. Questions about radio aid systems are then introduced. Initially, these are forced choice, followed by a simple linear scale and then a forced choice plus probe for more information.

Guided open ended questions about methods of setting up equipment investigate their professional practice, numerical scales are used to probe the respondents' understanding of the strengths and weaknesses of three different systems before an open question about the differences between two of the systems: the Phonak Roger Touchscreen and the Cochlear MiniMic 2+ (chosen for being the best-known representative of their class: standalone system capable of linking into a variety of devices from different manufacturers and device-specific remote microphone accessory respectively.

Questions about the individual are used last. Opinions vary about the placement of demographic questions with Dillman (2014) and Ary et al (2014) suggesting that they should be at the end and Newby (2014) preferring the start.

3.2.4.3 Expert validation

Artino (2014) proposes that questionnaires be socially constructed with the researcher identifying initial thoughts derived from literature review and focus groups which are then shared with others who have specialist knowledge in order to identify themes and suggests questions. For a small study of this kind, this would be excessive. However, the questions are rooted in the author's professional experiences and discussions with colleagues.

Dillman (2014) recommends that all questionnaires should be reviewed by experts in the relevant field before they are used. It is suggested that they should be tested by those who have expertise in the topic under investigation as well as by those who are experienced at questionnaire design (Artino, 2014; Boloworina, 2015).

The questionnaire in this study was sent via SurveyMonkey (the chosen platform) to be reviewed by 3 colleagues:

- An experienced QToD working within a peripatetic service
- An experienced QToD working as an ICToD
- An experienced QTVI who had recently completed a dissertation focusing on the process of designing an assessment instrument for completion by non-specialist teachers.

3.2.4.4 Distributing the questionnaire

Ary et al (2014) note the advantages of using the internet for a survey: it is possible to contact a large group of people with ease and the costs and effort required are relatively low compared to other strategies (eg telephone interviews, postal surveys). The target population for this questionnaire is Teachers of the Deaf, a group who, through their professional lives, are likely to have access to the internet and the skills necessary to access a questionnaire online.

Djazoul (2019) noted that a number of technologies are evolving to enable researchers to use web-based questionnaires but she found that some (eg, using a modifiable pdf format via Google Docs) had the potential to display inconsistently depending upon the type of technology used by the respondent. For this reason, it was decided to use a commercial survey platform to design and host the questionnaire. A well-laid out and visually attractive questionnaire can positively the affect the rate of response and ensure that questions are answered accurately, thus positively impacting upon both reliability and validity (Artino et al, 2014; Ary et al, 2014).

The questionnaire was advertised through BATOD, the professional organisation for Teachers of the Deaf. An invitation to participate was posted on the organisation's blog, disseminated via their Twitter account and emailed via the QToD forum (which is hosted by BATOD).

The author circulated it to Teachers of the Deaf within her own professional network (working as an ICToD within a hospital's Auditory Implant Service) and it was also circulated through the Head of Sensory Services (HOSS) network.

All requests for participation were accompanied by an appeal for the questionnaire to be forwarded to other participants.

3.3 Reflexivity

Newby (2014) observes that research into education is inevitably political and, while the researcher aims to be neutral, it is likely that her values will have informed the decision to undertake research in this area. Change should always be evidence-led and it is vital that the methods used should not prescribe the data that will emerge. As a Qualified Teacher of the Deaf, the author is working within a paradigm which emphasises access to sound as fundamental to the development of the brain, language, social inclusion and higher-level thinking skills. Given that technology exists which can maximise this access, the author considers that the use of this technology should be encouraged and seeks to find ways in this can happen. Identifying barriers to acceptance and usage could support changes in practice.

3.4 Ethics

The questionnaire is to be circulated to professionals, asking about their own practice and the beliefs which underpin it. There is no disbenefit to participation. The appropriate Ethics forms were completed and submitted to the Social Sciences, Arts and Humanities ECDA of the University (Appendix 1) and approval was given (Appendix 2).

3.4.1 Consent

The questionnaire starts with the EC6: Participant Information Sheet (Appendix 3) following which there is a page for the respondent to add her name and contact details. There is a single question:

Do you consent to take part in the study?

The survey is constructed so that only those who consent are directed to the next page.

4 Results

4.1 Response rates

In total, there were 59 respondents to the survey. There are approximately 1300 Teachers of the Deaf working in the UK (CRIDE, 2018) of whom 83% hold the Mandatory Qualification so this represents a response rate of close to 5%. Dillman et al (2014) suggests that a completion rate of 10% is to be expected for postal surveys but this is somewhat below that level.

4.2 Characteristics of the participants

The table below shows the professional characteristics of the respondents.

Qualified Teacher of the Deaf	34	57.8%
Teacher of the Deaf in training	3	5.1%
Employed as a Teacher of the Deaf but not in training	0	0%
Qualified Teacher of children with MSI	0	0%
Educational Audiologist	4	6.8%
Other • Educational Audiologist in training • QToD & QTVI • MSI teacher • Paediatric audiologist	4	6.8%
Did not answer	14	23.8%

Table 2: Question 29 - Professional characteristics of respondents

Respondents were asked how many years they had been working with deaf children.

0-10 years	15	25.5%
11-20	15	25.5%
21-30	9	15.3%
31+	6	10.2%
Did not answer	14	23.8%

Table 3: *Question 30 - Professional experience of respondents in years*

Overall, the completion rate for the questionnaire was 76%. However, completion rates varied through the questionnaire and it is noticeable that later questions have worse completion rates.

Section of questionnaire	Average number of questions skipped	Percentage of questions skipped
Developing children's language	4.16	7.01%
Radio Aid Systems	7	11.9%
Your current practice	14.25	24.23%
Strengths and weaknesses of Radio Aid Systems	16.5	28.05%
Your experience of training	16.75	28.48%

Table 4: *Non-completion rates for each section of the questionnaire: Mean number of questions skipped by each respondent*

Given the low level of both response and completion, it was decided that the data was not robust enough for statistical analysis. The response to each question is described below.

4.3 Responses to the questionnaire

4.3.1 Developing children's language – Questions 4-9

The questions in this section had the highest response rate.

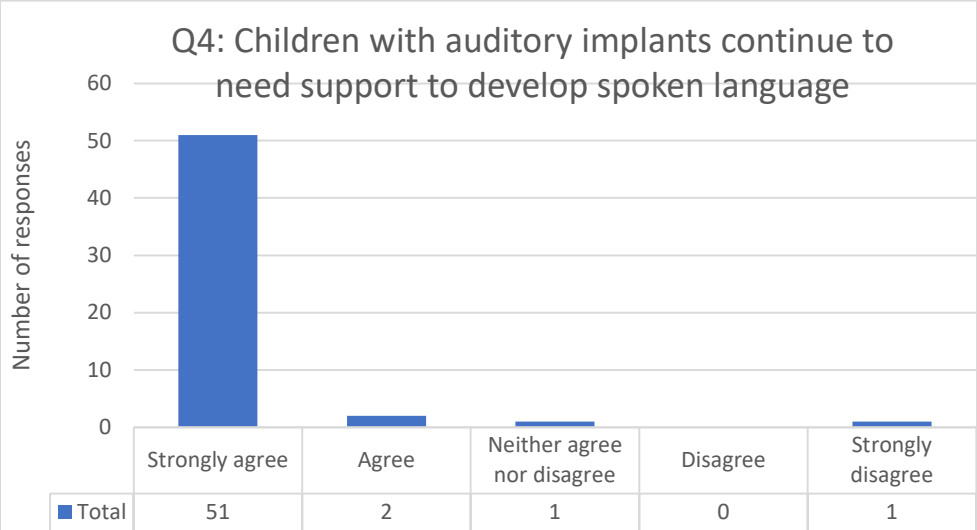

Table 5: Responses to Question 4

By far the majority of respondents (93%) *agreed strongly* with the statement that children with auditory implants will continue to need support to develop spoken language.

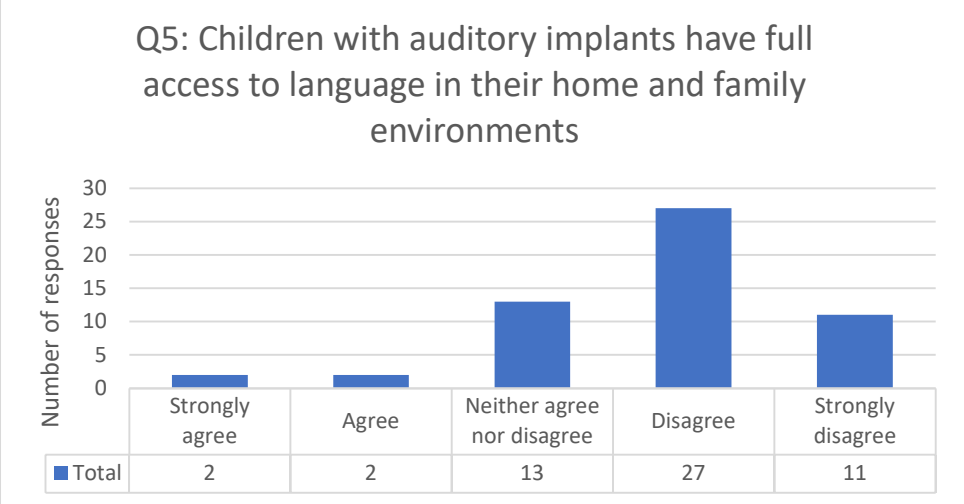

Table 6: Responses to Question 5

The majority of respondents do not believe that children who have auditory implants will have full access to language in their home and family environment with 69%

either *disagreeing* or *disagreeing strongly* with the statement. A further 23% *neither agreed nor disagreed*.

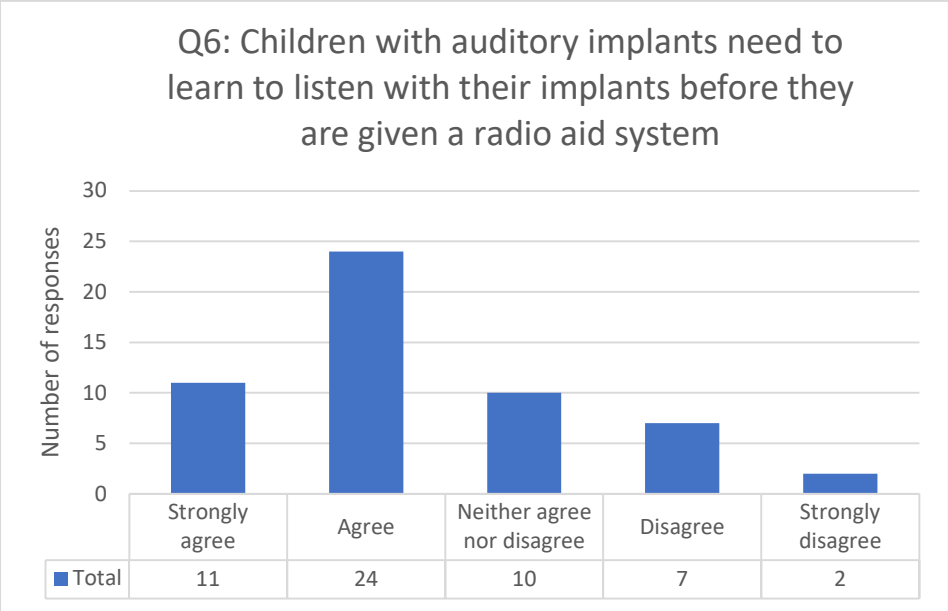

Table 7: *Responses to Question 6*

The majority of respondents (63%) *agreed* or *strongly agreed* with the statement that children with auditory implants need to learn to listen with their implants before they are given a radio aid system with 18% *neither agreeing nor disagreeing*.

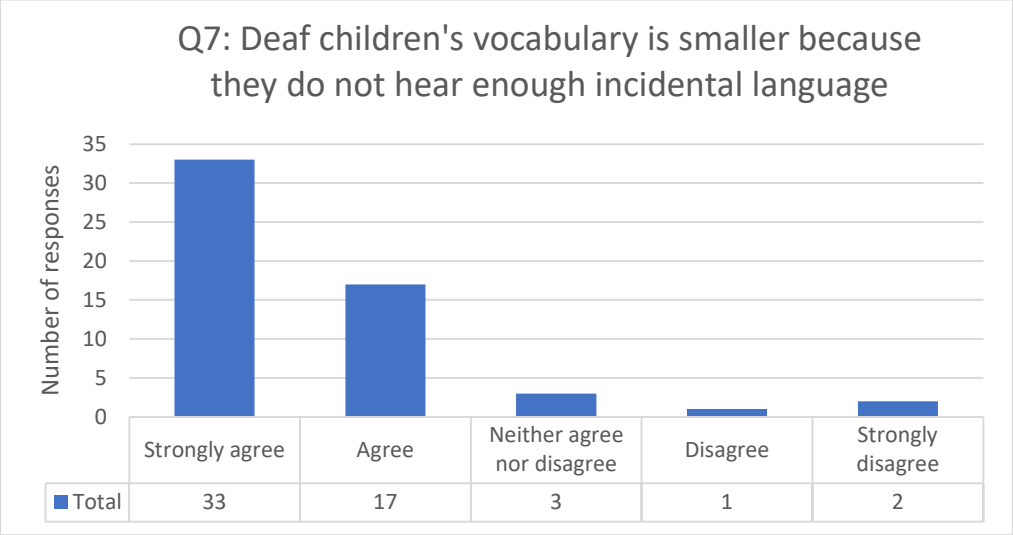

Table 8: *Responses to Question 7*

59% of respondents *strongly agreed* with the statement that deaf children's vocabulary is smaller because they do not hear enough language with a further 30% agreeing with the statement.

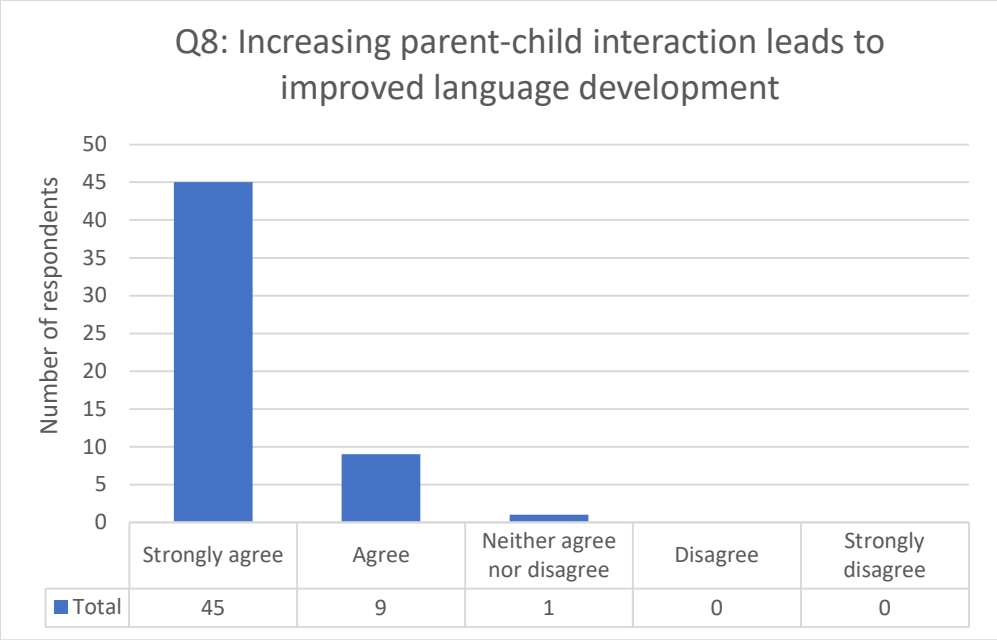

Table 9: *Responses to Question 8*

There was almost universal agreement with the statement that increasing parent-child interaction leads to improved language development with 82% *agreeing strongly* and 16% *agreeing* with the statement.

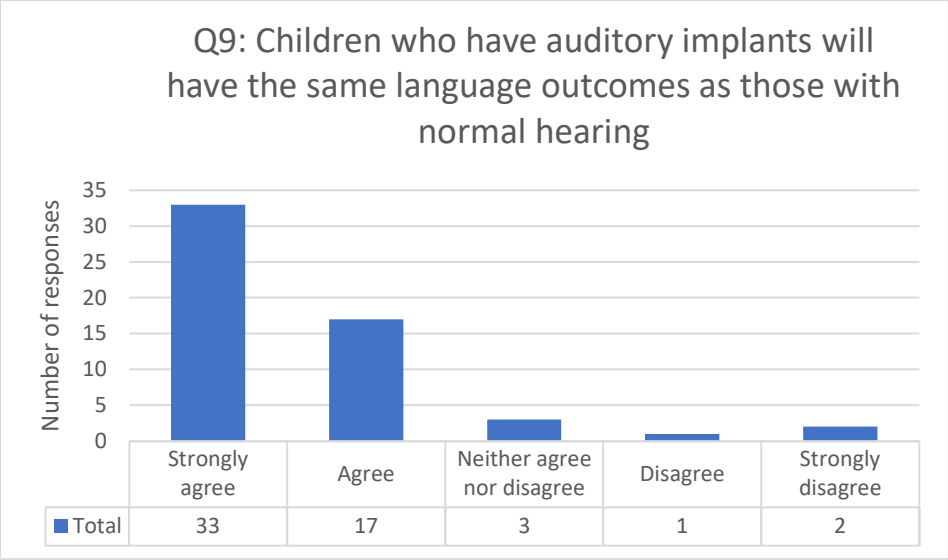

Table 10: *Responses to Question 9*

The majority of respondents *strongly agreed* (59%) or *agreed* (30%) with the statement that children who have auditory implants will have the same language outcomes as those with normal hearing.

4.3.2 Radio Aid Systems – Questions 10-15

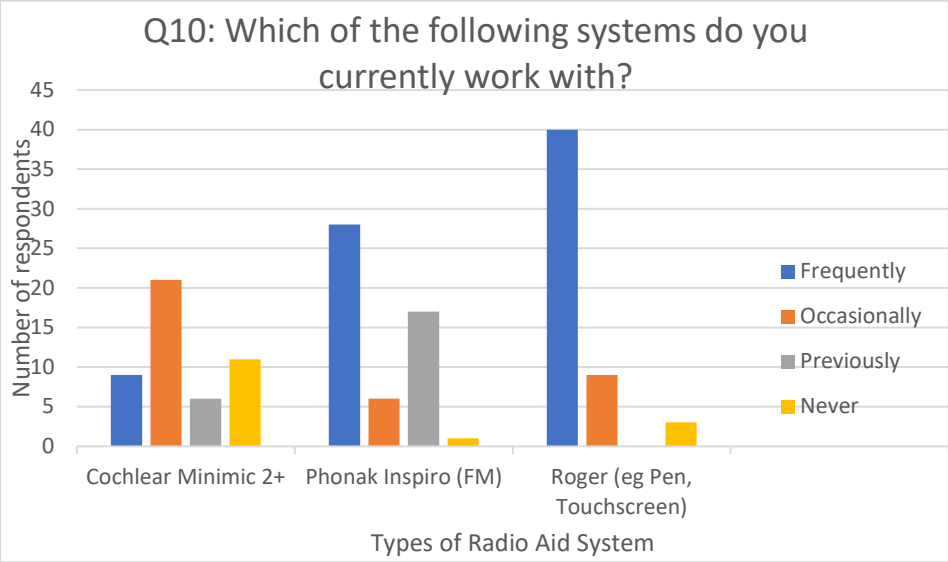

Table 11: *Responses to Question 10*

Most respondents (76%) were currently *working frequently* with a Roger system, 53% with an Inspiro system and only 9% with a Minimic system.
44% of respondents *occasionally worked* with a Minimic system, 17% *occasionally worked* with a Roger system and 12% with an Inspiro system.
33% of respondents had *previously used* an Inspiro system and 13% had *previously used* a Minimic system.
Almost a quarter (23%) had *never used* a MiniMic system whereas 6% had *never used* a Roger system and 2% had *never used* an Inspiro system.
Thus, respondents typically had more experience of working with Roger systems than with MiniMics.

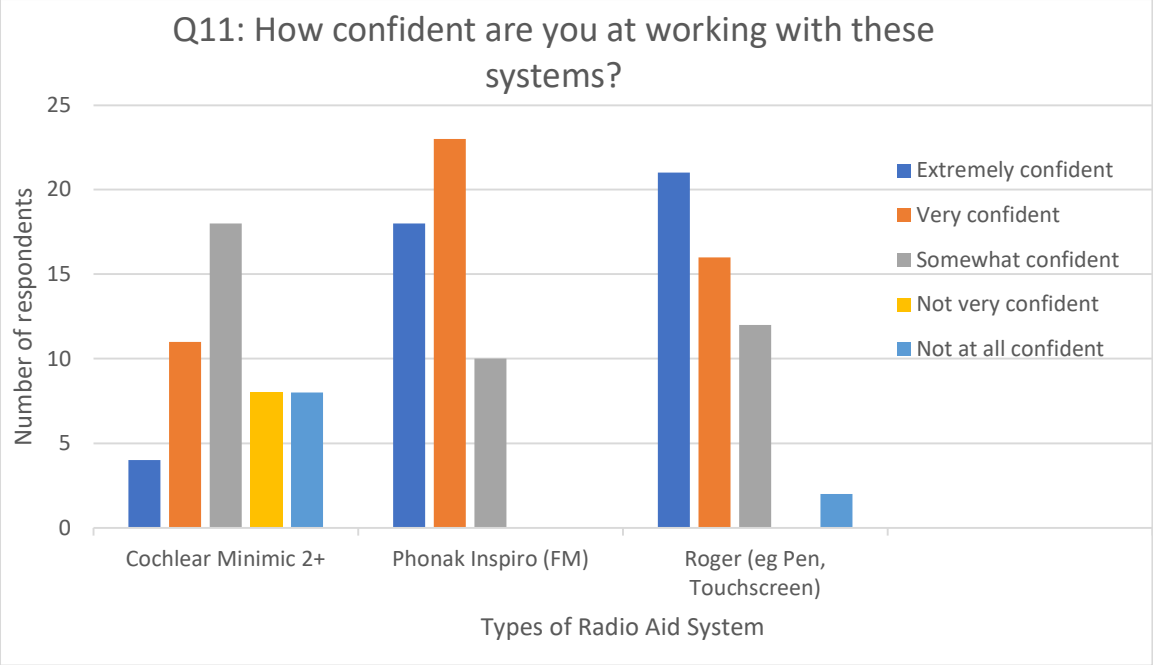

Table 12: Responses to Question 11

The majority of respondents felt *extremely confident* or *very confident* working with an Inspiro system (35% and 45% respectively).

Similarly, the majority felt *extremely confident* (41%) or *very confident* (31%) working with a Roger system.

However, the results for the Minimic system were different with the most common response being *somewhat confident* (37%). 30% of respondents considered themselves to be *extremely* or *very confident* and 33% *not very* or *not at all* confident.

Q 12: NDCS Quality Standards on Radio Aids recommend that children should be offered a Radio Aid System "at first fitting" of hearing aids. To what extent do you agree with this recommendation?

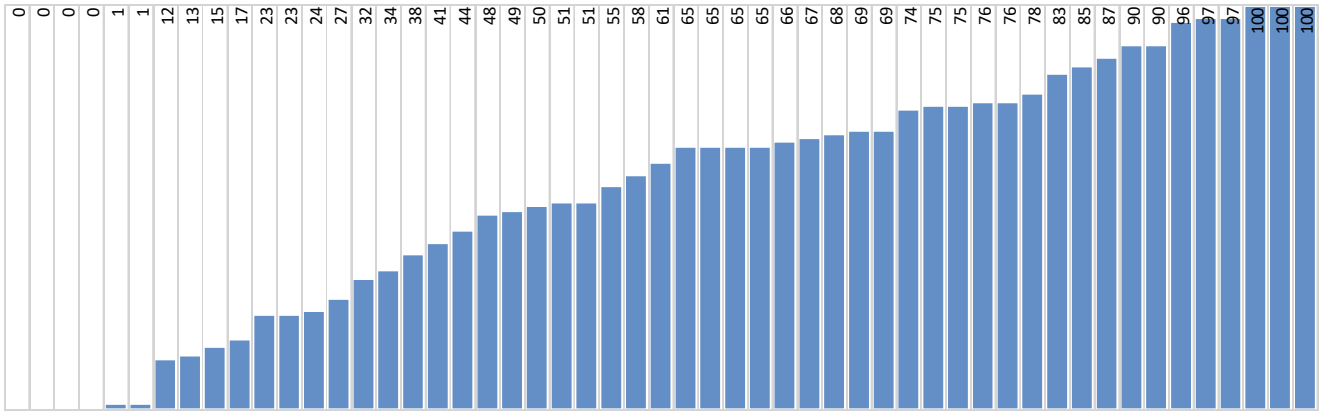

Table 13 Individual responses to Question 12

Respondents to this question expressed their view using a simple linear scale to which a numerical value was allocated by the software. Table 13 shows individual responses. There was a broad and relatively even spread of responses across the possible range with a Mean=54 and a Standard Deviation=32.

Q 13: To what extent is this implemented in your service?

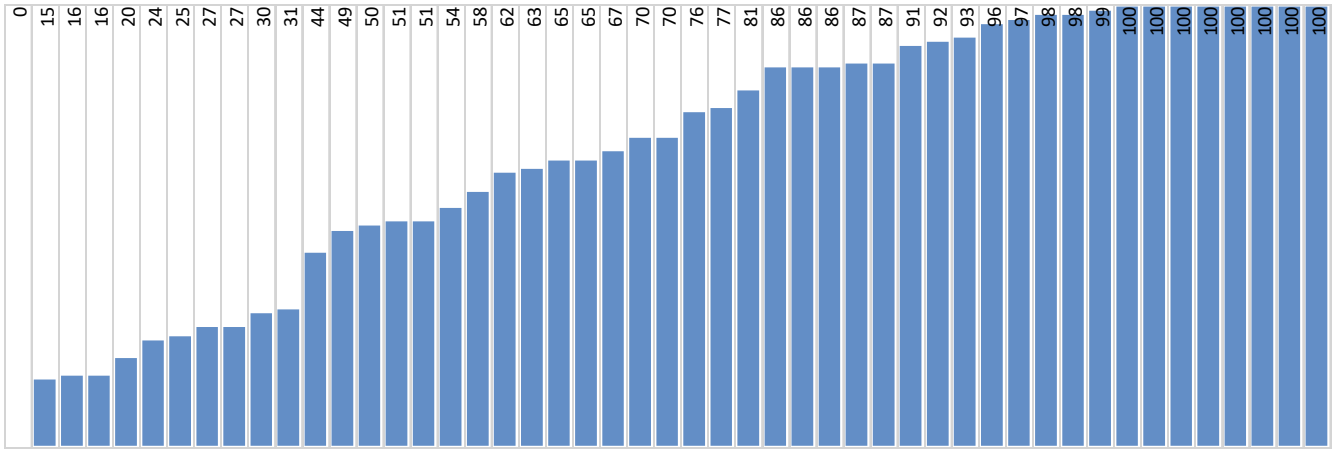

Table 14: Individual responses to Question 13

This question also used a simple linear scale and Table 14 shows individual responses. Responses suggest that, with a Mean=68, responses tend towards the higher end of the scale but, with a Standard Deviation=31, there is considerable variation in the implementation of the NDCS recommendation.

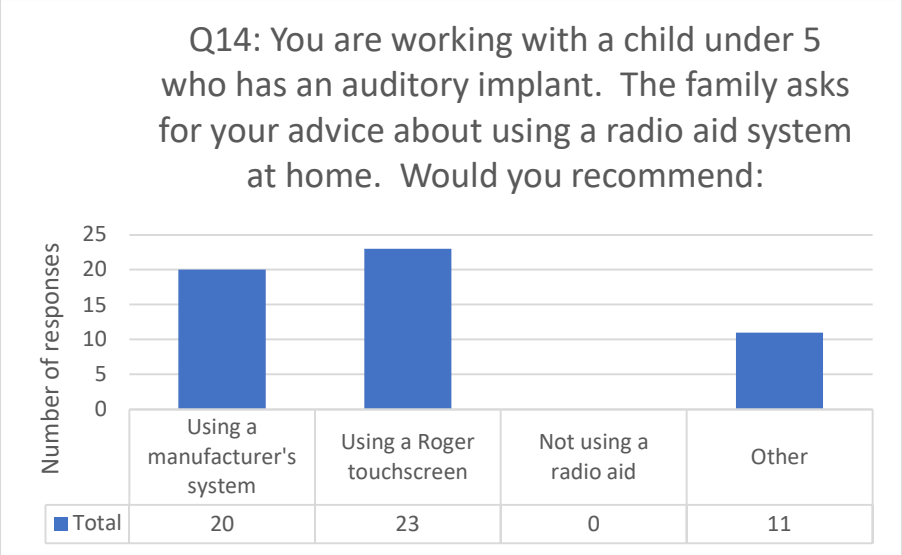

Table 15: *Responses to Question 14*

Responses for this question were evenly spread between using the *manufacturer's system* (36%) or using a *Roger Touchscreen* (41%). However, 20% of respondents chose a "Other" as their response.

The comments were analysed for common themes. A number of comments across the categories referred to the need for child/family-centred discussion and consideration of the child's current use of speech processors.

For those recommending the use of a manufacturer's system, comments included:

Ease of use *5 of 15 comments*	*"A MiniMic does not require an additional receiver which makes it practical to use. The addition of a receiver, even one which is called 'integrated' can be too bulky for the young child."*
Ease of provision *5 of 15 comments*	*"I'd recommend the minimic 2+ initially as they have easy access to that"*

Table 16: *Comments in response to Question 14: Manufacturer's systems*

For those recommending a Roger Touchscreen, comments included:

Sound quality 1 0f 10 comments	*"Better sound quality. Not a lot of research findings regarding the benefits of minimic vs Radio Aids"*
Familiarity with the system 2 0f 10 comments	*"I would be confident to use the Roger system as we know that it is fit for purpose (e.g. regarding operating range, frequency response, signal latency etc). I think we need to find out more about manufacturer's systems (would be great if they work well enough as they are so much cheaper)."*

Table 17: *Comments in response to Question 14: Roger Touchscreen*

Interestingly, 3 of the 10 responses commented that they did not have enough experience of the Minimic to compare the systems.

For those answering "Other", comments included:

Individual decision *4 of 10 comments*	*"It would involve a lot of discussion with the parents regarding the types of systems available, but it would also be governed by age of the child, the stage of rehabilitation, discussion with the implant centre, parent views. It would not be a straightforward decision-making process"*
Discuss with implant centre *3 of 10 comments*	*"I would discuss this with the implant centre, to check they have a stable map and are ready for this listening experience. I would use FM CHIP to support this decision."*
1 of 10 comments	*"We do not usually provide children under 3 with Radio Aids."*

Table 18: *Comments in response to Question 14: Other*

Question 15: Do you have any comments to add?

24 respondents contributed comments. Many were similar to those shown above but 3 other themes were identified.

Learning to listen 3 of 24	*"Wouldn't recommend fulltime use as would like to see development of listening in environment with and without background noise"*
Ability to report 1 of 24	*"Radio Aids are frequently not working correctly, usually presenting with interference/ intermittent. I am concerned that children under 3 are not able to report on their experiences"*
Funding 3 of 24	*"We would never hold back on issuing a PLD to a preschooler with implants - but our resources are finite"*

Table 19: *Responses to Question 15*

4.3.3 Your current practice – Questions 16-20

The response rate for these questions was lower with no question having more than 47 responses from a total of 59.

Q 16: When you are setting up a radio aid system with hearing aids, what process do you use?

45 respondents answered this question. As this was an open question with little guidance as to the response that was expected, participants varied in their interpretation of the question and level of detail involved. Key word analysis showed the following:

Terminology	*Mentions*	*%*
Test box/Aurical HIT/FP35	23	51%
Balancing/Acoustic transparency/verification	14	31%
Listening checks/speech discrimination/validation	10	22%
Protocols (QS, Ewing, NATSIP, NDCS, FM Advantage, Radio Aid Working Group all named)	6	13%
Roger Touchscreen default	1	2%

Table 20: *Comments in response to Question 16*

The most common method cited for setting up a Radio Aid System with hearing aids was the use of a test box: 51% of respondents used this terminology. 31% of respondents noted that the system was balanced or verified and 22% mentioned validating the system set-up through speech discrimination, listening checks and subjective opinion of the child. Six participants mentioned that a protocol was followed and several were named; some respondents named more than one protocol.

Q 17: When you are setting up a radio aid system with a Bone Conduction Hearing instrument (eg BAHA), what process do you use?

There were 44 responses to this question, of which 22 were reports that the participant had never had to do this.

10 participants referenced the use of the Minimic as being the only option, either as a complete system or as a component in linking to a Roger Touchscreen via a Roger X receiver. 3 commented on the impossibility of verifying the system and one reported use of an Aurical for verification.

Q 18: When you are setting up a radio aid system with cochlear implants, what process do you use?

43 responses

Terminology	*Mentions*	*%*
Test box/Aurical HIT/FP35	17	40%
Balancing/Acoustic transparency/verification	9	21%
Auditory Implant Centre	6	14%
Listening checks/speech discrimination/validation	5	12%
Protocols (QS, Ewing, NATSIP, NDCS, FM Advantage, Radio Aid Working Group all named)	4	9%
Roger Touchscreen default	1	2%

Table 21: *Comments in response to Question 18*

As with setting up a Radio Aid System with a hearing aid, most respondents to this question referenced the used of an electro-acoustic testbox (40%) for the purposes of balancing the system (21%). 14% of participants indicated that the Auditory

Implant team would be involved in the process or that the implant team might have sole responsibility.

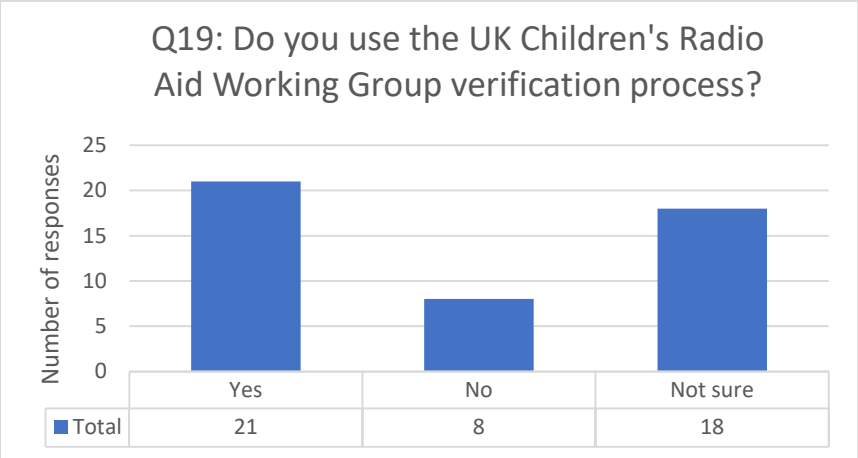

Table 22: *Comments in response to Question 19*

There were 47 responses to this question. 45% of respondents reported that they used the UK Children's Radio Aid Working Group verification process and 17% reported that they did not.

38% were *not sure* whether they used this process

Q 20: Can you tell me more?

Seventeen participants offered comments.

Comments from those who answered "Yes" included comparisons other protocols, the need to stay up-to-date and the need for a Service to have a Radio Aid policy. The use of technicians was referenced by 2 respondents.

Of the 8 participants who answered "No", one was not involved in setting up Radio Aid systems and one commented "I would like to know more!".

38% of respondents were not sure whether their Service used the UK Children's Radio Aid Working Group verification process. One commented that they used instructions "kept in the testbox", one that they used instructions from a commercial provider and one that they bought in technical support to undertake this work.

4.3.4 Strengths & weaknesses of Radio Aid Systems: Questions 21-28

Responses to the questions in this section were provided by 39-45 of the 59 participants.

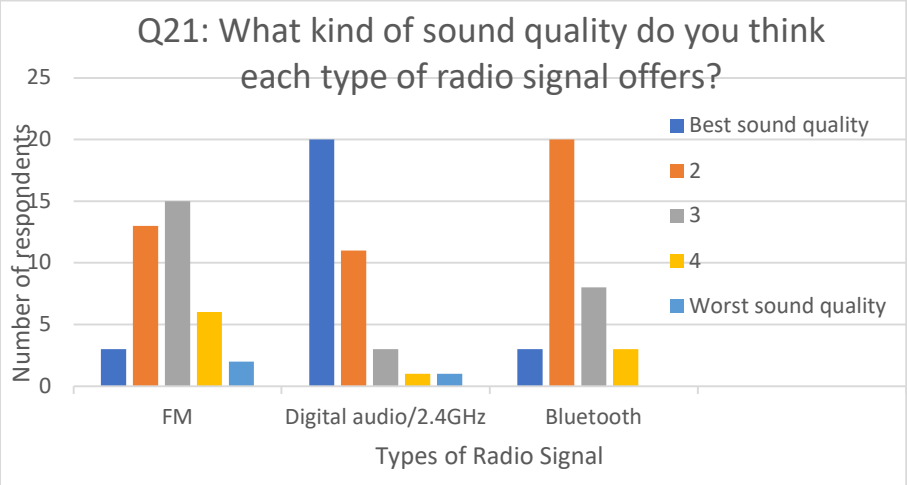

Table 23: *Responses to Question 21*

Of the 41 people answering this question, 56% believed that the digital audio/2.4GHz signal offers *best sound quality* with a further 31% rating it at the next point on the scale. One participant believed it to be the *worst sound quality*.

While only 9% believed that Bluetooth offered the *best sound quality*, 59% believed it to offer quality at the next point on the scale. No participant believed it to offer the *worst sound quality*.

Participants tended to rate the quality of the FM signal in the centre of the scale with 38% believing it to be at the mid-point of the scale, 8% believing it to be the best and 5% believing it to be the worst.

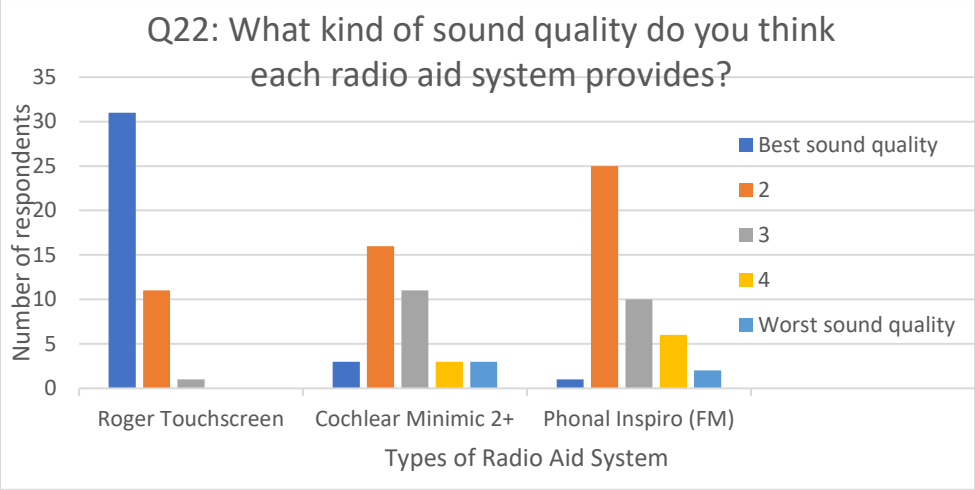

Table 24: Responses to Question 22

The Roger Touchscreen system is considered to offer the *best sound quality* by 72% of respondents and sound quality at the next point on the scale by a further 26%; no respondents considered it to offer the *worst sound quality*.

Opinions on the sound quality of the Minimic are far more variable with 44% believing it to be at point 2 and a further 31% at point 3. 8% believed it to offer the *best sound quality* but another 8% believed it to be the *worst*.

57% of responses indicated the belief that the Phonak Inspiro (FM) system offered sound quality at point 2. One participant rated it as offering the *best sound quality* and 2 as offering the *worst*.

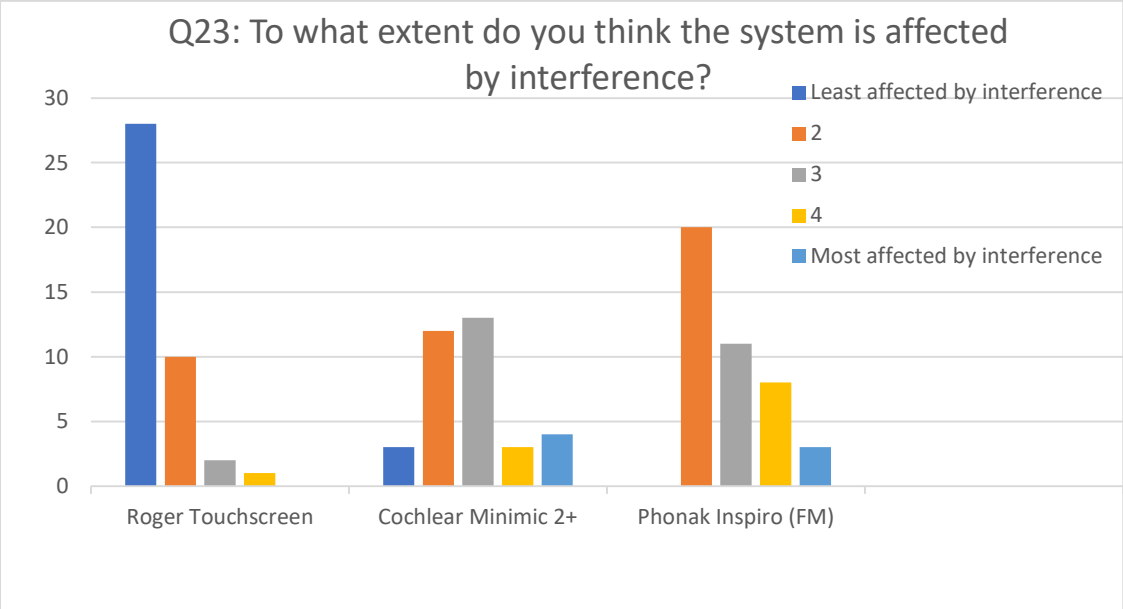

Table 25: Responses to Question 23

The results for Question 23 also show a considerable advantage for the Roger Touchscreen with 68% believing it to be *least affected by interference*.
9% believed the Minimic to be *least affected by interference* with 34% identifying scale point 2 and 37% scale point 3. However, 11% believed it to be *most affected by interference*.
No respondent believed that the Phonak Inspiro was least affected but 48% of respondents considered it to be scale point 2. Three respondents (7%) believed it to be *most affected by interference*.

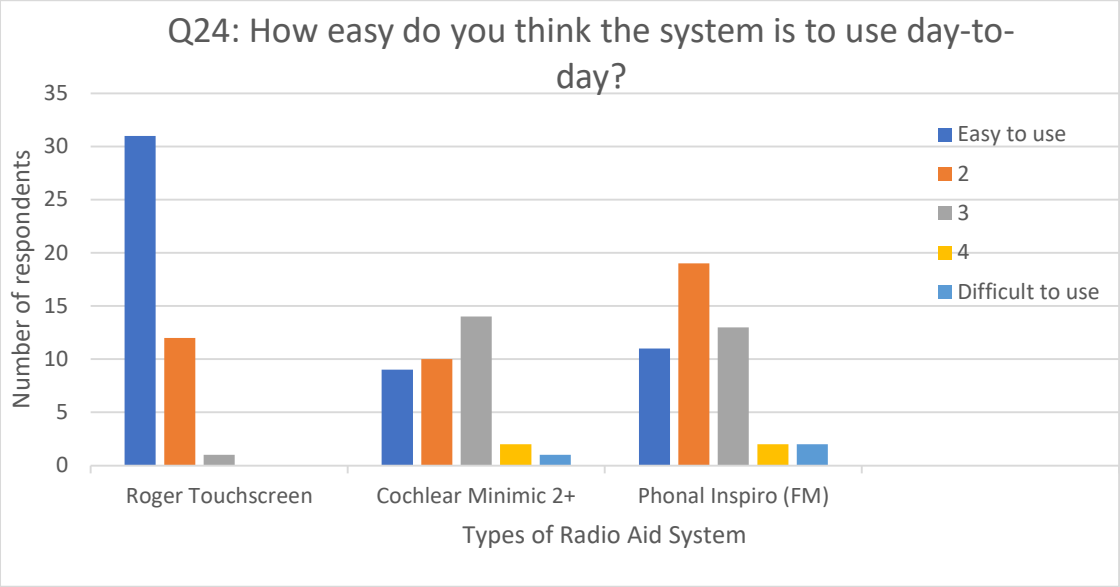

Table 26: *Responses to Question 24*

44 respondents answered the question with respect to the Touchscreen and 45 with respect to the Inspiro but only 36 with respect to the Minimic. This may reflect the participants having had less experience of working with the system (*see Q10 above*).
70% of respondents considered the Roger Touchscreen to be *easy to use* with a further 27% choosing the next scale point.
25% believed the Minimic to be *easy to use* with a further 28% choosing scale point 2 and 39% scale point 3.
24% believed the Phonak Inspiro to *easy to use* and a further 42% chose scale point 2.

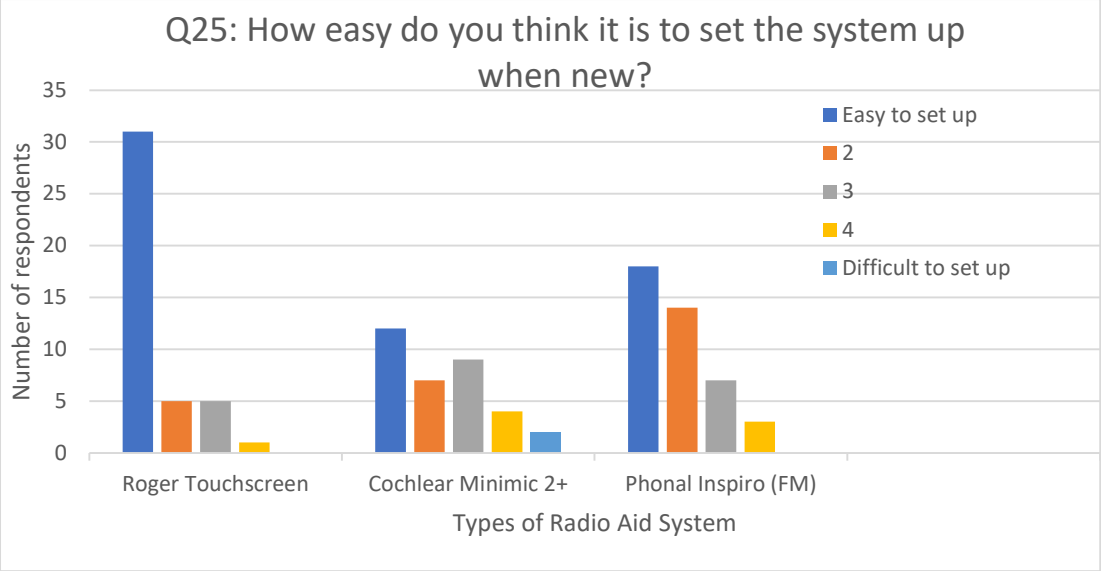

Table 27: *Responses to Question 25*

As with Question 24, fewer people answered the question with respect to the Minimic (34 participants) by comparison with the other 2 systems (42 respondents each). 70% believed the Touchscreen to be *easy to set-up*, 35% believed the Minimic to be *easy to set up* and 42% believed the Inspiro to be *easy to set up*.

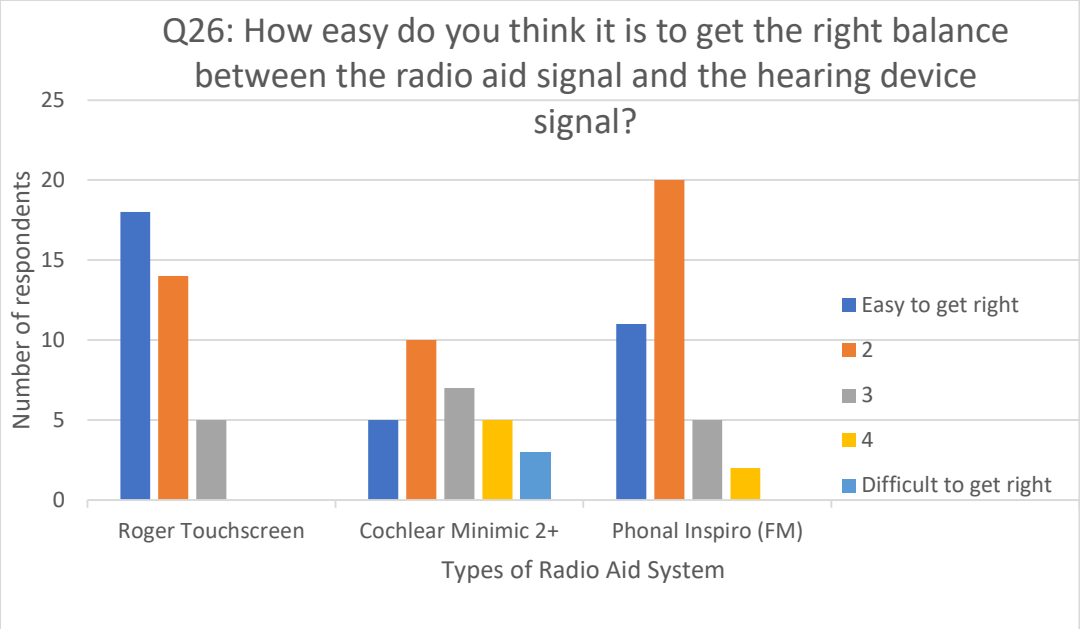

Table 28: *Responses to Question 26*

Of the 37 respondents who rated the Touchscreen, 49% believed it *easy to get the balance right* and a further 39% rating it at scale point 2 (total 88%).

Of the 38 respondents who rated the Inspiro, 29% believed it to be *easy to get the balance right* with a further 53% believing it to be at scale point 2 (total 82%).

However, of the 30 respondents who rated the Minimic, only 17% believed it to be *easy to get the balance right* with a further 33% believing it to be at scale point 2 (total 50%); half of all respondents believed the Minimic to be at scale point 3 or below for ease of getting the balance right.

Q 27: Do you have any comments to add?

Of the 21 additional comments, 10 related to job role, noting that they did not balance radio aids or had little experience of Minimics and 3 commented on problems with receivers. There were no other clear themes.

"Always difficult with implants because you can never actually test the whole system nor listen to it."
"it is not necessarily about interference but no signal in certain situations such as fabric interfering eg metal."
"With digital it is much more cliff edge - the signal falls off and there is nothing rather than quality reduces." *"Have been told that balancing of Roger technology is not necessary."*
"This is very difficult to determine a consistent response, as it often depends on the type of receiver used and the consistency of signal has many additional variables outside of the device itself"

Table 29: *Comments in response to Question 27*

Q 28: Could you describe briefly what you believe to be the main differences between the two?

There were 40 responses to this question which were analysed for key words and themes as shown below:

Signal range	*"The Mini Mic is not recommended for use in schools as it has a shorter range than the Roger and also its signal can be blocked by things in the way between the speaker and receiver. "*	10
Bluetooth	*"One is Bluetooth the other digital"*	6
Number of users	*"Roger can be paired to multiple devices but the minimic can only connect to one"*	6
Suitability for schools	*"the roger touchscreen is designed to be used in classrooms"*	5
Receivers	*Roger Touchscreen has a connection by receivers*	5
Physical difference	*"The mini mics are less versatile or robust for little hands"*	3
Mute function	*"The mute function is easier on the Tx"*	3
Functionality	*"Mini Microphone 2+:- reliable and improves speech understanding in difficult listening situations where distance, background noise or poor acoustics are an issue. - connects to audio source, e.g. music player, PC, phone to stream audio directly to the sound processors. "* *"Roger Touchscreen: - automatic microphone function which switches from an individual talker to a small group interaction mode, based on the orientation of the device"*	3
Signal	*"The one issue of concern to me with the MiniMic2+ is the signal delay which can be difficult for some children to deal with or to ignore. "*	2

Table 30: *Comments in response to Question 28*

4.3.5 Your experience of training – Questions 29-35

Q 29: Which of the following best describes you?

As shown in *Table 2: Question 29 - Professional characteristics of respondents* (above) the majority of respondents (76%) described themselves as QToDs with a further 7% ToDs in training. 9% described themselves as Educational Audiologists and 9% as Other.

Q 30: In your career so far, how many years have you worked with deaf children?

As shown in *Table 3: Question 30 - Professional experience of respondents in years* (above), there was a wide variation in years of experience ranging from 2-36. The mean years of experience was 17 with a standard deviation of 10.

Q 31: How do you keep up-to-date with developments in practice?

Source of Professional Development	Number of responses	Percentage
BATOD (specifying the magazine)	26 (9)	58% (20%)
Organisations (eg NDCS, BAEA, CHSWG)	12	27%
Colleagues	8	18%
Conferences	7	16%
Online and social media	7	16%
Manufacturers	6	13%
Reading	5	11%

Table 31: *Comments in response to Question 31*

Over half of those who responded to the survey reported that BATOD was a source of professional support with 20% of respondents specifying the organisation's magazine. Of the 7 people citing conferences, 4 specified the BATOD conference. Other not-for-profit organisations (such as NDCS) were named by just over a quarter of respondents whilst manufacturers were mentioned by only 13%.

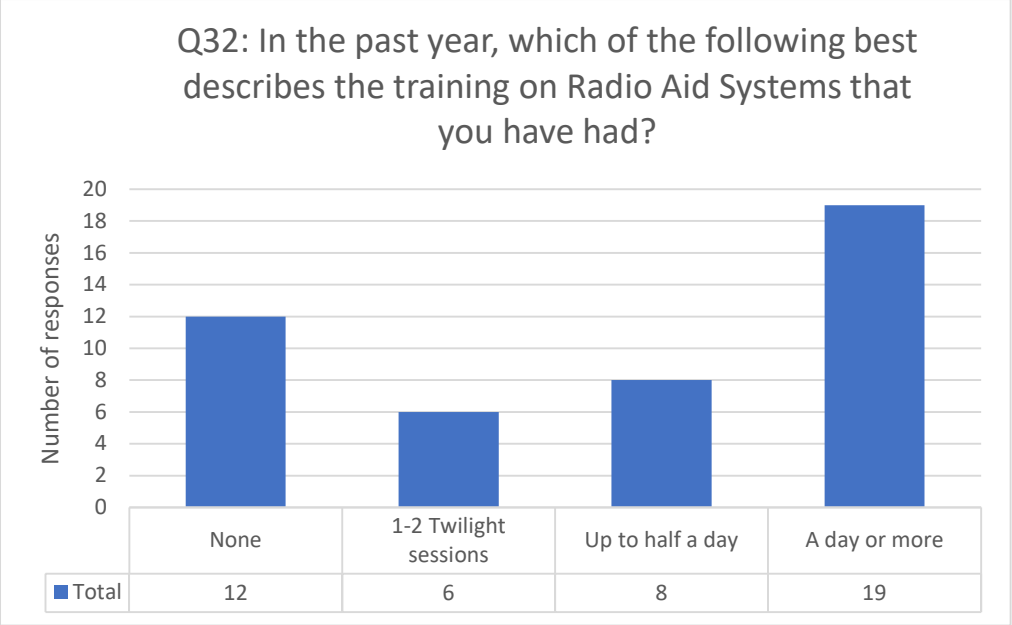

Table 32: Responses to Question 32

Of the 45 respondents who completed this question, 42% had had *a day or more* training whilst 27% had had *none*.

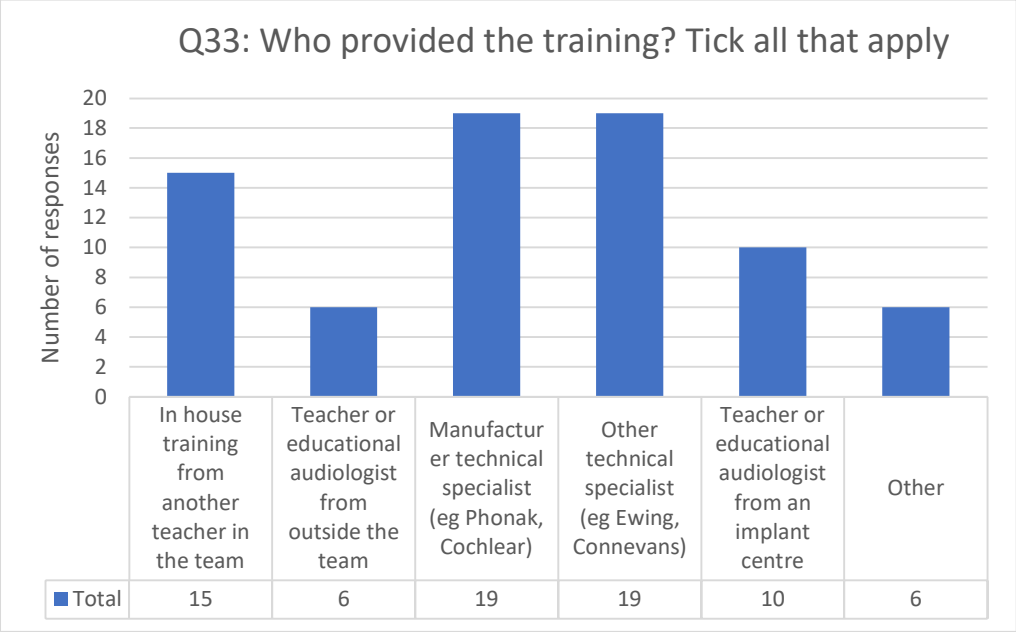

Table 33: Responses to Question 33

Technical specialists from either manufacturers or other relevant organisations provided the majority of training on Radio Aids with 56% of the respondents having attended such events.

In-house training provided by colleagues was listed by 15 respondents (44%).

Training from teachers or Educational Audiologists from Implant Centres (29%) and other external teams (18%) delivered most of the rest.

Of those choosing Other, 3 listed training from their current University course, 2 listed in-house training from an Audiology specialist and one commented “It’s more likely that I would give the training.”

Table 34: Responses to Question 34

The majority (69%) of respondents continue to feel the need for further training.

Q 35: If yes, how do you feel that they should be met?

Ongoing training as technology changes	*“More regular, more robust training to keep up to date with the developments (rather than just behind the developments as it sometimes feels)”*	8	26%
Use of the MiniMic	*“If parents are using MINIMICS at home, then ToDs need to know how to support parents with them”*	6	19%
Training from the Implant Centre	*“The best advice I received was when I worked closely with audiologist and ToDs from implant centre and they could visit us at school. We researched together. Those days are gone I fear!”*	4	13%

Use of Radio Aids at home	*"I would like training on helping parents use radio aids in the home, and how best to use them, what conditions".*	2	6%
Other	*"More transparency from manufacturers regarding their products"*	1	3%
	"With great difficulty as zero training budget and working solo!"	1	3%

Table 35: *Comments in response to Question 35*

There were 31 responses in total, the majority commenting that ongoing training was essential. With the exception of the four respondents who would welcome training from their implant centre, participants named the *topic* that they wanted rather than the means of delivering it. Specific needs included the use of the MiniMic and supporting Radio Aids in the home.

5. Discussion

5.1 Summary of the results

Four themes emerge in analysing the responses to the survey

- Design of the survey and reasons for the response level
- Teachers' attitudes to the use of radio aid systems
- Factors affecting professional practice
- Barriers to change

5.2 Survey design and response level

The survey was, as far as possible, compiled in accordance with principles of good questionnaire design (eg Artino, 2014; Dillman, 2014) with consideration given to types of question, order of questions and method of circulation. Nonetheless, the response rate is estimated to be approximately 5% which means that, while analysis of the responses is interesting and worthwhile, it cannot safely be considered as representative of views of the population of Teachers of the Deaf as a whole. The non-response rate to a questionnaire is unlikely to be random; non-responders may differ systematically from responders and this can introduce systematic error into the results.

Dillman (2014) comments that:

> *"For many recipients of survey requests, the invitations come as annoying intrusions into their lives" [p19].*

In order to reach the target audience, the questionnaire was circulated with the assistance of BATOD, the professional body representing Teachers of the Deaf. However, it was not circulated to their entire membership but rather publicised via their social media presence. Whilst having the implicit approval of BATOD may have helped to build trust and encourage ToDs to click through to the questionnaire, it is likely that the existence of the survey was unknown to most members. The hoped-for snowballing of responses appeared not to have happened as the vast majority of responses were received within a day or two of the request going live. It may be that the initial participants were those with an interest in the topic; those with less interest might simply delete the emails without having read them. (Coughlan, 2019)

As noted in *Section 3.2.3.2*, the questions had been arranged to place first those questions which the author considered to be of high interest to Teachers of the Deaf: those pertaining to the language development of deaf children. However, inevitably in the context of academic research (as opposed to, for example, marketing) the first two pages of the survey consisted of a detailed Participant Information Sheet and a Consent Form; Dillman (2014) observes that there are significant cut offs on web surveys when the first page consists of a consent form.

He further notes that "Surveys that are completely electronic…are the fastest growing form of surveying" [p301] but cautions that questionnaires sent in this way empower the respondent who can respond at her leisure but can equally choose to exit at any point with a single mouse click.

In order to reduce the load for the respondent, it is recommended that surveys should be kept short and the questions easy (Ary et al, 2014). Realising that they cannot answer questions causes respondents to terminate the survey (Dillman, 2014). The length of the survey and the technical knowledge required are two reasons which may have been the cause of many choosing not to complete the survey or to skip particular questions.

5.3 Teachers' attitudes to the use of radio aid systems

However, despite the methodological limitations of the survey, some interesting data was collected.

5.3.1 Access to speech

As was predicted, the Teachers of the Deaf who responded to the survey overwhelmingly believed that children who have auditory implants will continue to need support to develop language (93%) with 69% believing that children with auditory implants do not have full access to the language of their home and family. There was considerable support for the statements that increased interaction would lead to improved language and that deaf children have smaller vocabularies as a result of their reduced ability to overhear.

Thus, it would be hypothesised that respondents would support the use of technology to increase the child's access to speech. Moeller & Tomblin (2015) emphasise that audibility is one of the key factors in the deaf child's Cumulative

Linguistic Experience that will underpin their language outcomes and note that hearing equipment is restricted by the need to be within optimal distance of the microphone – what Dorn (2018) terms the "listening bubble" [p237].
Cole & Flexer (2016) comment that the key reason for the use of a RMS is to effectively move the speaker's voice closer to the child's microphone, thereby improving the SNR and enabling the auditory information to be channeled to the brain. However, there continues to be a belief that children with cochlear implants should not be given access to Radio Aid technology in the early stages of learning to listen.
In this survey, 63% of respondents *agreed* or *strongly agreed* that children with auditory implants need to "learn to listen through their implants" before using a RMS.
Cole & Flexer (2016) argue that:

"Expecting a child with hearing loss to listen and understand in noise, day after day, is like expecting a child to learn to read in the dark" [p204].

5.3.2 Experience of Radio Aid Systems

The next section of the survey focused on individuals' experiences of 3 radio aid systems:

- Phonak Roger (digital audio system eg Roger Inspiro, Touchscreen, Pen)
- Phonak Inspiro (FM system)
- Cochlear MiniMic2+ (digital audio for Cochlear devices only)

The majority of teachers surveyed (76%) work frequently with Roger systems (eg Roger Touchscreen or Pen) and a further 17% work with them occasionally making them the dominant presence in this survey and in UK education today. 72% of respondents report themselves to be extremely *confident* or *very confident* using them.
The Cochlear MiniMic2+ is issued by the manufacturer to recipients of BAHAs and cochlear implants. Only 9% of participants work frequently with the MiniMic2+ system although a further 44% had worked with one occasionally. 23% of the respondents had *never* used a MiniMic2+ by comparison with 6% who had *never* used a Roger system. Levels of confidence in using the MiniMic2+ are much lower with only 30% of respondents feeling *extremely confident* or *very confident*.

The inclusion of the Inspiro (FM) system for comparison was methodologically contentious as it is a legacy system, no longer supported by the manufacturer and the name allows it to be confused with the subsequent Roger Inspiro. It had been hoped to gather data as to respondents' understanding of the different signal qualities between FM and digital audio but it was clear from responses that some participants were unaware that Inspiro and Roger Inspiro referred to different systems so it proved impossible to unpick this issue.

In *paragraph 2.4.5*, it was suggested that the MiniMic2+ might be useful to increase RMS use at no additional cost to local authority Sensory Support Services. Responses to Q14 suggest that this is already happening with an even number of recommendations for using the implant manufacturer's system and for using a system such as a Roger Touchscreen plus a further group who would make a recommendation on a case-by-case basis.

5.3.3 Understanding of Radio Aid Systems

As noted above, both the MiniMic2+ and Roger systems make use of the 2.4GHz digital audio signal which is the industry standard open access radio frequency and the use of the FM wavelength is now obsolete. There appears to be a lack of understanding of the type of signal used by systems and this is impacting upon Teachers of the Deaf and their view of the quality of systems. For example, in Q28, when asked for differences between the Roger Touchscreen and the Cochlear MiniMic2+, 6/40 respondents (15%) commented that the MiniMic2+ used a Bluetooth signal which is not the case.

There is a wide range of beliefs surrounding the factors which might impact upon the use of different systems (sound quality, signal quality, interference, ease of setting up and achieving acoustic transparency). The small sample size renders it frustratingly difficult to draw conclusions about ToDs' understanding of the technology and how this would impact upon their professional practice. However, for all 5 dimensions listed above, there was a clear advantage for the Roger system; understanding of the strengths and weaknesses of the MiniMic2+ was much less well-established.

5.3 Factors affecting professional practice

Question 12 asked the extent to which participants agreed with the expectation expressed in the Quality Standards for Personal Radio Aids (NDCS, 2017) that children should be offered a Radio Aid "at first fitting" of hearing aids. This revealed a wide spectrum of attitudes amongst participants which suggests that Teachers of the Deaf are not yet aware of the evidence-base for this recommendation or have opted to disregard it.

Giboney Wall (2018) considers that teachers' beliefs about professional practice are often constructed over many years' practice and are "deeply personal" [p30]. This may cause them to evaluate new methods in terms of familiarity or personal preference rather than researched best practice. Marschark & Swanwick (2013) contend that evidence obtained through academic research is rarely translated into classroom practice and question whether this is due to a lack of time to seek out this evidence or resources to implement them. Further, they suggest that policy-making is often governed by administrative expedience rather than by evidence.

Nelson (2016) emphasises that it is impossible for Teachers of the Deaf to work effectively without access to research outcomes and technological advances whilst Simpson (2018) notes that, while all fields of education recognise the need for evidence-based practice, there is a history of ideology in decision-making for children who are deaf. Similarly, Marschark & Swanwick (2013) note that, within the field of deaf education, "there is a legacy of polarised debate… and a tendency for belief or conviction rather than evidence to drive practice" [p222].

Lockton (2017) also observes that research rarely changes instructional practices in schools. She suggests that teachers make sense of their context through deliberations with colleagues. Professional networks (formal and informal) offer opportunities to discuss their ideas and values and how these will guide practice. She cites Opfer & Pedder's (2011) contention that change in education is slow as teachers - in order to change their practice - must change their underlying beliefs.

Norman & Jamieson (2015) report that early career Itinerant Teachers of the Deaf are more open to professional development, suggesting that those who are more experienced have a greater sense of self-efficacy which may impact upon their motivation to engage in CPD. It was noted that 30% of participants in this study identified that they had *no need for further training* with respect to RMS technology.

Regrettably it was not possible to identify whether there was a correlation between this and number of years of professional experience.

5.4 Barriers to change

There is a tension between the need to improve the quality of support and the need to work within logistical and financial constraints. Harrison-Blount et al (2019) outline issues relating to change management within health professionals.

It is noted that there is often a reluctance to embrace evidence-based practice as professionals continue to use methods which are familiar rather than in accordance with modern research. Changes in guidance, accessing new research and the need to secure appropriate training are all considered to act as barriers to change.

The Change Model Guide (NHS England, 2018) notes that the adoption of best practice “does not just happen” [p10] but is driven by the *shared purpose* of the team.

It may be argued that this study demonstrates that there is a shared purpose amongst Teachers of the Deaf; the majority of respondents shared an understanding of the challenges facing children who are deaf as they develop their linguistic skills. However, it continues to be necessary to identify ways to manage change within the profession such that children have universal access to the high quality auditory input they need and practice which is evidence-led.

6. Conclusions

There is an increasing awareness that children who are deaf are not simply “hearing children who cannot hear” (Marschark et al, 2011 [p4]). Inadequate or absent stimulation to the auditory cortex from before birth, a degraded auditory signal through amplification and the limitations of hearing equipment (including cochlear implants) in noise or at a distance bring significant challenges to the child as he grows.

Language acquisition - which is predicated upon having good auditory access to significant quantities of clear speech together with interaction with sensitive and responsive caregivers – is fundamentally violated. Further, as the child grows, the restricted auditory signal continues to impact upon new word learning in a continuing negative spiral. Issues of both reduced vocabulary and reduced access to adults’ modelling of their own mental states predispose children who have significant hearing loss to atypical development of theory of mind and other aspects of executive function.

The small sample recruited for this survey makes any conclusions tentative at best. It is likely that the length of the questionnaire itself may have reduced participation rates and some questions (eg regarding current practice for setting up RMS systems) yielded data which was only minimally helpful in answering the research question.

Teachers of the Deaf show significant levels of agreement about the difficulties which children who are deaf will find in developing their language. They also agree that children who have cochlear implants will continue to need support to develop their language.

Whilst many are broadly supportive of the early use of RMS systems with implanted children, there remain a significant number who evidence some reluctance, often suggesting a value to listening in poor acoustic conditions or that children need to listen through their implants first, despite the evidence that the use of RMS will help children to develop their speech discrimination, engage in interaction with caregivers and thereby contribute to the development of Theory of Mind. As Norman & Jamieson (2015) note, the relationship between a family and the ToD is unique and there is a close bond of trust. It is essential that the ToD offers the family information

about best practice rather than acting as a gatekeeper to information based upon flawed understanding (Tattersall & Young (2006).

Within the profession, there is a high degree of understanding of and confidence in the Phonak Roger radio aid system. However, practitioners are less experienced in using the Cochlear MiniMic2+ and there is less consistency in professionals' opinions about its functionality or understanding of its specification. While this continues to be the case, it is unlikely that usage will increase.

The majority of those polled indicated an awareness of the need for further training. There is a growing expectation that it is the local Teacher of the Deaf rather than the ICToD who will introduce and manage the RMS, even though this may be of a type unfamiliar to the ToD. Additionally, Teachers of the Deaf have typically developed skills in managing RMS in schools; some identify the need to develop parallel skills to support families at home.

Teachers of the Deaf often work within small teams and may lack access to colleagues who can support adoption of new technology. It was noted that training is often provided by manufacturers who are not always transparent about the limitations of their systems or how they compare with competitors'. BATOD was the most cited source of support and one possibility may be that they could develop new means of engaging ToDs in peer-led professional development. Post-coronavirus, remote training via a platform such as Zoom has become more familiar and this may be a way to allow the development of regular, unbiased updates at reasonable cost and flexibility.

There is a growing evidence-base for the use of radio aids with young children who have cochlear implants. It is essential that Teachers of the Deaf have access to continuing training which supports them to develop expertise in both the use of new technology and the assumptions underlying its implementation.

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Appendix 1

UNIVERSITY OF HERTFORDSHIRE

FORM EC1A: APPLICATION FOR ETHICS APPROVAL OF A STUDY INVOLVING HUMAN PARTICIPANTS

(Individual or Group Applications)

Please complete this form if you wish to undertake a study involving human participants.

Applicants are advised to refer to the Ethics Approval StudyNet Site and read the Guidance Notes (GN) before completing this form.

http://www.studynet2.herts.ac.uk/ptl/common/ethics.nsf/Homepage?ReadForm

Applicants are also advised to read the FAQ General Data Protection Regulation (GDPR) before completing this form.
http://www.studynet2.herts.ac.uk/ptl/common/ethics.nsf/Frequently+Asked+Questions/4AD88CD88D0F3F2D8025829800300621

Use of this form is mandatory [see UPR RE01, 'Studies Involving Human Participants', Sections 7.1-7.3]

Approval must be sought **and granted** before any investigation involving human participants begins [UPR RE01, S 4.4 (iii)]

If you require any further guidance, please contact either hsetecda@herts.ac.uk or ssahecda@herts.ac.uk

Abbreviations: GN = Guidance Notes UPR = University Policies and Regulations

THE STUDY

Q1 Please give the title of the proposed study

Use of Remote Microphone Accessories with Young Children who have Cochlear Implants / Bone Conducting Hearing Implants. An Investigation of Professionals' Opinions and Experiences.

THE APPLICANT

Q2 Name of applicant/(principal) investigator (person undertaking this study)

Marianne Haylett

Student registration number/Staff number

15014383

Email address

mh15adx@herts.ac.uk

Status:

☐Undergraduate (Foundation) ☐Undergraduate (BSc, BA)

☒Postgraduate (taught) ☐Postgraduate (research)

☐Staff ☐Other

If other, please provide details here:

Click here to enter text.

School/Department:

Education

If application is from a student NOT based at University of Hertfordshire, please give the name of the partner institution: Mary Hare

Name of Programme (eg BSc (Hons) Computer Science): MA Deaf Education Studies

Module name and module code: 7FHE1108-0905-Research Methods and Dissertation - Mary Hare

Name of Supervisor: Imran Mulla Supervisor's email: imran.mulla@herts.ac.uk

Name of Module Leader if applicant is undertaking a taught programme/module:

Imran Mulla

Names and student/staff numbers for any additional investigators involved in this study (students should read GN Sections 1.5 and 2.2.1 concerning responsibilities of all members of the group)

Is this study being conducted in collaboration with another university or institution and/or does it involve working with colleagues from another institution?

☐Yes ☒No

If yes, provide details here:

DETAILS OF THE PROPOSED STUDY

Q3 Please give a short synopsis of your proposed study, stating its aims and highlighting where these aims relate to the use of human participants (See GN 2.2.3)

Evidence supports the use of remote microphone technology with children who have received a cochlear implant/bone conducting hearing implant. The use of this technology promotes interaction between caregiver and child and increases the amount of language which the child is exposed to.

Manufacturers of cochlear implants / bone conducting hearing implants used in the UK typically offer families a choice of free accessories, one of which is a remote microphone. However, usually support for its use is not offered by either the implant centre or the child's local Teacher of the Deaf and, anecdotally, many families do not make use of it. Where they have been supported in their use, families often report satisfaction and commitment to continue.

This study aims to examine the attitudes and beliefs of the key professionals working with children who have implants. By understanding the barriers to use, it may be possible to suggest a way forward to encourage greater use of these devices.

Q4 Please give a brief explanation of the design of the study and the methods and procedures used. You should clearly state the nature of the involvement the human participants will have in your proposed study and the extent of their commitment. Ensure you provide sufficient detail for the Committee to, particularly in relation to the human participants. Refer to any Standard Operating Procedures SOPs under which you are operating here. (See GN 2.2.4).

The study would initially make use of a questionnaire which would be circulated to professionals working with children who have been implanted. Children with hearing loss typically have access to a Qualified Teacher of the Deaf (QToD) who visits on a regular basis at home or school to support the family and other caregivers in maximising access to speech and supporting the development of language. The study

would investigate the attitudes of the QToDs to the use of radio aids for these children and their confidence in supporting families in decision making and use of the proprietary accessories. Similar questionnaires would also investigate the attitudes and understanding of the equipment amongst the key rehabilitation personnel at Implant Centres: Audiologists, Speech and Language Therapists and Teachers of the Deaf.

Finally, it is planned to hold a group discussion/focus group event at a training session which is due to be facilitated by the Implant Centre where I work which is aimed at QToD and SALT who are less experienced at working with children who are implanted. This would be an opportunity to allow participants to explore their understanding of the technology and the potential barriers to its implementation.

Q5 Does the study involve the administration of substances?

☐Yes ☒No

PLEASE NOTE: If you have answered yes to this question you must ensure that the study would not be considered a clinical trial of an investigational medical product. To help you, please refer to the link below from the Medicines and Healthcare Products Regulatory Agency: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/317952/Algothrim.pdf

To help you determine whether NHS REC approval is required, you may wish to consult the Health Research Authority (HRA) decision tool: http://www.hra-decisiontools.org.uk/ethics/

If your study is considered a clinical trial and it is decided that ethical approval will be sought from the HRA, please stop completing this form and use Form EC1D, 'NHS Protocol Registration Request'; you should also seek guidance from Research Sponsorship.

I confirm that I have referred to the Medicines and Healthcare Products Regulatory Agency information and confirm that that my study is not considered a clinical trial of a medicinal product.

Please type your name here: Click here to enter text.

Date: Click here to enter a date.

Q6.1 Please give the starting date for your recruitment and data collection: As soon as Ethics approval is agreed.

Q6.2 Please give the finishing date for your data collection: 14.03.2020

(For meaning of 'starting date' and 'finishing date', see GN 2.2.6)

Q7.1 Where will the study take place?

Via email for the original questionnaires. The group interview would take place at the Isobel Family Centre, Linden Lodge School, under the auspices of the St George's Auditory Implant Service

Please refer to the Guidance Notes (GN 2.2.7) which set out clearly what permissions are required;

Please tick all the statements below which apply to this study

Q7.2 **Permissions**

This question is about two types of permission you may need to obtain. Depending on the study you may need more than one of each of these:

i Permission to access a particular group or groups of participants to respond to your study

ii Permission to use a particular premises or location in which you wish to conduct your study

If your study involves minors/vulnerable participants, please refer to Q18 to ensure you comply with the University's requirement regarding Disclosure and Barring Service clearance.

TICK THE APPROPRIATE BOXES IN EACH COLUMN

(i) Permission to access participants (tick)		(ii) Permission to use premises/location (tick)	
	I confirm that I have obtained permission to access my intended group of participants and that the permission is attached to this application		Permission has been obtained to carry out the study on University premises in areas outside the Schools and the agreement is attached to this application.
X	I have yet to obtain permission but I understand that this will be necessary before I commence my study. For student applicants only: I understand that the original copies of the permission letters must be verified by my supervisor before data collection commences		Permission has been obtained from an off-campus location to carry out the study on their premises and the agreement is attached to this application
	This study involves working with minors/vulnerable participants. I/we have obtained permission from the organisation (including UH/UH Partner Institutions when appropriate) in which the study is to take place and which is responsible for the minors/vulnerable participants. The permission states the DBS requirements of the organisation for this study and confirms I/we have satisfied their DBS requirements where necessary	X	I have yet to obtain permission but I understand that this will be necessary before I commence my study. For student applicants only: I understand that the original copies of the permission must be verified by my supervisor before data collection commences
	Permission is not required for my study. **Please explain why:**		Permission is not required for my study. **Please explain why:**

HARMS, HAZARDS AND RISKS

Q8.1 It might be appropriate to conduct a risk assessment (in respect of the hazards/risks affecting both the participants and/or investigators). **Please use form EC5, Harms, Hazards and Risks, if the answer to any of the questions below is 'yes'.**

If you are required to complete and submit a School-specific risk assessment (in accordance with the requirements of the originating School) it is acceptable to make a cross-reference from this document to Form EC5 in order not to have to repeat the information twice.

Will this study involve any of the following?

Invasive Procedures/administration of any substance/s? ☐YES ☒NO

IF 'YES' TO THE ABOVE PLEASE COMPLETE EC1 APPENDIX 1 AS WELL AND INCLUDE IT WITH YOUR APPLICATION

Are there potential hazards to participant/investigator(s) from the proposed study? (Physical/Emotional or other non-physical harm) ☐YES ☒NO

Will or could aftercare and/or support be needed by participants? ☐YES ☒NO

Q8.2 Is the study being conducted off-campus (i.e. not at UH/UH Partner?) ☒YES ☐NO

It might be appropriate to conduct a risk assessment of the proposed location for your study (in respect of the hazards/risks affecting both the participants and/or investigators) (this might be relevant for on-campus locations as well). Please use Form EC5 and, if required, a School-specific risk assessment (See GN 2.2.8 of the Guidance Notes).

If you do not consider it necessary to submit a risk assessment, please give your reasons:

The venue is regularly used as a conference venue. The group interview would take place as part of a Conference

ABOUT YOUR PARTICIPANTS

Q9 Please give a brief description of the kind of people you hope/intend to have as participants, for instance, a sample of the general population, University students, people affected by a particular medical condition, children within a given age group, employees of a particular firm, people who support a particular political party, and state whether there are any upper or lower age restrictions.

Qualified Teachers of the Deaf working in the community with children under 5 who have cochlear implants/bone conducting hearing implants.
Audiologists, Speech and Language Therapists and Qualified Teachers of the Deaf who are employed by Auditory Implant Centres.
There are no age restrictions

Q10 Please state here the maximum number of participants you hope will participate in your study. Please indicate the maximum numbers of participants for ***each*** method of data collection.

Maximum numbers of participants for questionnaire 1 (Local QToDs) is 75.
Maximum number of participants for questionnaire 2 (Implant Centre staff) is 50
Maximum number of participants for group interview is 40.

Q11 By completing this form, you are indicating that you are reasonably sure that you will be successful in obtaining the number of participants which you hope/intend to recruit. Please outline here your recruitment (sampling) method and how you will advertise your study. (See GN 2.2.9).

The questionnaires will be circulated to QToDs via their Heads of Service; there are approximately 1500 QToDs working in the UK, As unsolicited emails, participation is likely to be a low percentage of the total possible number. Expected response rate would be around 5% so potentially 50-75 participants.
There are 20+ centres in the UK offering cochlear implants and more offering bone

conducting hearing implants, each of which employs a small number of audiologists, SALTS and QToDs. As they can be approached individually through a professional network of which I am a part, an expected response rate might be higher yielding data from possibly 50 participants.

The Conference is part of a series of training conferences which are being offered by the 4 Implant Centres in London. Expected numbers are 20-40 but, as it is the first time that this conference has been run, this may be inaccurate

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CONFIDENTIALITY AND CONSENT

(For guidance on issues relating to consent, see GN 2.2.10, GN 3.1 and UPR RE01, SS 2.3 and 2.4 and the Ethics Approval StudyNet Site FAQs)

Q12 How will you obtain consent from the participants? Please explain the consent process for each method of data collection identified in Q4

☒ Express/explicit consent using an EC3 Consent Form and an EC6 Participant Information Sheet (or equivalent documentation)

☒ Implied consent (participant information will be provided, for example, at the start of the questionnaire/survey etc)

☐ Consent by proxy (for example, given by parent/guardian)

Use this space to describe how consent is to be obtained and recorded for each method of data collection. The information you give must be sufficient to enable the Committee to understand exactly what it is that prospective participants are being asked to agree to.

The front page of the questionnaire will outline the purpose of the study and the fact that data collection is anonymous unless the participant chooses otherwise.

The group interview will be advertised on the programme as being part of a MA dissertation. The informed consent form would be circulated as part of the conference papers and additional copies would be available at the beginning of the session. Participants would be assured that no individual data would be collected at this session and no notes would be made which would identify particular participants or their views.

If you do not intend to obtain consent from participants please explain why it is considered unnecessary or impossible or otherwise inappropriate to seek consent.

Q13 If the participant is a minor (under 18 years of age) or is unable for any reason to give full consent on their own, state here whose consent will be obtained and how? (See especially GN 3.6 and 3.7)

Q14.1 Will anyone other than yourself and the participants be present with you when conducting this study? (See GN 2.2.10)

☒YES ☐NO

If YES, please state the relationship between anyone else who is present other than the applicant and/or participants (eg health professional, parent/guardian of the participant).

Other members of the Implant Centre Team will be present at the Conference. One may be available to make notes or contribute to the discussion

Q14.2 Will the proposed study be conducted in private?

☒YES ☒NO

If 'No', what steps will be taken to ensure confidentiality of the participants' information. (See GN 2.2.10):

Participants will be reminded that the session is part of a research project and that any contributions they make will be anonymised before they are included in the data. Other participants will be asked to commit to not sharing information with colleagues outside the conference.
Participants who wish to absent themselves from this part of the conference will be assured that they are able to do so without penalty.

Q15.1 Are personal data of any sort (such as name, age, gender, occupation, contact details or images) to be obtained from or in respect of any participant? (See GN 2.2.11) (You will be required to adhere to the arrangements declared in this application concerning confidentiality of data and its storage. The Participant Information Sheet (Form EC6 or equivalent) must explain the arrangements clearly.)

☒YES ☐NO

If YES, give details of personal data to be gathered and indicate how it will be stored.

Participants will be asked to supply professional data (qualification, length of experience, type of employment) but individually identifying data (eg name, age, employer) will not be collected. Participants will be asked to provide an email if they are willing to be approached for further questions or clarification but it will be clear that this is optional.

PLEASE NOTE: If you are processing personal information you MUST consider whether you need to complete a Data Protection Impact Assessment (DPIA). Please read the DPIA guidance available from the FAQ section of the UH Ethics Approval StudyNet site:

http://www.studynet2.herts.ac.uk/ptl/common/ethics.nsf/Frequently+Asked+Questions/935D97CDBC546E69802583A9005213A6

If you need to complete one, please find the DPIA template in the University's website at the following link:

https://www.herts.ac.uk/__data/assets/pdf_file/0006/233619/IM08-apxI-Template-Data-Protection-Impact-Assessment.pdf

The DPIA must be completed in consultation with the University's Data Protection Officer and submitted with your application for ethics approval.

Will you be making audio-visual recordings?

☐YES ☒NO

If YES, give details of the types recording to be made and indicate how they will be stored.

Q15.2 If you have made a YES response to any part of Q15.1, please state what steps will be taken to prevent or regulate access to personal data and/or audio-visual recordings beyond the immediate investigative team, as indicated in the Participant Information Sheet.

All data will be kept in a password protected file on a secure drive housed in a building to which there is no routine public access

Indicate what assurances will be given to participants about the security of, and access to, personal data and/or audio-visual recordings, as indicated in the Participant Information Sheet.

The records of this session will not ask for or keep track of your name or other identifying features. All data will be analysed as part of a large data set and no individual contributions will be identified.
All notes from the session will be stored securely and will be destroyed at the end of the study

Data will be anonymised prior to storage. All data will be kept secure for 24 months from the end of the study.

State as far as you are able to do so how long personal data and/or audio-visual recordings collected/made during the study will be retained and what arrangements have been made for its/their secure storage and destruction, as indicated in the Participant Information Sheet.

All data will be kept secure for 24 months from the end of the study. The study will finish in April 2020.

Q15.3 Will data be anonymised prior to storage? ☒YES ☐NO

Q16 Is it intended (or possible) that data might be used beyond the present study? (See GN 2.2.10) ☒YES ☐NO

If YES, please indicate the kind of further use that is intended (or which may be possible).

The data may need to be analysed in a different way as part of preparation for publication or presentation.

If NO, will the data be kept for a set period and then destroyed under secure conditions? ☐YES ☐NO

If NO, please explain why not:

Q17 Consent Forms: what arrangements have been made for the storage of Consent Forms and for how long?

Consent forms will be stored electronically in a password protected file on a secure drive in a building to which the public does not have routine access.
Any consent forms which are in hard copy form will be stored in a locked drawer in the same building until they have been scanned and saved electronically as above at which point they will be destroyed.

Q18 If the activity/activities involve work with children and/or vulnerable adults satisfactory Disclosure and Barring Service (DBS) clearance may be required by investigators. You are required to check with the organisation (including UH/UH Partners where appropriate) responsible for the minors/vulnerable participants whether or not they require DBS clearance.

Any permission from the organisation confirming their approval for you to undertake the activities with the children/vulnerable group for which they are responsible should make specific reference to any DBS requirements they impose and their permission letter/email must be included with your application.

More information is available via the DBS website - https://www.gov.uk/government/organisations/disclosure-and-barring-service

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REWARDS

Q19.1 Are you receiving any financial or other reward connected with this study? (See GN 2.2.14 and UPR RE01, S 2.3)

☐YES ☒NO

If YES, give details here:

Click here to enter text.

Q19.2 Are participants going to receive any financial or other reward connected with the study? (Please note that the University does not allow participants to be given a financial inducement.) (See UPR RE01,
S 2.3)

☐YES ☒NO

If YES, provide details here:

Click here to enter text.

Q19.3 Will anybody else (including any other members of the investigative team) receive any financial or other reward connected with this study?

☐YES ☒NO

If YES, provide details here:

Click here to enter text.

OTHER RELEVANT MATTERS

Q20 Enter here anything else you want to say in support of your application, or which you believe may assist the Committee in reaching its decision.

Click here to enter text.

DOCUMENTS TO BE ATTACHED

Please indicate below which documents are attached to this application:

☐ Permission to access groups of participants

☐ Permission to use University premises beyond areas of School

☐ Permission from off-campus location(s) to be used to conduct this study

☐ Form EC5 (Harms, Hazards and Risks: assessment and mitigation)

☒ Consent Form (See Form EC3/EC4)

☐ Form EC6 (Participant Info Sheet)

☐ Data Protection Impact Assessment (DPIA)

☐ A copy of the proposed questionnaire and/or interview schedule (if appropriate for this study). For unstructured methods, please provide details of the subject areas that will be covered and any boundaries that have been agreed with your Supervisor

☐ Any other relevant documents, such as a debrief, meeting report. Please provide details here:

Click here to enter text.

DECLARATIONS

1 DECLARATION BY APPLICANT

I undertake, to the best of my ability, to abide by UPR RE01, 'Studies Involving the Use of Human Participants', in carrying out the study.

I undertake to explain the nature of the study and all possible risks to potential participants,

Data relating to participants will be handled with great care. No data relating to named or identifiable participants will be passed on to others without the written consent of the participants concerned, unless they have already consented to such sharing of data when they agreed to take part in the study.

All participants will be informed **(a)** that they are not obliged to take part in the study, and **(b)** that they may withdraw at any time without disadvantage or having to give a reason.

(**NOTE**: Where the participant is a minor or is otherwise unable, for any reason, to give full consent on their own, references here to participants being given an explanation or information, or being asked to give their consent, are to be understood as referring to the person giving consent on their behalf. (See Q 12; also GN Pt. 3, and especially 3.6 & 3.7))

Enter your name here: Marianne Haylett Date 06/01/2020

GROUP APPLICATION

(If you are making this application on behalf of a group of students/staff, please complete this section as well)

I confirm that I have agreement of the other members of the group to sign this declaration on their behalf

Enter your name here: Click here to enter text. Date Click here to enter a date.

DECLARATION BY SUPERVISOR (see GN 2.1.6)

I confirm that the proposed study has been appropriately vetted within the School in respect of its aims and methods; that I have discussed this application for Ethics Committee approval with the applicant and approve its submission; that I accept responsibility for guiding the applicant so as to ensure compliance with the terms of the protocol and with any applicable ethical code(s); and that if there are conditions of the approval, they have been met.

Enter your name here: Click here to enter text. Date Click here to enter a date.

Appendix 2

University of Hertfordshire UH

SOCIAL SCIENCES, ARTS AND HUMANITIES ECDA

ETHICS APPROVAL NOTIFICATION

TO	**Marianne Haylett**
CC	**Imran Mulla**
FROM	**Dr Ian Willcock, Social Sciences, Arts and Humanities ECDA Chairman**
DATE	**14/02/20**

Protocol number: **cEDU/PGT/UH/04463**

Title of study: Use of Remote Microphone Accessories with Young Children who have Cochlear Implants / Bone Conducting Hearing Implants. An Investigation of Professionals' Opinions and Experiences.

Your application for ethics approval has been accepted and approved with the following conditions by the ECDA for your School and includes work undertaken for this study by the named additional workers below:

no additional workers named

Conditions of approval specific to your study:

Ethics approval has been granted subject to the following conditions:

The supervisor must see and approve the following prior to recruitment and data collection –

- Permissions
- Survey

General conditions of approval:

Ethics approval has been granted subject to the standard conditions below:

Permissions: Any necessary permissions for the use of premises/location and accessing participants for your study must be obtained in writing prior to any data collection commencing. Failure to obtain adequate permissions may be considered a breach of this protocol.

1

External communications: Ensure you quote the UH protocol number and the name of the approving Committee on all paperwork, including recruitment advertisements/online requests, for this study.

Invasive procedures: If your research involves invasive procedures you are required to complete and submit an EC7 Protocol Monitoring Form, and copies of your completed consent paperwork to this ECDA once your study is complete.

Submission: Students must include this Approval Notification with their submission.

Validity:

This approval is valid:

From: 14/02/20

To: 14/03/20

Please note:

Failure to comply with the conditions of approval will be considered a breach of protocol and may result in disciplinary action which could include academic penalties.
Additional documentation requested as a condition of this approval protocol may be submitted via your supervisor to the Ethics Clerks as it becomes available. All documentation relating to this study, including the information/documents noted in the conditions above, must be available for your supervisor at the time of submitting your work so that they are able to confirm that you have complied with this protocol.

Should you amend any aspect of your research or wish to apply for an extension to your study you will need your supervisor's approval (if you are a student) and must complete and submit form EC2.
Approval applies specifically to the research study/methodology and timings as detailed in your Form EC1A. In cases where the amendments to the original study are deemed to be substantial, a new Form EC1A may need to be completed prior to the study being undertaken.

Failure to report adverse circumstance/s may be considered misconduct.
Should adverse circumstances arise during this study such as physical reaction/harm, mental/emotional harm, intrusion of privacy or breach of confidentiality this must be reported to the approving Committee immediately.

cEDU PGT UH 04463 Haylett M 15014383 Notification.pdf

Appendix 3

UNIVERSITY OF HERTFORDSHIRE

ETHICS COMMITTEE FOR STUDIES INVOLVING THE USE OF HUMAN PARTICIPANTS ('ETHICS COMMITTEE')

FORM EC6: PARTICIPANT INFORMATION SHEET

1 **Title of study**

Use of Remote Microphone Accessories with Young Children who have Cochlear Implants / Bone Conducting Hearing Implants. An Investigation of Professionals' Opinions and Experiences

2 **Introduction**

You are being invited to take part in a study. Before you decide whether to do so, it is important that you understand the study that is being undertaken and what your involvement will include. Please take the time to read the following information carefully and discuss it with others if you wish. Do not hesitate to ask us anything that is not clear or for any further information you would like to help you make your decision. Please do take your time to decide whether or not you wish to take part. The University's regulations governing the conduct of studies involving human participants can be accessed via this link:

http://sitem.herts.ac.uk/secreg/upr/RE01.htm

Thank you for reading this.

3 **What is the purpose of this study?**

This study aims to explore the use of remote microphone technology such as the MiniMic2+ which are supplied by manufacturers to families as part of their cochlear implant / bone conducting hearing implant package.

There is an increasing amount of research which examines the use of remote microphone technology with young children who have a hearing loss. Quality Standards for the Use of Personal Radio Aids (NDCS, 2017) recommends the use of radio aid technology at first fitting of hearing aids. However, this is some way from being implemented.

This study aims to explore the use of the MiniMic2+ with children under 5 who have received a cochlear implant / bone conducting hearing implant and the attitudes and experiences of the professionals who are working with them.

4 **Do I have to take part?**

It is completely up to you whether or not you decide to take part in this study.

It is very important that Qualified Teachers of the Deaf establish an evidence base for our practice. This study is hoping to support professionals by understanding their experience and expectations of the MiniMic2+ and identifying how these can be improved to better support d/Deaf children.

5 **Are there any age or other restrictions that may prevent me from participating?**

To participate you must be working with children aged under 5 who have a cochlear implant / bone conducting hearing implant. You must have an appropriate qualification as a teacher, a Speech and Language Therapist or as an audiologist. Those who are training whilst in employment are also welcome to participate.

6 **How long will my part in the study take?**

If you decide to take part in the study, you will be asked to participate in a short discussion about the use of MiniMic2+ with a group of other professionals. This will take 30 minutes as part of the Training Day
The study will finish in April 2020.

7 **What will happen to me if I take part?**

The researcher will lead a group session asking participants about their experience of the MiniMic2+. There is no requirement to contribute to the discussion. There will be notes made at the session but these will be anonymous and no individual contributions will be identifiable in the published work.

8 **What are the possible disadvantages, risks or side effects of taking part?**

There are no risks or disadvantages to taking part in this study.

9 **What are the possible benefits of taking part?**

By agreeing for your data to be used in the study, we will be able to identify patterns of understanding, concern or training need amongst those who work with children who use cochlear implants / bone conducting hearing implants. This could feed into new opportunities for professional development or the provision of information to families.

10 **How will my taking part in this study be kept confidential?**

The records of this session will not ask for or keep track of your name or other identifying features. All data will be analysed as part of a large data set and no individual contributions will be identified.
All notes from the session will be stored securely and will be destroyed at the end of the study.

11 **What will happen to the data collected within this study?**

All data will be kept secure for 24 months from the end of the study. The study will finish in April 2020.

13 **Will the data be required for use in further studies?**

This data will not be used in further studies.

14 **Who has reviewed this study?**

This study has been reviewed by:

14.2 The University of Hertfordshire Social Sciences, Arts and Humanities Ethics Committee with Delegated Authority

The UH protocol number is 04463

15 **Factors that might put others at risk**

Please note that if, during the study, any medical conditions or non-medical circumstances such as unlawful activity become apparent that might or had put others at risk, the University may refer the matter to the appropriate authorities.

16 **Who can I contact if I have any questions?**

If you would like further information or would like to discuss any details personally, please get in touch with me, in writing, by phone or by email:
Marianne Haylett
07906 054751
mh15adx@herts.ac.uk

Although we hope it is not the case, if you have any complaints or concerns about any aspect of the way you have been approached or treated during the course of this study, please write to the University's Secretary and Registrar.

Thank you very much for reading this information and giving consideration to taking part in this study.