Factors influencing pursuit of hearing evaluation: Enhancing the health belief model with perceived burden from hearing loss on communication partners

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Abstract
Objective: There is limited application of health behavior-based theoretical models in hearing healthcare, yet other fields utilizing these models have shown their value in affecting behavior change. The health belief model (HBM) has demonstrated appropriateness for hearing research. This study assessed factors that influence an individual with suspected hearing loss to pursue clinical evaluation, with a focus on perceived burden of hearing loss on communication partners, using the HBM as a framework.

Design: Cross-sectional design collecting demographics along with three validated hearing-loss related questionnaires.

Study sample: Patients from Duke University Medical Center Otolaryngology Clinic aged 55–75 years who indicated a communication partner had expressed concern about their hearing. A final sample of 413 completed questionnaire sets was achieved.

Results: The HBM model construct ‘cues to action’ was a significant (p<0.001) predictor of pursuing hearing evaluation. Perceived burden of hearing loss on communication partners was a significant (p<0.001) predictor of pursuing hearing evaluation and improves the model fit when added to the HBM: 72.0% correct prediction when burden is added versus 66.6% when not (p<0.0001). Conclusions: Hearing healthcare initiatives that incorporate these factors may improve hearing help-seeking behavior. More research using sound theoretical models in hearing healthcare is warranted.

Key Words: Perceptions about hearing loss; hearing impaired; health-care seeking behavior; health behavior; HBQ; SOS-HEAR; HHIE-S

Background
Hearing loss and health behavior
Age-related hearing loss is the third most common chronic condition affecting older adults in the United States: one-third of individuals over age 60 and two-thirds of those over age 70 have some degree of hearing loss (Lin et al, 2011a). Despite the prevalence of hearing loss, health-care provider referrals for hearing loss evaluation are low (Gilliver & Hickson, 2011), and less than a quarter of those with a confirmed hearing loss who could benefit from a hearing aid use one (NIDCD, 2010).

Loss of hearing can make it difficult to follow a physician’s advice, respond to safety warnings, and communicate effectively with family and friends. Impaired communication ability can lead to social isolation (Berkman et al, 2000), compromised communication in the health-care setting, and contribute to cognitive decline (Lin et al, 2011b, 2013; Wallhagen et al, 2008). Hearing loss can dramatically impact a person’s quality of life, affecting his/her ability to work, be productive, and participate in social and physical activities. Left untreated, there is the potential for other negative consequences such as dementia, anxiety, and depression (Lin et al, 2011b; Manchaiah et al, 2013).

Such negative consequences impact not only the individual with the hearing impairment but also those with whom they communicate (i.e. ‘communication partners’). While an understudied topic, Wallhagen et al (2004) found that having a spouse with hearing impairment increased one’s likelihood of poorer physical, psychological, and social well-being. In a more recent study, Scarinci et al explored third party disability, defined as ‘the disability and functioning of family members as a result of the health condition of their significant other’ (2012, p. 698). The authors found that spouses of older people with hearing impairment experience disability such as communication challenges, impeded daily...
An overview of the document's content:

**Hearing loss research and health behavior model application**

A psychological health behavior model is valuable for hearing research because hearing impairment is a condition for which there exists an effective treatment and yet only a quarter of those who could benefit from the use of a hearing aid are using one (NIDCD, 2010). Assessment of health behaviors must be part of the research endeavor in understanding the lack of health promoting behavior.

Sobel and Meikle (2008) urged researchers in hearing conservation to reap the benefits from health behavior theory by developing studies and programs designed with sound conceptual frameworks. Yet the application of theoretical models in hearing healthcare research remains limited. In a discussion paper about the use of health behavior change models in hearing healthcare studies, Manchaiah (2012) proposed that the lack of model use in these studies is due to multiple constraints. The simplified explanation he provided is that it is rare that all elements or constructs of a model can be applied in hearing healthcare. Some of the more detailed reasons for this omission include limited precedent for health behavior change research in hearing healthcare, limited provider time with hearing healthcare patients which impedes application of model principles, and lack of training for hearing healthcare clinicians in health behavior change models (Manchaiah et al., 2013). However, despite these challenges, the body of work in hearing healthcare research that is based on theoretical models should not be disregarded. Some examples of recently published work include: Laplante-Lévesque et al. (2012, 2013) who used the transtheoretical (‘stages of change’) model as it relates to communication programs and hearing rehabilitation services; Meyer et al. (2014) who explored the influence of both hearing and non-hearing related factors on help-seeking behavior in older adults using the health belief model; Meister et al. (2014) who studied intention to use hearing aids based on the theory of planned behavior; Laplante-Lévesque et al. (2015) who describe the psychometric properties of the stages of change in adults who failed on online hearing screening; and Saunders et al. (2013) who examined hearing health beliefs based on the health belief model.

Based on a review of the theory-based literature in hearing healthcare (and associated measurement tools) as well as the proposed study design, the principal investigator (KS) determined the health belief model (HBM) was an appropriate framework for this study. Therefore, assessment of hearing health behaviors within the context of a multifactorial HBM may result in better understanding influential factors across multiple chronic conditions (Saunders et al., 2012).

The HBM was originally developed to explain health behaviors, particularly regarding the uptake of health services (Rosenstock, 1974; Jans & Becker, 1984). In its current form, the model aims to predict or explain acceptance of care recommendations as influenced by six constructs: (1) perceived susceptibility: the feeling of being vulnerable to a condition and the extent to which the individual believes he/she is at risk of acquiring it; (2) perceived severity: the belief in the seriousness of the consequences incurred if affected by the condition both medically and socially; (3) perceived benefits: the belief that intervention will result in positive benefits; (4) perceived barriers: the barriers an individual believes he or she needs to overcome in order to effectively conduct some form of intervention; (5) self-efficacy: the individual’s belief in his or her ability to use and gain benefit from the intervention; and (6) cues to action: cues that prompt an individual to take action, which could be internal, such as symptoms of a health problem, or external, such as media communications, interpersonal communications, or information from healthcare providers. Although not without limitations, it has proven to be one of the most useful frameworks in health behavior change (Noh et al., 1994) with constructs relevant to those with hearing impairment (Meyer et al., 2014; Saunders et al., 2012; van den Brink et al., 1996). While not widely applied to assess hearing health behaviors, empirical data has shown that these constructs are effective in influencing health promoting behavior (Saunders et al., 2013).

Towards this endeavor of the HBM’s application in hearing healthcare, Saunders et al (2013) developed and tested a questionnaire assessing hearing beliefs (i.e. hearing beliefs questionnaire or HBQ) and found that the framework of the HBM (as assessed...
through the HBQ) is appropriate and has value in evaluating hearing health beliefs and predicting hearing health behaviors. The endpoint of the HBM pathway is the likelihood of health-promoting behavior (in the case of this study, whether or not hearing evaluation was pursued). The pathways to having pursued hearing evaluation are depicted in Figure 1. The figure reflects the model utilized in the initial study testing the hearing beliefs questionnaire (Saunders et al, 2013) with the enhancement explored in this study, perceived burden on communication partners.

The objective of this study was to explore factors that influence pursuit of hearing evaluation in eligible participants based on the standard HBM and to determine whether model fit is improved when the model is enhanced with a measure of perceived burden of hearing loss on communication partners.

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**Methods**

**Design**
The study used a cross-sectional design. It received Institutional Review Board exemption by the Duke University Health System Institutional Review Board (FWA #00009025). Participation in the survey was completely voluntary and no patient identifiers (i.e. the 18 identifiers defined in the Health Insurance Portability and Accountability Act) were captured in the survey. Participants
Former and current patients of Duke University Medical Center (DUMC) Otolaryngology clinic, aged 55–75 years, being seen for evaluation or follow-up for any ear, nose and/or throat-related complaint who indicated that a communication partner had expressed concern about their hearing in the last year were eligible to participate. For the purpose of this study, the definition of communication partner is as follows: ‘those with whom the person with hearing impairment communicates on a regular basis. The term communication partner has been used to refer to significant others, which may include their spouse, siblings, children, friends, relatives, colleagues, or carers’ (Manchaiah et al, 2013, p. 1).

**Recruitment**
Survey data were collected over a three-month period from June to September 2014. The questionnaire set was available in both paper and online versions. The approach to recruitment was multi-mode. Fliers were placed in the clinic with eligibility criteria for participation in the survey and contact information for those interested. Otolaryngology clinic providers discussed the survey with eligible patients. Hard copy survey packets and postcards with an online link to the survey were available in the clinics and provided to interested patients. Additionally, patients in the DUMC electronic health record system who were 55–75 years of age, and had been seen at the Duke Otolaryngology clinic in the last five years for any reason, were sent a blind copied email invitation with eligibility criteria, a brief description, and link to the voluntary survey.

**Questionnaire set**
Interested patients were asked to complete one required question, as well as one custom, and three validated questionnaires. The one required question in follow-up to eligibility confirmation (i.e. a
Table 1. Description of questionnaires assessing HBM and additional construct of perceived burden on communication partner.

| Questionnaire                                      | Description                                                                 | Number of Items |
|---------------------------------------------------|-----------------------------------------------------------------------------|-----------------|
| Demographics                                      | Custom: age, gender, access to care and cost challenges, type of communication partner, mode of communication, etc. | 13              |
| Hearing handicap inventory for the elderly (HHIE-S) | Assesses the degree of hearing handicap perceived [none (0–8); mild/moderate (10–22); significant (24–40)] | 10 with 3-point response scale¹ |
| Hearing beliefs questionnaire (HBQ)                | Assesses hearing beliefs within the constructs of the health belief model: Susceptibility; Severity; Benefits; Barriers; Self-efficacy; Cues to action. Adapted to add the perceived burden construct | 26 with 11-point response scale² |
| Significant other scale for hearing disability (SOS-HEAR) | Measures the effects of hearing impairment on the significant other in the following domains: Changes to communication; Communication burden; Relationship changes; Going out and socializing; Emotional reactions to adaptations; Concern for partner | 27 with 5-point response scale³ |

¹3-point scale of: yes (=4); sometimes (=2); no (=0). ²11-point scale from: 0 = completely disagree, to 10 = completely agree. ³5-point scale from: 0 = no problem, to 4 = a complete problem.

communication partner had expressed concern about their hearing in the last year) was ‘did you pursue clinical evaluation of suspected hearing loss?’ The three questionnaires are described in detail in Table 1 and summarized herein. The custom questionnaire captured patient demographics and relevant background information such as insurance coverage for hearing evaluations and hearing aids. The three validated instruments were the Hearing handicap inventory for the elderly - screening version (HHIE-S) (Ventry & Weinstein, 1982), the Hearing beliefs questionnaire (HBQ) (Saunders et al, 2013), and the Significant other scale for hearing disability (SOS-HEAR) (Scarinci et al, 2009). The HHIE-S was selected to describe the degree of hearing handicap (or participation restrictions) perceived by the study patients. The HBQ is a new instrument and one of the only tools in hearing healthcare based upon a theoretical model, in this case, the HBM. The SOS-HEAR measures the effects of hearing impairment on the significant other (or communication partner, as defined in this study). The SOS-HEAR is intended to be completed by the communication partner, however, in this study, the patient was asked to fill it out as they believed their communication partner would, in order to capture the patient’s perception of the burden of their suspected hearing loss on their communication partner. Since the survey was completely voluntary, patients could also opt to skip questions they were not comfortable answering.

Statistical analysis
The study’s recruitment goal (N = 200) was determined by sample size projections based on an alpha of 0.05 and detectable odds ratio of 1.30 via a logistic regression analysis. While a sample size of 200 was deemed adequate, DUHS IRB approval and survey invitations indicated up to 1000 surveys could be collected. Minimum recruitment goals were exceeded and the achieved power at alpha = 0.05 was >95%. The approach first explored, via univariate analyses, whether there were significant differences (p < 0.05) in demographics and questionnaire scores between the primary outcome measure (whether or not hearing evaluation was pursued). Summary statistics were used to present the demographics, background data, and univariate questionnaire scores of each primary outcome group. Categorical data were summarized with frequencies and chi-square / Fisher’s exact p-values, as appropriate. Continuous data were summarized as means and standard deviations, with medians and interquartile ranges provided as measures of spread. Statistical significance of continuous data was assessed via the Wilcoxon rank sum test. Significant differences observed in the univariate analyses were used to select the initial covariates included in the subsequent multivariate logistics analysis. In addition to the regression approaches, receiver operator characteristics (ROC) plots and the likelihood-ratio test were used to assess model fit. All analyses were performed in SAS v9.3 and JMP Pro 11.2.1.

Results
There were 476 surveys returned by participants. There were 41 participants who were excluded because they discontinued the survey at some point during the process; 12 participants were excluded because they did not meet the eligibility criteria (i.e. age 55–75 and had a communication partner that indicated concern about their hearing in the last year); and 10 participants were excluded because they did not answer the question referencing the primary outcome measure. The final sample included 413 completed questionnaires, 65 (15.7%) of these were hard copy surveys completed in clinic, while the majority were completed through the online link. There were no significant differences in age, sex, veteran status, insurance type, or communication partner

Data management
To manage data for this study, an annotated database was developed in REDCap, a secure and appropriate online platform for clinical research (Harris et al, 2009). Paper copies completed were entered into the REDCap database by the study coordinator. Surveys completed online by study participants were directly captured into the REDCap database.

Primary outcome measure
The primary outcome measure for this study is the endpoint of the HBM (Figure 1) – whether or not hearing evaluation was pursued (in the past year after a communication partner expressed concern). This was ascertained from the one required opening question in the patient questionnaire set.
type between those who completed the questionnaire in hard copy and those who completed it online. Regarding the primary outcome measure, 272 participants did pursue hearing evaluation and 141 did not. The results of the statistical analyses on these data are organized as follows: (1) background data (demographics and perceived hearing loss); (2) assessment of proposed HBM enhancement variable (perceived burden); and (3) model fit (HBM versus HBM-enhanced).

**Background data**

**DEMOGRAPHICS**

The mean age of patients was 66.0 years old. Males represented a larger percentage of the participants (57.9%) than females, and about one-quarter (22.3%) of the participants indicated they were veterans. A little more than half (51.9%) indicated private payer insurance, followed by government insurance (47.6%), and no insurance (0.5%). The majority indicated that their communication partner (whom indicated concern about their hearing) was a spouse or partner (86.9%), followed by adult child (7.0%), friend (5.1%), and caregiver or co-worker (each 0.5%). Thirty-six percent indicated they had hearing aids and of those, 71.2% responded ‘yes’ to the question asking whether they wear their hearing aids regularly. These demographics were compared at the primary outcome measure level, and no statistically significant difference was found in these demographics between those who pursued hearing evaluation and those who did not.

Insurance coverage for hearing evaluation was significantly higher ($p < 0.001$) in those who pursued hearing evaluation versus those who did not, 15.4% versus 8.6% respectively. Insurance coverage for hearing aids was significantly higher ($p < 0.001$) in those who pursued hearing evaluation versus those who did not, 57.4% versus 6% respectively. Overall, when asked directly on the demographics questionnaire, 9.0% of patients indicated they were unsure if they had hearing loss; 28.2% were unsure whether insurance covered hearing evaluations; and 37.3% were unsure whether insurance covered hearing aids. Patients that were unsure about whether they had a hearing loss, and/or did not know whether they had insurance coverage for hearing evaluations or hearing aids were significantly ($p < 0.001$) less likely to pursue hearing evaluation. The proportion of patients that did not pursue hearing evaluation was 8.2 times higher in those that indicated that they were unsure if they had a hearing loss, 2.1 times higher in those that were unsure if hearing evaluation was covered, and 3.1 times higher in those that were unsure if hearing aids were covered, when compared to those that knew the answers to these questions.

**HEARING LOSS**

The HHIE-S total score yields a category determination of potential hearing handicap: no self-perceived handicap, mild to moderate handicap, and significant handicap. There was a statistically significant ($p < 0.001$) relationship between each of the three hearing handicap categories and primary outcome measure. The odds of pursuing hearing evaluation were 5.42 (95% CI, 3.22, 9.30) times higher for those whose HHIE-S scores categorized them as mild to moderate versus no self-perceived handicap; 10.88 (95% CI, 6.1, 20.2) times higher for those categorized as significant versus no self-perceived handicap; and 2.01 (95% CI, 1.15, 3.57) times higher for those categorized as significant versus mild to moderate. Figure 2 depicts the relationship between hearing handicap category and primary outcome measure. Regardless of a communication partner expressing concern about their hearing, individuals with no self-perceived handicap pursue hearing evaluation only about one-third of the time; this more than doubles in the categories of mild/moderate (77%) and significant perceived handicap (84%). At the demographics/descriptors level, there was no significant difference between hearing handicap category and each of the following variables: age, sex, veteran status, insurance type, and communication partner type.

![Figure 2](image-url)

*Figure 2.* The proportion of patients who pursued a hearing evaluation [light grey] versus those who did not [dark grey] by hearing handicap category and overall. Values within the bars represent the corresponding sample sizes.
Assessment of proposed HBM enhancement variable: Perceived burden

The overall SOS-HEAR score, the proxy for perceived burden from hearing loss on communication partners, was utilized to determine whether the HBM for hearing help seeking behavior (as measured by the HBQ) might potentially be enhanced with this factor. In order to determine the potential value of this factor and a rationale for enhancing the existing health belief model for hearing healthcare, an analysis was performed on the SOS-HEAR score as it relates to the primary outcome measure and perceived hearing handicap category as measured by the HHIE-S, the results of which are presented in Table 2. The overall SOS-HEAR mean score for all participants was 0.84 (SD = 0.81). The greatest perceived area of difficulty was ‘changes to communication’ with a mean score of 1.38 (SD = 1.05) followed by ‘emotional reactions to adaptations’ with a mean score of 0.90 (SD = 0.93).

Table 2. SOS-HEAR scores by primary outcome measure and hearing handicap category.

| SOS-HEAR scores                  | Primary outcome measure                  | p-values          |
|----------------------------------|------------------------------------------|-------------------|
|                                  | All patients N = 413                      | Did not pursue hearing evaluation N = 141 | Pursued hearing evaluation N = 272 | (Wilcoxon rank sum) |
| SOS-HEAR score Mean (SD)         | 0.84 (0.81)                               | 0.56 (0.63)       | 0.98 (0.86)       | <0.001             |
|                                  | Median (Q1, Q3)                           | 0.58 (0.11, 1.22) | 0.35 (0.11, 0.85) | 0.68 (0.33, 1.38) |
| Changes to communication Mean (SD) | 1.38 (1.05)                               | 1.04 (0.96)       | 1.56 (1.05)       | <0.001             |
|                                  | Median (Q1, Q3)                           | 1.17 (0.50, 2.17) | 0.83 (0.33, 1.67) | 1.33 (0.83, 2.33) |
| Communication burden Mean (SD)   | 0.64 (0.90)                               | 0.39 (0.61)       | 0.78 (0.99)       | <0.001             |
|                                  | Median (Q1, Q3)                           | 0.17 (0.00, 1.00) | 0.00 (0.00, 0.50) | 0.33 (0.00, 1.25) |
| Relationship changes Mean (SD)   | 0.56 (0.94)                               | 0.34 (0.76)       | 0.68 (1.01)       | <0.001             |
|                                  | Median (Q1, Q3)                           | 0.00 (0.00, 0.67) | 0.00 (0.00, 0.33) | 0.00 (0.00, 1.00) |
| Going out and socializing Mean (SD) | 0.56 (0.81)                               | 0.38 (0.68)       | 0.65 (0.85)       | <0.001             |
|                                  | Median (Q1, Q3)                           | 0.25 (0.00, 0.75) | 0.00 (0.00, 0.50) | 0.25 (0.00, 1.00) |
| Emotional reactions to adaptations Mean (SD) | 0.90 (0.93)                               | 0.62 (0.82)       | 1.05 (0.95)       | <0.001             |
|                                  | Median (Q1, Q3)                           | 0.60 (0.14, 1.40) | 0.20 (0.00, 1.00) | 0.80 (0.20, 1.80) |
| Concern for partner Mean (SD)    | 0.66 (0.88)                               | 0.35 (0.61)       | 0.83 (0.95)       | <0.001             |
|                                  | Median (Q1, Q3)                           | 0.33 (0.00, 1.00) | 0.00 (0.00, 0.67) | 0.33 (0.00, 1.33) |

Hearing handicap category

| SOS-HEAR scores                  | No self-perceived handicap N = 108 | Mild-Moderate handicap N = 162 | Significant handicap N = 143 | p-values          |
|----------------------------------|-----------------------------------|--------------------------------|-----------------------------|-------------------|
| SOS-HEAR Score Mean (SD)         | 0.29 (0.47)                       | 0.69 (0.56)                    | 1.41 (0.89)                 | <0.001             |
|                                  | Median (Q1, Q3)                   | 0.15 (0.04, 0.37)              | 0.55 (0.32, 1.00)           | 1.22 (0.70, 2.04) |
| Changes to communication Mean (SD) | 0.60 (0.68)                       | 1.27 (0.79)                    | 2.11 (1.06)                 | <0.001             |
|                                  | Median (Q1, Q3)                   | 0.50 (0.00, 0.92)              | 1.17 (0.67, 1.67)           | 2.17 (1.33, 2.83) |
| Communication burden Mean (SD)   | 0.16 (0.45)                       | 0.47 (0.68)                    | 1.21 (1.07)                 | <0.001             |
|                                  | Median (Q1, Q3)                   | 0.00 (0.00, 0.00)              | 0.17 (0.00, 0.67)           | 1.00 (0.33, 2.00) |
| Relationship changes Mean (SD)   | 0.17 (0.58)                       | 0.40 (0.71)                    | 1.04 (1.17)                 | <0.001             |
|                                  | Median (Q1, Q3)                   | 0.00 (0.00, 0.00)              | 0.00 (0.00, 0.33)           | 0.67 (0.00, 1.67) |
| Going out and socializing Mean (SD) | 0.16 (0.52)                       | 0.41 (0.63)                    | 1.03 (0.93)                 | <0.001             |
|                                  | Median (Q1, Q3)                   | 0.00 (0.00, 0.00)              | 0.25 (0.00, 0.50)           | 0.75 (0.25, 1.75) |
| Emotional reactions to adaptations Mean (SD) | 0.33 (0.60)                       | 0.79 (0.72)                    | 1.46 (1.04)                 | <0.001             |
|                                  | Median (Q1, Q3)                   | 0.00 (0.00, 0.40)              | 0.60 (0.20, 1.20)           | 1.40 (0.60, 2.20) |
| Concern for partner Mean (SD)    | 0.14 (0.43)                       | 0.52 (0.62)                    | 1.22 (1.06)                 | <0.001             |
|                                  | Median (Q1, Q3)                   | 0.00 (0.00, 0.00)              | 0.33 (0.00, 0.67)           | 1.00 (0.33, 2.00) |

SD = standard deviation; Q1 and Q3 are the interquartile ranges.
There was a statistically significant ($p<0.001$) relationship between the overall SOS-HEAR score and primary outcome measure. The likelihood of pursuing a hearing evaluation increased 2.21 times per each unit increase of the SOS-HEAR score (95% CI, 1.60, 3.12). Overall, and at the individual construct level, higher perceived burden of hearing loss on communication partners is a significant predictor of having pursued hearing evaluation.

There was also a statistically significant ($p<0.001$) relationship between the overall SOS-HEAR score and hearing handicap category from the HHIE-S. Mean SOS-HEAR scores were 2.0 higher in those who were categorized as having significant hearing handicap than those with mild to moderate; and close to 5.0 times higher than those with no self-perceived hearing handicap. All constructs were also individually significant at $p<0.001$ and had higher mean scores (meaning greater perceived burden) across each increasing hearing handicap category. Overall, and at the individual construct level, those with perceived higher degrees of hearing handicap also perceived higher burden on their communication partners.

**Model fit analysis: HBM versus HBM-enhanced**

HBM

As described earlier, the HBQ statements collapse into the six HBM constructs. Average scores for the HBQ range from 0–10 with 10 being the highest agreement with the construct statements. Table 3 presents the HBQ in relation to each of the primary outcome measure and hearing handicap categories. The overall mean HBQ score was 6.46 ($SD=1.00$). There was a statistically significant ($p<0.001$) difference in the overall HBQ score between the primary outcome measure.

At the construct level, both ‘perceived benefits’ ($p=0.016$), ‘perceived barriers’ ($p=0.024$), and ‘cues to action’ [to pursue hearing evaluation] ($p<0.001$) were statistically significant. Those who pursued hearing evaluation had higher mean scores for ‘perceived benefits’ than those who did not, 6.64 versus 6.26 respectively. Those who pursued hearing evaluation also had higher mean scores for ‘perceived barriers’ than those who did not. In addition to being a significant predictor, the ‘cues to action’ [to pursue hearing evaluation] construct also had the highest mean scores for this construct of 8.44 versus 7.35 for those who did not. ‘Cues to action’ [to pursue hearing evaluation] is a significant predictor of having pursued hearing evaluation.

When the HBQ constructs are compared to the perceived hearing handicap category from the HHIE-S, the only significant ($p=0.035$) construct is ‘cues to action’ with mean scores increasing with each increasing hearing handicap category: 7.52, 8.10, and 8.44 respectively. Those who perceived their degree of hearing handicap to be more severe also perceived having greater ‘cues to action’.

**HBM ENHANCED**

The value of enhancing the HBM as related to hearing help seeking behavior with a construct assessing perceived burden on communication partners was investigated in this analysis (depicted in Figure 1). Using the overall SOS-HEAR score as a proxy for perceived burden of hearing loss on communication partners, logistic regression and goodness of fit analyses were conducted to assess the differences between: (1) HBM model (the six HBM constructs as assessed by the HBQ); and (2) HBM-enhanced model (the HBM model + the overall SOS-HEAR score representing perceived burden of hearing loss on communication partner).

The results of this analysis indicate that adding a perceived burden on communication partners construct [via overall SOS-HEAR score] improves the fit, meaning that more variation is accounted for in the HBM-enhanced model. The HBM-enhanced model exhibited lower AICc (Akaike information criterion with correction for finite sample sizes) values (487.896 vs. 506.179) and higher AUC (area under the curve) values which support the conclusion of a better model fit: 72.0% correct prediction when perceived burden is added versus 66.6% when excluded (based on the receiver operating characteristics plot presented in Figure 3). Using the likelihood-ratio test, the HBM-enhanced model was a significantly better fit than the HBM without the SOS-HEAR: ($X^2(1, 413) = 20.36, p<0.0001$). Additional sensitivity analyses were conducted to determine the influence of other potential covariates to include combinations of factors including age, sex, Veteran status, and type of communication partner, however these variables were not found to be significant within the model nor did they improve model fit.

**Discussion**

This study was based upon a sound theoretical framework and aimed to assess the constructs of the HBM as they pertain to hearing health care utilizing the HBQ. Further, after demonstrating its potential value, this study explored the additional variance explained by enhancing the HBM with an additional construct of perceived burden of hearing loss on communication partners.

One of the unknowns in planning for this study was the distribution of patients for the primary outcome measure, whether or not hearing evaluation was pursued. The results were surprising as close to two times the respondents indicated they had pursued hearing-loss evaluation versus those who did not (272 versus 141). This distribution was unexpected given that the literature indicates low referral rates for hearing evaluation (Gilliver & Hickson, 2011) and low hearing-aid uptake from those who could benefit (NIDCD, 2010). The larger proportion of patients who had pursued evaluation may be due in part to the setting itself, an otolaryngology clinic where providers are more apt to discuss the importance of hearing healthcare even if not the reason for the visit. There may also be a greater willingness of those who had pursued hearing evaluation to participate in a survey that reflected upon burden on communication partners. This aspect of this study will be revisited later in the discussion about subjective norms.

Use of the SOS-HEAR as reported by the patient as proxy for their communication partner was a novel and new approach. However the top domains were similar to those found in the initial validation of the questionnaire with communication partners. As with the Scarinci et al (2009) study, the top two greatest perceived areas of difficulty were ‘changes to communication’ and ‘emotional reactions to adaptations’. This speaks to a potential awareness (unconscious or accepted) by the patient about the challenges that hearing loss may present in relationships.

In the development and testing of the HBQ, Saunders et al (2013) found that ‘cues to action’ and sex were each significantly ($p<0.001$) correlated to whether or not hearing had been tested recently. While sex did not correlate significantly with pursuit of...
hearing evaluation in this study, ‘cues to action’ was found to be significantly \( p < 0.001 \) related. The three questions that comprise this construct are: (1) I have heard good things about hearing aids; (2) I know where to go to get my hearing tested; and (3) I know where to get hearing aids if I were to need them. Patients that pursued hearing evaluation had a mean score of 8.44 (out of a high score of 10 which indicates complete agreement with the statement), which was 15% higher than those who did not pursue evaluation (7.35).

This has been found in previous studies, whereby help-seekers in hearing healthcare have higher ‘cues to action’ (van den Brink et al, 1996; Saunders et al, 2013). This is an important replicated finding, supporting further testing and translation in practice, such as with the deployment of health education approaches that empower patients. In this study, patients with high ‘cues to action’ scores had heard good things about hearing aids; knew where to get their hearing tested; and knew where to get hearing aids if they needed them. Empowering the patient with this knowledge can be facilitated by

| HBQ scores | All patients \( N = 413 \) | Did not pursue hearing evaluation \( N = 141 \) | Pursued hearing evaluation \( N = 272 \) | p-values |
|------------|-----------------------------|-----------------------------|-----------------------------|---------|
|  |  |  |  | (Wilcoxon rank sum) |
| HBQ score (overall) | Mean (SD) | 6.46 (1.00) | 6.22 (0.99) | 6.59 (0.99) | <0.001 |
|  | Median (Q1, Q3) | 6.42 (5.73, 7.27) | 6.19 (5.54, 6.92) | 6.58 (5.81, 7.38) | 0.89 |
| Perceived susceptibility | Mean (SD) | 6.27 (1.30) | 6.24 (1.29) | 6.28 (1.31) | 0.173 |
|  | Median (Q1, Q3) | 6.25 (5.50, 7.25) | 6.25 (5.25, 7.25) | 6.25 (5.50, 7.25) | 0.016 |
| Perceived severity | Mean (SD) | 7.10 (2.09) | 6.92 (2.10) | 7.19 (2.08) | <0.001 |
|  | Median (Q1, Q3) | 7.33 (5.67, 8.67) | 7.00 (5.33, 8.33) | 7.33 (6.00, 8.67) | 0.024 |
| Perceived benefits | Mean (SD) | 6.51 (1.54) | 6.26 (1.56) | 6.64 (1.52) | 0.127 |
|  | Median (Q1, Q3) | 6.60 (5.40, 7.80) | 6.20 (5.40, 7.20) | 6.80 (5.50, 7.80) | 0.001 |
| Cues to action | Mean (SD) | 6.37 (2.13) | 6.06 (2.11) | 6.54 (2.13) | 0.105 |
|  | Median (Q1, Q3) | 6.38 (4.88, 8.25) | 6.00 (4.50, 7.88) | 6.63 (5.00, 8.38) | 0.035 |
| Self-efficacy | Mean (SD) | 4.60 (1.84) | 4.71 (1.90) | 4.54 (1.81) | 0.396 |
|  | Median (Q1, Q3) | 4.67 (3.33, 6.00) | 4.67 (3.33, 6.00) | 4.33 (3.33, 5.67) | 0.774 |

| Hearing handicap category | No self-perceived handicap \( N = 108 \) | Mild-Moderate handicap \( N = 162 \) | Significant handicap \( N = 143 \) | p-values |
|---------------------------|-----------------------------|-----------------------------|-----------------------------|---------|
|  |  |  |  | (Wilcoxon rank sum) |
| HBQ score | Mean (SD) | 6.27 (1.04) | 6.22 (0.95) | 6.82 (0.93) | 0.992 |
|  | Median (Q1, Q3) | 6.19 (5.58, 7.04) | 6.19 (5.58, 6.92) | 6.96 (6.19, 7.54) | 0.105 |
| Perceived susceptibility | Mean (SD) | 6.03 (1.33) | 6.25 (1.30) | 6.47 (1.26) | 0.396 |
|  | Median (Q1, Q3) | 6.13 (5.25, 6.75) | 6.25 (5.50, 7.25) | 6.25 (5.50, 7.50) | 0.774 |
| Perceived severity | Mean (SD) | 6.88 (2.24) | 6.70 (2.07) | 7.72 (1.85) | 0.595 |
|  | Median (Q1, Q3) | 7.00 (5.33, 8.33) | 6.67 (5.33, 8.33) | 8.00 (6.67, 9.00) | 0.035 |
| Perceived benefits | Mean (SD) | 6.28 (1.61) | 6.24 (1.55) | 7.00 (1.37) | 0.133 |
|  | Median (Q1, Q3) | 6.40 (5.00, 7.60) | 6.20 (5.20, 7.40) | 7.20 (6.00, 8.00) | 0.687 |
| Perceived barriers | Mean (SD) | 6.20 (2.22) | 6.09 (2.10) | 6.82 (2.04) | 0.035 |
|  | Median (Q1, Q3) | 6.13 (4.54, 8.13) | 5.88 (4.63, 7.88) | 7.13 (5.38, 8.38) | 0.133 |
| Cues to action | Mean (SD) | 7.52 (1.98) | 8.10 (1.54) | 8.44 (1.57) | 0.016 |
|  | Median (Q1, Q3) | 8.00 (6.33, 9.00) | 8.33 (7.33, 9.33) | 8.67 (7.67, 10.00) | 0.001 |
| Self-efficacy | Mean (SD) | 4.84 (1.88) | 4.58 (1.87) | 4.44 (1.77) | 0.016 |
|  | Median (Q1, Q3) | 5.00 (3.33, 6.00) | 4.33 (3.33, 6.00) | 4.33 (3.33, 5.67) | 0.001 |

SD = standard deviation; Q1 and Q3 are the interquartile ranges.
the provider, and facilitated by complementary educational materials. A 2015 study provides evidence and support for the use of a multimedia educational program for first-time hearing-aid users (Ferguson et al, 2015). A potentially tangential finding is from the insurance questions asked in this study about whether hearing evaluation and hearing aids are covered by one’s insurance. As indicated in the results, not knowing if a service was covered was statistically correlated with not pursuing a hearing evaluation. This suggests that not knowing whether services are covered might impede ‘cues to action’ and increase ‘perceived barriers’.

Those who pursued hearing evaluation also had higher mean scores for perceived barriers than those who did not, 6.54 versus 6.06 respectively. These results are somewhat unexpected. The questions that comprise this construct focus primarily on perspectives about hearing aids. It might therefore be that the individuals who ultimately pursued a hearing evaluation had thought more about hearing aids prior to completing the HBQ than those who did not ultimately pursue a hearing evaluation, and that therefore were more sensitive to the issues associated with hearing aids. This explanation is purely hypothetical and requires further investigation.

In terms of the value of better understanding perceived burden of hearing loss on communication partners, this study elucidated how influential this factor may be, both individually and when it is used to enhance the HBM. It also provides additional support for designing studies based on theoretical models in hearing healthcare, especially those exploring the influence of awareness of perceived burden of hearing loss on communication partners on help seeking decisions. Future studies assessing this component may benefit from designs based on other theoretical models such as the theory of planned behavior and a focus on subjective norm (or how much social pressure an individual feels to engage in a behavior). Hypothetically, subjective norms may have influenced the distribution of respondents across the primary outcome measure in this study. Those individuals who engage in a behavior (in this case seeking hearing evaluation) due to social pressure may also have been more willing to reflect upon it and participate in this study.

From this study we conclude that those who perceive the burden of hearing loss on communication partners as greater are more likely to have pursued evaluation. Both engaging the communication partner when possible and directly raising awareness of this potential burden with patients may be an effective approach to encouraging hearing-loss evaluation at a minimum, and ideally, will open the door to the discussion of rehabilitation options (e.g. communication programs, hearing aids, other devices) more broadly with clients and family members. If more patients can be motivated to pursue hearing evaluation, there is the potential to head off more severe downstream consequences associated with untreated hearing loss, such as social isolation and depression. Provider-patient discussions that incorporate communication partners and openly discuss these downstream consequences as you would with other chronic conditions and support help-seeking behaviors (e.g. regular hearing evaluation, hearing-aid uptake and use) should be a standard component of the healthcare visit with this age group. A second paper resulting from this study will focus more specifically on this topic.

**Limitations**

This study has five limitations to note. First, specific to the study, otolaryngologists treat a vast range of complaints related to the ear, nose, and/or throat. In this study, the patient’s chief complaint or condition was not captured, therefore it is not possible to assess how this variable may have influenced the distribution of the primary outcome measure, whether or not hearing evaluation was pursued. As this study did not capture any health identifiers or protected health information, it is also not possible to assess whether a patient filled out the survey more than once. Second, we relied on self-report as to whether or not an individual had sought a hearing evaluation. It is possible that some individuals claimed to have sought an evaluation after a communication partner expressed concern when they had not. However, since the participant knew their data were anonymous, this seems an unlikely scenario and thus they probably had indeed had a hearing test if they reported one. Third, the study was cross-sectional rather than longitudinal, therefore it is not possible to conclude causality between current beliefs and prior behaviors. The relationship between these could be clarified with a longitudinal study in which beliefs are measured at baseline and behavior is tracked over time. Fourth, response rate cannot be calculated because of the multi-mode approach and inability to capture the actual denominator (i.e. the number of patients who picked up information and ultimately did not participate was not captured). Finally, while the HBQ has been validated, it is a relatively new questionnaire (published in late 2013).

Specific to the model chosen, while the health belief model was determined appropriate for this study, it is not the only viable model to explore the questions posed. The results presented here can be strengthened by future studies that also explore factors influencing hearing help-seeking behavior using alternate multi-factorial models and approaches.

**Conclusions**

Hearing healthcare research needs to embrace and encourage approaches that are based upon sound theoretical models in order for results to be actionable and supportive of health education approaches and health behavior change. Validated instruments...
measuring health behaviors should be used more frequently in research order to replicate and contribute to change in hearing healthcare. Given their limited use to-date, enhancing the body of knowledge will also support their refinement over time and adoption in clinical practice. The SOS-HEAR provides a validated instrument for assessing communication partner burden in the enhanced model as well as a viable approach when completed by the patient to measure and/or raise awareness of potential burden of hearing loss on others. Using the overall SOS-HEAR score in conjunction with the HBQ (the HBM-enhanced model) increased model fit over just using the HBQ. More research needs to occur in this area in order to support translation of hearing healthcare initiatives into practice, as well as more broad scale changes at the industry, employer, and policy levels. Specifically, experimental validation of the importance of communication partner burden from hearing loss on a patient’s hearing healthcare decisions is necessary for developing health education approaches to this growing public health issue.

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