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Computer and internet interventions to optimise listening and learning for people with hearing loss: accessibility, use and adherence

Melanie Ferguson PhD[1], Helen Henshaw PhD[2]

[1]NIHR Nottingham Hearing Biomedical Research Unit, Nottingham University Hospitals NHS Trust, Nottingham UK
[2]NIHR Nottingham Hearing Biomedical Research Unit, Otology and Hearing Research Group, Division on Clinical Neuroscience, University of Nottingham UK

Corresponding author:
Melanie Ferguson
NIHR Nottingham Hearing Biomedical Research Unit
113 The Ropewalk
Nottingham, UK
NG1 5DU

Tel: (+44)115 8232619
Fax: (+44)115 8232615

Email: melanie.ferguson@nottingham.ac.uk

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Abstract

Purpose: To examine accessibility, use and adherence to computerised and online interventions for people with hearing loss.

Method: Four intervention studies of people with hearing loss were examined: two auditory training studies, one working memory training study, and one study of multimedia educational support.

Results: A small proportion (~15%) of participants had never used a computer, which may be a barrier to the accessibility of computer and internet-based interventions. Computer competence was not a factor in intervention use or adherence. Computer skills and internet access influenced participant preference for the delivery method of the multimedia educational support programme.

Conclusions: It is important to be aware of current barriers to computer and internet-delivered interventions for people with hearing loss. However, there is a clear need to develop and future-proof hearing-related applications for online delivery.

Introduction

There is an ever increasing use of personal computers and the internet to provide healthcare and health-related information (Brouwer et al., 2011), and hearing healthcare is no exception. Telehealth applications in audiology, or tele-audiology, include hearing screening (Smits, Merkus, & Houtgast, 2006; Swanepoel, Myburgh, Howe, Mahomed, & Eikelboom, 2014), diagnosis (Krumm, Ribera, & Klich, 2007), and interventions such as auditory training (Ferguson, Henshaw, Clark, & Moore, 2014; Sweetow & Henderson Sabes, 2006), counselling (Laplante-Lévesque, Pichora-Fuller, & Gagné, 2006; Lundberg, Andersson, & Lunner, 2011) and patient education (Ferguson, Brandreth, Leighton, Brassington, & Wharrad, In Review; Thorén, Öberg, Wänström, Andersson, & Lunner, 2013). Advantages of tele-audiology include improved time-, clinical- and cost-effectiveness, and increased accessibility to healthcare (Fabry, 2010), with the added advantage of being delivered remotely in patients' homes (Ferguson et al., 2014; Henshaw & Ferguson, 2013). A systematic review of peer-reviewed articles concluded that tele-audiology provided the potential to extend services beyond the audiology clinic, in particular to under-served communities and those with poor accessibility to audiology services (Swanepoel & Hall, 2010).

Typically, discussions on accessibility of hearing healthcare and the benefits of tele-audiology focus on remote and rural communities in underdeveloped and developing countries, as well as those countries with large geographic distances, such as Australia. However, issues accessing hearing services are not limited to these countries, they are also relevant to smaller, developed countries, such as the UK (Ferguson, 2012). Firstly, it is estimated that only one in three people in the UK who would benefit from a hearing aid have one (AoHL, 2014). Secondly, many hearing aid users have significant hearing difficulties for at least ten years before they receive hearing aids (Davis, Smith, Ferguson, Stephens, &

Gianopoulos, 2007). Thirdly, there is a failure of family doctors to refer those in the pre-typical hearing aid age group to audiology services. Just under half (47%) of those with a significant hearing loss in the 55-74 year age group who went to their general practitioner with complaints of hearing loss failed to get an onward referral to audiology services (Davis, et al., 2007). Finally, two-thirds of the 10 million people with hearing loss in the UK are over the age of 65 years. Tele-audiology can only be effective if it is accessible, used and adhered to by the target population.

In the case of existing hearing aid users, it is important to be mindful of the skill set required to access personal computers (PCs), the internet, and mobile technologies without which access to tele-audiology solutions can be limited. We carried out a study of 50-74 year olds (n=1298) and showed significant effects of age, gender and socioeconomic status (SES) on PC and internet use, with poorer use seen in older people, women, and those with lower SES (Henshaw, Clark, Kang, & Ferguson, 2012). PC and internet use in the youngest group (50-54 years) was 85% and 36% respectively but was significantly lower in the oldest group (70-74 years) at 36% and 17%. These differences were consistent with other reports (Seybert & Lööf, 2010; Thoren, Öberg, Wänström, Andersson, & Lunner, 2013). Current data on internet use shows a year-on-year increase in 55-74 year olds (2010 =61%, 2012 = 70%, 2014 = 78%), suggesting teleaudiology will become more prevalent in this age group (UNECE, 2015) over the coming years.

There has been little published on the effect of hearing loss on PC and internet use in older adults. In our study of PC and internet use (Henshaw et al., 2012), use was greater for those aged 63-74 years with slight hearing difficulties than those reporting no difficulties, although those with moderate hearing difficulties showed less use. This suggests that potential uses of tele-audiology in this age group, including early intervention such as auditory training,

provision of education and support, and hearing screening, may be best served for those with milder hearing losses prior to obtaining hearing aids.

The main aim of this investigation was to examine accessibility, use and adherence with three different home-delivered interventions in older adults with hearing loss who had a broad range of computer skills.

Methods

Four studies are presented and assessed: two adaptive computerised auditory training with a control period (AT); computerised working memory training (WMT) with two arms, adaptive training and an active control (i.e. span stimuli were fixed at three items); multimedia educational support (MES) using reusable learning objects (RLOs), which are chunks of interactive multimedia learning, containing highly visual components to illustrate concepts and processes, in this case hearing aids and communication strategies (Windle & Wharrad, 2010). In addition, preference for the delivery mode of the MES is reported. Outline details of the studies and participants included in this investigation are shown in Table 1. Participants were recruited and took part in in only one study. The studies and the results are described in more detail elsewhere (AT1, Ferguson et al., 2014; AT2, Henshaw & Ferguson, 2014; WMT, Henshaw & Ferguson, 2013; MES, Ferguson et al., in review). Three studies (AT1, AT2, MES) showed positive results, with at least moderate effect sizes. The WMT results are currently unpublished.

Computer skills were rated by participants on a validated three-category scale (Never used a computer, Beginner or Competent, see Henshaw et al., 2012). The percentage of participants in each category provides a measure of accessibility in terms of PC skills (Table 1). For the auditory training studies, the training program was demonstrated to the participants on a laptop, which was then loaned for use at home. Use was reported as the mean training

duration in minutes. Adherence was reported as percentage of total requested time on task achieved, which was 360 and 210 minutes for AT1 and AT2 respectively. The working memory training program was delivered online. Use was reported as the number of sessions completed (35-45 minutes each), and adherence was reported as the percentage of participants who completed all 25 sessions as requested. For all training intervention studies, participants received a weekly telephone call from a researcher to monitor technical and procedural issues. For the education study, participants were offered the choice of delivery based on accessibility in their homes (DVD for TV or PC, or via the internet). Participants were requested to watch each of the seven RLOs, and use was measured as the mean number of RLOs watched. Adherence was the percentage who attended the six-week evaluation session and watched all seven RLOs at least once.

Results

Accessibility, use and adherence results are shown in Table 1.

Auditory training. There was a broadly similar mix of computer skills across both studies, with the Never category having the fewest participants (~15%). There was no significant difference in use across categories ($p > .05$), suggesting that PC competence did not influence the use of auditory training. Adherence was generally high, with no drop-outs for either study. Adherence was similar for all categories in AT1 and not significant ($p>.05$).

Working memory training. All users were required to have internet access at home in order to participate in the study, so by definition this intervention was not accessible to those without internet access. There were twice as many Competent users as Beginners. Use was similar for each category. Adherence was lower in the Competent users, but this was not significant ($p > .05$). There were however more drop outs for adaptive training (n=4) than for active-control

training (n=1), which may reflect the highly challenging nature of this type of training intervention. Further examination of the effects of motivations and gameplay are required.

Multimedia educational support. The Never category had the smallest number of participants, similar to the auditory training studies. However, there were twice as many Competent users than Beginners, not seen in the auditory training studies. This may be because the MES study was carried out a few years later and so reflects the trend of increased PC and internet use over time (see UNECE, 2015). Despite a range of delivery modes, 21% of the patients were excluded from participating in the study because they did not have access to a DVD player, PC or internet. Use of the MES was greatest in the Never category, which watched more RLOs than the Beginners or Competent users, although this difference was not statistically significant ($p > .05$). Eight people watched 21+ RLOs (i.e. each RLO more than three times), and when they were excluded the mean number of RLOs watched was 9.7, 10.0 and 10.8 for Never, Beginner and Competent respectively. Adherence was very high, with no effect of PC skill. For choice of delivery, not surprisingly, all the Never category chose DVD for TV, as did most of the Beginners, with only a low number (11%) opting for internet delivery. The majority of Competent users (60%) opted for internet delivery, with three-quarters choosing a PC-based option. Even so, a quarter of Competent users chose DVD for TV, although the reasons for this are not known.

Discussion and Conclusion

We have examined accessibility, use and adherence to three types of interventions for people with hearing loss who have a range of computer skills. Accessibility is an inherent barrier to interventions if either the person does not have either access to the hardware (e.g. DVD player, PC or internet) or have the skills to use it. However, only a relatively small proportion of the participants (~15%) had never used a computer. As our study participants were on average younger than the typical first-time hearing aid user (74 years, Davis et al, 2007),

accessibility is likely to be lower in a typical (older) UK hearing aid clinic sample. Nevertheless, access to IT and mobile technologies for the over-55s is increasing, and will continue to increase over the coming years (Deloitte, 2014). There was no evidence that PC skill was a factor in either use or adherence with these interventions. It is possible that other factors, such as individuals' extrinsic and intrinsic motivations to use these interventions, are influential (Henshaw, McCormack, & Ferguson, In press). In conclusion, the potential for online applications to reach many people with hearing loss who cannot or will not access conventional audiology services is substantial. Although there are currently some barriers to internet access for a proportion of people with hearing loss, there is a clear need to develop and future-proof internet-delivered applications.

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Table 1. Study and participant characteristics. Percentage, mean use and mean adherence of three categories of computer skills (Never, Beginner, Competent). BEA= better ear average, HA = hearing aid, RLOs = reusable learning objects, TV=television, PC-personal computer, Web=internet

	Auditory training 1			Auditory training 2			Working memory training			Multimedia educational support					
Study type	RCT			Repeated measures			RCT			RCT					
Intervention	Phoneme discrimination in quiet			Phoneme discrimination in noise			Verbal and Visuospatial working memory and storage tasks			Reusable learning objects					
Intervention duration	360 minutes (6 hours) across 4 weeks			210 minutes (3.5 hours) across 1 week			25 sessions (approx.. 16.5 hours) across 5 weeks			7 RLOs = 58.7 minutes across 6 weeks					
n participants (n females)	44 (15)			30 (10)			57 (30)			100 (41)					
Participants (source of recruitment)	Non-HA users (general practitioner)			Existing HA users (volunteer database)			Existing HA users (volunteer database)			First-time HA users (audiology service)					
Age mean(SD), range in years	65.3 (5.7), 53-74			67.4 (7.1), 50-74			64.0 (6.0), 50-74			68.8 (9.2), 42-87					
Mean $BEA_{0.5\text{-}4kHz}$ (SD) dB HL	32.5 (6.0)			43.8 (13.4)			42.6 (13.88)			35.8 (9.0)					
Data collection period	2009- 2011			2011-2012			2012-2014			2012-2013					
	%	Use (mins)	Adherence (%)	%	Use (mins)	Adherence (%)	%	Use (sessions)	Adherence (%)	%	Choice of delivery (%)			Use (RLO's watched)	Adherence (%)
											TV	PC	Web		
Never	15.9	379	105%	13.3	193	92	0	-	-	16.2	100	0	0	17.3	100
Beginner	45.5	378	105%	40.0	193	92	33.3	25.0	100	27.2	62	27	11	12.4	95
Competent	38.6	380	106%	46.7	203	97	66.7	23.3	87	56.6	24	16	60	11.9	96

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