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Internet competency in hearing aid users

Internet competency predicts practical hearing aid knowledge and skills in first-time hearing aid users.

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Running head:

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Key words:

Hearing aids

Hearing loss

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Hearing aid handling skills

Self-efficacy

1 **Purpose**

2 To assess whether internet competency predicts practical hearing aid knowledge and handling
3 skills in first-time hearing aid users.

4

5 **Method**

6 The design was a prospective, randomized controlled trial of a multimedia educational
7 intervention consisting of interactive video tutorials (or reusable learning objects: RLOs).
8 RLOs were delivered through DVD for TV or PC, and online. Internet competency was
9 measured at the hearing aid fitting appointment, whereas hearing aid knowledge and practical
10 handling skills were assessed six-weeks post-fitting.

11

12 **Results**

13 Internet competency predicted practical hearing aid knowledge and handling skills,
14 controlling for age, hearing sensitivity, educational status and gender, for the group that
15 received the RLOs. Internet competency was inversely related to the number of times the
16 RLOs were watched.

17

18 **Conclusion**

19 Associations between internet competency and practical hearing aid knowledge, handling
20 skills, and watching the RLOs fewer times may have arisen because of improved self-
21 efficacy. Therefore, first-time hearing aid users that are more competent internet users may
22 be better equipped to apply newly learnt information to effectively manage their hearing loss.

1 **Introduction**

2

3 An educational program for first-time hearing aid users has been previously developed that
4 included practical and psychosocial aspects of hearing aids and communication (Ferguson et
5 al., 2015). The program (branded as C2Hear) is based on the concept of reusable learning
6 objects (RLOs), which are ‘chunks’ of interactive multimedia learning, containing highly
7 visual components (e.g. animations, video clips, patient testimonials), and based on
8 pedagogical principles (Windle et al., 2010). Previous research in 2010/11 had shown that PC
9 and internet use was low in the typical first-time hearing aid user age-group (70-74 years) in
10 the UK, with 36.3% and 17.5% reporting that they used a PC or the Internet respectively
11 (Henshaw et al., 2012). Consequently, the RLOs were developed for delivery through DVD
12 for TV or PC, and via the internet, to maximize accessibility by first-time hearing aid users.
13 This required the RLOs to be developed for a DVD platform, which inherently limited
14 interactivity and individualization (Ferguson et al., 2016a).

15

16 Following development of the RLOs, a randomized control trial (RCT) was conducted to
17 evaluate their effectiveness. Half (50.6%) of the participants chose the DVD for TV mode of
18 delivery, 15.2% opted for delivery via DVD for PC and 32.9% chose to view them online.
19 The RCT showed a number of benefits for first-time hearing aid users who received the
20 RLOs (RLO+), in comparison to the standard management condition (RLO-). Six weeks
21 post-fitting, the RLO+ intervention group had significantly greater knowledge on how to use
22 their hearing aids and were more confident and skilled at using their hearing aids (Ferguson
23 et al., 2015; Ferguson et al., 2016a). Self-reported hearing aid use was also significantly
24 greater in the RLO+ group, but only for ‘suboptimal’ users.

25

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1 Since the RLOs were originally developed in 2011/12, the UK has seen a year-on-year
2 increase in internet use in 55-74 year olds (2010=61%; 2012=70%; 2014=78%) (United
3 Economic Commission for Europe, 2015). Similarly, there has been a dramatic increase in
4 computer use in 65+ year olds, from 9% (2006) to 45% (2015), while in 55-64 year olds use
5 has increased from 36% (2006) to 72% (2015) (UK Office for National Statistics, 2015). The
6 increasing digital competency in older adults suggests the time is right to focus on the
7 development of internet-delivered hearing-related interventions (Ferguson & Henshaw,
8 2015). Indeed, there are now a number of online rehabilitation programs that have been
9 developed for adult hearing aid users (Thorén et al., 2014) and people with tinnitus
10 (Greenwell et al., 2015).

11

12 It is likely that a number of factors, such as age and internet competency, impact use and
13 acceptance of internet-based hearing interventions (Moore et al., 2015). There is also some
14 value in understanding whether internet competency affects the effectiveness of digital
15 interventions, as it may serve as a potential barrier to an older population. Furthermore, an
16 improved understanding of the impact of internet competency will inform how interventions
17 should be developed and optimally delivered to people with hearing loss. Thus, the aim of
18 this study was to assess whether internet competency was predictive of practical hearing aid
19 knowledge and handling skills following intervention of the multimedia educational RLOs.

20

21 **Method**

22 We report unpublished data from the original study (Ferguson et al., 2016a), evaluating the
23 RLOs in first-time hearing aid users. The design was a single-center, prospective clinically
24 registered RCT (<http://www.isrctn.com/ISRCTN11486888>) of 203 first-time hearing aid
25 users (mean age=67.8 years, SD=9.5, range=42.2-94.8; mean better ear average_{0.25-4kHz}=32.0

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1 dB HL, SD=8.7, range=6-74) with two arms: (i) the intervention group received the RLOs
2 immediately following their hearing aid fitting appointment (RLO+, n=103); (ii) the control
3 group received standard clinical management only (RLO-, n=100). A detailed account of the
4 study methods is reported in Ferguson et al. (2016a).

5

6 Internet competency was rated by participants at the hearing aid fitting appointment on a
7 validated three-category scale (Never used, Beginner, or Competent) (Henshaw et al., 2012).

8 Educational status was also reported on a three-category scale (Secondary school, up to 15
9 years; A-Level/Diploma or equivalent; Degree level or above – corresponding to junior high,

10 senior high, college/university respectively). Outcomes were assessed six-weeks post-hearing
11 aid fitting, and included self-report questionnaires on knowledge of practical and

12 psychosocial aspects of hearing aids and communication (Hearing Aid and Communication

13 Knowledge questionnaire, HACK; (Ferguson et al., 2015), and practical hearing aid handling

14 skills (Practical Hearing Aid Skills Test, PHAST;(Desjardins & Doherty, 2009). All outcome

15 measures were completed by two audiologists at the Nottingham Hearing Biomedical

16 Research Unit, who were blind to the participant's group allocation at the beginning of the

17 session.

18

19 **Statistical Analysis**

20 A difference in internet competency within each group was tested using the Chi-square, and
21 between RLO+ and RLO- groups using an independent samples Mann-Whitey U test.

22 Spearman's rho correlation coefficients were used to test associations between internet

23 competency and demographic characteristics (across the entire sample) and RLO mode of

24 delivery (RLO+ only), in addition to hearing aid knowledge and skills (separately for RLO+/-

25 groups). For each questionnaire, *p*-values were Holm-Bonferroni corrected for each sub-scale

1 (Aickin & Gensler, 1996; Holm, 1979). For all significant correlations ($p \leq .05$), multiple
2 linear regression analysis tested whether internet competency predicted outcomes six-weeks
3 post-hearing aid fitting.

4

5 **Results**

6 A significantly lower proportion of individuals reported that they had either never used the
7 internet (RLO+, 20.1%; RLO-, 22.1%) or were ‘beginners’ (RLO+, 28.7%; RLO-, 31.6%), in
8 comparison to those reporting that they were ‘competent’ users (RLO+, 51.1%; RLO-,
9 46.3%) in both the RLO+ ($X^2(2, N=94)=14.32, p=.001$) and RLO- groups ($X^2(2,$
10 $N=95)=8.48, p=.014$) (Table 1). Internet competency did not significantly differ between the
11 RLO+/- groups ($U=4254.5, p=.543$).

12

13 Across the whole sample, greater internet competency was significantly correlated with a
14 younger age ($R_s(189)=-.29, p<.001$), better-hearing threshold ($R_s(189)=-.23, p=.001$), higher
15 educational status ($R_s(155)=.23, p=.004$), and with being male ($R_s(189)=.17, p=.021$). In the
16 RLO+ group, greater internet competency was also strongly associated with selecting the
17 internet mode of delivery ($R_s(99)=.62, p<.001$).

18

19 For the RLO+ group, greater internet competency was associated with significantly greater
20 knowledge of practical hearing aid issues ($R_s(56)=.34, p=.010$) (Fig. 1A), but not
21 psychosocial issues ($R_s(56)=.17, p=.190$). Greater internet competency was also associated
22 with better practical hearing aid handling skills at follow-up ($R_s(74)=.27, p=.02$) (Fig. 1B). In
23 contrast, greater internet competency was significantly associated with watching the RLOs
24 fewer times ($R_s(66)=-.33, p=.006$) (Fig 1C). Internet competency was the only significant
25 predictor of practical hearing aid knowledge ($\beta=5.47, t(54)=2.76, p=.008$), accounting for

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1 12% of the variance. Internet competency also significantly predicted practical hearing aid
2 handling skills ($\beta=3.0$, $t(72)=2.6$, $p=.011$, $R^2=.09$), in addition to times watched ($\beta=-3.39$,
3 $t(65)=-2.95$, $p=.004$, $R^2=.12$). No additional variance was accounted for by age, hearing
4 threshold, level of education or gender when entered into each model ($p\geq.080$).

5

6 There was no significant relationship between internet competency and practical hearing aid
7 knowledge and handling skills ($p\geq.11$) in the RLO- group.

8

9 **Discussion**

10 In this study we assessed the extent to which self-reported internet competency predicted
11 practical hearing aid knowledge and handling skills. Greater internet competency predicted
12 superior practical hearing aid knowledge and handling skills. Internet competency was also
13 predictive of how many times the RLOs were watched, with greater competency associated
14 with watching the RLOs fewer times. Furthermore, internet competency was a significant
15 predictor of hearing aid knowledge and skills after controlling for demographic
16 characteristics (age, hearing threshold, educational status, gender), which have all been
17 shown previously to be related to internet use (Henshaw et al., 2012). However, greater
18 internet competency predicted superior practical hearing aid knowledge and handling skills
19 only in individuals that received the RLO intervention (RLO+). While internet competency
20 did not differ significantly between RLO+/- groups, no relationship between internet
21 competency and outcomes was found for the standard clinical management control group
22 (RLO-).

23

24 One potential explanation for why greater internet competency predicted hearing aid handling
25 skills and knowledge in the RLO+ group only may be attributed to perceived self-efficacy (or

1 confidence) to perform a specific behavior. In the audiological field, the impact of self-
2 efficacy on health behavior and patient outcomes has been increasingly recognized (Coulson
3 et al., 2016), with recent research showing that individuals with higher levels of self-efficacy
4 for using hearing aids are more likely to obtain them and become successful users (Ferguson
5 et al., 2016b; Ferguson et al., in press; Hickson et al., 2014; Meyer et al., 2014). The use of
6 digital technologies in the treatment and management of hearing loss has also been shown to
7 improve patient compliance to hearing healthcare treatment, which has been attributed to
8 increased self-efficacy (Amlani, 2015).

9

10 Although self-efficacy for hearing aids was not specifically tested in this study, our results
11 may provide additional support for the argument that individuals in the RLO+ group that had
12 greater internet competency may also have had greater self-efficacy to use the intervention,
13 and subsequently perform hearing aid related behaviors (e.g. changing the battery, using the
14 telephone, etc.). This may have later manifested itself in terms of superior practical hearing
15 aid knowledge and handling skills. This implies that the provision of the RLO intervention
16 not only improves hearing aid handling skills and knowledge relative to standard care
17 (Ferguson et al., 2015), but is enhanced further with increasing internet competency.

18 Differences between intervention groups may have arisen as a consequence of: (i) additional
19 information being covered in the RLOs that was not given by the audiologist during the
20 fitting appointment due to limited time constraints (Ferguson et al., 2015); (ii) the RLOs
21 providing additional cues that improved retention of the information provided; (iii) the RLOs
22 facilitating more realistic expectations that resulted in better outcomes (Ferguson et al., in
23 press); or (iv) a combination of (i), (ii) and/or (iii).

24

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1 Greater self-efficacy may also help to explain why the RLOs were watched fewer times in
2 people with greater internet competency, because they potentially had greater confidence in
3 their ability to use the RLOs. Greater computer literacy has been shown to be associated with
4 greater computer self-efficacy, which impacts user acceptance of web-based interventions
5 (Moore et al., 2015). Therefore, it is likely that individuals with greater internet competency
6 may have familiarized themselves more readily with the content of the RLOs, resulting in
7 fewer times watched. As a consequence, considerations should be made when developing
8 digital interventions to ensure that they are both accessible and engaging for users with
9 differing levels of competency, such as through the delivery of mobile-enabled RLOs (or m-
10 RLOs) that can be used via smartphones, tablet computers, and PCs.

11

12 **Future directions**

13 The evidence presented here, in addition to research supporting the effectiveness of the RLOs
14 (Ferguson et al., 2016a) and that from other Interactive Health Communication Applications
15 (see systematic review, Murray, Burns, See, Lai, & Nazareth, 2005), suggests that the use of
16 digital interventions will provide additional benefits to hearing aid users, which will likely to
17 extend to their family members and friends. Furthermore, it is unlikely that digital skills will
18 pose a significant barrier in the self-management of age-related hearing loss in the future,
19 given that computer and internet literacy skills are on the rise in 55+ year olds (UK Office for
20 National Statistics, 2015; United Economic Commission for Europe, 2015).

21

22 With this in mind, based on participant feedback, the RLOs have been branded and
23 distributed commercially as C2Hear, and are freely available via the internet,
24 (<https://www.youtube.com/>, search C2HearOnline). We are also currently developing a
25 platform that will deliver m-RLOs. The content is initially being designed for communication

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1 partners of hearing aid users in the form of a web-based app, with three RLOs (Hearing loss
2 and its consequences; Communication tactics; Psychosocial aspects of hearing loss). The app
3 will be designed so that it can be presented on multiple mobile devices and computer
4 browsers, providing the potential to download self-contained RLOs. We anticipate that this
5 mode of delivery also has greater potential to enhance interactivity and accessibility for end-
6 users. This app will form the foundation for further developments aimed at hearing aid users,
7 where we plan to develop an m-RLO resource that can be individually tailored to meet the
8 needs of the end-user. It is also expected that the use of internet-based interventions under
9 development will enable individualized learning and recall of relevant information in
10 situations where it is needed ‘on the go’, either within or outside the home environment.

11

12 To summarize, while first-time hearing aid users with greater internet competency who
13 received the RLO intervention had better practical hearing aid knowledge and handling skills,
14 they also watched the RLOs fewer times. We suggest that these findings reflect the
15 possibility that first-time hearing aid users who are more competent internet users are better
16 equipped to apply newly learnt information to effectively manage their hearing loss.
17 Nevertheless, given that digital literacy skills continue to increase year-on-year in older
18 adults, the time is now right to design and deliver internet-based interventions in this
19 population. Internet-based interventions may also have the capacity to provide additional
20 benefits, not only with regards to self-management of hearing loss and hearing aids, but will
21 likely provide a means of personalizing healthcare delivery to further enhance hearing
22 outcomes.

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Conflicts of interest:

The Nottingham University Hospitals NHS Trust and University of Nottingham will receive a proportion of any royalties from the sale of the C2Hear RLOs (DVD format).

Figure Legend

Figure 1. Mean scores (%) for A. practical hearing aid knowledge, and B. hearing aid handling skills; C. Mean total number all RLOs watched, for each internet competency category rated by participants in the RLO+ group. HACK = Hearing Aid and Communication Knowledge questionnaire; PHAST = Practical Hearing Aid Skills Test.

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