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# Predictors of Rehabilitation Intervention Decisions in Adults With Acquired Hearing Impairment

Ariane Laplante-Lévesque,[a] Louise Hickson,[a] and Linda Worrall[a]

**Purpose:** This study investigated the predictors of rehabilitation intervention decisions in middle-age and older adults with acquired hearing impairment seeking help for the first time.
**Method:** Using shared decision making, 139 participants were offered intervention options: hearing aids, communication programs (group or individual), and no intervention. Multivariate analysis (logistic regression) provided odds ratios and 95% confidence intervals for intervention decision predictors when all other variables were held constant.
**Results:** Seven intervention decision predictors were identified: (a) application for subsidized hearing services (participants more likely to choose hearing aids and less likely to choose communication programs), (b) hearing impairment (hearing aids more likely and no intervention less likely), (c) communication self-efficacy (hearing aids less likely), (d) powerful others as locus of control (hearing aids less likely), (e) hearing disability perceived by others and self (hearing aids more likely), (f) perceived communication program effectiveness (communication programs more likely), and (g) perceived suitability of individual communication program (hearing aids less likely and communication programs more likely).
**Conclusion:** Findings suggest the need for clinicians to explicitly elicit the predictors identified by this study when involving adults with acquired hearing impairment in intervention decisions.

**Key Words:** hearing impairment, rehabilitation, decision making, adults, hearing aids

Hearing impairment is common among middle-age and older adults and is associated with poorer quality of life (e.g., Chia et al., 2007). Effective rehabilitation interventions are available: Hearing aids (Cox & Alexander, 2002; Kramer, Goverts, Dreschler, Boymans, & Festen, 2002), a group communication program (Hickson, Worrall, & Scarinci, 2006), and an individual communication program (Kramer, Allessie, Dondorp, Zekveld, & Kapteyn, 2005) have yielded overall self-reported outcomes of similar magnitude as measured by the International Outcome Inventory (Hickson et al., 2006). Communication programs are present in large numbers, and their effectiveness has been systematically reviewed (Hawkins, 2005; Sweetow & Palmer, 2005).

When several interventions with comparable outcomes exist for a health condition, client involvement in decision making is recommended (Charles, Gafni, & Whelan, 1997, 1999). Shared decision making occupies the middle of the health decision-making continuum from paternalistic decision making (clinician making the decision with little client involvement) to informed decision making (client making the decision with little clinician involvement). Shared decision making—characterized by the client and the clinician both participating in the information exchange, the deliberation, and the decision—is considered the best health decision-making practice. According to a systematic review, shared decision making is especially suitable for people with a chronic health condition and when the intervention involves more than one session (Joosten et al., 2008). Although shared decision making lacks a universal definition, its two main concepts are the acknowledgment of clients' perspectives and the discussion of intervention options (Makoul & Clayman, 2006). Shared decision making also views

[a]Communication Disability Centre, University of Queensland, Brisbane, Australia

Correspondence to Ariane Laplante-Lévesque, who is now with the Eriksholm Research Centre, Oticon, Snekkersten, Denmark: arl@oticon.dk

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intervention delay or decline as valid options (Montori, Gafni, & Charles, 2006). The rehabilitation intervention options for acquired hearing impairment are known (for a review, see Laplante-Lévesque, Hickson, & Worrall, 2010b), but the factors that significantly contribute to the decisions of people with hearing impairment need to be better understood.

Previous studies that surveyed factors influencing hearing rehabilitation decisions have tended not to specify the model of decision making adopted (paternalistic, shared, or informed); therefore, the extent to which clients were involved in the decision making is unknown (for a review, see Vestergaard Knudsen, Öberg, Nielsen, Naylor, & Kramer, 2010). Furthermore, there has been no previous study in which a choice of rehabilitation interventions for hearing impairment, other than hearing aids, was available. This is a significant limitation of previous studies, as people compare intervention options against one another when making decisions (Bower, King, Nazareth, Lampe, & Sibbald, 2005).

In an effort to explore the decisions of people with acquired hearing impairment seeking help for the first time, we offered middle-age and older adults intervention options (hearing aids, group and individual communication programs, and no intervention) using shared decision making, and we interviewed them following their intervention decisions. Using a qualitative approach, we identified seven factors that the participants reported as influencing their intervention decisions: (a) convenience; (b) expected adherence and outcomes; (c) financial costs; (d) hearing disability; (e) nature of intervention; (f) other people's experiences, recommendations, and support; and (g) preventive and interim solution (Laplante-Lévesque, Hickson, & Worrall, 2010a). The individual interviews allowed for the perspectives of adults with hearing impairment toward intervention decisions to be better understood. However, the qualitative methodology of the study was not suited to determining the relative impact of the seven factors on intervention decisions in a larger sample.

The aim of the present study was to determine the predictors of rehabilitation intervention decisions of middle-age and older adults with acquired hearing impairment seeking help for the first time. Previously studied predictors, predictors identified as needing to be studied as discussed above, and predictors unveiled in our recent qualitative study were included in this quantitative study.

# Method

## Measures

The potential predictors of intervention decisions (potential predictor variables) examined in this study were as follows: age, gender, living situation, education, socioeconomic status, eligibility for subsidized hearing services, application for subsidized hearing services, hearing impairment, time since onset of hearing impairment, self-reported hearing disability, communication self-efficacy, stages of change, locus of control, and intervention beliefs. Socioeconomic status was defined as high or low according to the Australian Government's (2010) assets test. In Australia, application to publicly subsidized hearing services requires a referral from a medical practitioner and gives written information about the assessment and intervention services provided (see the Procedure section for more information on subsidized hearing services in Australia). Self-reported hearing disability, communication self-efficacy, stages of change, locus of control, and beliefs elicited in a previous qualitative study as relevant to intervention decisions (Laplante-Lévesque et al., 2010a) were measured with questionnaires. Each questionnaire is described below along with available psychometric properties.

*Self-reported hearing disability.* The Hearing Handicap Questionnaire (HHQ; Gatehouse & Noble, 2004) measures hearing handicap as defined by the original World Health Organization's (1980) International Classification of Impairments, Disabilities, and Handicaps. In the more recent World Health Organization's (2001) International Classification of Functioning, Disability, and Health, the concepts of handicaps as well as impairments, activity limitations, and participation restrictions are collectively referred to as *disability* (Gagné, Jennings, & Southall, 2009). The 12 items of the HHQ (e.g., "How often do you feel tense or tired because of your hearing difficulty?") target "emotional distress and discomfort, social withdrawal, and general restriction on participation" (Gatehouse & Noble, 2004, p. 88). The five response options are 1 = *never*, 2 = *rarely*, 3 = *sometimes*, 4 = *often*, and 5 = *almost always*. Total scores range from 12 to 60, with higher scores indicative of greater disability. The HHQ has a single-factor structure in older adults with hearing aids or those who pursue a group communication program (Gatehouse & Noble, 2004; Hickson, Worrall, & Scarinci, 2007b). The factor structure may vary by population; furthermore, a two-factor structure has been reported in cochlear implant users (Noble, Tyler, Dunn, & Bhullar, 2008).

*Communication self-efficacy.* The perceived self-efficacy score of the Self-Efficacy for Situational Communication Management Questionnaire (SESMQ; Jennings, 2005), on the basis of Bandura's (1977) social–cognitive theory, measures "an individual's judgment of his/her capabilities to mobilize the motivation, cognitive resources and courses of action needed to meet the demands of the range of everyday difficult listening environments" (Jennings, 2005, p. 60). The questionnaire includes 20 situations (e.g., "You are at a party where the conversation is

noisy. Someone who you have never met before comes over to speak to you."). For each situation, respondents rate their hearing (hearing score) and their confidence in handling the situation (perceived communication self-efficacy score). The response options of the perceived communication self-efficacy score are on an 11-point Likert scale ranging from 0 (*not confident at all*) to 10 (*very confident*). Total perceived communication self-efficacy scores range from 0 to 200, with higher scores indicative of greater perceived communication self-efficacy. The SESMQ has good test–retest reliability (Jennings, 2005). Principal component analysis (PCA) of the SESMQ data obtained from 153 participants in this study confirmed a single-factor structure accounting for a large amount (52%) of the variance in scores.

*Stages of change.* The University of Rhode Island Change Assessment (URICA; McConnaughy, Prochaska, & Velicer, 1983) measures attitudes and behaviors relevant to the four stages of change toward intentional health behavior acquisition and modification (transtheoretical model): (a) precontemplation (problem denial), (b) contemplation (problem awareness and ambivalence toward the pros and cons of change), (c) action (healthy behavior acquisition or modification), and (d) maintenance (sustained healthy behavior and relapse prevention; Prochaska, DiClemente, & Norcross, 1992). The URICA has 32 items (eight items per stage of change); however, as the study participants were seeking help for the first time, the eight items relevant to the maintenance stage were not applicable and were excluded. The 24-item version of the URICA has previously been used with clinical populations (e.g., Lam, McMahon, Priddy, & Gehred-Schultz, 1988; Treasure et al., 1999). Statements include the phrase "the problem," which was replaced here by "the hearing problem." Eight items target each of the three relevant stages of change: precontemplation (e.g., "As far as I'm concerned, I don't have any hearing problems that need changing"), contemplation (e.g., "I hope that someone here will have some good advice for me"), and action (e.g., "I am actively working on my hearing problem"). The five response options are 1 = *strongly disagree*, 2 = *disagree*, 3 = *undecided*, 4 = *agree*, and 5 = *strongly agree*. Total stage scores range from 8 to 40, with higher scores indicative of greater endorsement of the relevant stage of change. The URICA has a four-factor structure consistent with the four stages of change (e.g., Carney & Kivlahan, 1995; McConnaughy et al., 1983) and has good test–retest reliability (Abellanas & McLellan, 1993).

*Locus of Control (LoC;* Levenson, 1972*).* The LoC Internality, Powerful Others, and Chance Scales measure perceived causation of life events. People with a high internal locus of control (Internality Scale) consider themselves as having more control over their lives, whereas people with a high external locus of control consider other people (for the Powerful Others Scale) or chance and fate (for the Chance Scale) as having more control over their lives. Eight items target each of the three scales: Internality Scale (e.g., "When I make plans, I am almost certain to make them work"), Powerful Others Scale (e.g., "I feel like what happens in my life is mostly determined by powerful people"), and Chance Scale (e.g., "When I get what I want, it's usually because I'm lucky"). The six response options are –3 = *strongly disagree*, –2 = *disagree somewhat*, –1 = *slightly disagree*, 1 = *slightly agree*, 2 = *agree somewhat*, and 3 = *strongly agree*. Each scale is scored and analyzed independently, thereby providing multiple loci of control for each respondent. For each scale, total scores range from 0 to 48 (24 is added to each scale to avoid negative total scores), with higher scores indicative of more agreement with the relevant locus of control. The LoC has a three-factor structure consistent with the three loci of control (Walkey, 1979) and has good test–retest reliability (Levenson, 1974).

*Intervention Questionnaire.* A questionnaire was developed for the purpose of the present study to assess beliefs that could predict intervention decisions. The Intervention Questionnaire was based on our earlier qualitative study of interviews with adults with acquired hearing impairment following intervention decisions (Laplante-Lévesque et al., 2010a). Twenty-six Intervention Questionnaire items (e.g., "Other people tell me I should do something about my hearing") were generated according to the seven factors identified in the qualitative study. To optimize face and content validity, the Intervention Questionnaire items borrowed the words and phrases that the participants used in the interviews. The response options are on an 11-point Likert scale ranging from 0 (*not true at all*) to 10 (*very much true*). For each item, potential scores range from 0 to 10, with a higher score indicative of greater belief agreement. The Intervention Questionnaire test–retest reliability was assessed on 44 participants chosen to provide a representative subsample of the full sample. The second Intervention Questionnaire administration occurred between 7 and 24 days after the first administration ($M$ = 8.09 days, $SD$ = 2.82 days). Most Intervention Questionnaire item scores were not normally distributed, and transformations failed to normalize all Intervention Questionnaire scores. For this reason, Spearman's rank correlation coefficients were obtained in lieu of interclass correlation coefficients. Spearman's rank correlation coefficients were moderate ($\rho$ between .4 and .7) for one item, high ($\rho$ between .7 and .9) for eight items, and very high ($\rho > .9$) for 10 items (Bohannon, 1992).

PCA with varimax rotation was performed to simplify the 26-item Intervention Questionnaire scores. Seven of the 26 Intervention Questionnaire items loaded on more than one component and were therefore removed. PCA identified seven components with eigenvalues

greater than 1, explaining 76% of the remaining 19-item Intervention Questionnaire total variance. The seven components can be interpreted as measuring the following: (a) hearing disability perceived by others and self, (b) perceived communication program effectiveness, (c) perceived suitability of individual communication program, (d) perceived likely adherence, (e) perceived suitability of group communication program, (f) other people's recommendation of the communication programs, and (g) concerns about hearing aid cost and practices. The 19 Intervention Questionnaire items are presented in Table 1.

The PCA of the Intervention Questionnaire scores supports the initial qualitative study (Laplante-Lévesque et al., 2010a). The qualitative study grouped potentially influential factors according to thematic similarities and therefore cut across the intervention options (e.g., the "convenience" factor referred to convenience of any intervention option). In contrast, the PCA grouped potentially

**Table 1.** Intervention Questionnaire: Components identified with principal component analysis, corresponding Intervention Questionnaire items, factors as reported in a qualitative study (Laplante-Lévesque et al., 2010a), and component loading.

| Component | Intervention Questionnaire item | Corresponding factor from qualitative study | Component loading |
|---|---|---|---|
| Hearing disability perceived by others and self (15% of total variance) | Other people tell me I should do something about my hearing. | Other people's experiences, recommendations, and support | .89 |
| | Other people tell me I have trouble hearing. | Other people's experiences, recommendations, and support | .86 |
| | Other people tell me I should get hearing aids. | Other people's experiences, recommendations, and support | .83 |
| | My hearing affects me in my day-to-day life. | Hearing disability | .62 |
| Perceived communication program effectiveness (14% of total variance) | The individual program will prevent my hearing problems from affecting me more in the future. | Preventive and interim solution | .84 |
| | The group program will prevent my hearing problems from affecting me more in the future. | Preventive and interim solution | .82 |
| | The group program is most likely to address my current hearing problems. | Expected adherence and outcomes | .79 |
| | The individual program is most likely to address my current hearing problems. | Expected adherence and outcomes | .75 |
| Perceived suitability of individual communication program (11% of total variance) | I am comfortable with learning from reading to address my hearing problems. | Nature of intervention | .87 |
| | It is convenient for me to do the individual program. | Convenience | .84 |
| Perceived likely adherence (10% of total variance) | If I were to decide to do the group program, I would persevere with it. | Expected adherence and outcomes | .86 |
| | If I were to decide to do the individual program, I would persevere with it. | Expected adherence and outcomes | .84 |
| | If I were to decide to get hearing aids, I would persevere with them. | Expected adherence and outcomes | .54 |
| Perceived suitability of group communication program (10% of total variance) | It is convenient for me to do the group program. | Convenience | .86 |
| | I am comfortable with learning from group sessions to address my hearing problems. | Nature of intervention | .75 |
| Other people's recommendation of the communication programs (9% of total variance) | Other people tell me I should do the individual program. | Other people's experiences, recommendations, and support | .91 |
| | Other people tell me I should do the group program. | Other people's experiences, recommendations, and support | .89 |
| Concerns about hearing aid cost and practices (6% of total variance) | Hearing aids are expensive for me. | Financial costs | .75 |
| | People at the hearing aid clinic would not have my best interests at heart. | Nature of intervention | .73 |

influential factors according to participants' Intervention Questionnaire scores and therefore tended to follow preferences for specific intervention options (e.g., the "perceived suitability of individual communication program" component referred to convenience as well as suitable format of the individual communication program). These differences in the organization of the qualitative and quantitative findings highlight the complementary nature of the two research methods.

## Participants

Adults 50 years of age and older seeking help for the first time were recruited via the Office of Hearing Services of the Australian Government's Department of Health and Ageing (Australian publicly subsidized hearing services for people receiving a government pension), print and electronic media, notice boards, and word-of-mouth in Brisbane, Queensland, Australia. Recruitment materials stated that people who had trouble hearing and were "thinking of doing something about their hearing for the first time" were sought and that the study included a free hearing screening and discussion of hearing needs with a qualified audiologist. Potential participants completed a hearing assessment (otoscopy and air conduction pure-tone audiometry). Eligibility was restricted to those who presented with a hearing impairment, defined as an average of air conduction thresholds at 0.5, 1, 2, and 4 kHz greater than 25 dB HL in at least one ear. A total of 153 participants were recruited, but 14 of them did not complete all measures and were therefore excluded. The final sample consisted of 139 participants, and the final data set was exempt of missing values. Sample characteristics ($n$ = 139) are presented in Table 2. The study received ethical clearance from the University of Queensland's Behavioural and Social Sciences Ethical Review Committee and the Australian Government's Department of Health and Ageing Ethics Review Committee.

## Procedure

Each participant attended a face-to-face appointment with the same clinical audiologist to complete all measures (except the Intervention Questionnaire, which evaluated beliefs in relation to intervention decisions and therefore had to be completed after the intervention decision) before discussing the rehabilitation intervention options using shared decision making as described above (Charles et al., 1997, 1999). Three intervention options were presented: hearing aids, communication programs (group or individual), and no intervention. In line with shared decision making, discussion focused on participants' rehabilitation goals, preferences for interventions, and information needs. Discussion avoided, for example, a paternalist intervention prescription based on clinical presentation, such as degree of hearing impairment. Each participant received a decision aid (written summary of the intervention options) that was published elsewhere (Laplante-Lévesque et al., 2010a) and attended a second face-to-face or telephone appointment with the clinical audiologist at least 1 week after the first appointment to make the intervention decision. The Intervention Questionnaire was administered following the intervention decision. Participants could then select and complete their intervention of choice. Another intervention could be considered after completion of the initial intervention.

*Hearing aids.* Participants who opted for hearing aids were provided with them by their preferred clinic. The participants eligible for subsidized hearing services (73%) were entitled to two free digital standard behind-the-ear, thin-tube behind-the-ear, in-the-ear, or in-the-canal hearing aids with the following minimal requirements: two-channel compression, feedback cancellation, adaptive noise reduction, manual volume control, telecoil, and directional microphone (the latter only applicable to standard behind-the-ear hearing aids). Participants could also elect to contribute toward the cost of hearing aids with features additional to the minimal requirements. For the participants not eligible for subsidized hearing services (27%), the current market cost of hearing aids was approximately $1,250–$4,500 per hearing aid.

*Communication programs.* Participants who opted for a communication program could choose between the Active Communication Education (ACE) program (Hickson, Worrall, & Scarinci, 2007a) and the Individual–Active Communication Education (I-ACE) program, an adaptation of ACE suitable for at-home individual sessions instead of group sessions, by the Audiology Clinic of the University of Queensland for free.

ACE, the group communication program, consisted of five 2-hr sessions on consecutive weeks discussing problem-solving strategies to improve communication. The topics covered depend on the participants' needs but can include communication strategies and hearing assistive technology. The ACE sessions were facilitated by an audiologist and included 6–10 people (participants' significant others were encouraged to attend). By providing peer support and involving significant others, ACE can help address some of the psychosocial consequences of hearing impairment. The effectiveness of the ACE program was documented in a double-blinded randomized controlled trial in which, unlike participants in placebo group sessions, participants in ACE group sessions reported reduced hearing disability following the program (Hickson et al., 2007b).

I-ACE, the individual communication program, consisted of five written chapters with content similar to ACE but with a focus on individualization to suit each

**Table 2.** Potential predictors of intervention decisions.

| Potential predictor | Intervention decision = hearing aids (*n* = 75) | Intervention decision = communication programs (*n* = 34) | Intervention decision = no intervention (*n* = 30) | Full sample (*n* = 139) |
|---|---|---|---|---|
| Age | | | | |
| *Mdn* | 70.90 | 69.70 | 68.79 | 69.80 |
| 25th–75th percentiles | 66.26–76.58 | 64.69–77.45 | 65.82–74.24 | 65.82–76.44 |
| Gender, *n* (%) | | | | |
| Male | 58 (77.33) | 23 (67.65) | 17 (56.67) | 98 (70.50) |
| Female | 17 (22.67) | 11 (32.35) | 13 (43.33) | 41 (29.50) |
| Living situation, *n* (%) | | | | |
| Alone | 18 (24.00) | 6 (17.65) | 10 (33.33) | 34 (24.46) |
| With other(s) | 57 (76.00) | 28 (82.35) | 20 (66.67) | 105 (75.54) |
| Education, *n* (%) | | | | |
| None or primary school | 14 (18.67) | 4 (11.74) | 4 (13.33) | 22 (15.83) |
| High school or technical school | 36 (48.00) | 18 (52.94) | 18 (60.00) | 72 (51.80) |
| University | 25 (33.33) | 12 (35.29) | 8 (26.67) | 45 (32.37) |
| Socioeconomic status, *n* (%) | | | | |
| Low | 16 (21.33) | 9 (26.47) | 11 (36.67) | 36 (25.90) |
| High | 59 (78.67) | 25 (73.53) | 19 (63.33) | 103 (74.10) |
| Eligibility for subsidized hearing services, *n* (%) | | | | |
| Not eligible for subsidized hearing services | 17 (22.67) | 13 (38.24) | 8 (26.67) | 38 (27.34) |
| Eligible for subsidized hearing services | 58 (77.33) | 21 (61.76) | 22 (73.33) | 101 (72.66) |
| Application for subsidized hearing services, *n* (%) | | | | |
| Not applied for subsidized hearing services | 16 (21.33) | 23 (67.65) | 15 (50.00) | 54 (38.85) |
| Applied for subsidized hearing services | 59 (78.67) | 11 (32.35) | 15 (50.00) | 85 (61.15) |
| Hearing impairment (0.5, 1, 2, and 4 kHz average in better ear; in dB HL) | | | | |
| *Mdn* | 35.00 | 27.50 | 27.50 | 32.50 |
| 25th–75th percentiles | 30.00–40.00 | 25.00–33.75 | 23.75–36.25 | 26.25–37.50 |
| Time since onset of hearing impairment (in years) | | | | |
| *Mdn* | 8.00 | 5.00 | 5.00 | 6.00 |
| 25th–75th percentiles | 3.00–15.00 | 3.00–15.00 | 1.00–10.00 | 3.00–15.00 |
| Self-reported hearing disability (HHQ) [12–60] | | | | |
| *Mdn* | 26.00 | 24.00 | 18.50 | 25.00 |
| 25th–75th percentiles | 22.00–33.00 | 21.00–28.00 | 14.00–28.00 | 20.00–31.00 |
| Communication self-efficacy (SESMQ Perceived Self-Efficacy Scale) [0–200] | | | | |
| *Mdn* | 117.00 | 127.50 | 147.50 | 127.00 |
| 25th–75th percentiles | 95.00–140.00 | 113.00–151.00 | 137.00–172.00 | 137.00–172.00 |
| Precontemplation stage of change (URICA Precontemplation Scale) [8–40] | | | | |
| *Mdn* | 13.00 | 16.00 | 18.00 | 15.00 |
| 25th–75th percentiles | 10.00–16.00 | 14.00–18.00 | 15.00–20.00 | 15.00–20.00 |
| Contemplation stage of change (URICA Contemplation Scale) [8–40] | | | | |
| *Mdn* | 33.00 | 32.00 | 31.00 | 32.00 |
| 25th–75th percentiles | 31.00–36.00 | 31.00–33.00 | 25.00–32.00 | 31.00–34.00 |
| Action stage of change (URICA Action Scale) [8–40] | | | | |
| *Mdn* | 32.00 | 30.00 | 30.00 | 31.00 |
| 25th–75th percentiles | 30.00–33.00 | 28.00–32.00 | 23.00–32.00 | 29.00–32.00 |
| Internality locus of control (LoC Internality Scale) [0–40] | | | | |
| *Mdn* | 39.00 | 38.00 | 40.00 | 39.00 |
| 25th–75th percentiles | 35.00–43.00 | 35.00–41.00 | 33.00–44.00 | 35.00–42.00 |
| Powerful others locus of control (LoC Powerful Others Scale) [0–48] | | | | |
| *Mdn* | 15.00 | 20.00 | 19.00 | 17.00 |
| 25th–75th percentiles | 10.00–19.00 | 13.00–25.00 | 13.00–25.00 | 12.00–23.00 |
| Chance locus of control (LoC Chance Scale) [0–40] | | | | |
| *Mdn* | 17.00 | 18.50 | 22.00 | 19.00 |
| 25th–75th percentiles | 88.00–22.00 | 12.00–26.00 | 17.00–30.00 | 10.00–25.00 |

*(Continued on the following page)*

**Table 2** *Continued.* Potential predictors of intervention decisions.

| Potential predictor | Intervention decision = hearing aids ($n$ = 75) | Intervention decision = communication programs ($n$ = 34) | Intervention decision = no intervention ($n$ = 30) | Full sample ($n$ = 139) |
|---|---|---|---|---|
| Hearing disability perceived by others and self (Intervention Questionnaire component) [0–32.07] | | | | |
| *Mdn* | 21.82 | 15.78 | 7.45 | 17.03 |
| 25th–75th percentiles | 13.19–26.45 | 8.69–20.07 | 3.23–17.74 | 9.36–22.97 |
| Perceived communication program effectiveness (Intervention Questionnaire component) [0–31.99] | | | | |
| *Mdn* | 6.40 | 15.46 | 6.37 | 6.37 |
| 25th–75th percentiles | 0.00–10.37 | 12.16–18.65 | 1.59–11.14 | 1.59–11.14 |
| Perceived suitability of individual communication program (Intervention Questionnaire component) [0–17.09] | | | | |
| *Mdn* | 9.42 | 15.34 | 11.91 | 11.96 |
| 25th–75th percentiles | 5.13–13.67 | 12.73–16.21 | 7.67–14.51 | 6.80–15.38 |
| Perceived likely adherence (IQ component) [0–22.45] | | | | |
| *Mdn* | 17.00 | 16.34 | 16.84 | 16.78 |
| 25th–75th percentiles | 12.27–20.21 | 13.29–20.21 | 8.33–20.21 | 12.36–20.21 |
| Perceived suitability of group communication program (Intervention Questionnaire component) [0–16.09] | | | | |
| *Mdn* | 5.96 | 8.12 | 4.89 | 6.20 |
| 25th–75th percentiles | 2.47–8.79 | 3.96–12.13 | 0.86–9.54 | 2.35–9.54 |
| Other people's recommendation of the communication programs (Intervention Questionnaire component) [0–18.04] | | | | |
| *Mdn* | 0.00 | 0.00 | 0.00 | 0.00 |
| 25th–75th percentiles | 0.00–0.00 | 0.00–0.89 | 0.00–0.00 | 0.00–0.00 |
| Concerns about hearing aid cost and practices (Intervention Questionnaire component) [0–14.80] | | | | |
| *Mdn* | 6.69 | 6.69 | 5.96 | 6.69 |
| 25th–75th percentiles | 2.98–8.17 | 2.23–8.89 | 3.73–7.46 | 2.98–8.15 |

*Note.* HHQ = Hearing Handicap Questionnaire; SESMQ = Self-Efficacy for Situational Communication Management Questionnaire; URICA = University of Rhode Island Change Assessment; LoC = Locus of Control.

participant. Significant others were encouraged to participate by, for example, completing some sections by themselves and some with the participants. Participants completed each of five chapters at home one at a time before contacting the facilitator, an audiologist, to discuss it. The facilitator then sent the next chapter via mail or e-mail, according to the participant's preference. The effectiveness of the I-ACE program has yet to be reported; however, it was directly adapted from the ACE program, whose effectiveness is known (Hickson et al., 2007b), and participants in an at-home program similar to I-ACE reported greater satisfaction and quality of life than a control group who did not receive the program (Kramer et al., 2005).

*No intervention.* Delaying or declining the intervention is outlined in the health literature as a valid option in several clinical circumstances. The option of no intervention acknowledges that some participants, after considering their condition and the benefits and barriers to intervention, choose not to pursue an intervention for their hearing impairment.

## Data Analysis

Data were analyzed using Stata (Version 10.1). The outcome variables (the intervention decisions) were expressed as three categories: hearing aids, communication programs (group or individual communication program), and no intervention. Group and individual communication programs were combined for analyses because of the small number of participants who chose to pursue the group communication program. All analyses compared one intervention decision (e.g., hearing aids) versus all other intervention decisions (e.g., communications programs or no intervention). This allowed for direct comparisons of adults with acquired hearing impairment making a specific intervention decision with the general population of adults with acquired hearing impairment seeking help for the first time.

First, unadjusted associations between the potential intervention decision predictor variables and the outcome variables (intervention decisions) were identified with bivariate logistic regression with an alpha level of .10. Unadjusted odds ratios (ORs), representing the ratios of the probability of the occurrence of the relevant intervention decision to the probability of occurrence of other intervention decisions before adjusting for covariates, are reported along with 90% confidence intervals (CIs) in Table 3.

An OR greater than 1 indicates that the likelihood of the relevant intervention decision is significantly higher. Conversely, an OR less than 1 indicates that the likelihood of the relevant intervention decision is significantly lower.

**Table 3.** Logistic regression models with multivariate-adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for significant intervention decision predictors at the bivariate level.

| Intervention decision predictor | Outcome variables: Intervention decisions | Unadjusted OR with 90% CI | Multivariate-adjusted OR with 95% CI |
|---|---|---|---|
| Age | Hearing aids vs. others | 1.04 [1.01, 1.08] | *ns* |
| | Communication programs vs. others | *ns* | *ns* |
| | No intervention vs. others | *ns* | *ns* |
| Gender | Hearing aids vs. others | 0.49 [0.26, 0.91] | *ns* |
| | Communication programs vs. others | *ns* | *ns* |
| | No intervention vs. others | 2.21 [1.09, 4.48] | *ns* |
| Application for subsidized hearing services | Hearing aids vs. others | 5.39 [2.89, 10.07] | 16.76 [3.59, 78.20] |
| | Communication programs vs. others | 0.20 [0.10, 0.40] | 0.27 [0.10, 0.74] |
| | No intervention vs. others | *ns* | *ns* |
| Hearing impairment (0.5, 1, 2, and 4 kHz average in better ear; in dB HL) | Hearing aids vs. others | 1.11 [1.06, 1.16] | 1.14 [1.03, 1.25] |
| | Communication program vs. others | 0.93 [0.89, 0.97] | *ns* |
| | No intervention vs. others | 0.94 [0.90, 0.98] | 0.93 [0.85, 0.99] |
| Self-reported hearing disability (HHQ) | Hearing aids vs. others | 1.08 [1.03, 1.12] | *ns* |
| | Communication program vs. others | *ns* | *ns* |
| | No intervention vs. others | 0.91 [0.86, 0.96] | *ns* |
| Communication self-efficacy (SESMQ Perceived Self-Efficacy Scale) | Hearing aids vs. others | 0.98 [0.97, 0.99] | 0.97 [0.95, 0.99] |
| | Communication program vs. others | *ns* | *ns* |
| | No intervention vs. others | 1.03 [1.02, 1.04] | *ns* |
| Precontemplation stage of change (URICA Precontemplation Scale) | Hearing aids vs. others | 0.78 [0.72, 0.86] | *ns* |
| | Communication program vs. others | 1.07 [1.01, 1.14] | *ns* |
| | No intervention vs. others | 1.21 [1.11, 1.32] | *ns* |
| Contemplation stage of change (URICA Contemplation Scale) | Hearing aids vs. others | 1.23 [1.12, 1.35] | *ns* |
| | Communication program vs. others | *ns* | *ns* |
| | No intervention vs. others | 0.73 [0.65, 0.83] | *ns* |
| Action stage of change (URICA Action Scale) | Hearing aids vs. others | 1.17 [1.08, 1.25] | *ns* |
| | Communication program vs. others | *ns* | *ns* |
| | No intervention vs. others | 0.87 [0.81, 0.94] | *ns* |
| Powerful others locus of control (LoC Powerful Others Scale) | Hearing aids vs. others | 0.95 [0.92, 0.99] | 0.90 [0.83, 0.98] |
| | Communication program vs. others | *ns* | *ns* |
| | No intervention vs. others | *ns* | *ns* |
| Chance locus of control (LOC Chance scale) | Hearing aids vs. others | 0.96 [0.93, 0.99] | *ns* |
| | Communication program vs. others | *ns* | *ns* |
| | No intervention vs. others | 1.05 [1.01, 1.09] | *ns* |
| Hearing disability perceived by others and self (Intervention Questionnaire component) | Hearing aids vs. others | 1.11 [1.07, 1.15] | 1.09 [1.01, 1.18] |
| | Communication program vs. others | *ns* | *ns* |
| | No intervention vs. others | 0.89 [0.85, 0.94] | *ns* |
| Perceived communication program effectiveness (Intervention Questionnaire component) | Hearing aids vs. others | 0.91 [0.87, 0.95] | *ns* |
| | Communication program vs. others | 1.24 [1.16, 1.33] | 1.18 [1.08, 1.29] |
| | No intervention vs. others | 0.94 [0.89, 0.99] | *ns* |
| Perceived suitability of individual communication program (Intervention Questionnaire component) | Hearing aids vs. others | 0.90 [0.85, 0.95] | 0.81 [0.69, 0.95] |
| | Communication program vs. others | 1.21 [1.11, 1.33] | 1.15 [1.01, 1.31] |
| | No intervention vs. others | *ns* | *ns* |
| Perceived suitability of group communication program (Intervention Questionnaire component) | Hearing aids vs. others | *ns* | *ns* |
| | Communication program vs. others | 1.10 [1.03, 1.18] | *ns* |
| | No intervention vs. others | *ns* | *ns* |

*Note.* *ns* = not significant with alpha level of .10 (for unadjusted ORs) and with alpha level of .05 (for adjusted ORs).

Second, the intervention decision predictors significantly associated with the intervention decisions were introduced in three logistic regression models (hearing aids vs. other intervention decisions, communication programs vs. other intervention decisions, and no intervention vs. other intervention decisions) in a single step to investigate adjusted associations. All predictors were kept in the models, and stepwise regression was not used, as the sequence of dependent tests it requires has been proven to introduce bias (e.g., Steyerberg, Eijkemans,

& Habbema, 1999). Adjusted ORs, representing the ratios of the probability of the occurrence of the relevant intervention decision to the probability of occurrence of other intervention decisions after adjusting for covariates, are reported along with 95% CIs. Finally, postestimation diagnostic tests were performed to evaluate the three logistic regression models.

## Results

The majority of the sample opted for hearing aids (54%), whereas 24% of the sample opted for communication programs (of those, 24% chose the group communication program, and 76% chose the individual communication program), and 22% opted for no intervention. Significant intervention decision predictors, at the level of either bivariate or multivariate analyses, are summarized in Table 3 and are described below. Living situation, education, socioeconomic status, eligibility for subsidized hearing services, time since onset of hearing impairment, perceived likely adherence, other people's recommendation of the communication programs, and concerns about hearing aid cost and practices were not significant intervention decision predictors at the bivariate level. These are not reported in Table 3 and are not discussed below.

### Age

Participants ranged from 50 to 87 years of age. Although significant unadjusted associations between age and intervention decisions existed, these associations did not remain significant after adjusting for covariates.

### Gender

Most of the participants (77%) were male. Although significant unadjusted associations between gender and intervention decisions existed, these associations did not remain significant after adjusting for covariates.

### Application for Subsidized Hearing Services

Most of the sample (73%) was eligible for subsidized hearing services, and 61% had recently applied for subsidized hearing services. Although eligibility for subsidized hearing services was not a significant intervention decision predictor, application for subsidized hearing services was. After adjusting for covariates, participants who had applied for subsidized hearing services were significantly more likely to opt for hearing aids (OR = 16.76; 95% CI [3.59, 78.20]). Conversely, after adjusting for covariates, participants who had applied for subsidized hearing services were significantly less likely to opt for communication programs (OR = 0.27; 95% CI [0.10, 0.74]).

### Hearing Impairment

Participants had on average a mild hearing impairment in their better ear. After adjusting for covariates, participants with a greater hearing impairment were significantly more likely to opt for hearing aids (OR = 1.14; 95% CI [1.03, 1.25]) and were more likely to pursue an intervention (OR = 0.93; 95% CI [0.85, 0.99]).

### Self-Reported Hearing Disability

The HHQ scores ranged from 12 to 44 ($M$ = 25.39, $SD$ = 7.92). This is consistent with a previous study in which 178 older adults with hearing impairment scored, on average, 27.97 ($SD$ = 9.36) on the HHQ prior to intervention (Hickson et al., 2007b). Although significant unadjusted associations between self-reported hearing disability and intervention decisions existed, these associations did not remain significant after adjusting for covariates.

### Communication Self-Efficacy

The SESMQ scores ranged from 16 to 200 ($M$ = 127.40, $SD$ = 34.32), similar to results obtained on 68 adults with hearing impairment by Jennings (2005). In the present study, after adjusting for covariates, participants who reported higher communication self-efficacy were significantly less likely to opt for hearing aids (OR = 0.97; 95% CI [0.95, 0.99]).

### Stages of Change

The URICA Precontemplation Scale scores ranged from 8 to 36 ($M$ = 15.04, $SD$ = 4.84), whereas the Contemplation Scale scores ranged from 13 to 40 ($M$ = 32.17, $SD$ = 4.24), and the Action Scale scores ranged from 8 to 40 ($M$ = 29.95, $SD$ = 5.47). A literature review failed to identify previous studies using the URICA with people with hearing impairment; however, Milstein and Weinstein (2002) used a staging algorithm to assign 147 older adults who attended a hearing screening session to a discrete stage of change, and the majority of their sample was in the precontemplation or contemplation stage of change. In the present study, 60% of the participants were in the contemplation stage of change. Furthermore, although significant unadjusted associations between stages of change and intervention decisions existed in the present study, these associations did not remain significant after adjusting for covariates.

## Locus of Control

The LoC Internality Scale scores ranged from 15 to 48 ($M$ = 38.09, $SD$ = 5.88), whereas the Powerful Others Scale scores ranged from 0 to 44 ($M$ = 17.33, $SD$ = 8.80), and the Chance Scale scores ranged from 0 to 47 ($M$ = 17.94, $SD$ = 9.99). These results are similar to the norms established by Cox, Alexander, and Gray (2005). After adjusting for covariates, internality and chance loci of control were not associated with intervention decisions in the present study. However, participants who reported greater powerful others as their locus of control were significantly less likely to opt for hearing aids (OR = 0.90; 95% CI [0.83, 0.98]).

## Intervention Questionnaire

*Hearing disability perceived by others and self.* After adjusting for covariates, participants who reported greater hearing disability perceived by others and self were significantly more likely to opt for hearing aids (OR = 1.09; 95% CI [1.01, 1.18]).

*Perceived communication program effectiveness.* After adjusting for covariates, participants who reported greater perceived communication program effectiveness were significantly more likely to opt for communication programs (OR = 1.18; 95% CI [1.08, 1.29]).

*Perceived suitability of individual communication program.* After adjusting for covariates, participants who reported greater perceived suitability of the individual communication program were significantly more likely to opt for communication programs (OR = 1.15; 95% CI [1.01, 1.31]) and were less likely to opt for hearing aids (OR = 0.81; 95% CI [0.69, 0.95]).

*Perceived suitability of group communication program.* Although significant unadjusted associations between suitability of group communication program and intervention decisions existed, these associations did not remain significant after adjusting for covariates.

## Post-Estimation Diagnostic Tests

The collinearity between the potential intervention decision predictors was uniformly very low (variance inflation factors were all less than 4) for all three logistic regression models. The Hosmer–Lemeshow goodness of fit test was insignificant for the three models, confirming that they fit the data well. The receiver operating characteristic curves depicted good predictive power for the three models, with large areas under receiver operating characteristic curves (.95 for the hearing aids vs. other intervention decisions model, .89 for the communication programs vs. other intervention decisions model, and .87 for the no intervention vs. other intervention decisions model). Moreover, the models had high sensitivity and specificity, with the hearing aids versus other intervention decisions model correctly classifying 86% of cases, the communication programs versus other intervention decisions model correctly classifying 83% of cases, and the no intervention versus other intervention decisions model correctly classifying 82% of cases.

# Discussion

To our knowledge, the present study is the first to identify the predictors of intervention decisions of middle-age and older adults with hearing impairment seeking help for the first time when intervention options other than hearing aids are available and when a formal model of health decision making (i.e., shared decision making) is used.

Many of the intervention decision predictors tested here are interrelated, making their unique association with the intervention decisions challenging to isolate. For example, for a given hearing impairment, self-reported hearing disability decreases with increasing age (Gatehouse, 1991; Gordon-Salant, Lantz, & Fitzgibbons, 1994; Wiley, Cruickshanks, Nondahl, & Tweed, 2000), whereas psychological attributes such as self-efficacy, locus of control, and personality traits affect self-reported hearing disability (Gatehouse, 1990; Jang, Mortimer, Haley, Hnath Chisolm, & Borenstein Graves, 2002; Kempen et al., 1999; Saunders & Cienkowski, 1996). The multivariate analyses conducted here controlled for such covariance and therefore greatly reduced the threat to internal validity that confounding factors (factors both associated with the predictor variable and with the outcome variable) usually pose. For example, whereas the bivariate analyses identified 10 potential predictors of the decision to not pursue any intervention, the multivariate analyses identified only one predictor (i.e., hearing impairment). In this case, nine of the 10 potential predictors were in fact confounders. However, the number of covariates is limited by the sample size. If the sample size had been larger, a greater number of potential predictor variables could have been entered in the models that would have increased their predictive power. For example, health status was raised as a reason to decline hearing aids among older adults with moderate-to-severe or profound hearing impairment (Rosenhall & Karlsson Espmark, 2003), but this was not tested in the current study. Similarly, more variables describing clinical interactions, such as recommendations from other health care clinicians or previous experiences with hearing aid clinics (e.g., when accompanying a family member or friend), could have been included in this study. Nonetheless, seven predictors uniquely contributed to the intervention decision and are discussed in more detail below.

## Application for Subsidized Hearing Services

Adults with acquired hearing impairment seeking help for the first time who had already applied for subsidized hearing services were almost 17 times more likely to opt for hearing aids, and, conversely, they were about four times less likely to opt for communication programs. This was by far the strongest intervention decision predictor identified in the present study. Interestingly, application for subsidized hearing services was significantly associated with intervention decisions, whereas eligibility for subsidized hearing services was not. In other words, people who had applied for publicly subsidized hearing services were more likely to choose to obtain hearing aids and were less likely to opt for communication programs than their peers who were eligible for such publicly subsidized hearing services but who had not applied for them. Therefore, this predictor reflects a process that goes beyond eligibility to publicly subsidized hearing services. Australian publicly subsidized hearing services emphasize hearing aids, and these could predispose people toward hearing aids and away from other intervention options such as communication programs. It can be hypothesized that consultation with a medical practitioner and/or application to other publicly subsidized hearing services, such as the Veterans Affairs system in the United States or the National Health Services in the United Kingdom, could predispose people toward specific intervention decisions, particularly if they emphasise hearing aids over other intervention options. Alternatively, adults with acquired hearing impairment who have already taken some initial steps toward help seeking could already have made the decision to opt for the intervention most well known to them: hearing aids.

## Hearing Impairment

Adults with a greater acquired hearing impairment (defined in the present study as the average hearing impairment at 0.5, 1, 2, and 4 kHz in the better ear) were more likely to opt for hearing aids and were less likely to opt for no intervention. Previous studies have also identified greater hearing impairment as a predictor of help seeking and hearing aid ownership (e.g., Garstecki & Erler, 1998; Helvik, Wennberg, Jacobsen, & Hallberg, 2008; Swan & Gatehouse, 1990; van den Brink, Wit, Kempen, & van Heuvelen, 1996). In some instances, clinicians might contribute to this association by recommending hearing aids to people with a greater hearing impairment. This pattern of hearing aid recommendation has been identified previously in a study of audiologists' hearing aid decisions (Doyle & Thomas, 1995).

## Communication Self-Efficacy

Interestingly, adults with acquired hearing impairment with greater communication self-efficacy were less likely to opt for hearing aids. Similarly, Cox et al. (2005) found that adults with hearing impairment who were less curious and imaginative—the "openness" personality dimension according to the NEO Five-Factor Inventory (Costa & McCrae, 1992)—were more likely to seek hearing aids than their counterparts. However, people with greater communication self-efficacy were not more likely to opt for communication programs or no intervention. People with greater communication self-efficacy may be inclined to use resources other than hearings aids—either internal resources, such as self-taught communication strategies or readily available hearing assistive technology, or external resources, such as communication programs—to address their hearing-related activity limitations and participation restrictions.

## LoC

Adults with acquired hearing impairment who reported powerful others to be in control of their lives were less likely to opt for hearing aids. In parallel with the present study's findings, previous studies have reported that hearing aid seekers and owners have a more internal locus of control (Cox et al., 2005; Garstecki & Erler, 1998). As participants who reported greater communication self-efficacy were also less likely to opt for hearing aids, the present study's findings corroborate the literature, suggesting that measures of locus of control and self-efficacy may be markers of the same higher order psychological trait (Judge, Erez, Bono, & Thoresen, 2002) that would be an intervention decision predictor. Alternatively, a shared decision-making approach, in contrast to a paternalist decision-making approach, may be less suited to participants who describe powerful others to be in control of their lives and may therefore result in them not pursuing hearing aids.

## Hearing Disability Perceived by Others and Self

Adults with acquired hearing impairment who perceived greater hearing disability, either through self-awareness or through awareness raised by other people such as communication partners, were more likely to opt for hearing aids. In the present study, the hearing disability perceived by others and self Intervention Questionnaire component—consisting of three items focusing on others' perception of the hearing disability and one item on self-perception of hearing disability (see Table 1)—was associated with intervention decisions, whereas scores on the HHQ were not. This suggests that

a hearing disability's impact on others (Scarinci, Worrall, & Hickson, 2009) is central to intervention decisions for adults with acquired hearing impairment. The literature is unequivocal on the positive relationship between self-reported hearing disability and hearing help seeking and hearing aid uptake (e.g., Davis, Smith, Ferguson, Stephens, & Gianopoulos, 2007; Duijvestijn et al., 2003; Humes, Wilson, & Humes, 2003; Meister, Walger, Brehmer, von Wedel, & von Wedel, 2008; Stephens, Meredith, Callaghan, Hogan, & Rayment, 1990; Swan & Gatehouse, 1990; van den Brink et al., 1996). Similarly, communication partners' input is a significant predictor of hearing help seeking and hearing aid uptake (Duijvestijn et al., 2003; Mahoney, Stephens, & Cadge, 1996; van den Brink et al., 1996).

## Perceived Communication Program Effectiveness

Adults with acquired hearing impairment who perceived communication programs as more effective were more likely to opt for communication programs. It may be that they perceived the communication program outcomes likely to be in line with their own rehabilitation goals. People who have higher hearing aid expectations are more likely to obtain hearing aids (van den Brink et al., 1996), and the present study confirms that this finding also applies to communication programs.

## Perceived Suitability of Individual Communication Program

Adults with acquired hearing impairment who perceived greater suitability of the individual communication program (i.e., belief that the individual communication program is convenient and that the format is suitable) were more likely to opt for communication programs and, conversely, were less likely to opt for hearing aids. The same finding of intervention suitability influencing intention to take action after failing a hearing screening was identified by Milhinch and Doyle (1990), and the present study confirms that this also applies to communication programs. The perceived suitability of group communication program belief (see Table 1) did not reach adjusted significance in the present study, but this is most likely caused by the small number of participants who opted for the group communication program (24% of the participants who chose communication programs) compared with the number of participants who opted for the individual communication program (76% of the participants who chose communication programs).

Interestingly, age, gender, living situation, education, socioeconomic status, eligibility for subsidized hearing services, time since onset of hearing impairment, self-reported hearing disability, stages of change, perceived likely adherence, perceived suitability of group communication program, other people's recommendation of the communication programs, and concerns about hearing aid cost and practices were not significant intervention decision predictors in the multivariate analyses. This highlights how some conventional wisdom, for example that socioeconomic status or eligibility for subsidized hearing services predispose people toward hearing aids, does not always corroborate with research evidence. In this study, aspects of "readiness," such as time since onset of hearing impairment or stages of change, also did not predict the intervention decisions of adults with hearing impairment. Furthermore, powerful others as locus of control was a predictor of intervention decisions, but having an internal or chance locus of control did not predict intervention decisions. A number of these predictors have been found to be significant predictors in previous research (e.g., Cox et al., 2005; Garstecki & Erler, 1998; Helvik et al., 2008). However, direct comparisons should be made cautiously, as previous research efforts did not specify the model of decision making adopted (paternalistic, shared, or informed) and did not offer communication programs.

## Clinical Implications

When offered intervention options, 46% of the study participants did not opt for hearing aids: 24% opted for communication programs, and 22% opted for no intervention. In contrast, only 23% of 173 adults with hearing impairment referred by their medical practitioner to an audiology clinic had not received hearing aids 18 months later (Helvik et al., 2008). The availability of options other than hearing aids varies from one clinical setting to the other, but, in light of the present study's findings, the range of intervention options offered to adults with acquired hearing impairment seeking help for the first time needs to be expanded. The present study identified seven variables that accurately predicted more than 80% of the intervention decisions of adults with hearing impairment when hearing aids, communication programs, and no intervention were available. These predictors were as follows: application for subsidized hearing services, hearing impairment, communication self-efficacy, locus of control, and three beliefs (hearing disability perceived by others and self, perceived communication program effectiveness, and perceived suitability of individual communication program). The predictive value of these had been substantiated by other research but had not been modeled. To facilitate decision making with adults with acquired hearing impairment, clinicians could explicitly elicit the intervention decision predictors identified here. For example, clinicians can ask clients to describe their communication self-efficacy and locus of control when faced with hearing-related activity limitations and participation restrictions, as this may increase their

clients' awareness of these factors on which they base their decisions. This may in turn facilitate the decision making. The Intervention Questionnaire items (see Table 1) are a good starting point for clinicians to discuss such beliefs with their clients. For example, the influence of other people, as expressed in the belief hearing disability perceived by others and self, needs to be acknowledged by adults with acquired hearing impairment. Clinicians can ask clients to describe their communication partners' reactions to their hearing or, if present, can directly ask communication partners to voice their views on the clients' hearing. The purpose of this is not to push clients to opt for a particular intervention but rather to support them in accessing the information they require to make a suitable intervention decision, compatible with their situation, beliefs, and perceptions. Overall, as many predictors of intervention decisions were identified, clinicians should use a client-centered approach and seek to understand their clients' perspectives regarding their hearing disability and suitable interventions (e.g., Hétu, Jones, & Getty, 1993).

## *Future Directions*

The outcome variables of interest in the present study were intervention decisions, that is, the intervention that participants intended to pursue. However, as reported when investigating willingness to use hearing aids in 100 older adults with hearing impairment (Meister et al., 2008), discrepancies between intervention intention and intervention behavior (e.g., intervention action and successful intervention outcomes) do exist. Meister et al. (2008) found that some participants who had stated high willingness to obtain hearing aids did not obtain them, whereas some who had low willingness did. Approximately one quarter of their participants adopted an intervention behavior that was not consistent with their intention, and a similar pattern is emerging from the present study's follow-up data, with approximately 25% of participants adopting an intervention behavior different from their intention. These discrepancies refer to nonadherence and outline how the intervention decision is only a first step toward successful intervention outcomes. Further research needs to investigate whether the intervention decision predictors uncovered in the present study are also associated with intervention adoption and reduction of hearing-related activity limitations and participation restrictions over time.

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## References

**Abellanas, L., & McLellan, A. T.** (1993). "Stage of change" by drug problem in concurrent opioid, cocaine, and cigarette users. *Journal of Psychoactive Drugs, 25,* 307–313.

**Australian Government.** (2010). *Assets test.* Retrieved from www.centrelink.gov.au/internet/internet.nsf/payments/chartab.htm.

**Bandura, A.** (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84,* 191–215.

**Bohannon, R.** (1992). Spearman correlations of .60 are not poor. *American Journal of Occupational Therapy, 46,* 472.

**Bower, P., King, M., Nazareth, I., Lampe, F., & Sibbald, B.** (2005). Patient preferences in randomised controlled trials: Conceptual framework and implications for research. *Social Science and Medicine, 61,* 685–695.

**Carney, M. M., & Kivlahan, D. R.** (1995). Motivational subtypes among veterans seeking substance abuse treatment: Profiles based on stages of change. *Psychology of Addictive Behaviors, 9,* 135–142.

**Charles, C., Gafni, A., & Whelan, T.** (1997). Shared decision making in the medical encounter: What does it mean? (Or it takes at least two to tango). *Social Science and Medicine, 44,* 681–692.

**Charles, C., Gafni, A., & Whelan, T.** (1999). Decision-making in the physician–patient encounter: Revisiting the shared treatment decision-making model. *Social Science and Medicine, 49,* 651–661.

**Chia, E.-M., Wang, J. J., Rochtchina, E., Cumming, R. R., Newall, P., & Mitchell, P.** (2007). Hearing impairment and health-related quality of life: The Blue Mountains Hearing Study. *Ear and Hearing, 28,* 187–195.

**Costa, P. T. J., & McCrae, R. R.** (1992). *Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) professional manual*. Odessa, FL: Psychological Assessment Resources.

**Cox, R. M., & Alexander, G. C.** (2002). The International Outcome Inventory for Hearing Aids (IOI-HA): Psychometric properties of the English version. *International Journal of Audiology, 41,* 30–35.

**Cox, R. M., Alexander, G. C., & Gray, G. A.** (2005). Who wants a hearing aid? Personality profiles of hearing aid seekers. *Ear and Hearing, 26,* 12–26.

**Davis, A., Smith, P., Ferguson, M., Stephens, D., & Gianopoulos, I.** (2007). Acceptability, benefit and costs of early screening for hearing disability: A study of potential screening tests and models. *Health Technology Assessment, 11*(42), 1–294.

**Doyle, J., & Thomas, S. A.** (1995). Capturing policy in hearing-aid decisions by audiologists. *Medical Decision Making, 15,* 58–64.

**Duijvestijn, J. A., Anteunis, L. J. C., Hoek, C. J., van den Brink, R. H. S., Chenault, M. N., & Manni, J. J.** (2003). Help-seeking behaviour of hearing-impaired persons aged

≥ 55 years: Effect of complaints, significant others and hearing aid image. *Acta Oto-Laryngologica, 123,* 846–850.

**Gagné, J.-P., Jennings, M. B., & Southall, K.** (2009). The international classification of functioning: Implications and applications to audiologic rehabilitation. In J. J. Montano & J. B. Spitzer (Eds.), *Adult audiologic rehabilitation* (pp. 37–61). San Diego, CA: Plural.

**Garstecki, D. C., & Erler, S. F.** (1998). Hearing loss, control, and demographic factors influencing hearing aid use among older adults. *Journal of Speech, Language, and Hearing Research, 41,* 527–537.

**Gatehouse, S.** (1990). Determinants of self-reported disability in older subjects. *Ear and Hearing, 11*(Suppl. 5), 57–65.

**Gatehouse, S.** (1991). The role of non-auditory factors in measured and self-reported disability. *Acta Oto-Laryngologica: Supplementum, 476,* 249–256.

**Gatehouse, S., & Noble, W.** (2004). The Speech, Spatial and Qualities of Hearing Scale (SSQ). *International Journal of Audiology, 43,* 85–99.

**Gordon-Salant, S., Lantz, J., & Fitzgibbons, P.** (1994). Age effects on measures of hearing disability. *Ear and Hearing, 15,* 262–265.

**Hawkins, D. H.** (2005). Effectiveness of counseling-based adult group aural rehabilitation programs: A systematic review of the evidence. *Journal of the American Academy of Audiology, 16,* 485–493.

**Helvik, A. S., Wennberg, S., Jacobsen, G., & Hallberg, L. R.-M.** (2008). Why do some individuals with objectively verified hearing loss reject hearing aids? *Audiological Medicine, 6,* 141–148.

**Hétu, R., Jones, L., & Getty, L.** (1993). The impact of acquired hearing impairment on intimate relationships: Implications for rehabilitation. *Audiology, 32,* 363–381.

**Hickson, L., Worrall, L., & Scarinci, N.** (2006). Measuring outcomes of a communication program for older people with hearing impairment using the International Outcome Inventory. *International Journal of Audiology, 45,* 238–246.

**Hickson, L., Worrall, L., & Scarinci, N.** (2007a). *Active Communication Education (ACE): A program for older people with hearing impairment*. Brackley, England: Speechmark.

**Hickson, L., Worrall, L., & Scarinci, N.** (2007b). A randomized controlled trial evaluating the Active Communication Education program for older people with hearing impairment. *Ear and Hearing, 28,* 212–230.

**Humes, L. E., Wilson, D. L., & Humes, A. C.** (2003). Examination of differences between successful and unsuccessful elderly hearing aid candidates matched for age, hearing loss and gender. *International Journal of Audiology, 42,* 432–441.

**Jang, Y., Mortimer, J. A., Haley, W. E., Hnath Chisolm, T. E., & Borenstein Graves, A.** (2002). Nonauditory determinants of self-perceived hearing problems among older adults: The role of stressful life conditions, neuroticism, and social resources. *Journals of Gerontology: Series A, Biological Sciences and Medical Sciences, 57,* 466–469.

**Jennings, M. B.** (2005). *Factors that influence outcomes from aural rehabilitation of older adults: The role of perceived self-efficacy* (Unpublished doctoral dissertation). University of Western Ontario, London, Canada.

**Joosten, E. A. G., DeFuentes-Merillas, L., de Weert, G. H., Sensky, T., van der Staak, C. P. F., & de Jong, C. A. J.** (2008). Systematic review of the effects of shared decision-making on patient satisfaction, treatment adherence and health status. *Psychotherapy and Psychosomatics, 77,* 219–226.

**Judge, T. A., Erez, A., Bono, J. E., & Thoresen, C. J.** (2002). Are measures of self-esteem, neuroticism, locus of control, and generalized self-efficacy indicators of a common core construct? *Journal of Personality and Social Psychology, 83,* 693–710.

**Kempen, G. I. J. M., van Heuvelen, M. J. G., van Sonderen, E., van den Brink, R. H. S., Kooijman, A. C., & Ormel, J.** (1999). The relationship of functional limitations to disability and the moderating effects of psychological attributes in community-dwelling older persons. *Social Science and Medicine, 48,* 1161–1172.

**Kramer, S. E., Allessie, 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.

**Kramer, S. E., Goverts, S. T., Dreschler, W. A., Boymans, M., & Festen, J. M.** (2002). International Outcome Inventory for Hearing Aids (IOI-HA): Results from the Netherlands. *International Journal of Audiology, 41,* 36–41.

**Lam, C. S., McMahon, B. T., Priddy, D. A., & Gehred-Schultz, A.** (1988). Deficit awareness and treatment performance among traumatic head injury adults. *Brain Injury, 2,* 235–242.

**Laplante-Lévesque, A., Hickson, L., & Worrall, L.** (2010a). Factors influencing rehabilitation decisions of adults with acquired hearing impairment. *International Journal of Audiology, 49,* 497–507.

**Laplante-Lévesque, A., Hickson, L., & Worrall, L.** (2010b). Rehabilitation of older adults with hearing impairment: A critical review. *Journal of Aging and Health, 22,* 143–153.

**Levenson, H.** (1972). Distinctions within the concept of internal–external control: Development of a new scale. In *Proceedings of the 80th Annual American Psychological Association Convention* (pp. 261–262). Honolulu, HI: American Psychological Association.

**Levenson, H.** (1974). Activism and powerful others: Distinctions within the concept of internal–external control. *Journal of Personality Assessment, 38,* 377–383.

**Mahoney, C. F. O., Stephens, S. D. G., & Cadge, B. A.** (1996). Who prompts patients to consult about hearing loss? *British Journal of Audiology, 30,* 153–158.

**Makoul, G., & Clayman, M. L.** (2006). An integrative model of shared decision making in medical encounters. *Patient Education and Counseling, 60,* 301–312.

**McConnaughy, E. A., Prochaska, J. O., & Velicer, W. F.** (1983). Stages of change in psychotherapy: Measurement and sample profiles. *Psychotherapy: Theory, Research and Practice, 20,* 368–375.

**Meister, H., Walger, M., Brehmer, D., von Wedel, U.-C., & von Wedel, H.** (2008). The relationship between pre-fitting

expectations and willingness to use hearing aids. *International Journal of Audiology, 47,* 153–159.

**Milhinch, J. C., & Doyle, J.** (1990). Clients' decision-making: Choosing a hearing health care service. *Australian Journal of Audiology, 12,* 45–53.

**Milstein, D., & Weinstein, B. E.** (2002). Effects of information sharing on follow-up after screening for older adults. *Journal of the Academy of Rehabilitative Audiology, 35,* 43–58.

**Montori, V. M., Gafni, A., & Charles, C.** (2006). A shared treatment decision-making approach between patients with chronic health conditions and their clinicians: The case of diabetes. *Health Expectations, 9,* 25–36.

**Noble, W., Tyler, R. S., Dunn, C., & Bhullar, N.** (2008). Hearing handicap ratings among different profiles of adult cochlear implant users. *Ear and Hearing, 29,* 112–120.

**Prochaska, J. O., DiClemente, C. C., & Norcross, J. C.** (1992). In search of how people change: Applications to addictive behaviors. *American Psychologist, 47,* 1102–1114.

**Rosenhall, U., & Karlsson Espmark, A.-K.** (2003). Hearing aid rehabilitation: What do older people want, and what does the audiogram tell? *International Journal of Audiology, 42*(Suppl. 2), 53–57.

**Saunders, G. H., & Cienkowski, K. M.** (1996). Refinement and psychometric evaluation of the Attitudes Toward Loss of Hearing Questionnaire. *Ear and Hearing, 17,* 505–519.

**Scarinci, N., Worrall, L., & Hickson, L.** (2009). The effect of hearing impairment in older people on the spouse: Development and psychometric testing of the Significant Other Scale for Hearing Disability (SOS-HEAR). *International Journal of Audiology, 48,* 671–683.

**Stephens, S. D. G., Meredith, R., Callaghan, D. E., Hogan, S., & Rayment, A.** (1990). Early intervention and rehabilitation: Factors influencing outcomes. *Acta Oto-Laryngologica: Supplementum, 476,* 221–225.

**Steyerberg, E. W., Eijkemans, M. J. C., & Habbema, J. D. F.** (1999). Stepwise selection in small data sets: A simulation study of bias in logistic regression analysis. *Journal of Clinical Epidemiology, 52,* 935–942.

**Swan, I. R. C., & Gatehouse, S.** (1990). Factors influencing consultation for management of hearing disability. *British Journal of Audiology, 24,* 155–160.

**Sweetow, R., & Palmer, C.** (2005). Efficacy of individual auditory training in adults: A systematic review of the evidence. *Journal of the American Academy of Audiology, 16,* 494–504.

**Treasure, J. L., Katzman, M., Schmidt, U., Troop, N., Todd, G., & de Silva, P.** (1999). Engagement and outcome in the treatment of bulimia nervosa: First phase of a sequential design comparing motivation enhancement therapy and cognitive behavioural therapy. *Behaviour Research and Therapy, 37,* 405–418.

**van den Brink, R. H. S., Wit, H. P., Kempen, G. I. J. M., & van Heuvelen, M. J. G.** (1996). Attitude and help-seeking for hearing impairment. *British Journal of Audiology, 30,* 313–324.

**Vestergaard Knudsen, L., Öberg, M., Nielsen, C., Naylor, G., & Kramer, S. E.** (2010). Factors influencing help seeking, hearing aid uptake, hearing aid use and satisfaction with hearing aids: A review of the literature. *Trends in Amplification, 14,* 127–154.

**Walkey, F. H.** (1979). Internal control, powerful others, and chance: A confirmation of Levenson's factor structure. *Journal of Personality Assessment, 43,* 532–535.

**Wiley, T. L., Cruickshanks, K. J., Nondahl, D. M., & Tweed, T. S.** (2000). Self-reported hearing handicap and audiometric measures in older adults. *Journal of the American Academy of Audiology, 11,* 67–75.

**World Health Organization.** (1980). *International Classification of Impairments, Disabilities, and Handicaps: A manual of classification relating to the consequences of disease*. Geneva, Switzerland: Author.

**World Health Organization.** (2001). *International Classification of Functioning, Disability, and Health*. Geneva, Switzerland: Author.