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Review

A Systematic Review of Interventions to Reduce the Effects of Cognitive Biases in the Decision-Making of Audiologists

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Abstract

Background: Audiologists are constantly making decisions that are key to optimizing client/patient outcomes, and these decisions may be vulnerable to cognitive biases.

Purpose: The purpose was to determine the present state of knowledge within the field of audiology regarding the potential impact of cognitive biases on clinical decision-making and the use of interventions to reduce such impact.

Research Design: A systematic review was conducted to identify and consider the outcomes of all studies in which an intervention, strategy, or procedure was implemented with the aim of reducing the impact of cognitive biases on the decision-making of audiologists.

Data Collection: The review was part of a larger scale search which included the broader disciplines of health science and medicine. Electronic database searches were supplemented by citation searches of relevant reviews and a gray literature search. Following title and abstract screening, 201 full-text studies were considered for inclusion.

Results: No studies were found which fulfilled the eligibility criteria.

Conclusions: Despite initial calls to respond to these types of cognitive biases being made three decades ago, no peer-reviewed scientific studies testing strategies to reduce the impact of cognitive biases on the decision-making of audiologists were found. There is a clear need for a more concerted research effort in this area if audiologists are to consistently deliver truly evidence-based care.

Key Words: audiology, audiologists, clinical decision-making, cognitive bias

Abbreviation: GP = general practitioners

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INTRODUCTION

Although individuals may strive to make rational, consistent, and informed decisions, decision-making can be influenced by a range of cognitive errors, also known as biases (Tversky and Kahneman, 1974). For example, the "anchoring bias" refers to the tendency to rely on a particular (often first obtained) piece of information when making a decision (Richards and Wierzbicki, 1990), whereas "confirmation bias" refers to the tendency to view the available evidence as being more supportive of a preconceived belief than it is in reality (Oswald and Grosjean, 2004). To ease the cognitive burden associated with processing the wealth of information relevant to any one of many required decisions, heuristic techniques are frequently used (Tversky and Kahneman, 1974; Gigerenzer and Gaissmaier, 2011). Heuristics are simple and efficient cognitive rules that, when applied to decisions, result in fewer cues being processed, reduced effort in retrieving cue values, and simplified cue weighting so that the decision maker may integrate less information and examine fewer decision alternatives (Shah and Oppenheimer, 2008). Although heuristics facilitate faster decision-making and reduce cognitive load, they can also result in suboptimal outcomes which may themselves be influenced by cognitive biases. For example, the availability heuristic makes use of information which comes most readily to mind when making a judgment (Tversky and Kahneman, 1973; Schwarz and Vaughn, 2002), and this can produce an availability bias, whereby more easily retrieved information is used instead of potentially more accurate information that is difficult to retrieve.

The quality, and sometimes the speed, of decision-making by health care practitioners is crucial to maximizing client/patient outcomes. Audiologists provide assessment, diagnostic, treatment, and rehabilitative services to people with dysfunctions of the auditory and vestibular systems. In a comprehensive discussion of clinical decision-making in audiology, Doyle and Thomas (1988) listed 28 possible decisions in five categories, viz: diagnostic, rehabilitative, interpersonal/communication, referral, and managerial. Most audiologists surveyed reported that they made diagnostic (69%) or rehabilitative (59%) decisions "several times daily" (Doyle, 1989). The most frequent decisions were which audiologic tests to select (diagnostic) and whether a hearing aid was required (rehabilitative). Over half of the audiologists reported some degree of difficulty in making these decisions, although at least 80% were "completely" or "almost completely" confident with them.

The audiology field has changed since the late 1980s, with significant increases in diagnostic testing and rehabilitation options, an increasing focus on evidence-based practice (Moodie et al, 2011) and patient-centered care (Meyer et al, 2017), and a consequent increase in the number and complexity of the decisions that audiologists make. In a 2017 survey, audiologists reported a wide range of information sources were used for such decision-making (Boisvert et al, 2017), with audiometric results, clinical experience, client/patient opinion, and practice guidelines being most important, followed by the peer-reviewed literature, and the opinions of colleagues and experts. Compared with the 1989 study (Doyle, 1989), more respondents reported some degree of difficulty (90% versus 58–65%) and fewer were "completely/almost completely" confident in their decision-making (<60% versus >80%), although this may be because Boisvert et al proposed decision scenarios with no clear solution.

In summary, there is evidence that audiologists use an array of information sources to make a range of complex decisions many times each day (Doyle and Thomas, 1988; Doyle, 1989; Boisvert et al, 2017). Furthermore, audiologists frequently find their decisions difficult to make and are sometimes not confident of their decisions (Doyle, 1989; Boisvert et al, 2017). Despite this, there are few studies that have examined the robustness of audiologists' decisions or the factors that may influence those decisions. Two studies have suggested that some types of audiological decisions may be influenced by confirmation bias. Observers (not identified by profession) scoring the responses to sound of children with multiple disabilities appeared to be influenced by their knowledge of the stimulus level (Gans and Flexer, 1982). For low-level stimuli, observers with knowledge of the stimulus level scored fewer responses than those with no knowledge, whereas the reverse occurred for high-level stimuli. In another study, audiologists provided significantly lower ratings of speech intelligibility when the speaker's hearing was described as profoundly impaired versus mild-to-moderately impaired or not described (Doyle, 1987). In both studies, the observer/audiologist appeared to have developed a preconceived belief based on the available information, and the decisions leading to their subjective judgments confirmed these beliefs. Doyle specifically referred to the potential impact of the cognitive bias of selective perception, suggesting that this bias "operates to achieve consistency between present perceptions and the existing schema of expectations" (pg. 5), with the outcome then being that the audiologists saw what they expected to see.

More recent work demonstrating variation across audiologists in decision-making during hearing aid fitting also raises questions about the influence of cognitive biases in this key area of rehabilitation. Audiologists were shown to be reliable in deciding when hearing aids were required but varied substantially in the weightings given to different pieces of information in making that decision (Doyle and Thomas, 1995). The authors did not attempt to identify any influential factors, but it is reasonable to speculate that cognitive biases may have influenced the weightings given by individual audiologists. In another study, 93% of audiologists surveyed reported having a preferred hearing aid brand which they dispensed at least 70% of the time (Johnson et al, 2009). Seven distinct factors most influential in the brand preference decision included brand aptitude (which included reliability, quality, fit, and comfort), image, and sales/delivery support. For the six most important factors, the mean importance did not differ across preferred brands, or across audiologists categorized by factors such as gender or type of clinical setting. Despite their decision being influenced by the same set of distinct factors, which were assigned a similar level of relative importance, the outcome varied for individual audiologists, with 20 different brands being identified as preferred. The authors did not discuss the impact of cognitive biases on the brand preference decision; however, it is reasonable to speculate that they may have influenced the audiologists' interpretation and application of brand information, potentially alongside clinical experience, training, colleague recommendations, brand exposure, and employer policy. Johnson and colleagues also reported substantially different dispensing rates across audiologists for four hearing aid features: digital feedback suppression processing (mean rate = 88%, standard deviation = 17.5%), digital noise reduction processing (87%, 16.4%), directional processing (84%, 20.9%), and telecoil (64%, 29.1%) (Johnson and Ricketts, 2010). Furthermore, dispensing rates were not consistent with evidence-based practice guidelines (Valente et al, 2006). The most important variable influencing dispensing rates was the price/level of the hearing aid technology, with larger and/or more expensive aids more likely to have more features. The next most important variables were the characteristics of the audiologist. First, the "audiologist-specific feature candidacy criterion," (i.e., their own criterion of the level of client/patient) needs to be exhibited before the feature was dispensed. Second, the audiologist's personal effectiveness belief; audiologists with less belief in the effectiveness of a feature dispensed it less often. The actual patient population had very little impact on dispensing rates. The overall analysis, with dispensing rates for all features combined, indicated that more features were dispensed by female versus male audiologists, and more were dispensed to younger versus older clients/patients. Again, this study did not explicitly consider the impact of cognitive biases; however, given that the study showed that some audiological decisions were influenced by personal criteria, beliefs, and gender, it is probable that cognitive biases played a role.

Although audiological studies have given little consideration to the impact of cognitive biases on clinical decision-making, there is broader evidence of their impact, particularly in the medical field. Saposnik et al (2016) conducted a systematic review with one objective being to evaluate the influence of cognitive biases on diagnostic accuracy and medical errors in management or treatment. In the seven studies identified as measuring diagnostic accuracy, the presence of cognitive biases was associated with diagnostic inaccuracies in 36.5–77% of case scenarios. For example, information biases, anchoring effects, and representativeness bias were associated with diagnostic errors in 51% of skin biopsy case scenarios (Crowley et al, 2013). Of the seven studies identified as measuring therapeutic or management errors, five studies reported an association between cognitive biases and therapeutic or management errors. For example, when provided with written case scenarios, family practitioners referring a patient with painful hip osteoarthritis were more likely to also prescribe a medication if there was only one medication option; if two options were provided, they were more likely to refer without prescribing (Redelmeier and Shafir, 1995). The same apparent effect when multiple options were provided was also shown by neurologists and neurosurgeons deciding which patient to prioritize for carotid artery surgery.

Given the potential impact of cognitive biases on diagnostic accuracy and on therapeutic and management decisions, mitigating the negative effects of these biases could play a significant role in improving outcomes for health service consumers. An increase over time in the number of studies evaluating strategies to mitigate cognitive biases suggests that there is growing recognition of the need for mitigation (Ludolph and Schulz, 2017), although this increase must be considered in the light of an overall increase in research output over time. Approaches to reducing the impact of cognitive biases (debiasing) have been proposed (Trowbridge et al, 2013), and the effectiveness of particular interventions (such as education, visual aids, checklists, guided reflection, and cognitive forcing strategies) has been evaluated. A systematic review of the debiasing research in a medical context (including health promotion and disease prevention as well as clinical settings) found that 60 of the 87 interventions assessed were completely or partially successful (Ludolph and Schulz, 2017). An example of an effective intervention was a decision support system for general practitioners (GPs) (Kostopoulou et al, 2017). In predetermined clinical scenarios involving an actor as the patient, the computer software generated a list of potential diagnoses in response to the reason for the consultation. This list was continuously modified by the system in real time in response to the GP entering information reported by the "patient" during the consultation. The use of the system resulted in an increase in diagnostic accuracy and appropriate management. In addition, the dynamic nature of the system resulted in more information being recorded in the "patient's" file during the consultation rather than after the consultation, when memory and the final diagnosis may influence the information recorded by the GP.

Although promising, this 2017 study involved a prototype system which only supported decision-making when the reason for consulting the GP was chest pain, abdominal pain, or shortness of breath. Moreover, it is noteworthy that only a minority of studies identified in the systematic review of Ludolph and Schulz (13 of 87) targeted medical personnel rather than patients and that most of these (10 of 13) included a majority of participants who were students. Thus, there is insufficient evidence to draw any general conclusions regarding the most effective intervention for medical personnel specifically.

As health care practitioners, it is highly likely that audiologists' decision-making is also vulnerable to cognitive biases. Such biases may lead to errors in the evaluation of performance and in diagnosis, leading to clinical management which is inappropriate or not optimal for the needs of the client/patient; in a minority of cases, such errors may have a significant negative and unnecessary impact on the health and communication abilities of the client/patient. Cognitive biases may also impact on rehabilitation options recommended to a client/patient and on the evaluation of hearing device or treatment benefit. Hearing device–related decisions are particularly fraught because they often involve a financial outlay for the client/patient and, in many cases, a financial benefit for the audiologist or their employer. As such, the implementation of effective interventions to reduce the impact on clinical reasoning is crucial to optimizing the accuracy of diagnostic decisions and to the provision of rehabilitation that is patient centered and maximally effective. To date, there has been no systematic review of evidence that investigates interventions that support optimal decision-making by reducing cognitive bias within the field of audiology. The objective of this study was to identify and appraise the quality and outcomes of all studies in which an intervention, strategy, or procedure was implemented with the aim of reducing the impact of cognitive biases on the decision-making of audiologists in clinical practice.

METHODS

Search Strategy

This review was undertaken as part of a larger scale search strategy designed to include all possible studies testing interventions aimed at countering the impact of cognitive biases in each or any of the professions of audiology, speech pathology, optometry, physiotherapy, nursing, social work, or medicine. The review was conducted in October 2017 according to a predetermined protocol. Studies specific to audiology were identified at the final full-text-screen stage. Keywords relating to "decision-making," "health care," "cognitive bias/error," and "debiasing" were used to search the following databases: (1) Ovid MEDLINE(R), Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily, and Ovid OLDMEDLINE(R) (1946-present); (2) Ovid EMBASE Classic + EMBASE (1947-present); (3) Cumulative Index to Nursing and Allied Health Literature (CINAHL) via EBSCO (1980-present); (4) PsycINFO; (5) EmCare; (6) Evidence-based Medicine Reviews; (7) Social Services Abstracts (ProQuest); and (8) Scopus. Text word searches were mapped verbatim into each database with adjustments for the database-specific syntax (refer to Appendix). An English language criterion was included as translation services were not accessible. A gray literature search was undertaken using (1) OpenGrey and (2) ProQuest Dissertations and Theses. The reference lists of relevant systematic reviews were hand searched for additional primary studies.

Data Management and Software

Titles and abstracts obtained through the aforementioned searches were entered into the EndNote 6 reference management software (Clarivate Analytics, 2017) and duplicates were removed. Studies were then moved to the Covidence systematic review data management software (Covidence, 2017) for record management, study screening, and identification of disagreements.

Selection of Studies

The authors received training to ensure a shared understanding of the purpose of the review and the inclusion criteria before title/abstract and full-text screenings (Table 1). Titles and abstracts were independently screened by at least two authors. A third reviewer resolved disagreements. A full-text review was undertaken when the title or abstract was unclear or missing. Full texts were independently screened by two authors. Disagreements were discussed and resolved by a third reviewer. Figure 1 outlines the study selection process consistent with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (Liberati et al, 2009).

Inclusion Criteria

Studies

Studies were eligible if their design included the implementation of an intervention aimed at reducing the impact of specific cognitive bias/es or error/s within an audiological practice setting. As specified in Table 1, studies using only broad terms (e.g., errors in clinical reasoning) were excluded. In these more general studies, it would be difficult to determine which aspect of the decision-making process was being impacted if an intervention were implemented. Therefore, the search was limited to studies

Table 1. Study Inclusion Criteria Applied at the Title/Abstract Screen

	Inclusion Criteria
Studies	• Cognitive bias/es or error/s were specified/named, or the terms "cognitive bias/es" or "cognitive error/s" were used. • Excluded studies that used only more general terms such as "diagnostic error/s" or "error/s in clinical reasoning."
Participants	• Health care professionals, either fully trained or students in training.
Settings	• Any setting where health care services can be administered or taught by a provider (i.e., hospitals, schools, universities, homes, residential facilities, etc.). • Any hypothetical or simulated scenarios, vignettes, or surveys that directly relate to professional decision-making within a health care context.
Interventions	• Any intervention/s where the primary or secondary aim was to mitigate the effect of specified cognitive bias/es or cognitive error/s in the decision-making process.
Outcome measures	• Reported decision outcomes resulting from the implementation of the strategy, procedure, or intervention. • Reported outcomes relating to the reduction of cognitive bias/es or error/s as a result of the implementation of the strategy, procedure, or intervention.

Note: Studies that were not directly related to audiology, and those that did not meet the study design criteria (see types of study designs in "Studies"), were excluded at the full text screen.

targeting a specific defined cognitive bias/es. Study designs included, but were not limited to, qualitative designs, randomized controlled trials, non-randomized controlled trials, interrupted time series and repeated measures, and controlled before–after studies.

Participants

Participants included audiology students or trained audiologists. Studies in which the primary participants were medical clinicians, other allied health professionals, or complementary medicine providers were not included. Studies that focussed on client/patient/consumer decision-making or explored decision-making within other professions were not included; however, when the decision under examination was made in-situ, it would necessarily involve a client/patient/consumer and/or their family alongside the audiologist.

Settings

Settings included hospitals, clinics, community centers, schools, private homes, universities, and any other settings where audiological services could be administered or taught by a provider. Studies that used hypothetical or simulated scenarios, vignettes, or surveys were also included, provided that there was a direct relationship to a decision being made within a health care context by audiologists.

Interventions

A broad definition of "intervention" was used to capture all interventions, strategies, or procedures specifically designed to limit the impact of any cognitive bias or thinking error and tested to determine whether decision-making was improved. These included the following:

- Decision aids
- Targeted education or training
- Content and instructional strategies
- Affective debiasing interventions
- Group decision strategies
- Cognitive forcing strategies
- Administrative tools such as checklists and diagnostic rules
- Error recovery approaches
- Metacognition or mindfulness

Outcome Measures

The review process was designed to identify studies with outcome variables that measured change in a particular type of decision made by an audiologist following implementation of an intervention designed to reduce the impact of cognitive bias/es. The focus was on outcomes that would detect a change in proximal decision outcomes which would represent a reduction in the impact of any specified cognitive bias/es. For example, altering the order or type of information presented in a decision aid (the intervention) may alter a professional's decision to opt for one treatment over another (proximal decision outcome). In this example, the choice of one treatment over the other would reflect a successful reduction of cognitive bias/es, such as an order effect or framing effect.

RESULTS

As an outcome of the larger scale search strategy 201, full-text articles were assessed for eligibility (Figure 1). For the purpose of this audiology-specific review, all studies were excluded for one or more of the following reasons: not an actual study, did not include an intervention, did not specify a cognitive bias, no full text available, or did not involve audiology/audiologists.

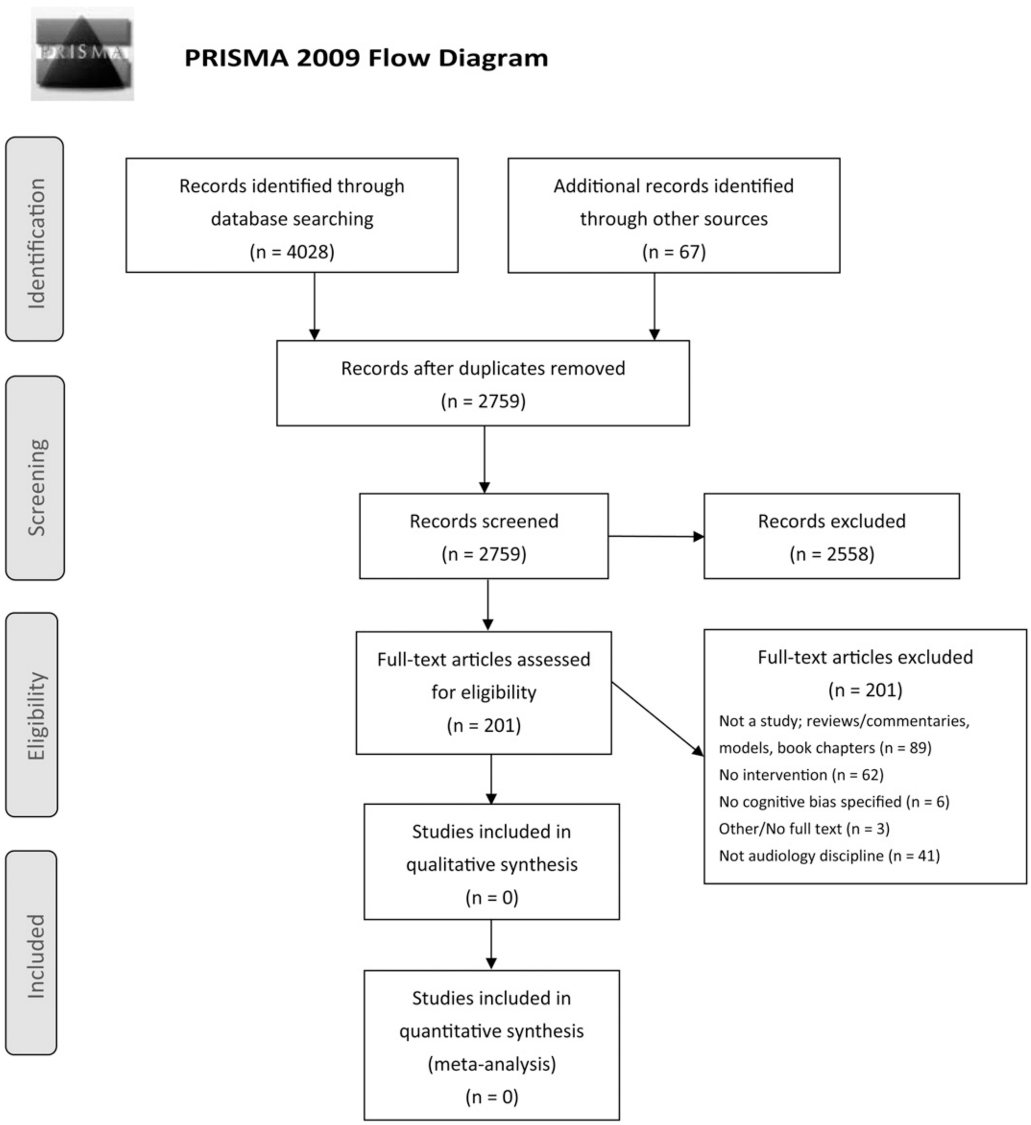

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart of study acquisition.

Thus, no studies were identified which evaluated an intervention, strategy, or procedure implemented with the aim of reducing the impact of cognitive biases on the decision-making of audiologists. Of the 201 full-text articles excluded, the largest group was excluded at the first stage of "not a study." The book chapters that were excluded did not report any studies fulfilling the inclusion criteria and only provided general discussion or a review of the role of cognitive biases in decision-making. The only article with any audiological content was an overview of problem-solving as "approached theoretically and empirically by psychologists" (pg. 14), with a few examples illustrating the relevance to problem-solving in rehabilitative audiology (Demorest, 1986). It was often the case that a single article excluded for a broader reason would, if not excluded for this reason, ultimately have been excluded for a more specific reason. The final, and most specific, reason for exclusion was that the study did not involve audiology/audiologists. For example, the six studies specified in Figure 1 as being excluded because of "no cognitive bias specified" were all from the fields of nursing and medicine and, thus, would not have been included in this audiology-specific review even if a cognitive bias had been specified.

DISCUSSION

This systematic review did not identify any studies that evaluated the implementation of an intervention, strategy, or procedure designed to reduce the impact of cognitive biases on the decision-making of audiologists. The studies reviewed in the "Introduction" section indicate that, as with other health care professionals, audiologists are likely to be subject to cognitive biases which may result in inaccurate or incorrect diagnosis, and/or suboptimal client/patient management. There is a strong need for research in the field of audiology to evaluate existing or new interventions designed to reduce the impact of cognitive biases. As indicated in the "Introduction" section, there has been discussion in the field since the late 1980s emphasizing the importance of diagnostic, rehabilitative, and other decision-making by audiologists. Although a few studies are reported in the literature, the breadth and depth of research examining the types of decisions being made by audiologists, and the factors that influence those decisions, is manifestly inadequate, given the importance of the topic.

There has been a significant amount of research promoting and examining evidence-based practice (Moodie et al, 2011) and client/patient-centered care in audiology (Meyer et al, 2017). The model of evidence-based practice promotes the use of scientific evidence in clinical decision-making by audiologists. The model of client/patient-centered care promotes shared decision-making. Research into evidence-based practice and client/patient-centered care has obviously considered decision-making in audiology; however, the focus has been on the translation of evidence into clinical practice and on how decisions are (or should be) shared. There are many broader questions regarding the different types of decisions audiologists need to make (including those not shared with the client/patient), all of the potential sources of information (not just scientific evidence) and how they are used in decision-making, and all of the factors which may influence (negatively or positively) the decisions being made. Research examining these questions will result in a better understanding of decision-making in modern audiological practice, thereby providing a knowledge base for the evaluation of audiology-specific interventions to reduce the impact of cognitive biases on decision-making.

A challenge for intervention design is the large number of potential cognitive biases relevant to the provision of health care (Saposnik et al, 2016), certain of which are likely to be more influential depending on the particular client/patient group receiving care (Snowden, 2003; van Ryn et al, 2011). It has been theorized that the impact of cognitive biases will vary by clinical setting, with a greater impact in settings in which the cognitive load for clinicians is higher (Burgess, 2010), and by the affective state of the clinician (Phua and Tan, 2013). In addition, it may be the case that the presence of a cognitive bias does not mean that a decision will be incorrect or, even if it is incorrect, that the error is the result of that bias (Norman, 2014). Thus, it is challenging both to design and to evaluate interventions to reduce cognitive biases. Nevertheless, such work is vital if audiological care is to be truly evidence based, patient centered, and consistent.

Limitations of this review include the application of relatively stringent criteria regarding the definition of cognitive bias or error, and the possibilities that some relevant literature was not identified either because the specific terminology of "cognitive bias" was not used in the research article or because it was not published in English. Although the search strategy implemented included other areas of health care, this had no negative impact on the identification of audiology-related studies and actually facilitated the possible identification of allied health studies which included audiologists.

This review has identified that there is currently no published research on the topic of reducing the impact of cognitive biases on the decision-making of audiologists. It is, however, clear that audiologists are constantly making diagnostic, rehabilitative, and other decisions that are key to optimizing outcomes for clients/patients. Along with other health care practitioners, audiologists are inevitably vulnerable to cognitive biases in this decision-making. Audiological research has demonstrated the impact of some specific biases and has identified issues with audiologists' decision-making which are likely to be related to the impact of cognitive biases. This empty review provides unequivocal evidence of the need for a more concerted research effort aimed at developing and evaluating interventions to reduce the impact of cognitive biases on audiologists' decision-making. An important decision frequently made by audiologists is whether an individual may benefit from a hearing aid (Doyle, 1989), yet there is evidence that hearing aid brand decisions and hearing aid feature fitting decisions are neither entirely evidence based nor always made according to clinical guidelines (Johnson et al, 2009; Johnson and Ricketts, 2010). Thus, hearing aid fitting could be a worthwhile first target for research investigating the impact of cognitive biases on decision-making by audiologists and how such impact may be reduced through the application of appropriate interventions.

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APPENDIX

Example search strategy (Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present).

Searches Results

1. exp Decision Making/ 177889
2. decision*.ti,ab. 307547
3. diagnosis.ti,ab. 1342579
4. diagnostic.ti,ab. 621219
5. clinical assessment.ti,ab. 21752
6. goal setting.ti,ab. 3005
7. care planning.ti,ab. 4856
8. goal planning.ti,ab. 80
9. consumer*.ti,ab. 58669
10. treatment.ti,ab. 3804036
11. or/1-10 5452702
12. exp Health Personnel/ 460537
13. social work*.ti,ab. 13245
14. nurs*.ti,ab. 412489
15. 15 midwi*.ti,ab. 21513
16. physiotherap*.ti,ab. 21336
17. physical therap*.ti,ab. 18744
18. speech therap*.ti,ab. 2841
19. communicat*.ti,ab. 244836
20. stutter*.ti,ab. 4157
21. language.ti,ab. 121124
22. audiolog*.ti,ab. 8977
23. audiometr*.ti,ab. 13074
24. hearing care.ti,ab. 51
25. medicine.ti,ab. 380537
26. medical.ti,ab. 1000328
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