Social Connectedness and Perceived Listening Effort in Adult Cochlear Implant Users: A Grounded Theory to Establish Content Validity for a New Patient-Reported Outcome Measure

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ABSTRACT

Objectives: Individuals with hearing loss often report a need for increased effort when listening, particularly in challenging acoustic environments. Despite audiologists' recognition of the impact of listening effort on individuals' quality of life, there are currently no standardised clinical measures of listening effort, including patient reported outcome measures (PROMs). To generate items and content for a new PROM, this qualitative study explored the perceptions, understanding, and experiences of listening effort in adults with severe-profound sensorineural hearing loss (SNHL) before and after cochlear implantation.

Design: Three focus groups (1-3) were conducted. Sampling was purposive and participants were recruited from a cochlear implant (CI) centre in the United Kingdom (U.K.). The participants were adults (mean age = 64.1 years, range 42 to 84 years) with acquired severe-profound SNHL (and their normal hearing (NH) significant others (SO), n = 2) who satisfied the U.K.'s national candidacy criteria for cochlear implantation. Group 1 (n = 4) used hearing aids (HA) and were awaiting cochlear implant (CI) surgery; Groups 2 (n = 5) and 3 (n = 4) used either a unilateral CI only or a CI and contralateral HA. Data from a pilot focus group (n = 2) were also included in the analysis. The data, as verbatim transcripts of the focus group proceedings, were analysed qualitatively using a constructivist Grounded Theory (GT) methodology.

Results: A GT of listening effort in cochlear implantation was developed from participants' accounts. Analyses suggested participants' listening effort was motivated by a need to maintain a sense of social connectedness (i.e., the subjective awareness of being in touch with one's social world). Before implantation and despite high listening effort, severe-profound SNHL resulted in participants experiencing low social connectedness. When sustained, the imbalance between high listening effort and low reward (i.e., low social connectedness) encouraged self-alienating behaviours and resulted in social isolation with adverse effects for

~~on~~ participants'-wellbeing and quality of life. Receiving a CI moderated but did not remove fully the requirement for listening effort. After implantation, listening effort, in combination with an improved auditory signal, enabled successful communication. Participants reported a restored sense of social connectedness and an acceptance of the continued need for listening effort. Additionally, participants provided rich descriptions of the multi-dimensional nature of their listening effort. Listening effort was described as the mental effort of attending to and processing the auditory signal, as well as the effort required to adapt to, and compensate for, the hearing loss.

Conclusions: Social connectedness, effort-reward balance, and listening effort as a multi-dimensional phenomenon were the core constructs identified as important to participants' experiences and understanding of listening effort. The study's findings suggest: 1) perceived listening effort is related to social and psychological factors and 2) these factors may influence how individuals with hearing loss report on the actual cognitive processing demands of listening. These findings are in alignment with the Framework for Understanding Effortful Listening (FUEL) that describes listening effort as a function of both motivation and demands on cognitive capacity. This GT will establish the content validity for a new PROM of listening effort.

INTRODUCTION

Hearing impairment is one of the leading causes of global burden of disease (Olusanya et al. 2014; Vos et al. 2016). It has consequences for physical, cognitive, occupational and social functioning and quality of life (Demorest & Erdman 1986; Kramer et al. 2006; Hua et al. 2013; Nachtegaal et al., 2009; Nachtegaal et al. 2012; Ramage-Morin 2016; Taljaard et al. 2016). The negative health effects of hearing impairment are not solely related to issues surrounding audibility (Pichora-Fuller et al. 2016) but are linked to a requirement for increased mental effort to compensate for the hearing loss and to enable people to listen well (McCoy et al. 2005; Zekveld et al. 2010). Previous research suggests that hearing-impaired listeners invest greater effort when listening compared with normal-hearing listeners, particularly in adverse listening conditions (Ohlenforst & Zekveld 2017). Interest in listening effort has grown over the past two decades commensurate with an increasing awareness of auditory-cognitive interactions in hearing loss and the emergence of the field of cognitive hearing science (Arlinger et al. 2009).

Listening effort has been defined as the attentional and cognitive resources needed to undertake auditory tasks such as detecting, decoding, and responding to speech (Hicks & Tharpe 2002;Bess & Hornsby 2014; McGarrigle et al. 2014). The recently published Framework for Understanding Effortful Listening (FUEL; Pichora-Fuller et al. 2016) extends this definition of listening effort to include the dimension of motivation. The FUEL defines listening effort as “a special form of mental effort” and refers to “the deliberate allocation of mental resources to overcome obstacles in goal pursuit when carrying out a listening task” (Pichora-Fuller et al., p. 10S). Current understanding of listening effort is founded on the work of Broadbent (1958), Baddeley & Hitch (1974) and Kahneman’s (1973) seminal work, the Capacity Model of Attention. The Capacity Model of Attention considers cognitive capacity to be limited. When cognitive resources are allocated to the execution of a specific

task, fewer resources are available for other, concurrent tasks. In the context of listening effort, the more distorted or degraded the speech signal, (due to the presence of hearing loss, noise or accented speech), the greater the demand for cognitive resources and, presumably, greater listening effort. According to the FUEL, the decision to allocate cognitive capacity to listening is presumed to be informed not only by task demands but also by motivation, described as task engagement or energization of behaviour. Previous studies have shown that a listener's mental state (i.e., motivation) may influence subjective reports of listening effort (Picou & Ricketts 2014). Brehm and Self (1989) suggest effort investment and task engagement are informed by individual's judgements of task difficulty. If a task is perceived as too difficult, effort will be less. Motivation, in turn, may be influenced by psychological factors such as belonging, self-efficacy, pleasure and fatigue (Matthen 2016; Pichora-Fuller 2016; Pichora-Fuller et al.).

With publication of the FUEL and the growing body of literature on listening effort generally, there is recognition by clinicians and researchers, that despite provision of hearing aids and cochlear implants, individuals with hearing loss must continue to invest effort to succeed in participating in the listening situations of everyday life. For audiologists to effectively address the continued requirement for listening effort, clinical tools to support its measurement are needed. However, a validated method of measuring listening effort with good clinical utility is not yet available (McGarrigle et al. 2014; Pichora-Fuller et al. 2016). Much of the published research conducted with the aim of developing viable clinical measures of listening effort has focussed on the objective measurement of the mental effort associated with listening during specific tasks under particular conditions. These objective measures include the use of dual-task paradigms and physiological measures such as pupilometry and electroencephalography (EEG). The dual-task paradigm, based upon the Capacity Model of Attention (Kahneman, 1973), assumes a limited cognitive resource. An

individual is requested to perform two tasks, typically a primary speech task and a secondary non-speech task. These tasks are performed separately (the baseline) then concurrently (the dual-task condition). Listening effort is considered to be the measured change in performance between the baseline and the dual-task condition. Dual-task paradigms have been used extensively to study listening effort (see Gagné et al. 2017 for a review). For example, in relation to background noise (Sarampalis et al. 2009; Picou et al. 2013), modality (Fraser et al. 2010; Picou et al. 2013), listener age (Anderson-Gosselin & Gagné 2011), noise reduction and signal processing algorithms (Desjardins & Doherty 2014; Ng et al. 2015; Desjardins 2016), and hearing aid use (Downs 1982; Hornsby 2013). Studies utilising EEG typically measure changes in brain oscillations associated with attentional processes such as the alpha frequency range (Strauß et al. 2014). Studies utilising pupilometry measure changes in pupil dilation during a listening task as physiological correlates of listening effort. These physiological measures have been used to study listening effort, particularly in relation to changes in speech intelligibility (Zekveld et al. 2014; Koelewijn et al. 2015; Petersen et al. 2015). The application of these objective measures as clinical tools appears promising; however, there is a lack of consistency across studies deploying these approaches (Gagné et al. 2017; Ohlenforst & Zekveld 2017) which presently limits their clinical utility (McMahon et al. 2016).

A complementary approach to the objective clinical measurement of listening effort is to consider the listening effort construct more broadly and in relation to individuals' self-reported experiences of effortful listening in everyday life. Patient reported outcome measures (PROMs) are tools used to gain insight from the perspective of the patient into how aspects of a health condition and its treatment impact their lifestyle and subsequently their quality of life (Meadows 2011). They are designed to provide information around a given construct, such as listening effort, to assess its impact on individuals' functional abilities. A

systematic review conducted by the authors (Hughes et al., Reference Note 1) assessed the quality of existing PROMs used to measure listening effort in the published literature. The findings from this review established that many studies utilising self-report measures rely on simple rating scales (e.g., visual analogue scales) to assess the magnitude of effort investment during a specific listening task. Far fewer studies use PROMs as a comprehensive measure of self-reported listening effort. Furthermore, several of the identified questionnaires measure listening effort at the subscale or item level (Gatehouse & Noble, 2004; Akeroyd et al. 2014) or assess related constructs such as "ease of communication" (Cox & Gilmore, 1990) and "communication performance" defined as "the ability to communicate effectively in a variety of situations without a great deal of effort or emotional strain" (Demorest & Erdman, 1987) rather than listening effort per se. Other questionnaires, such as the Hearing Handicap Inventory for the Elderly (Ventry & Weinstein 1982) were developed to assess the psychosocial impacts of hearing loss, but without addressing how listening effort may contribute to the hearing handicap. Importantly, none of the existing measures were developed with direct input from the target population to generate items that capture the experience and significance of daily listening effort in SNHL.

Developing a new PROM requires that the patient perspective forms the basis for the new instruments' content validity (Patrick et al. 2011). Content validity is a judgement of whether an instrument samples all the relevant content or domains deemed to be important by the target population (Cappelleri et al. 2014). It is an aspect of PROM development that has often been overlooked (McKenna 2011) with an historic reliance on expert opinion, a judgement of "validity by assumption" (Streiner & Norman 2008, p.6) on whether an instrument appears fit for purpose. Ensuring content validity is vital if a PROM's measurement properties are to be considered meaningful. Qualitative methodologies are

recommended for concept elicitation (Patrick et al.) and act as evidence of a PROM's content validity.

As part of a larger study to develop and validate a new PROM of listening effort for use in the CI clinic, the present qualitative study was undertaken to explore how listening effort is perceived and experienced by adult CI candidates. It was conducted specifically to support item generation and to establish the new PROM's content validity. To the authors' knowledge there are no published studies exploring the experiences and understanding of listening effort in individuals with hearing loss who use either HAs or CIs. This qualitative study also aims to address this gap.

MATERIALS AND METHODS

Grounded Theory as a Method of Qualitative Inquiry

This paper presents a constructivist Grounded Theory (GT) analysis (Charmaz 2014) of focus group transcripts and observer field notes conducted with CI candidates and CI recipients. A constructivist GT is a qualitative research approach that aims to generate an explanatory theory to define and describe in detail a given phenomenon (i.e., perceived listening effort), with the definitions and descriptions constructed from data that has been systematically obtained and analysed (Glaser & Strauss 1967). As an inductive method of inquiry, GT relies "on a type of reasoning that begins with a study of a range of cases and extrapolates from them to form a conceptual category" (Charmaz 2006 cited in Bryant & Charmaz 2007, p. 15). It does not involve the generation of a priori hypotheses or the use of a pre-existing conceptual model. As the findings (the emergent theory) are derived from (grounded in) the data, GT is suitable for developing an understanding of the phenomenon of interest from the perspective of the target population and, therefore, was considered an appropriate method for concept elicitation in PROM development.

Several forms of GT were available to the researchers and the choice of which to adopt is generally determined by the researchers' epistemological perspective. A constructivist approach to GT was adopted for this study (Mills et al. 2006; Charmaz 2014). Constructivist GT is influenced by symbolic interactionism (Blumer 1969), a theoretical perspective compatible with the lead researcher's philosophical position on the construction of meaning. Symbolic interactionism assumes people construct a persona and, as a result, notions of society and reality through interaction. Drawing from symbolic interactionism's thesis that argues in favour of the centrality of interaction in the formation of meaning, constructivist GT considers theories derived from data to be constructed based on the shared experiences of researcher and participants. Theoretical understanding is negotiated rather than discovered as an objective reality. Constructivist GT views emergent theory as an interpretation, a plausible account, and an explanation of aspects of a phenomenon under review, rather than objective truth.

Participants and Sampling

Purposive sampling was used to recruit: 1) hearing aid users who met the UK CI candidacy criteria and were awaiting CI surgery and 2) CI recipients to focus groups. Information sheets describing the study and an invitation to participate were sent to 51 adults from a U.K. CI programme who fulfilled the study inclusion criteria: a diagnosis of post-lingual SNHL, satisfied the U.K. national CI candidacy criteria (National Institute for Health and Care Excellence (NICE), 2009), used hearing aids and/or CI(s), were 18 years of age or older, proficient English speakers, and had no additional medical diagnoses precluding participation in a focus group. Twenty-four participants expressed an interest in participating in the focus groups and subsequently consented and enrolled in the study. A summary of participant characteristics is presented in Table 1. Speech performance outcomes for the participants with SNHL are described in Table 2.

Each participant was allocated to one of four focus groups by applying principles of maximum variation to ensure the groups were balanced for gender, with efforts to achieve variability in age range, socio-economic status, device use (HA and or CI), and duration of device use. Three focus groups were conducted, initially. Of these groups, two focus groups (the postimplant groups) included participants who were CI recipients (n = 9). The third focus group (the preimplant group) included prospective CI recipients who used HAs and were awaiting CI surgery (n = 4). A fourth discretionary focus group was scheduled to take place after initial data collection if the research team determined that further data collection was needed to ensure theoretical saturation (the point in data collection when no new conceptualisations emerge). In the end, the fourth focus group was unnecessary as theoretical saturation was established after analysis of the data from the initial three focus groups, with inclusion of pilot data to complete the set.

A snowball sampling procedure (Bloor et al. 2001) was used to recruit SO. SO were included to provide an alternative viewpoint on the experiences of listening effort in hearing loss. The original protocol specified a separate focus group for SO. However, due to a poor response rate (8.3%, n = 2) this group was not undertaken as a separate focus group. The SO (both female with self-reported normal hearing) who consented to participate joined the same focus group as their loved ones for practical reasons (e.g., to minimise disruption and travelling time for these individuals). Finally, to ground the study in the target population, two CI recipients (1 male; 1 female) were recruited as lay representatives to the study's research management group (RMG). The RMG was responsible for the design and conduct of the study and included CI clinicians, academics and two lay representatives. The lay representatives participated in a pilot focus group to field test the topic guide. Also, through email correspondence and face-to face meetings, they provided feedback to assist topic guide development, offered suggestions regarding the conduct of the focus groups, and verified the

accuracy of the pilot focus group transcripts. The total sample size for the study was n = 17 (CI recipients n = 11; HA users n = 4; significant others n = 2).

Data Collection

A topic guide was used to explore participants' experiences and understandings in an in-depth manner, and to examine perceptions of listening effort and listening-related fatigue. Table 3 displays exemplar questions from the topic guide. The questions were crafted to probe the mental and physical characteristics of listening effort and fatigue, participants' management of listening effort, their thoughts and opinions in respect of the support received from CI clinicians in the management of listening effort, and personal experiences of listening effort in daily life. They were informed by sensitising concepts (Charmaz 2014) identified in the published literature and the lead researcher's experiences as a CI professional. The topic guide was piloted in a focus group comprised of the RMG lay representatives and the data analysed immediately. The emergent concepts informed the final 10-item version of the topic guide, consistent with principles of theoretical sampling and the iterative and generative process of a constructivist GT. The pilot data (n = 2) were included in the final data set and added to the richness and "thick descriptions" within the data captured.

The three focus groups were held within a two-week period, in June 2015. The focus groups took place in a community setting away from the CI centre to maintain neutrality. Each group lasted approximately three hours including breaks. The focus groups were led by the first author (SEH), a trained facilitator experienced in interacting with people with severe-profound SNHL. An observer, also an experienced CI clinician, documented non-verbal behaviours, contextual cues, and interactions among group members. The observer sat away from the group and was not an active participant except to seek clarification or elicit further discussion on topics raised.

The focus group venue was a small meeting room with good lighting in quiet surroundings. A speech-to-text recorder (STTR) provided communication support through subtitling and a hearing loop system was available and utilized by one participant. To facilitate communication, each group was limited to six participants. The participants and facilitator could see each other and the seats were arranged in a semicircle around a table to allow viewing of the real-time subtitles. Written materials, including copies of the topic guide, focus group rules, and a general description of the research study, were provided to participants. Interpreting in British Sign Language (BSL) was not provided as all participants used spoken English as their preferred mode of communication.

Research Team Reflexivity

Reflexivity is a key principle of a constructivist GT methodology and refers to a process of critical self-reflection concerning how the researchers' interests, viewpoints, and assumptions influence the conduct of a study (Charmaz 2014). The first author (SEH) is a trained speech and language therapist with extensive experience providing hearing rehabilitation services as part of a CI multidisciplinary team. The first author knew the participants through her clinical role. To clarify her reflexive stance in relation to the participants and the topic, she wrote reflexive, methodological and conceptual memos throughout the processes of data collection and analysis to identify and understand how her personal experiences and perspectives, the researcher lens, informed the construction of the emergent theory. The first author, as focus group facilitator, debriefed with the observer after each focus group to record insights, observations and address any concerns.

Ethical Considerations

The National Research Ethics Committee – East Midlands granted ethical approval for the study (Ref: 14/EM/1167). Written consent was obtained before an invitation to attend

a focus group was issued. Participants were assured of anonymity and confidentiality and free to withdraw from the study at any time.

Data Analysis

The speech-to-text reporter (STTR) supplied verbatim transcripts of the focus groups. The facilitator and observer checked the accuracy of transcription by reading the full transcripts and listening to five randomly selected 5-minute samples of each audio-recording (3 transcripts x 5 samples = 75 minutes in total) based on procedures recommended by Tong, Sainsbury et al. (2007). The RMG lay representatives verified the transcript from the pilot focus group, confirming it was an accurate representation of the discussion. NVivo 10 qualitative data analysis software was used to code the observer notes, participants' notes, and debriefing session notes. A second researcher compared the conceptual codes with the data to check consistency, thoroughness, and identify redundancies.

A constructivist GT methodology is underpinned by the premise that theory can be derived from textual data of first-hand accounts that reveal the phenomenon under review. Key to this, data are analysed and coded using a multi-stage process that enables a researcher to define the meaning of the data and how one might interpret that meaning. It is through the process of coding that the GT emerges. Coding refers to attaching of conceptual labels (i.e., codes) to data which allow the relationship between codes to be theorised in relation to any given phenomenon.

The constructivist GT underpinning this study was developed iteratively according to three stages of coding (Table 4). Proceeding line-by-line, open coding was used initially to break the data into meaningful units at the word or phrase level. These small units of data were each assigned a conceptual label or code using gerunds (the noun form of verbs). Gerunds were used as a heuristic device to define implicit meaning and actions and to facilitate the exploration of relationships between codes (Urquhart, 2013; Charmaz 2014).

The second stage of coding, focused coding, grouped similar concepts into more abstract, higher level categories. Finally, the core theoretical categories were identified, propositions developed, and the explanatory framework constructed. Throughout each level of coding, constant comparison, a fundamental process of GT methodology, was employed as an analytic tool. Constant comparison is a process of comparing data with other data, comparing data with concepts, and concepts with concepts (Glaser & Strauss 1967; Mills et al. 2006; Walker & Myrick 2006). Data analysis proceeded iteratively and written memos were used to appraise critically the concepts emerging from the data, to describe concepts' properties and dimensions and the relationships between concepts, and to define the causal conditions, contexts and consequences of actions and interactions related to the phenomenon (listening effort). Diagrams were used extensively in combination with Spradley's semantic relationships (relationships between aspects of the content or 'story line') (Spradley (1979) cited in Urquhart, 2013) to explore interactions and associations between categories. These visual representations of the data were developed using XMind v6 mind mapping software. The core category, the central concept which represents the main theme of the grounded theory, was identified according to the criteria specified by Strauss and Corbin (2015) that: 1) it should be related to all other categories, 2) appear frequently in the data, 3) be logical and consistent with no forcing of the data, 4) be sufficiently abstract enough so that it can be used as the overarching explanatory concept and used in other research, and 5) grow in explanatory power as other categories are related to it. Theoretical integration was achieved through an iterative process of reviewing and sorting concepts, categories, diagrams and memos. Finally, consistent with constructivist GT methodology, the literature review for this study was deferred until after analysis of the verbatim transcripts was completed. The scope of the literature review was broad, guided by the emergent concepts and categories and the principles of theoretical sampling. Theoretical sampling is a process of seeking additional

information to support and further develop the theoretical categories originating in the data (Charmaz 2014). Deferring the literature review enabled the researchers to compare the newly developed model with relevant constructs and theories in the published literature.

Credibility, Trustworthiness and Rigor

In constructivist GT, the terms reliability and validity are eschewed in favour of the terms credibility, trustworthiness and rigour (Krefting 1991; Tracy, 2010; Strauss & Corbin 2015). Through consensus discussions, the authors confirmed the credibility and applicability of the new GT by applying criteria established by Glaser and Strauss (1967): 1) the level of description and detail was sufficient, 2) the processes of data collection and analysis were transparent, 3) there were multiple comparison groups, 4) the theory 'fit' the data, 5) was understandable by laypersons and professionals and 6) sufficiently abstract to be usable (cited in Strauss & Corbin 2015, p. 345)

Criteria specified by Chiovitti and Piran (2003) and Strauss and Corbin (2015) were applied to confirm methodological rigor. Specifically, the research protocol stated the rationale and procedures for participant recruitment and the participants were encouraged to focus their group discussions on the topic guide questions. A second reviewer checked the codes for representativeness against the verbatim transcripts. The theory generated from the data was checked against participants' understandings of the listening effort through feedback from RMG lay representatives. Finally, the use of analytical tools recognised in the GT literature as promoting rigor (i.e., constant comparison, line-by-line microanalysis of the data, reflexive memos, and clear documentation of the research process) further ensured the study's trustworthiness.

RESULTS

Overview

———The constructivist GT is presented in two parts as shown in Figures 1 and 2 and each component will be described fully later in this paper. Conceptual and category labels generated by the coding process are indicated by use of italics. Briefly, the GT is comprised of two core categories. Firstly, it proposes that listening effort, for individuals with severe-profound SNHL who receive a CI, is a process of *seeking connectedness* (Figure 1). It suggests that perceived social connectedness, as a reward of effort expenditure, informs how individuals experience and make sense of listening effort in everyday life. Listening effort as a process of seeking connectedness was found to involve three sequential stages:

1. *Validating*
2. *Disconnecting*
3. *Restoring and reconciling*

This process, as captured in the data, suggests generally that a progressive severe-profound SNHL creates conditions whereby individuals must invest extensive listening effort to communicate optimally. Individuals are motivated to invest listening effort to preserve or validate their sense of social connectedness, described as a subjective awareness of being in touch with one's social worlds, a sense of belonging, and a fundamental human need (Baumeister & Leary, 1995; Lee & Robbins, 1998). However, diminishing hearing abilities cause the expenditure of listening effort to become ineffective, leading to increased social isolation and diminished well-being. The data suggest that receiving a CI moderates but does not remove the requirement for listening effort. Rather, the improved auditory signal, in combination with moderated listening effort, facilitates communication, which, in turn, increases recipients' perceived social connectedness. Perceived social connectedness informs how recipients assign value to listening effort and is a determiner of future listening effort expenditure. When listening effort and social connectedness are balanced, recipients consider

the continued need for listening effort to be an acceptable investment. However, a perceived effort-reward imbalance prompts a decrease in effort.

Secondly, the new GT suggests that individuals with severe-profound SNHL understand and experience listening effort as a multi-dimensional phenomenon (Figure 2), labelled in the constructivist GT as *active doing*. The authors labelled the second core category as active doing to depict the deliberate nature of the mental work involved in listening that was captured in the data. Listening effort as active doing appears to have three key dimensions:

1. *Attending*
2. *Processing*
3. *Adapting and compensating*

The dimensions of listening effort captured in the data appeared to be influenced by a range of contextual and causal conditions.

Context Conditions for Listening Effort

Participants provided detailed information on the contexts in which they experienced listening effort. Context was discussed both broadly in terms of the relationship between listening effort and the experience of living with a hearing loss and specifically by mining from participants' accounts the specific situations in which listening effort was likely to be required.

Broadly, listening effort was considered the functional manifestation of the participants' hearing loss. Listening effort framed and shaped participants lives in an all-encompassing and pervasive way. Most were accepting of their diagnosis of hearing impairment and did not consider the label of "deafness" to be problematic. However, it was the functional manifestation of their hearing loss as the non-negotiable requirement to invest listening effort and the consequences of failed effort investment that was perceived as

challenging. It was listening effort rather than the hearing loss that was suggested to negatively impact quality of life.

> "…it's not the deafness that's a problem, it's the effort required to get anything from the hearing. It's all effort." (Participant 012)

Perceptions of listening effort appeared to be influenced by the hearing devices participants used. Hearing aid users seemed overwhelmed by the effort associated with listening (note that in this study, HA users were all candidates for cochlear implantation). HA users struggled to reflect upon their experiences of listening effort, perhaps due to the minimal benefit HAs afforded them. They had fewer insights about their experiences of effortful listening. Compared with the CI recipients, their accounts focussed on the consequences of effortful listening rather than the qualities of listening effort. HA users commented that listening and communication were often unsuccessful despite listening effort and, consequently, these individuals no longer invested effort, finding it preferable to "switch-off" (Participant 001). By contrast, the CI users recalled experiencing similar feelings of overwhelm in relation to listening effort before receiving their implant; however, listening experience with a CI qualified these participants to compare the qualities of their listening effort and changes in its magnitude before and after implantation. The sense of overwhelm and the need to "switch-off" was suggested to diminish after cochlear implantation.

Listening effort appeared to be influenced by the specific context in which listening occurred. Both HA users and CI recipients discussed the need for less effort when speaking with one conversational partner as compared to the level of effort needed when listening in groups. One-to-one situations were described as "quite easy", "feeling relaxed", and "almost perfect" (Participants 012, 021). Groups were much more challenging for participants. In these situations, all the participants reported that they often found themselves unable to follow the conversation and unable to participate despite investing listening effort. In multi-

speaker conversations listening effort was described as the need for increased focus which left individuals feeling tired and stressed. For all participants, listening effort varied depending on the degree of background noise, the complexity of the information being conveyed, and speaker characteristics.

Causal Conditions for Listening Effort

The primary causal condition suggested to motivate the investment of listening effort is a reduced sense of social connectedness arising from severe-profound SNHL. The focus group discussions suggested threats to social connectedness (i.e., the presence of a severe-profound SNHL) motivated participants to invest listening effort as a way of realising their basic human need to feel socially connected. Social connectedness and hearing loss, as causal conditions, are reasons for the GT's core category –a basic social process of "seeking connectedness". Low social connectedness is "like being dead" (Participant 054). It gives rise to feelings of invisibility, of *being an outsider* to loved ones, and causes individuals to question their own existence. With diminishing hearing, low social connectedness becomes ubiquitous. Listening effort, as a deliberate form of action, is rationalized as a means of combatting low social connectedness.

Core Category: Seeking Connectedness

Preimplant Phase: Validating and Disconnecting

Participant accounts suggested individuals with HL are motivated to invest listening effort to maintain their sense of belonging and confirm social connectedness. Before cochlear implantation individuals utilise hearing aids, which offer minimal benefit due to the severity of the hearing loss. In this context, the severe and progressive nature of the hearing loss threatens social connectedness. To validate one's social connectedness increasingly greater levels of listening effort are invested, described by participants as *struggling to fit in* and

"trying so hard" (Participant 054). They compared listening and listening effort to a struggle for "survival" (Participant 048).

Validating is characterised by feelings of loneliness. Participants viewed themselves as different from hearing family and friends and were often recipients of stigma and negative attitudes. They suggested that, because of their hearing loss, they made others uneasy. To overcome these obstacles and to gain a feeling of belongingness, participants appeared to invest effort into listening. They viewed their investment of listening effort as obligatory to live up to the expectations of hearing loved ones, especially at social events. The participants expressed that they frequently blame themselves when they are unable to listen effectively and assume full responsibility when communication breakdowns occur.

As hearing diminishes it becomes increasingly difficult for individuals with severe-profound SNHL to maintain a sense of social connectedness despite maximum expenditure of listening effort. When effort and social connectedness are in an imbalanced state, motivation to invest listening effort decreases and individuals commence a process of disconnecting, the second stage in the core category of seeking connectedness. Disconnecting is a process of *increasing social distance*, characterised by a dread of social interaction which participants described as a desire to "walk out" (Participant 003), "slither away like a snake without anyone noticing" (Participant 016) and feeling "like I'm curling up inside" (Participant 021). Disconnecting means individuals begin *giving up* on listening, becoming increasingly socially isolated. For some participants, giving up was associated with feelings of guilt. Other participants viewed *switching off* as a selfless act undertaken to protect loved ones. These participants suggested that *opting out* of a social situation was preferable to *being a burden* to others. Being a burden was associated with feelings of dependence, helplessness, and being indebted to others. Social isolation and a continued requirement for high listening

effort were suggested to negatively impact participants' well-being by during the disconnecting phase.

> "For me it is everything that is the results of straining to hear and that can be physical effects, it can be mental effects, it can be emotional effects." (Participant 012)

Low self-confidence and self-esteem were related to low perceived social connectedness and participants' experiences of listening in sub-optimal conditions. Participants regularly experienced feelings of fear, vulnerability, guilt, frustration, and embarrassment. Feelings of frustration were commonly associated with the disconnecting phase and occurred when "you are putting a lot of effort in and not getting very much benefit from the effort" (Participant 007). Anxiety was experienced commonly during disconnecting and appeared to be linked to an individual's assessment of the upcoming listening situation and their appraisal of the effort expenditure needed to listen optimally. Increased anxiety correlated with greater listening effort. Effort judgements appeared to be influenced by the importance of the listening task, environmental factors, and speaker characteristics. For example, one participant noted higher levels of anxiety when he was required to listen to children or female speakers. Tasks rated as important were linked to higher anxiety levels. Overall, participants suggested anxiety was unavoidable when listening with a hearing loss. Anxiety levels were generally higher before implantation, presumably linked to a sustained need for increased listening effort.

Postimplant Phase: Restoring and Reconciling

Receiving a CI marks the beginning of the final phase in the process of seeking connectedness described as *restoring and reconciling*. Restoring and reconciling describes how social connectedness and receiving a cochlear implant impacts on subjectively experienced listening effort. Receiving a CI is a cause of *increasing social connectedness* which participants suggested was "the reward of a CI" (Participant 054). Cochlear implantation appears to correct the effort-reward imbalance described by participants in the

validating and disconnecting phases. Although listening effort is still required to derive meaning from the auditory stimulation provided by a CI, the focus group accounts suggested that listening effort after implantation is viewed more positively. The reward of renewed social connectedness and the moderating influence of a CI on the effort requirement appear to render acceptable the continued need for listening effort.

Increased connectedness included an individual's sense of being linked in with the auditory environment. An improved sense of connection with their soundscape was especially important to participants if the listening effort required for speech understanding remained unchanged after implantation. As individuals with post-lingual, progressive SNHL, the participants also associated increased connectedness with feelings of *being back* and "becoming a person again" (Participant 012). Being back meant restoring aspects of self-identity that had been constrained by the hearing loss. Being back also meant being back to others by reconnecting with loved ones and through a re-establishing of social roles.

> "I came out of dark, deep pit if you like into light, I could feel the difference there. The isolation I experienced before did not exist any longer. I could hear my wife's soft northern accent and my little granddaughter….and heard the birds singing in the trees and things – and hearing my own voice – I felt as though I were dreaming, if you like. I got onto the beach and listened to the sea gulls and the lashing of the waves and just tried to eavesdrop on people's conversation if you like just to hear the difference and the tone and using less muscles in my face and with that it was just like – it's a new world." (Participant 021)

Participants reported feelings of joy and elation when they realised they could take part successfully in social interaction. The restored sense of social connectedness experienced after implantation was suggested to lead to improvements in individuals' well-being and

quality of life. Participants reported feelings of contentment, happiness and optimism. Confidence was restored and self-esteem improved.

When asked about listening effort after implantation, the participants confirmed a continued requirement to invest listening effort. All viewed cochlear implantation positively and experienced benefit from their devices. However, even with a CI, they acknowledged "there will [always] be [listening] effort and there is not a magic cure" (Participant 004). Interestingly, for a few participants, listening effort reportedly increased generally after CI. They attributed their perception of increased listening effort to greater social participation and "doing more" (Participants 004, 018). These recipients stopped switching off and increased participation led them to judge their listening effort to be higher after implantation. While most participants could identify occasional listening situations when effort was increased, the requirement for listening effort was generally moderated by the CI. Moderated effort and increased social connectedness appeared sufficient to restore a perceived effort-reward balance such that participants no longer regarded listening effort as problematic. Whereas listening effort was described as overwhelming before implantation, it was described after implantation as a "chore" (Participant 018). Participants now considered the need for listening effort a tolerable aspect of using a CI, accepting they "will always have to make a considerable effort to communicate with others." (Participant 007)

Core Category: The Active Doing of Listening

The core category of seeking connectedness highlights the relationship between the constructs of social connectedness and effort-reward balance and the role of cochlear implantation in the subjective experience of effortful listening in severe-profound SNHL. In a second core category labelled "the active doing of listening", the GT describes the qualities of listening effort experienced in everyday listening. The participant accounts suggest listening effort is a complex, multi-dimensional and active process. It appears to comprise: 1)

the mental effort associated with *attending* to and 2) *processing* the auditory signal and 3) the effort invested in *adapting* to and *compensating* for the hearing loss (Figure 2).

All the participants associated attention and concentration with listening effort. The GT describes the category of attending as the process by which the participants focussed their mental energy on an auditory stimulus. Three sub-categories of attending were identified: 1) *scanning*, 2) *focussing*, and 3) *filtering*. The experience of attending varied, depending on the type of hearing device used. Before implantation, participants were mostly scanning and focussing. Scanning refers to maintaining a state of vigilance with participants monitoring the auditory environment to detect auditory information. When participants were scanning, they were in a state of "hyperarousal" (Participant 054) and heightened awareness, described as stretching, straining, and "being at 55,000 feet" (Participant 005).

> "Hyper-aroused feels like you are extending. On the roof you know, like on the ceiling, all your antennas going. You've got hundreds of antennas and they are all reaching out, reaching out, reaching out". (Participant 054)

For participants, scanning involved tension and was the opposite of being relaxed, which they related to being in a "flow state" (Participant 007) when "listening just happened" (Participant 012). Scanning meant being in a constant state of readiness that participants found exhausting. It was a style of listening that could not be sustained for long periods of time.

Focussing was the other form of attending particularly prevalent before implantation. Focussing is the opposite of scanning and refers to listening for discrete aspects of the speech signal such as specific phonemes or words. Participants considered it unlikely that they would understand a spoken message in its entirety. To compensate, many adopted the strategy of listening carefully to part of the speech signal (focussing) rather than employ a more gestalt approach. However, although most participants utilised focussing, there was a

consensus agreement that focussing is an ineffective form of listening effort. All participants shared experiences of struggling to follow conversational speech because they are "focussing so much on the individual words" (Participant 048). Like scanning, focussing is time-limited, intense, tiring and cannot be sustained for long periods.

Receiving a CI was suggested to change the participants' style of attending. Focussing and scanning were forms of attending made necessary by the badly degraded auditory signal. A CI provided participants with superior auditory stimulation compared to their hearing aids. Participant accounts suggested recipients were no longer required to invest effort in detecting auditory information. Instead, listening effort was directed at interpreting the auditory stimulation. Their style of attending shifted from focussing and scanning to a process of *filtering.* Filtering is the mental effort directed at analyzing sounds in an individual's soundscape.

> "You are working quite hard finding out what sounds belong, constantly all day putting stuff in the right slots all the time". (Participant 054)

Filtering was most prevalent immediately after switch-on. It eased over time but even with several years of CI experience, participants continued to view filtering as a necessary component of listening.

Processing, as a form of listening effort, refers to the interplay between cognition and audition as experienced by the focus group participants. It refers particularly to the cognitive and linguistic strategies deployed to decode an auditory message. Processing was suggested to have implications for working memory. Participants appeared to rely on context, prior experience and linguistic knowledge to support their listening and considered these strategies to be a dimension of listening effort. Specifically, they suggested processing involved the *piecing together* of information and *listening for key words*. Listening was often uncertain and involved "guesswork" (Participant 048). Knowing the topic of conversation and having

written material or other visual media to support understanding appeared to ease the requirement for processing as a dimension of listening effort.

The effort of listening with severe-profound SNHL meant that spoken messages were decoded slowly, presumably due to the increased requirement for cognitive processing to offset the badly degraded auditory signal. The time lag between hearing and understanding was often significant enough to limit social participation. The increased time requirement was particularly distressing in group conversations and in the workplace.

> “I feel isolated in group situations because I am unable to follow rapid dialogue (normal speech!). And listening effort means I always seem to mean being "behind" the group. Just tagging along, harder to contribute because of "listening and assimilating" time, the moment passes and someone else is speaking.” (Participant 001)

Both the HA users and CI recipients suggested listening effort as processing also impacted working memory by limiting ability to remember and recall conversational content. Difficulty *remembering and recalling* was linked with a perceived need to focus on specific aspects of the speech signal and a reliance on cognition to decode the spoken message.

> “I'd say what was that conversation about, what do I have to remember? I would not even pick out the main part of it because I've concentrated so much on listening to that first bit I've forgotten what they've said because I just can't hold on to what I have to… remember-, remembering is dreadful.” (Participant 030)

Participants also reported difficulty “multi-tasking” (Participant 016), which they described as the ability to perform another activity (e.g., taking notes, driving) while listening. *Multi-tasking* was most compromised before implantation. The associated effort required to decode the poor-quality speech signal meant listening became all-consuming, suggesting maximum

resource allocation to the listening task. It imposed social limitations and was noted to have a negative effect on performance in the workplace.

> "Sometimes we're talking about technical subjects and sometimes we might be speaking to someone who we've never met before and they might mumble and the effort of trying to understand them and write the notes and then, hang on, what did they just say? Because my concentration is split and it seems to affect my memory because you were talking about previous subjects. Somebody may have been talking about a previous subject which is also relevant to what is happening now, and all that mental juggling seems to affect my memory because I am trying to listen to you and trying to make some notes, I am trying to think what I want to say, and also remember what is going on. That listening effort is a big thing." (Participant 018)

The ability to listen and simultaneously perform a second task was suggested to improve after cochlear implantation. These were moments of significance for recipients, highlighting a benefit of cochlear implantation and a positive change in their listening abilities.

Processing was influenced by the acoustic environment. More challenging listening conditions (e.g., the presence of background noise) were suggested to impact negatively on participants' ability to perform a concurrent task while listening, irrespective of the hearing device being used. Processing was also suggested to affect participants' well-being. Processing affected participants' self-efficacy leading them to question their ability to be successful in social gatherings and in the workplace. Reduced self-efficacy, self-confidence and self-esteem, associated with their ability to decode, recall and understand a spoken message was particularly evident in the preimplant phases of validating and disconnecting.

> "I go in thinking 'Is that person thinking I'm very thick? Should I be doing the job that I'm doing?' Because this person has told me something I really should have

understood and I'm giving this blank face, I couldn't quickly respond so I have that feeling of lower ability I suppose." (Participant 016)

Adapting and compensating is the third dimension of listening effort mined from the participants' accounts. The participants suggested that they utilize specific strategies to adapt to and compensate for their hearing loss that require special mental effort. They associated the mental energy required to appraise the environment and the decision-making associated with the deployment of appropriate strategies to ensure successful communication to be a form of listening effort:

"What's the room going to be like? Will I have the light behind you? Will I be sitting in the dark? Will I be at the bottom of the table and I won't be able to hear? There are lots of considerations going on. To me that is part of the listening effort that a hearing person maybe won't even think about." (Participant 004)

Adapting and compensating involved *planning* when and how to listen and efforts directed at *engineering the environment* for optimal listening (e.g., sitting close to the speaker, evaluating the room layout). The effort invested in adapting and compensating appeared to be influenced by participants' perceived self-efficacy and anxieties about their ability to manage the listening and communication demands of a given situation. Additionally, the data suggested that the necessity for listening effort required HA users and CI recipients to monitor and carefully manage their mental and physical energy resources. Resource monitoring and the identification of opportunities for rest and recovery from listening were important aspects of adapting and compensating, considered necessary for participants to maintain their well-being.

DISCUSSION

In this GT study, focus groups provided personal accounts of the experiences and understanding of everyday listening effort before and after cochlear implantation. From these

narratives, common themes and processes were constructed to establish the content validity for a new patient reported outcome measure (PROM) to evaluate perceived listening effort in adult CI recipients. The study's findings suggest that listening effort is a multi-dimensional construct that significantly influences how individuals' experience and make sense of living with severe-profound sensorineural hearing loss. The participants considered listening effort to mean the mental work required to attend to and to process an auditory signal and the mental effort needed to plan for and deploy adaptive strategies to manage a listening situation. An individual's experience of listening effort and their motivation to invest future listening effort was informed by their perceived social connectedness, or sense of belonging, as a key reward of their effort investment. When efforts and rewards were in a state of imbalance individuals were less motivated to invest listening effort. Receiving a CI provided sufficient auditory stimulation that, when combined with listening effort, recipients experienced greater social connectedness. Increased social connectedness restored the effort-reward balance and listening effort was perceived to be an acceptable cost of having a CI.

Several studies have explored the role of motivation in the specific context of listening effort and the associated concept of listening-related fatigue (Hornsby et al. 2013; Picou & Ricketts 2014; Earle et al. 2015). The new GT adds to this literature and provides support for the role of motivation in effortful listening. It offers confirmatory evidence of the FUEL (Pichora-Fuller et al. 2016), a heuristic for understanding the complex relationship between the demands of the listening task, an individual's cognitive capacity, and the motivation to expend the necessary cognitive resources to listen optimally. The findings are also compatible with the well-established literature on the psychosocial impact of hearing loss (Hetu et al. 1988; Hallberg & Carlsson 1991; Hogan 1997; Hallberg et al. 2000; Hogan et al. 2011), psychological theories of motivation and belongingness (Baumeister & Leary 1995; Lee & Robbins 1995; Lee & Robbins 1998; Townsend & McWhirter 2005), effort-

reward imbalance (Siegrist 1996; van Vegchel et al. 2005), attention and vigilance (Kahneman 1973; Kuchinsky et al. 2016), and the growing body of literature on listening effort in hearing loss (see (Klink et al. 2012; McGarrigle et al. 2014; Ohlenforst & Zekveld 2017 for reviews). The findings, in particular the importance of maintaining an effort-reward balance, may also be compared to recent reports of how motivation affects compliance with certain interventions such as auditory training (Tye-Murray et al. 2012; Henshaw et al. 2015).

The core constructs identified in the model are consistent with psychological theories belongingness (Baumeister & Leary 1995; Hockey 2011), in particular social connectedness. Social connectedness is defined as the subjective awareness of being in touch with the social world (Lee & Robbins 1998). It is considered a fundamental and pervasive human motivation that drives individuals to invest effort in the pursuit of meaningful social interaction (Baumeister & Leary). The process of seeking connectedness identified in this study supports previous research that has established when social connectedness is threatened or disrupted, individuals experience social isolation, self-alienation, anxiety and poor mental and emotional well-being (Lee & Robbins 1995; Lee & Robbins 1998; Lee et al. 2001; Townsend & McWhirter 2005; Crisp 2010). The GT adds to previous qualitative studies that have shown social connectedness to be affected by hearing loss and to be a benefit of CI (Hogan 1997; Hallberg & Ringdahl 2004; Ramage-Morin 2016). For example, resonant with the participants' descriptions of being a burden before implantation and doing more after having a CI, Hallberg & Ringdahl (2004) identified a decreased dependency on others and increased social participation as central themes of a grounded theory study exploring individuals' experiences of living with a cochlear implant. Additionally, several of the constructs associated with the disconnecting phase of seeking connectedness (e.g., anxiety, low self-esteem, social isolation) are consistent with previous qualitative studies describing the impact of hearing loss on psychosocial well-being (Hetu et al. 1988; Hallberg & Carlsson 1991;

739 Hallberg et al. 2000; Hawthorne et al. 2004; Engelund 2006; Hogan et al. 2011). This GT
740 study extends these earlier findings by associating perceived listening effort with social
741 participation and psychosocial health in the case of cochlear implantation.

742 The findings in this study, in particular the concepts of effort-reward balance and the
743 negative consequences of effort-reward imbalance, are compatible with the effort-reward
744 imbalance (ERI) model of stressful experiences in work (Siegrist 1996). The ERI model of
745 occupational health claims that lack of reciprocity between 'costs' and 'gains' (i.e., high
746 effort/low reward conditions) causes a state of emotional distress and increases the risk of
747 poor health (van Vegchel et al. 2005) with negative effects on occupational role status (as a
748 type of social role). According to the ERI model, maintenance of social roles is considered
749 crucial for the safeguarding of self-efficacy and self-esteem (Siegrist, 2000). The finding that
750 the participants in this study attributed low self-esteem to an inequity between their sense of
751 social connectedness and the listening effort they invested to maintain their social roles is
752 similar to this model.

753 Complementary to the ERI model, the concept of effort-reward balance in evaluating
754 the requirement for listening effort also resonates with Brehm and Self 's (1989) model of
755 motivational intensity. This model suggests that cost-benefit evaluation of required effort is
756 undertaken in the context of task demands and task success importance. When task demands
757 are proportional to the importance of success then effort is expended. However, if task
758 success is impossible, despite importance, then effort is withheld. During the disconnecting
759 phase it appears that the task demands of listening become so great that continued investment
760 of effort cannot guarantee listening success, so effort is withdrawn. The findings also support
761 previous qualitative studies exploring help-seeking behaviour in hearing healthcare (Carson
762 2005) and hearing aid use in mild-moderate hearing loss (Lockey et al. 2010). Carson (2005)
763 suggested women's decision-making in relation to their hearing health was informed by an

analysis of "cost v benefits" where costs were defined as the "cognitive, physical and emotional effort of persevering" (p. 192) and benefits included improved understanding, leading to opportunity for increased participation. Lockey et al.'s (2010) phenomenological study related hearing aid use with the ability of the devices to enhance opportunities for social participation.

The GT conceptualizes listening effort as the mental work undertaken in attending to the auditory signal, processing auditory information and adapting to and compensating for hearing loss. The participant accounts of attending as scanning resonate with published studies of vigilance. Vigilance, the ability of humans to remain alert to stimuli over prolonged periods of time (Warm et al. 2008), is described in the focus group accounts as the need for "heightened awareness" when attending to auditory stimuli. Kuchinsky et al. (2016) studied vigilant listening using pupilometry and fMRI to ascertain that increased listening effort is associated with vigilant attention, consistent with the participants' accounts. The GT is further supported by previous studies of vigilance decrement. Kahneman (1973) described vigilance decrement as the decline of an individual's stimuli detection performance over time. In some instances, vigilance decrement occurs rapidly, a finding consistent with this GT in which participants, particularly the HA users, described their ability to attend to an auditory signal as time-limited. The reports of heightened arousal and vigilance are also consistent with findings that adults with hearing loss have an increased autonomic nervous system stress response in noisy environments, as evidenced with skin conductance and heart rate variability measures. Focussing, the effort invested by individuals to decode speech at the level of the phoneme, is a finding compatible with theories of auditory speech perception as a primary account of bottom-up processing (McClelland & Elman 1986; Marslen-Wilson 1987; Luce & Pisoni 1998; Edwards 2007; Stenfelt & Rönnberg 2009). Finally, the findings adds to previous research that has established the need for individual's to recruit additional

cognitive processes to segregate target stimuli from background information (Shinn-Cunningham & Best 2008). Filtering, the mental effort associated with attending to and discriminating salient auditory stimuli, resonates with studies using pupilometry to measure listening effort in dynamic auditory environments (Koelewijn et al. 2015).

Participants' experiences of processing suggested they associated listening effort with a reduced ability to remember and recall auditory information and a reduced ability to participate in conversations, particularly in challenging listening conditions. The findings share similarities with studies of listening effort and working memory (McCoy et al. 2005; Ng et al. 2013; Rönnberg et al. 2013). For example, McCoy et al. (2005) reported findings of increased listening effort and poorer word recall in mild hearing loss. Using a running memory span task, participants with hearing loss recalled significantly fewer words than a normal-hearing control group. Interpreted in the context of Kahenman's (1973) Capacity Model, the Ease of Language Understanding Model (Rönnberg 2003; Stenfelt & Rönnberg 2009; Rönnberg et al. 2013) and the FUEL (Pichora-Fuller et al. 2016), the GT lends support to the proposition that the allocation of additional attentional and cognitive resources to enable speech recognition has consequences for the downstream encoding processes needed for information storage and retrieval.

Participants described perceived listening effort as a difficulty with multi-tasking that they defined as listening and performing a second task simultaneously. Accounts of multi-tasking are consistent with published studies utilising dual task paradigms to measure listening effort. Similar to dual task paradigms where increased listening effort is assumed to be represented by a decrease in performance on a secondary, concurrent task (Gagné et al. 2017), the focus group participants reported more effortful listening when they were performing activities of daily living at the same time as listening, for example, having a conversation while driving.

Adapting to and compensating for the hearing loss as a form of mental effort associated with listening is consistent with previous qualitative studies describing the coping strategies utilised by individuals with a hearing loss to manage their listening (Hallberg & Carlsson 1991; Jaworski & Stephens 1998). The GT extends these findings by suggesting adults with severe-profound SNHL consider their use of strategies and communication tactics to be a form of listening effort. Deployment of compensatory strategies was suggested to be greater before implantation. Before implantation, the degraded auditory signal rendered the listening effort dimensions of attending and processing largely irrelevant. Participants' effort expenditure focussed on compensating for the lack of auditory input, a finding supported by Kahneman (1973, p. 10) who stated, "sometimes there are signals so faint that no amount of attention can make them plain".

The qualitative findings presented in this study contribute a description of listening effort before and after cochlear implantation as experienced by the studied sample. Importantly, the results of this study also clearly highlight the complexity of the psychosocial difficulties that exist with hearing loss despite the fitting of devices. The themes and processes that emerged in this study will underpin the conceptual framework that will inform item generation and the measurement model for a new PROM designed specifically to measure listening effort in daily life. The GT contributes to the new instrument's content validity by providing insights into listening effort collected directly from the target population.

PROMs are used widely (Devlin & Appleby 2010) to measure both individual symptoms and general well-being. The use of self-assessment measures is already well-established in the audiology and it is possible foresee several potential applications for a PROM of listening effort. A PROM has the potential to inform candidate counselling or be utilised to assess the efficacy of postimplantation rehabilitation (e.g., auditory training,

psychosocial interventions) for ameliorating the burden of high listening effort. It could be utilized to support patient counselling and, importantly, to inform decisions relating to CI candidacy. Speech recognition tests (e.g., Boothroyd, 1968; Bench et al. 1979) are established CI candidacy measures (NICE 2009). However, previous research suggests performance (i.e., percentage correct score) on speech perception tasks is weakly correlated with listening effort (see Ohlenforst & Zekveld 2017 for a review). Moreover, candidates often describe the speech perception measures used in the clinic as unrepresentative of their real world listening experiences. A PROM of listening effort referenced to the unique communication situations a potential CI recipient experiences in daily life could supplement the speech perception tasks used currently to evaluate CI candidacy. A PROM of listening effort could also be utilized as an outcome measure to document CI benefit.

The study has several limitations that deserve discussion. First, the data were potentially subject to recall bias as the CI recipients were asked to contrast their experiences of listening effort before and after cochlear implantation. It is possible that some focus group members over-reported their listening effort before implantation and under-reported their requirement for listening effort after implantation. Significant others were under-represented in the focus groups therefore accounts of listening effort from the perspective of loved ones are limited. Also, the GT was developed through co-construction, a process of negotiation between the participants and the lead researcher to establish the GT's concepts and explanatory relationships. Co-construction renders the data unique to the study population; therefore, these findings are limited and may not be applicable in other populations or different researchers may interpret the data differently. A postal questionnaire developed from the study findings is planned as a future study with the aim of verifying the grounded theory in a larger population of CI recipients. Finally, per principles of qualitative inquiry, this study is not intended to provide objective truths but offers an interpretation of the

listening effort construct from which propositions to inform future investigations may be derived. Future work to establish the constructivist GT's applicability in different sub-groups of the population of adults with hearing loss (e.g., mild-moderate hearing loss) and to situate it in the context of the FUEL is recommended.

In summary, PROMs developed with limited input from the target population risk failing to include those aspects of the construct of interest that are important to these individuals, bringing into question the content validity of these instruments. With the aim of establishing the content validity for a new PROM of listening effort, this qualitative study contributes to the field a wider conceptualisation of listening effort. The findings suggest that individuals with hearing loss have rich insights and the ability to reflect on and describe in-depth both the qualities of listening effort and its wider significance, both for the listening situations of everyday life and what it means to live with severe-profound SNHL. The study identifies as important the contribution of social connectedness as a motivator of listening effort and the role of effort-reward balance as a determiner of effort investment.

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REFERENCE NOTE

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