

Research Forum

Information Retention and Overload in First-Time Hearing Aid Users: An Interactive Multimedia Educational Solution

Melanie Ferguson,^{a,b} Marian Brandreth,^a William Brassington,^c and Heather Wharrad^d

Purpose: An educational intervention to improve knowledge of hearing aids and communication in first-time hearing aid users was assessed. This intervention was based on the concept of reusable learning objects (RLOs).

Method: A randomized controlled trial was conducted. One group received the educational intervention, and the other acted as a control group. RLOs were delivered online and through DVD for television and personal computer. Knowledge of both practical and psychosocial aspects of

hearing aids and communication was assessed using a free-recall method 6 weeks postfitting.

Results: Knowledge of both practical and psychosocial issues was significantly higher in the group that received the RLOs than in the control group. Moderate to large effect sizes indicated that these differences were clinically significant.

Conclusion: An educational intervention that supplements clinical practice results in improved knowledge in first-time hearing aid users.

If you are an audiologist, how confident are you that all of the information and advice you offer your first-time hearing aid patients is understood, absorbed, and then acted upon once they leave the comfort of your clinic room? It has been reported that 51% of first-time hearing aid users have difficulties using their hearing aids (Action on Hearing Loss [AOHL], 2011). For example, between 60% and 80% of first-time hearing aid users do not know how to use the telephone with their hearing aids and need further instruction (Goggins & Day, 2009; Vuorialho, Karinen, & Sorri, 2006). This is reflected in a statement from a typical first-time hearing aid user: “You get a lot of information . . . by the time you get home you’ve forgotten most of it” (AOHL, 2011). The problem of information overload and retention is not unique to hearing aid users.

It has been suggested that between 40% and 80% of information given verbally in clinical appointments is forgotten afterward (Kessels, 2003). A study of hearing aid users showed that of the information delivered at the hearing aid fitting appointment, 25% is forgotten 1 month later (Reese & Smith, 2006). However, this study used a multiple-choice method of assessment that may have artificially inflated the amount of information recalled. A free-recall method of assessment showed that 49.6% of the information delivered was recalled in first-time hearing aid users (62.9% of practical information and 34.3% of psychosocial information; El-Molla, Smith, Henshaw, & Ferguson, 2012).

To address this problem, delivery of high-quality written information is recommended as good clinical practice (AOHL, 2011; National Health Service Scotland, 2009). It is common for hearing aid users to receive a hearing aid-specific manufacturer’s user guide. However, two studies reported that these user guides are not optimal in terms of content, design, and readability (Brooke, Isherwood, Herbert, Raynor, & Knapp, 2012; Caposecco, Hickson, & Meyer, 2014). Furthermore, it is important to recognize that delivery of information from audiologist to patient is not the same as educating the patient and increasing his or her knowledge base (Boothroyd, 2007). Constructivist learning theory

^aNIHR Nottingham Hearing Biomedical Research Unit, Nottingham University Hospitals NHS Trust, United Kingdom

^bNIHR Nottingham Hearing Biomedical Research Unit, Otolaryngology and Hearing Research Group, Division of Clinical Neuroscience, University of Nottingham, United Kingdom

^cNottingham Audiology Service, Nottingham University Hospitals NHS Trust, United Kingdom

^dUniversity of Nottingham, United Kingdom

Correspondence to Melanie Ferguson:
melanie.ferguson@nottingham.ac.uk

Editor and Associate Editor: Larry Humes

Received December 21, 2014

Revision received April 5, 2015

Accepted April 10, 2015

DOI: 10.1044/2015_AJA-14-0088

Disclosure: The authors have declared that no competing interests existed at the time of publication. The views expressed are those of the authors and not necessarily those of the National Health Service, the National Institute for Health Research, or the Department of Health. The Nottingham University Hospitals NHS Trust and University of Nottingham will receive a small portion of any royalties from the sale of the C2Hear reusable learning objects. No payment will be made to any individual member of the research team.

suggests that interaction with learning materials promotes learning and that the greater the interactivity, the greater the learning (Zhang, Zhou, Briggs, & Nunamaker, 2006). Studies of education in hearing aid users as part of their rehabilitation include communication programs delivered in group or individual settings (Beynon, Thornton, & Poole, 1997; Hickson, Worrall, & Scarinci, 2007), remote programs home delivered by videotape (Kramer, Allesie, Dondorp, Zekveld, & Kapteyn, 2005), written materials supported by telephone follow-up calls (Lundberg, Andersson, & Lunner, 2011), and online education and rehabilitation programs (Thorén, Öberg, Wänström, Andersson, & Lunner, 2013).

Development of the Educational Intervention

The concept of reusable learning objects (RLOs) has been used in electronic learning environments. RLOs are short, highly visual chunks of interactive multimedia learning that illustrate concepts to support a specific learning goal. They enable engagement with the learning materials by activities, can be replayed as often as required, and include a self-assessment element that enables users to test their mastery of the content (Windle, McCormick, Dandrea, & Wharrad, 2010). We have developed an educational program consisting of RLOs for first-time hearing aid users that is underpinned by pedagogical principles and learning theory (Ferguson, Brandreth, Leighton, Brassington, & Wharrad, 2015). Each RLO has specific learning outcomes, includes reinforcement of good behaviors, explains the consequences of poor behaviors, and has an interactive multiple-choice quiz at the end. The RLOs include video clips, illustrations, animations, photos, sounds, and testimonials, and all are subtitled.

Seven RLOs were designed using a participatory approach that included audiologists and hearing aid users (Brandreth, Leighton, Wharrad, & Ferguson, 2013) to ensure that the RLOs met the users' needs (duration shown in parentheses):

1. Getting to know your hearing aids (9 min, 33 s)
2. How to insert hearing aids (4 min, 34 s)
3. What to expect when wearing hearing aids (6 min, 48 s)
4. Adapting to wearing hearing aids (9 min, 35 s)
5. Communication tactics (11 min, 52 s)
6. Using the phone and other devices (5 min, 36 s)
7. Hearing aid care and troubleshooting (7 min, 55 s)

There was also a short introduction (2 min, 52 s). The total duration of the RLOs was 58 min, 45 s. The aim of this study was to assess the effect of the RLOs on knowledge of hearing aids and communication in first-time hearing aid users 6 weeks postfitting.

Evaluation of RLOs

The effectiveness of the RLOs was investigated in a randomized controlled trial (RCT) of 203 first-time hearing

aid users (Registered Clinical Trial No. ISRCTN11486888). These were recruited from Nottingham Audiology Services as part of their standard clinical management, which comprised hearing aid fitting using the NAL-NL1 prescription; verification with probe tube measurements; and hearing aid orientation, including provision of the manufacturer's fitting guide and counseling. Outcome measures included hearing aid benefit, practical hearing aid skills, participation restrictions, well-being, and feedback on the RLOs assessed 6 weeks after hearing aid fitting (see Ferguson et al., 2015). The study was approved by the Nottingham Research Ethics Committee and Nottingham University Hospital's Trust Research and Development department.

The single-center prospective RCT had two arms: The intervention group received the RLOs as part of their standard clinical management at the hearing aid fitting (RLO+, $n = 103$), and the control group received standard clinical management only (RLO-, $n = 100$). Participants in the intervention group chose one of four RLO delivery methods: (a) interactive DVD for television (50.6%); (b) interactive DVD for personal computer (15.2%); (c) interactive RLOs via the Internet (32.9%); and (d) autoplay DVD for television, with no interactivity for participants who did not have a remote control (1.3%).

The 20-item free-recall Hearing Aid and Communication Knowledge Questionnaire (El-Molla et al., 2012) assessed knowledge of practical ($n = 12$) and psychosocial ($n = 8$) aspects of hearing aids and communication in 141 participants (see Table 1 for demographics). The reduced number was due to nonattenders at evaluation ($n = 32$) and a delay in using the knowledge questionnaire due to early piloting ($n = 30$). Composite scores were calculated as the mean of the practical items and psychosocial items. For each item there was a range of possible answers, with one mark for each correct answer (maximum = 2 or 3), which were presented as a percentage-correct score. For example, the question "How frequently and when does the tubing need to be replaced in the earmold?" had the following model answers: (a) "Every 4 to 6 months" and (b) "When the tubing becomes worn or damaged (e.g., yellow, hard, or

Table 1. Mean (*SD*) age and better ear average hearing thresholds (octave frequencies between 0.25 and 4.0 kHz), gender, and hearing aid fit for the intervention (RLO+; $n = 62$) and control (RLO-; $n = 79$) participants who completed the Hearing Aid and Communication Knowledge questionnaire.

Variable	RLO+	RLO-
Age (years)	68.1 (7.4)	67.3 (9.3)
Better ear average (dB HL)	32.7 (7.6)	31.4 (9.3)
Gender		
Male	41 (66%)	49 (62%)
Female	21 (34%)	30 (38%)
Hearing aid fit		
Bilateral	47 (76%)	56 (71%)
Unilateral	15 (24%)	23 (29%)

Note. RLO = reusable learning object.

split).” One point was given for each correct answer. Effect sizes (Cohen’s *d*) were categorized as small (.2), moderate (.5), and large (.8).

Composite scores were significantly better in the RLO+ group ($p < .001$), with generally large effect sizes (see Table 2). The range of responses was large, and each item ranged between 0% and 100%. There was no significant difference in age, hearing threshold, gender, or number of hearing aids fitted between the groups ($p > .05$). An analysis of variance showed no significant effects of age, gender, or hearing threshold on the composite scores ($p > .05$).

A multivariate analysis of variance (Wilks’s λ) of the items showed that the RLO+ group had significantly better scores ($p < .001$). Table 2 shows the *t* tests for the 14 items with a between-groups difference $> 3\%$, which included both practical ($n = 8/12$) and psychosocial ($n = 6/8$) items.

Benefits of RLOs for First-Time Hearing Aid Users

Knowledge about hearing aids and communication was suboptimal in first-time users and was poorer for the psychosocial compared with practical composite scores. There was, however, significantly higher practical and psychosocial knowledge in the intervention group compared

with the control group. The effect sizes for the total composite scores were moderate (.68) to large (.86, .93), suggesting that the improvements were clinically significant. It is not clear whether (a) the RLOs provided additional information that the audiologist did not have time to deliver in the 1-hr fitting appointment, (b) the information was delivered in clinic and the RLOs served as a reminder to participants who otherwise might have experienced poor information recall or information overload, or (c) a combination of both. However, the results suggest that the largest gains in knowledge in the RLO+ group were shown for areas that are not always covered by the audiologist due to time constraints, as there is a requirement to ensure that the basics are addressed. For the absolute essentials (e.g., how to use the battery, where to go to get advice, and the need to acclimatize to the hearing aid), there was almost no difference ($< 3\%$) between the two groups. Similar results were seen for basic hearing aid handling skills (hearing aid and battery insertion and removal), which were generally good, with no group difference (reported in Ferguson et al., 2015). It is interesting to note that knowledge of the limitations of hearing aids was higher in the RLO+ group, whereas there was no group difference for knowledge of the benefits of hearing aids. This suggests that audiologists may focus more on the benefits than on the limitations of hearing aids.

Table 2. Mean percentage Hearing Aid and Communication Knowledge scores for the composite and individual items for the intervention (RLO+) and control (RLO–) groups, mean difference between groups, and effect size (Cohen’s *d*).

Composite scores and items	Mean knowledge score (%)		Group difference (%)	<i>d</i>	<i>p</i>
	RLO+	RLO–			
Composite scores					
Total	57.4	48.2	9.2	.93	< .001
Practical	62.7	52.9	9.8	.86	< .001
Psychosocial	49.9	41.6	8.3	.68	< .001
Individual items					
How frequently and when does the tubing need to be replaced in the earmold? ^a	65.3	29.7	35.6	.97	< .001
When you are wearing your hearing aid(s) can you name three important ways to improve one-to-one communication?	66.1	40.1	26.0	.74	< .001
How would you use the telephone with hearing aid(s)? ^a	41.5	27.1	14.4	.57	.004
What should you not do with your hearing aid(s)? ^a	53.7	45.1	8.6	.52	.037
What do you check if your hearing aid starts to whistle? ^a	27.9	12.6	15.3	.49	.001
How do you clean the earmold? And the tube? ^a	79.4	67.4	12.0	.46	.007
What are the benefits of persevering with hearing aid(s)?	55.4	43.1	12.3	.42	.014
How do you tell which aid is the left and which is the right?	95.8	87.3	8.6	.37	.060
What would you check if your hearing aid sounds softer than usual or begins to crackle and buzz? ^a	43.8	36.5	7.3	.28	.097
What are the limitations of hearing aid(s)?	26.3	21.1	5.3	.26	.110
How long do you think it takes to get used to new hearing aid(s)?	37.1	30.4	6.7	.21	.100
What situations would help you experience and adapt to your hearing aid(s)?	30.1	22.2	7.9	.19	.100
How do you know when your batteries are about to run out? ^a	77.4	72.1	5.3	.18	.290
Do you expect your hearing aid(s) will restore normal hearing?	92.0	87.2	4.8	.15	.400

Note. The following questions showed minimal ($< 3\%$) group difference (the number in parentheses is the percentage of people who scored zero; i.e., no response): “Explain how to replace your battery” (2.8%); “When the hearing aid is not in use, how do you prevent the battery from running out?” (2.1%); “If you have a problem or query, where do you go to get advice?” (0.7%); “Where and how would you use the loop program?” (8.8%); “What is the best way to get used to your hearing aid?” (1.4%); and “What benefits might you get from wearing hearing aids?” (11.3%). RLO = reusable learning object.

^aPractical question.

Does this improvement in knowledge transfer to improved outcome measures? Results from the current study (presented in Ferguson et al., 2015) suggest that RLOs do provide benefits to hearing aid users. In the RLO+ group, practical earmold cleaning and telephone skills were significantly better, and hearing aid use was significantly greater in suboptimal users (use < 70%). The vast majority of users reported that the RLOs were highly useful, improved their confidence to discuss hearing aids and communicate with others, and were preferable to written materials. It is important to note that around one half the users watched the RLOs two or more times, and 20% watched them three or more times. Some watched the RLOs as many as seven times, suggesting that the RLOs were used to manage hearing loss, hearing aids, and communication. This was supported by postevaluation focus groups.

It should be noted that the participants in this research were younger and had less hearing loss than do typical hearing aid users from this clinic. It is possible that the impact of the RLOs on a typical older, more impaired population would be different. Finally, the RLOs have undergone further improvement on the basis of participant feedback and are now branded as C2Hear; they have been commercially available in the United Kingdom since November 2014. There are plans to tailor C2Hear to individuals using mobile technologies and to develop and evaluate RLOs for communication partners and non-audiological health care professionals.

There is clearly a gap in adult rehabilitation for an effective intervention that enhances knowledge and educates hearing aid users. It remains to be seen whether audiologists will adopt this educational intervention to supplement their clinical practice, which was the ultimate goal of this research.

Acknowledgments

This presents independent research funded by National Institute for Health Research Grant PB-PG-0909-20294 under its Research for Patient Benefit program. We thank research team members Holly Thomas, James Henderson, and Michael Taylor; the audiologists at Nottingham Audiology Service who recruited the participants; and our patient and public involvement panel.

References

- Action on Hearing Loss.** (2011). *Hear me out: Audiology services in Scotland—Services provided, patients' experience and needs*. London, United Kingdom: Author.
- Beynon, G. J., Thornton, F. L., & Poole, C.** (1997). A randomized, controlled trial of the efficacy of a communication course for first time hearing aid users. *British Journal of Audiology*, 31, 345–351.
- Boothroyd, A.** (2007). Adult aural rehabilitation: What is it and does it work? *Trends in Amplification*, 11, 63–71.
- Brandreth, M., Leighton, P., Wharrad, H., & Ferguson, M.** (2013). Development of interactive video tutorials to educate first-time hearing aid users: A participatory approach [Abstract]. *International Journal of Audiology*, 52, 273.
- Brooke, R. E., Isherwood, S., Herbert, N. C., Raynor, D. K., & Knapp, P.** (2012). Hearing aid instruction booklets: Employing usability testing to determine effectiveness. *American Journal of Audiology*, 12, 206–214.
- Caposecco, A., Hickson, L., & Meyer, C.** (2014). Hearing aid user guides: Suitability for older adults. *International Journal of Audiology*, 53(Suppl. 1), S43–S51.
- El-Molla, F., Smith, Z., Henshaw, H., & Ferguson, M.** (2012, November). *Retention of rehabilitation information by first-time hearing aid users with and without interactive patient information*. Paper presented at the meeting of the British Academy of Audiology, Manchester, United Kingdom.
- Ferguson, M., Brandreth, M., Leighton, P., Brassington, W., & Wharrad, H.** (2015). *A randomized controlled trial to evaluate the benefits of a multimedia educational programme for first-time hearing aid users*. Manuscript submitted for publication.
- Goggins, S., & Day, J.** (2009). Pilot study: Efficacy of recalling adult hearing-aid users for reassessment after three years within a publicly funded audiology service. *International Journal of Audiology*, 48, 204–210.
- Hickson, L., Worrall, L., & Scarinci, N.** (2007). A randomized controlled trial evaluating the active communication education program for older people with hearing impairment. *Ear and Hearing*, 28, 212–230.
- Kessels, R. P.** (2003). Patients' memory for medical information. *Journal of the Royal Society of Medicine*, 96, 219–222.
- Kramer, S. E., Alessie, G. H. M., Dondorp, A. W., Zekveld, A. A., & Kapteyn, T. S.** (2005). A home education program for older adults with hearing impairment and their significant others: A randomized trial evaluating short- and long-term effects. *International Journal of Audiology*, 44, 255–264.
- Lundberg, M., Andersson, G., & Lunner, T.** (2011). A randomized, controlled trial of the short-term effects of complementing an educational program for hearing aid users with telephone consultations. *Journal of the American Academy of Audiology*, 22, 654–662.
- National Health Service Scotland.** (2009). *Quality standards for adult hearing rehabilitation*. Retrieved from <http://www.scotland.gov.uk/Resource/Doc/270517/0080557.pdf>
- Reese, J. L., & Smith, S. L.** (2006). Recall of hearing aid orientation content by first-time hearing aid users. *Seminars in Hearing*, 27, 337–344.
- Thorén, E. S., Öberg, M., Wänström, G., Andersson, G., & Lunner, T.** (2013). A randomized controlled trial evaluating the effects of online rehabilitative intervention for adult hearing-aid users. *International Journal of Audiology*, 53, 452–461.
- Vuorialho, A., Karinen, P., & Sorri, M.** (2006). Counselling of hearing aid users is highly cost-effective. *European Archives of Oto-Rhino-Laryngology*, 263, 988–995.
- Windle, R. J., McCormick, D., Dandrea, J., & Wharrad, H.** (2010). The characteristics of reusable learning objects that enhance learning: A case-study in health-science education. *British Journal of Educational Technology*, 42, 811–823.
- Zhang, D., Zhou, L., Briggs, R. O., & Nunamaker, J. F.** (2006). Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness. *Information and Management*, 43, 15–27.