APPLICATION OF THE EXPECTANCY-DISCONFIRMATION MODEL IN THE PREDICTION OF HEARING AID USER SATISFACTION

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The relationship between expectations and satisfaction, across a variety of products and services, has been documented in consumer and health care literature. The expectancy-disconfirmation model of satisfaction has grown out of this work. This model proposes that the size of difference between a consumer's expectation and perception of a product or experience (disconfirmation) is predictive of the resulting satisfaction. This model has been empirically tested and shown to predict satisfaction in health care settings such as vision correction, hospital stays, and pharmacy purchases as well as in consumer services and purchases. Results from a study of the expectancy-disconfirmation model suggest that disconfirmation might be a strong predictor of satisfaction in Chinese first-time hearing aid users.

This topic is relevant to hearing health care and health care in general, at the conceptual and the clinical level. Patient satisfaction leads to increased patient compliance with the procedures or interventions offered, leading to better treatment outcomes. Patient satisfaction has an important influence on utilization patterns and on patients' responses to the care given. Many treatment outcomes, particularly those associated with hearing aid use, are dependent on a high level of patient compliance. As clinicians seek to attain optimal treatment outcomes, which should include improved quality of life; it is legitimate to pursue patient satisfaction as a prerequisite goal.

One component of this study was to develop a reliable hearing aid disconfirmation measurement instrument that could be used to investigate the relationship between

disconfirmation and satisfaction in first time purchasers of hearing instruments in the United States. Further research questions addressed more specific aspects of that relationship. Results indicated that disconfirmation is a strong predictor of satisfaction in first time hearing aid users. The perception of hearing aid performance and the disconfirmation contribute heavily to satisfaction, and seem to carry similar weighting. The use of self-report measures in hearing aid outcomes appears to be immune to the bias posed by socially desirable responding. This study provides the first empirical evidence that the expectancy-disconfirmation model of satisfaction can be applied to the study of satisfaction in first time hearing aid purchasers in the United States.

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PREFACE

I am grateful for the significant help and support I received from many of the faculty in the Communication Science and Disorders Department at the University of Pittsburgh, in particular Dr. Mick McNeil and Dr. Connie Tompkins. I have received invaluable input on this project from all of the PhD and AuD students who have passed through Dr. Catherine Palmer's lab since this project began. This dissertation would not have come to completion without both personal and statistical guidance from Dr. Elaine Rubinstein and Dr. John Miller. Undergraduate students Louis Billera and Katelin Archer provided essential assistance with data collection and coding, as did Jennifer Fruit of the University of Pittsburgh Medical Center.

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1.0 INTRODUCTION

The relationship between expectations and satisfaction, across a variety of products and services, has been documented in consumer and health care literature (Newsome & Wright, 1999; Oliver & DeSarbo, 1988; Spreng, MacKenzie, & Olshavsky, 1996; Thompson & Sunol, 1995; Zwick, Pieters, & Baumgartner, 1995). This topic addresses a research priority in audiology, specifically in the area of patient satisfaction with hearing aids. An international group of audiology researchers identified this priority when they convened for a workshop in 1999 (Cox & Alexander, 2000). Their purpose was to summarize the state of research addressing self-report outcome measures of audiologic rehabilitation. One goal of the workshop was to identify and rank research priorities in this area. Foremost among the resulting list of research priorities was the need to "explore the relationship between expectations and outcome, especially including satisfaction." The authors pointed out that pre-fitting expectations and post treatment outcome measures could have a significant impact on clinical treatment decisions. Since that time methods used to explain this relationship, and the data obtained, have not yielded a clear or consistent explanation of the expectation-satisfaction relationship (Cox & Alexander, 2000; Wong, 2004; Wong, Hickson, & McPherson, 2003).

The need to better explain satisfaction with hearing aid fitting goes beyond academic curiosity. This topic is relevant to hearing health care and health care in general, both at the conceptual and the clinical level. Healthcare providers have seen the role of the patient evolve to more closely resemble that of a consumer over the past thirty years (Batchelor, Owens, Read, & Bloor, 1994; Linder-Pelz, 1982b; Newsome & Wright, 1999; Sitzia & Wood, 1997; Susman, 1994). This may be due in part to increased direct-to-consumer marketing strategies on the part of hospitals, drug manufacturers, and physicians. Other authors have explained this phenomenon as a natural outgrowth of the cultural shift towards consumerism in all areas of service delivery (Sitzia & Wood, 1997).

Within the last two decades the internet has provided inquisitive patients with a plethora of information and misinformation by which expectations of outcome can be influenced. Patients receiving health related services expect to play an active role in the planning of diagnostic and treatment procedures. This attitude of consumerism applies across health care disciplines ranging from surgery to dentistry, pharmacy, rehabilitation services, and the dispensing of durable medical equipment. From a business prospective, health care providers are faced with the challenge of achieving satisfaction, or losing patients/consumers to other practitioners.

The goal of achieving patient satisfaction is not solely focused on creating an advantage in a competitive service environment. Patient satisfaction leads to increased patient compliance with the procedures or interventions offered, leading to better treatment outcomes (Francis, Korsch, & Morris, 1969; Garrity, 1981). Significantly,

patient satisfaction has an important influence on utilization patterns (Strattmann, 1975) and on patients' responses to the care given (Hill, 1977). Sherbourne et al.(1991) showed, in a longitudinal study, that patient satisfaction with certain attributes of care was positively associated with adherence to medical recommendations for cardiac patients. Many treatment outcomes, particularly those associated with hearing aid use, are dependent on a high level of patient compliance. Thus, as clinicians seek to attain optimal treatment outcomes, which should include improved quality of life, it is legitimate to pursue patient satisfaction as a prerequisite goal (Stark & Hickson, 2004).

In 1974 it was estimated that 21% of older adult hearing aid candidates in the United States actually used hearing aids (Arnold & McKenzie, 1998). This number remained stable over the next two decades as evidenced by Kochkin's 1992 estimate that 20% of patients who could benefit from amplification actually sought to make a hearing aid purchase (Kochkin, 1993a; Kochkin, 1993b; Kochkin, 1993c). During the following decade the industry saw hearing aids evolve from simple analog instruments to fully digital circuits with a variety of high level options and features. Despite these dramatic technological improvements, Kochkin's estimate of market penetration did not change when data were collected again in 2005 (Kochkin, 2005a). One explanation for this consistently low market penetration is reflected in a study showing that negative attitudes towards hearing aids serve as a significant barrier to instrument purchase (Kochkin, 2007). These attitudes seem to be based largely on the reported experiences or beliefs of friends, co-workers, or family members; influences that play a role in the development of hearing aid expectations.

If satisfactory experiences with these devices could be increased, it should follow that more hard-of-hearing individuals would become successful hearing aid users. This is of particular importance in the elderly population, where the incidence of hearing loss is high and is associated with cognitive impairment and/or depression and reduction of functional status (Cacciatore et al., 1999; Lin, 2011). In this population, hearing loss is associated with reduced quality of life and higher levels of depressive symptoms. Hard of hearing individuals who become hearing aid users show less depression and improved quality of life compared to those who do not use hearing aids (Chisolm et al., 2007; Mulrow et al., 1990; Stark & Hickson, 2004). Improved satisfaction with hearing aids should generally increase the number of users, enabling more people to experience the improved quality of life associated with better communication.

In order to pursue the goal of increased satisfaction it is necessary to understand the construct of satisfaction and to review approaches used to study its components and predictors. Suggestions for maximizing satisfaction should be based on a widely accepted approach that has been documented in the literature across a variety of disciplines. The relationship of expectations and satisfaction has been studied in the consumer satisfaction literature and in patient satisfaction literature via the expectancy-disconfirmation model of satisfaction (Churchill & Surprenant, 1982; Ho, Mursch, Ong, & Perttula, 1997; Kumar et al., 2007; Newsome & Wright, 1999; Oliver, 1977; Pager, 2004; Sitzia & Wood, 1997). Research on this model often involves the use of patient report outcomes, particularly in the assessment of patient benefit and/or satisfaction (Alazri & Neal, 2003; Humes et al., 2002; Kumar et al., 2007; Pager, 2004; Vestergaard, 2006).

There are a variety of instructional materials used for audiology student training and continuing education in the area of hearing aid dispensing. These include textbooks, journals, and online articles. Within this literature, the management of realistic hearing aid expectations is touted as a primary factor in achieving patient satisfaction (McLauchlin, 1992; Sweetow, 1999a; Sweetow, 1999b; Weigand, Bodkin, Madell, Rosenfeld, & Press, 2002). Empirical evidence of this expectation/satisfaction relationship, as applied to hearing aid fitting, has been limited to date (Cox & Alexander, 2000; Gatehouse, 1994; Jerram & Purdy, 2001; Wong et al., 2003; Wong, Hickson, & McPherson, 2004).

This paper begins with a review of the development of consumer satisfaction models. A review of literature describing application of the expectancy-disconfirmation model of satisfaction across a variety of disciplines is presented Literature that has explored the components of hearing aid satisfaction also is summarized. The application of the expectancy-disconfirmation model in hearing aid fitting is open for exploration. The goal of this review is to provide a rationale for applying this approach to modeling satisfaction among hearing aid users.

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2.0 LITERATURE REVIEW

2.1 MODELING CONSUMER SATISFACTION

Models of consumer satisfaction were created and researched well before the construct of patient satisfaction was widely accepted. The theoretical underpinnings of consumer satisfaction were drawn from research in areas of social and applied psychology (Oliver, 1980). During the 1970's a number of authors culled theoretical constructs and empirical data from a variety of disciplines to arrive at a conceptual understanding of consumer satisfaction (Day, 1977; Locker & Dunt, 1978; Oliver, 1977; Olshavsky & Miller, 1972; Olson, 1979). Contributions came from fields that included marketing theory, psychology, social science research, and business management. Out of this consolidation of theoretical and empirical research the expectancy-disconfirmation paradigm became the dominant model used to explain satisfaction. In this paradigm the consumer satisfaction/dissatisfaction outcome is believed to result from a process of comparison. The consumer forms expectations of a given product or brand prior to the purchase. These expectations are internal predictions of the nature and level of performance the buyer will receive from the product. Once the product is purchased and used, the consumer compares the perceived performance with the initial expected performance.

Confirmation results when there is a close match between the expected and perceived actual performance. The term disconfirmation is used when there is a mismatch between the expected and perceived actual performance. A disconfirmation can be either positive or negative. A positive disconfirmation occurs when the perceived performance exceeds the expectation. A negative disconfirmation occurs when the perceived performance falls below the level of expectation. The response to the disconfirmation is an emotional reaction called satisfaction/dissatisfaction, depending on the direction of the mismatch (Woodruff, Cadotte, & Jenkins, 1983).

There are four constructs that are encompassed in the basic expectancy-disconfirmation paradigm. These are expectations, perceived performance, disconfirmation, and satisfaction. A variety of designs have validated the nature of the relationships between these constructs throughout the disconfirmation literature. In particular, many of these studies have focused on the resulting dissatisfaction occurring when expectations are disconfirmed (Churchill & Surprenant, 1982). Additionally, many of the studies reviewed in this paper relate to understanding the nature and measurement of the constructs themselves (Alford, 1998; Cadotte, Woodruff, & Jenkins, 1987; Churchill & Surprenant, 1982; Fishbein & Ajzen, 1975; LaVois, Nguyen, & Attkisson, 1981; Linder-Pelz, 1982; Locker & Dunt, 1978).

A number of investigations have demonstrated significant disconfirmation effects on satisfaction across a variety of products and services (Oliver, 1980). Following wide acceptance of the expectancy-disconfirmation paradigm, several studies attempting to better explain and theorize the components and nature of pre-purchase expectations arose

in the consumer satisfaction literature (Oliver, 1980; Spreng & Olshavsky, 1993; Tse & Wilton, 1988; Woodruff et al., 1983). Oliver (1980) conducted a study demonstrating that attitude played a key role in the formation of expectation and satisfaction. Oliver's approach was derived from the Attitude Theory literature as the Expectancy- Value theory (Fishbein & Ajzen, 1975). According to Expectancy-Value models, beliefs and associated evaluations are the determinants of an attitude. Thus, patient satisfaction can be considered an attitude, composed of belief strength and attribute evaluations. Attributes refer to the dimensions or features of a product's performance (e.g., cost; reliability; convenience, etc.). Fishbein and Ajzen (1975) created a mathematical equation to model the relationship described above where B = belief strength and E= measures of evaluation. The formula for this model is:

$$\text{Attitude} = \sum B_1 E_1$$

This model was tested by Ware et al. (1978) and the *BE* measures were found to correlate significantly with direct measures of satisfaction. Ware's work was consistent with the Expectancy-Value model put forth by Fishbein and Ajzen, further giving rise to the accepted importance of expectancy-disconfirmation as a determinant of satisfaction. Oliver (1980) applied this model to the empirical study of the antecedents and consequences of satisfaction. He studied participants in a flu vaccination program and concluded that satisfaction resulted from a combination of initial expectation/attitude and disconfirmation.

Woodruff et al. (1983) expanded on the expectancy-disconfirmation paradigm by adding in the components of prior product and brand experience and experience based performance norms. Each of these are derived from personal experience, word-of-mouth opinions, and/or marketing efforts of a product manufacturer. These authors hypothesized that brand attitudes and brand expectations combine to form the norm to which evaluation of the product is compared. Thus, experience (of brand and/or product) combines with other preconceived performance norms to influence the amount of confirmation/disconfirmation. A graphic representation of the relationship between post-use performance, norm of performance, and confirmation/disconfirmation is shown in Figure 1.

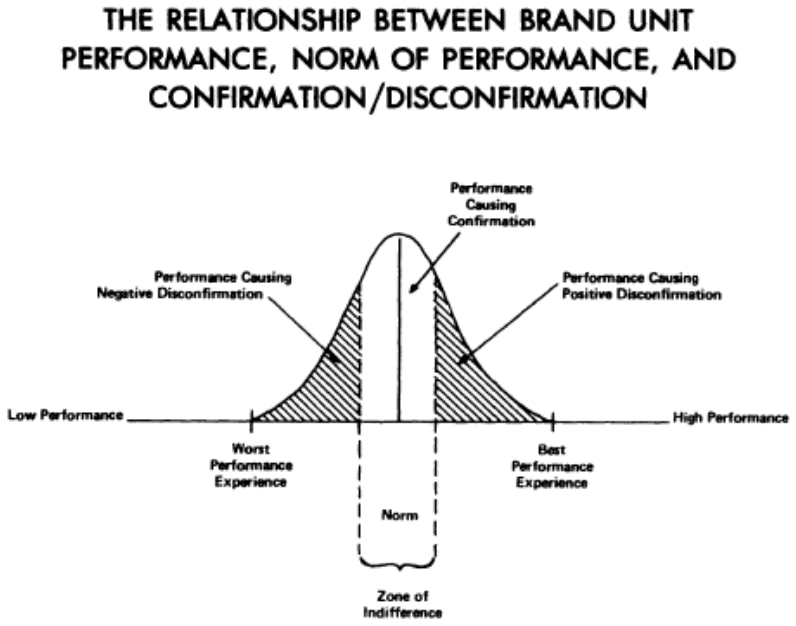

Figure 1. Woodruff's model of disconfirmation and the zone of indifference

Note that the area labeled *Norm* is a region or zone within which performance is perceived as essentially equivalent to the expectation. Woodruff et al. proposed that this area comprises a *zone of indifference*, where neither confirmation nor disconfirmation results (other authors have referred to this area as the *zone of tolerance).* In other words, perceived performance in this area does not evoke a conscious response enlisting attentional resources to the evaluation process. Responses outside of the zone of indifference are unusual or attention-arousing. In these conditions the satisfaction process evokes a positive or negative emotional response. Recall that the response of satisfaction is described as an emotion, thus only perceived performance falling outside of the zone of indifference results in confirmation/disconfirmation and thus satisfaction/dissatisfaction.

The Woodruff et al. article goes on to explore the outcomes of satisfaction/dissatisfaction in relation to consumer behavior, further arguing for the importance of understanding the satisfaction response. These authors state that for most consumer purchases, perceived performance falls within the zone of indifference. This means that most reactions to perceived performance may not evoke the emotional response necessary to constitute satisfaction or dissatisfaction. The authors reason that otherwise consumers would be "in a frequent state of excitement or frustration." Though this could well be the case with many hearing aid patients/consumers, the more typical satisfaction response is a continued desire to use the product. From a psychological standpoint, this response occurs because the match of perceived performance to pre-purchase expectations serves to reinforce the consumer's decision to engage with a product. The authors discussed the outcomes that arise when product performance is

unusually good or bad, that is, outside the zone of indifference. Some of these outcomes relate to the establishment or refinement of users' internalized norms or expectancy-disconfirmation for the product and or brand. These positive or negative satisfaction responses increase the likelihood that the consumer will react in some way. Reactions may include changing product/brand attitudes, intentions to use the product/brand again, giving word-of-mouth testimony or warnings to friends and family, complaining to the provider, or even taking legal action. This analysis of the behavior change resulting from the satisfaction response is useful in appreciating the importance of achieving satisfaction. It could be that the satisfaction a hearing aid provider seeks is best achieved by targeting the zone of indifference. Based on Woodruff et al., users in this category would be likely to have higher hours of use per day of their instruments. As we will see later, hours of use per day is associated with higher satisfaction in hearing aid users. On the other hand, would hearing aid dispensers be better off to understate expectations so that a larger positive disconfirmation could be achieved? This question has been addressed in the product marketing literature, as will be noted later in this paper (Spreng & Droge, 2001). Research regarding hearing aid satisfaction will need to take these issues into consideration.

Based on the above model, a number of questions and potential research hypotheses were suggested by these authors. This work set forth a modified theoretically based model and enough research questions to supply a career's worth of programmatic research on the expectancy-disconfirmation paradigm. Moreover, the authors focused on specific conceptual issues to be investigated in testing the model e.g., (1) Do experience-

based norms have a significant role in confirmation/disconfirmation responses? (2) Are there different types of norms and if so, what are they like? (3) Does a zone of indifference mediate between a cognitive and an emotional state? The authors believed that each of these general questions would lead to several research hypotheses which could then be applied in a variety of consumer experiences and products across service disciplines. Additionally, the authors described issues in operationalization of the constructs for each of the research questions. An important component of this work was a discussion of measurement challenges involved in the use of satisfaction/dissatisfaction scales and some suggested approaches to assessing the validity and characteristics of the zone of indifference. In essence, this foundational work laid out a very specific plan for further validation of the expectancy-disconfirmation model and tools that could be adopted for use in testing potential variations on the disconfirmation model.

In a later study (Cadotte et al., 1987) components of the above model were tested via a causal modeling method. Specifically, three variations of the expectancy-disconfirmation model were operationalized. Each one varied by the reference standard used for comparison of perceived performance to determine the disconfirmation. The first model used brand expectation as the comparison reference. The second model used best brand norm and the third used product norm. Each model was tested in relation to a variety of attributes of restaurant experiences in a large sample of typical restaurant consumers. Based on chi square values obtained in the analysis, the product norm model provided the best fit with the data, followed by the best brand norm model and then the brand expectation model. Of note, all of the disconfirmation models were supported by

the analysis, suggesting that the general expectancy-disconfirmation paradigm is a useful framework that might involve a variety of comparison processes. These authors used an array of restaurant experiences in this study. They found that in two of the three restaurant situations a different evaluation standard (product norm vs. best brand norm) better explained the data. These findings confirmed an earlier observation (Churchill & Surprenant, 1982) that comparison processes in satisfaction may vary across product and service categories or situations. For example, it could be that disconfirmation for fast food restaurants may involve a different reference standard than that for a leisurely family dining experience. Churchill and Surprenant (1982) had compared participants' satisfaction formation processes for video disc players versus chrysanthemum plants in order to reach their conclusion. This research expanded the view from the simple expectancy-disconfirmation paradigm to a more complex model whereby disconfirmation is tied to consumers' various standards of comparison depending on prior experience and on the product or service under evaluation. Later, (Cadotte et al., 1987) recognized this as a multidimensionality of standards used to compare brand performance.

Tse and Wilton (1988) expanded the disconfirmation model further when they examined, theoretically and empirically, the role of perceived perception in satisfaction formation. These authors argued that disconfirmation alone could not always adequately explain satisfaction. For example, if a consumer needed to use a product of inferior quality because the higher quality item was not available, s/he might perceive poorer performance without experiencing a disconfirmation. In addition to perceived performance as a direct determinant of satisfaction these authors noted that consumption

motivation could influence perceived performance. The research to validate these concepts involved a laboratory experiment in which expectations and product performance were manipulated. Subjects in this study role-played consumers trying out a new handheld record player for a trial period. Manipulation of expectations was achieved by supplying subjects with a one page description of the product, followed by elicitation of product performance/attribute expectations. Product performance manipulations were achieved by supplying subjects with either high or low performing players. Manipulation checks of the expectation and product performance treatments were included in the study. The results of this study supported the direct influence of perceived performance in satisfaction formation.

Zwick, Pieters, and Baumgartner (1995) contributed to the expectation literature by investigating the role of hindsight bias. Specifically, they questioned the role of hindsight bias in satisfaction formation and its impact on the pattern of relationships in the expectancy-disconfirmation model. Hindsight bias refers to the tendency for people to exaggerate in hindsight what could have been expected in foresight. Hindsight bias is said to occur when a consumer's experience with a product systematically distorts recall of foresight expectations in the direction of perceived product performance. Also known as the *I knew it all along effect*, hindsight bias is an important consideration in testing of the expectancy-disconfirmation model of satisfaction. Decisions regarding timing of the expectation measure should be made with this bias in mind.

In Zwick et al's study the authors manipulated expectations and product performance for a personalized envelope product. Foresight and hindsight expectations

were recorded and compared and the results showed that experience with the product did distort subjects' recall of their foresight expectations consistent with the hindsight bias phenomenon. Of note, in the subject groups where performance was manipulated in the positive direction, mean hindsight expectations were generally higher than foresight expectations. These authors argue that disconfirmation is mediated by hindsight versus foresight expectations for consumers in real world experiences. Their findings have significant implications for the design of research and instruments intended to test the effect of expectations on satisfaction. In many of the studies on disconfirmation researchers have based the disconfirmation construct on measurement of foresight expectations and perceived performance. This method has been referred to as direct versus subjective measurement of expectations (Yuksel, 2001). The use of foresight expectations, or measurement of direct disconfirmation, indicates that participants are asked to rate their expectations of a product or service's performance prior to exposure or use. For example, direct measurement occurs when a researcher asks a participant to rate his/her expectation of speech clarity in noise with a soon to be dispensed hearing aid. In a hindsight, or subjective disconfirmation approach the participant would first be fit with the hearing aid and asked to rate the aided speech clarity in noise. He or she would then be asked to rate how different the speech clarity in noise is from what was expected before the fitting. Direct measurement of expectation was generally thought to be the more valid strategy as it would avoid any memory bias inherent in asking subjects to recall pre-purchase expectations. Zwick et al.'s (1995) findings suggested that the use of subjective (hindsight expectations) disconfirmation would result in research findings that

were actually more valid and generalizable to marketplace circumstances. Intuitively, this makes sense in that direct disconfirmation is only captured in a research environment. In the real world, when consumers experience disconfirmation, it is always subjective in nature. In other words, disconfirmation in the marketplace does not occur until after experiencing a product or service. At that time, the recalling of initial expectations has already been contaminated with the hindsight bias. Though the foresight technique may be more objective, the hindsight approach may be more applicable to the real world.

Zwick et al.'s (1995) study is a valuable resource not only in examining foresight versus hindsight expectation measurement, but also in its in-depth management of expectation manipulation and the verification thereof. These authors indirectly manipulated expectations through a simulated advertising campaign. They then carefully analyzed the foresight expectation results to be sure that the manipulation successfully separated apart low and high expectation groups. This step is appropriate in any research design where expectation manipulation is used. As illustrated in a disconfirmation study to be described later (Kumar et al., 2007), the manipulation and verification process may be necessary in order to create enough variance in the disconfirmation to test for correlations.

The management of customer expectations was further reviewed and investigated (Spreng & Droge, 2001) in an attempt to better understand the impact of expectation management on customer satisfaction. Specifically, these authors questioned whether minimizing expectations of high performing products would result in a large positive disconfirmation and therefore, higher satisfaction. Secondly, the authors questioned

whether manipulations of expectations in the upward direction would result in higher satisfaction, regardless of actual product performance. This second goal could be described as looking for a direct relationship between expectations and satisfaction versus the direct relationship between disconfirmation and satisfaction. These first questions were based on earlier research (Boulding, Kalra, Staelin, & Zeithaml, 1993; Olshavsky & Miller, 1972; Yi, 1990) showing divergent results on the impact of expectation management, as mentioned earlier in this paper. The question addressed by this study was, simply stated: Do people see what they expect to see (Perceived Performance model) such that satisfaction is mediated directly by expectations, or is satisfaction mediated by the size and direction of disconfirmation (expectancy-disconfirmation model). This study focused specifically on information given directly to customers from a retail salesperson versus externally supplied information such as word-of-mouth reports or printed advertising. These authors created appropriate hypotheses to test each model in regard to products and services that might be offered in retail settings. In addition to the comparison of the Perceived Performance versus Expectancy/ Disconfirmation models, these authors probed the impact of managing expectations on satisfaction with information. This aspect of their investigation was based on Spreng et al's (1996) earlier proposal of the construct *satisfaction with product information.* With potential relevance to hearing aid use, this construct is based on the argument that a disconfirmation response to product performance comes not only from perceived product performance, but from perceived adequacy or inadequacy of the pre-purchase product information. This dissatisfaction with information provided can then influence overall satisfaction. This

argument differentiates satisfaction with product information from satisfaction with product attributes. The authors propose that the truth and accuracy of information may play an important role in determining overall satisfaction. The perception that the product information was untruthful in either a negative or positive direction may lead to information dissatisfaction.

Finally, these authors tested the determinants of satisfaction by measuring the individual impact of each of the above described three predictors (expectations; perceived performance; and information satisfaction) on overall satisfaction, in an attempt to empirically validate the above arguments. The experiments were conducted in a laboratory using a camcorder as the target product. Both expectation and performance for the camcorders were manipulated across three different attributes (ease of use, image quality, versatility). For example, expectations were manipulated by giving participants differing written descriptions of a camcorder device that each participant would operate for a short period. One group of participants was given information suggesting that the product would be easy to use but that the images would not be high quality. The other group was instructed that operation of the product was difficult but that the images would be very high quality. Expectations were then elicited on the target camcorder attributes, providing a manipulation check. Performance was manipulated by showing subjects either one of two different camcorders and giving a demonstration of the camcorder features. One of the camcorders was easy to use while the other was difficult to operate. Versatility and image quality were controlled as well. Subjects then used the camcorders and were asked to report on perceived attribute performance and satisfaction. There were

two levels of the expectation factor (high, low) and two levels of the performance factor (high, low). Measures of perceived performance served as performance manipulation checks in addition to providing data to test the hypotheses. These authors verified that appropriate disconfirmations (or confirmations) were created for each attribute by asking subjects to rate the level at which the attribute performance met initial expectations. After rating attribute performance, subjects were asked to rate their satisfaction with the product. This aspect of the study raises the question as to whether a perception of satisfaction can be validly elicited from a subject who is neither purchasing nor earning a product. These authors argued that, in this study, satisfaction could be elicited because participation in the experiment required a sacrifice of time resulting in a cash and product donation to the subjects' church. In addition to being asked about general satisfaction with the product, subjects were asked to rate their satisfaction with the product information.

Analysis of these results began with verification of the manipulation effect on expectations and performance. Appropriate differences were measured in the expectations and perceived performance ratings of each manipulation group. Other findings from this study have importance to research in this area. The first important result relates to the intentional lowering of expectation so that a larger positive disconfirmation is created. In this study, when attribute expectations were managed in a downward direction, satisfaction was not greater than when expectations were managed to match performance. Similarly, greater dissatisfaction was not observed when a larger negative disconfirmation was created, for two of the three attributes under study. These

findings suggest that consumers' perception of product quality is influenced by their satisfaction with the information supplied with the product. Participants were probably reacting to the falsity of the information provided when they expressed lower satisfaction in this part of the study. The authors noted that disconfirmation did positively predict satisfaction for each of the attributes. In regard to the question of a direct relationship between expectations and perceived performance, these authors found that perception of performance was higher when expectations had been raised, in two of the three product attributes. This was true even when actual performance was managed to be lower. Similarly, downward management of expectations resulted in lower perceived performance. These results support a direct link from manipulated expectations to perceived performance. Notably, as will be reported later in this paper, this finding of a direct link from expectations to perceived performance has been found in the hearing aid literature (Cox & Alexander, 2000; Wong et al., 2004). Finally, in evaluating satisfaction with information, these authors found that regardless of the direction of expectation or performance manipulation, satisfaction for information was greatest when the information accurately reflected future performance. These authors argue against manipulation of expectations in order to achieve greater satisfaction. Overall conclusions from this study mainly focus on the effect of information accuracy in the formation of satisfaction. Though disconfirmation did positively predict satisfaction in the study, the accuracy of product information is clearly an important factor in satisfaction. Additionally, these authors demonstrated the direct relationships between expectation and perceived performance.

One limitation of applying this study to satisfaction with hearing aids relates to the relative difficulty one encounters in accurately predicting perceived performance of a hearing aid versus service or performance of a consumer product. For example, a passenger airline might choose to follow the Expectancy-Disconfirmation model to increase customer satisfaction. As such, they might tell customers that the flight on which they are about to embark will be very bumpy when weather conditions are such that it should be very smooth. Alternatively, the airline might employ the Perceived Performance model and truthfully inform passengers that the flight will likely be bumpy when data indicate that will be the case. Translation of this manipulation of product/service attribute to hearing aid attributes is much more complex. Performance of the most meaningful hearing aid attributes cannot be as clearly predicted as expected weather during an airline flight. For example, it is difficult to predict with certainty how much a user will benefit when listening to speech in noise or receiving information on the telephone. Thus, expectation of hearing aid attributes may not be as easily managed or targeted, since attribute performance may be variable across users.

2.1.1 Cross Cultural Considerations

Studies of disconfirmation in products and service have been conducted in the United States and in a number of other countries. Are the results from one culture applicable to members of another cultural and or geographic area where distribution of products and services are different? One study examined cross cultural application of the expectancy-

disconfirmation model by matching samples of students in the United States and Taiwan (Spreng & Chiou, 2002). Specifically, these authors set out to demonstrate that the model was generalizable to the Asian population in Taiwan. The authors noted that societies in places like Taiwan, Hong Kong, South Korea, and other Asian countries demonstrated a collective versus an individualistic culture. A collectivist society has a more close-knit social structure and members have clear impressions of who is in the *in-group* and who is not. In individualistic societies, such as in the United States, Canada, Great Britain, and other western cultures, people are more motivated by self-interests. The authors were particularly interested to see if the collectivist culture in Taiwan vs. the individualistic culture in the United States might differentially influence satisfaction decision processes. This study was a laboratory experiment using digital cameras as the product of focus. The experiment was conducted in separate sites in the United States and in Taiwan. Both expectations and product performance were manipulated to ensure variance in the disconfirmation. Expectation was manipulated via varying versions of pre-use product information. Product performance was manipulated by showing subjects photographs purportedly produced by the camera under consideration. The photographs varied in quality across subjects. Subjects in both sites were asked to rate expectations after product information was shared. After viewing the photographs, subjects were asked to rate performance and then satisfaction for the attribute of quality of the picture. Analysis of these data confirmed the predictions of the model. Importantly, the results showing the relationships between model constructs was not significantly different between the US and Taiwanese groups. The authors proposed further research in this area; however, this

study supports the applicability of the expectancy-disconfirmation model across cultures. The finding would be of interest to hearing aid manufacturers and audiologists serving diverse cultures and locations. Of note, the issue of cross cultural applicability will be mentioned later in this paper in reference to patient satisfaction studies conducted in Israel, a Middle Eastern country with yet different cultural influences than those in the United States or Asia (Baron-Epel, Dushenat, & Friedman, 2001) and in Hong Kong (Wong et al., 2004). As will be evident in this paper, much of the literature on patient satisfaction has come from research conducted in countries where administration of health care is a governmental function. Studies showing that results are equivalent across cultures and health care delivery help to provide a solid rationale for application of the model to hearing aid fitting in the United States.

2.1.2 Summary

The studies reviewed so far are summarized in table 1. The methodologies and conclusions offer direction in the application of the model if/when it is used outside of the consumer context.

Table 1. Summary of reviewed expectancy-disconfirmation studies in consumer context

Study	Product/Service	Aims	Issues Addressed	Method	Conclusions
Oliver, 1980	Flu vaccination program participation	identify antecedents and consequences of satisfaction	belief strength, evaluation, attitude contribute to expectation	subjective measure of disconfirmation e.g., "better or worse than expected scale"	post usage ratings of satisfaction result from a combination of an expectations/attitude component and disconfirmation
Woodruff et al.(1983)	N/A- model only	proposed model of Satisfaction using Experience Based Norms	experience with product and/or brand, zone of indifference	N/A- model only	further research needed to: 1)determine role of experience based norms; 2) explore other types of norms; 3)role of zone of indifference in cognitive vs. emotional response
Cadotte et al. (1987)	restaurant experience	explore role of Experience Based Norms (i.e. Brand experience) on disconfirmation	brand expectations; best brand norm; product norm	causal modeling	Best Brand Norm and Product Norm standards are used by consumers to evaluate brand performance

Table 1 (continued)

Study	Product/Service	Aims	Issues Addressed	Method	Conclusions
Churchill & Surprenant (1982)	video disc player/ chrysanthemum plant	Is disconfirmation vs. expectations/performance necessary to measure in prediction of satisfaction? Does product type affect role of disconfirmation in satisfaction formation	Interrelationships among expectations, perceived performance, disconfirmation, and satisfaction; satisfaction formation in durable vs. non-durable goods;	manipulation of performance for two products; analysis of correlations among measures from each construct	comparison processes in satisfaction vary across products and service categories
Tse & Wilton (1988)	record player	Does perception of product performance, in addition to disconfirmation, influence satisfaction formation?	perceived perception of performance	manipulation of expectation and product performance; laboratory study;	found direct influence of perceived performance in satisfaction formation
Zwick et al. (1995)	personalized envelopes	What is the role of hindsight bias in satisfaction formation?	hindsight bias-tendency for people to exaggerate in hindsight what could have been expected in foresight	manipulation of expectation, comparison of foresight and hindsight expectations	Hindsight expectations (vs. foresight expectations) are higher and should be used in disconfirmation studies. Foresight expectations are more objective but less generalizable.

Table 1 (continued)

Study	Product/Service	Aims	Issues Addressed	Method	Conclusions
Spreng & Droge (2001)	camcorder	What is the impact of expectation level alone on satisfaction formation? How does pre-purchase product information impact satisfaction?	expectation level vs. disconfirmation in satisfaction formation; satisfaction with information;	manipulated expectancy with written material, manipulated perceived performance with different quality products	providing inaccurate product information to consumers results in lower satisfaction with product information; increasing attribute expectation increased perception of attribute performance
Spreng & Chiou (2002)	digital cameras	Does the disconfirmation model generalize to non-American cultural groups?	collectivist vs. individualist culture in Asian countries vs. the U.S.	manipulation of expectation and product performance; laboratory study;	disconfirmation model applies across cultures
Spreng & Page (2003)	college student advising services, camcorder	comparison of five methods of operationalizing disconfirmation	lab vs. field study, timing of expectation measurement, expectation probe questions	5 methods applied to study of one service and one product in both lab and field settings	Additive Difference Model (subjective report of expectation and perceived outcome after delivery) was best across product and service categories

2.2 FROM CONSUMER TO PATIENT SATISFACTION

As shown in the above literature review, researchers have not reached agreement that a single expectation norm accounts for the comparison standard that is formed by consumers across all types of products and services. Perhaps this is one reason why the conceptualization of patient satisfaction needed to be modified from the strictly consumer focused models. For example, none of the models we have reviewed so far have considered influence from physician or provider affect or impact on health status or quality of life. For example, it is reasonable to suppose that a patient's desire for improved quality of life would have some impact on the formation of the expectation for medical services. The next section of this paper addresses the application of the expectancy-disconfirmation paradigm in studies of patient satisfaction.

Articles addressing the issue of patient satisfaction with health care became evident in research literature in the 1970's and early 1980's (Linder-Pelz, 1982; Locker & Dunt, 1978; Ware, Davies-Avery, & Stewart, 1978). Linder-Pelz (1982b) explained this interest as an outgrowth of the consumer movement and recognition that satisfied patients are more compliant and therefore have better healthcare outcomes. Patient satisfaction was seen as one of the goals of health care delivery. The theoretical basis for studies of patient satisfaction had not been developed (Locker & Dunt, 1978). A conceptual model of patient satisfaction would allow for definition of the concept and more valid study of its various determinants and consequences (Linder-Pelz, 1982b). By reviewing the body of literature on consumer satisfaction and job

satisfaction Linder-Pelz (1982b) put forth the definition of patient satisfaction as: “positive evaluations of distinct dimensions of the health care” (p. 578).

Linder-Pelz’s (1982) efforts to develop a conceptual theory of patient satisfaction drew not only from the social science literature, but also from a body of research on job and pay satisfaction. The studies she reviewed posited a variety of theories of satisfaction. Those most widely accepted were the fulfillment theory, the discrepancy theory, and the equity theory. These theories varied somewhat in their approaches to exploring the components of satisfaction however all of them involved some focus on the fulfillment of expectation (Lawler, 1971; Vroom, 1964). Linder-Pelz concluded her work with definitions of the hypothesized determinants of satisfaction with health care. These included: expectations; value; entitlement; occurrences; and interpersonal comparisons. Each of these determinants was seen as a perception with the exception of value, which is seen as an attitude. These definitions were applied to the development of several hypotheses reflecting the social psychological determinants of patient satisfaction as follows:

1. Satisfaction scores will be directly related to the sum of the products of beliefs (expectations) and valuations (values) scores regarding various aspects of the care.
2. Satisfaction scores will vary positively with the extent to which perceived occurrence concurs with prior expectation.
3. Satisfaction scores will be directly related to the perceived occurrence score less the expectation score, all divided by the expectation score.
4. Satisfaction will vary positively with the concurrence of perceived occurrence and prior expectation only when the object is valued

5. A combination of positive expectation and positive perceived occurrence will yield the highest satisfaction scores, while positive expectation and negative occurrence will result in the lowest satisfaction scores

As is evident above, the variable of expectations was prevalent in these early hypotheses of patient satisfaction.

The continued development of the construct of patient satisfaction can be traced through several articles published after the Linder-Pelz work cited above. As the construct became more widely explored and accepted the article titles progressed from referring to the concept of *consumer satisfaction* to *consumer satisfaction with healthcare/medical care* to *patient satisfaction* (Locker & Dunt, 1978; Williams, 1994; Zastowney, Roghmann, & Hengst, 1983), reflecting the incorporation of elements from Oliver's earlier work.

The validity of the construct of patient satisfaction was explored extensively by Williams in 1994. He noted that the relationship of patient satisfaction to patient compliance had long been accepted and thus patient satisfaction was directly related to treatment outcomes. Therefore, patient satisfaction had become an attribute of quality and a legitimate health care goal. This notion was implemented as policy by the National Health Service in Great Britain in 1983. At that time, managers and directors of health facilities were instructed to solicit patient perceptions as a means of monitoring medical service quality. This idea had been promoted earlier by a well-known author, Donabedian, in the field of quality assurance. In the often quoted words of Donabedian (1988): "patient satisfaction may be considered to be an …element in health status itself." (Williams, 1994, p. 23) The resulting proliferation of patient surveys stimulated a number of researchers to investigate the methodologies used to measure patient satisfaction. From this

perspective, Williams argued that the construct of patient satisfaction had to be thoroughly validated by empirical research. In reviewing research data up to this point he highlighted a few major concerns. First, he argued that models of consumer satisfaction used to explain patient satisfaction had not been substantially supported in published literature. While evidence did suggest that patient's expectations and values were involved in evaluations, they did not appear to be related in a simplistic fashion. Secondly, Williams questioned the assumption that patient's expressions of satisfaction are valid representations of approval. Williams referred to the problem of patients assuming that medical providers are technically competent, and therefore unable to validly rate the attribute of clinician competency. This topic will be addressed later in this paper in regards to studies of dental patient satisfaction (Alford, 1998; Newsome & Wright, 2000). Thirdly, Williams questioned the assumption that patients will have valid expectations of the healthcare visit and that these expectations have equivalence to consumer expectations of products. He argued that the nature of the patient role and the power differential between patient and clinician might inhibit valid expressions of perceived performance. Williams called for investigations of these issues before satisfaction questionnaires could be used to judge quality of services.

A few years later, some of William's concerns were answered by Sitzia and Wood (1997) in an extensive review of patient satisfaction research. In describing determinants of satisfaction these authors noted that expectancy-disconfirmations continue to emerge as a fundamental element of satisfaction. More specifically, the Discrepancy Model was described as a modification of the expectancy-disconfirmation Model. The Discrepancy Model argues that satisfaction is a relative concept, defined mainly by the perceived discrepancy between a

patient's expectation and their actual experience. Other variables also are described as having an influence on satisfaction, though none are as influential as is expectation. These other variables include demographic characteristics such as age, level of education, gender, and ethnicity. Additionally, these authors described some psychosocial variables implicated in expressions of satisfaction. These relate to patient's perceptions of their own role in the patient-caregiver relationship. One example would be the *ingratiating response bias* in which respondents provide invalid positive satisfaction responses in order to ingratiate themselves to the researchers or care providers. Similarly, the *self-interest bias* occurs as patients feel that the very service under evaluation may be threatened if negative responses are supplied. In this case the respondents provide invalid positive responses in their own self interest in maintaining the availability of the service. The self-interest bias is of particular concern in patient satisfaction studies conducted in countries with government managed health care delivery, e.g., Great Britain or Canada. In these settings respondents may fear that lower satisfaction ratings may threaten the continuation of given health services. Another type of bias, with relevance to both health care and marketing research is the *social desirability response bias*. This bias results when patients/consumers report higher satisfaction than they actually perceived because they think that positive comments will be more acceptable to survey administrators. It would seem that these influences, once empirically validated, would need to be considered in any future studies using satisfaction questionnaires. These psychosocial factors were noted to potentially influence satisfaction ratings, though little empirical evidence of this effect was available at the time of the Sitzia and Wood review. Recently, Steenkamp et al. (2010) reviewed literature addressing socially desirable responding (SDR). This form of response bias was identified as one of the most

pervasive threats to validity of marketing surveys. The problem of response bias has been addressed in at least one hearing aid satisfaction study and will be described in further detail in a later section of this paper (Cox, Alexander, & Gray, 2007). The problem of controlling for these potential response biases could pose a major challenge to future work in understanding hearing aid satisfaction. Of note, these biases were elucidated by LaVois (1981) who referred to them as *artifacts.* The use of this term implies that survey results will include these biases by the very nature of the survey method. Though researchers need to be aware of these potentially confounding factors it may be very difficult to control for them in a research design.

Studies of patient satisfaction often focus on the outcome of whether patients will return to a given health care provider. This link between satisfaction with a health care provider and intention to return to that provider is established and might be grounded in Woodruff et al's (1983) association of the zone of indifference and continued product use (see page 10) (Alford, 1998; Baron-Epel et al., 2001; Solomon, Surprenant, Czepiel, & Gutman, 1985). Alford (1998) addressed three areas believed to contribute to patient satisfaction and intention to return to a given provider. His three areas of focus included the patient's perception of provider affect, perceived attributions of the health care provider, and the role of disconfirmation on satisfaction with the health care provider. This study was focused on service encounters alone. As such, no provision of product or purchase of product was involved in this study. Based on theoretical principles applied to each of the constructs of interest, Alford developed hypotheses to assess the contribution of affect, attribution, and disconfirmation on patients' repeat patronage intention. Of interest is the method he used to operationalize each of these constructs and the approach used to collect data. With regard to methodology this author acknowledged the trade-off between

control and generalizability in studies of satisfaction. He chose to conduct a laboratory study using a scenario approach to collect the data. As described earlier in a number of studies reviewed in this paper, this approach has been used widely in satisfaction research (Churchill & Surprenant, 1982; Jayanti, 1996). In this case subjects were asked to watch video recorded scenarios of dental care appointments and to imagine themselves in the place of the video recorded patient. The dental visit scenarios were created such that positive and negative versions of the patient encounter were created. Manipulated factors demonstrated in the videos included service outcome (e.g., was the patient's toothache resolved by the end of the appointment) and provider affect (whether the dentist was likable). Disconfirmation was defined as the difference between subjects' expectation of how the dental visit should go, and their perceptions of the dentist's performance. The author did not give specific detail on the manner in which the disconfirmation data were collected (e.g., subjective versus direct disconfirmation measurement). Two groups of subjects each watched videotapes that portrayed either a positive or negative encounter for the patients. The hypotheses were tested via regression analysis with dependent variables being both satisfaction and repeat patronage intention. The results showed that affect strongly influenced subject's initial response to the scenarios. In other words, subjects who liked the dentist showed more satisfaction and intention to return. Contrary to the findings in product related studies discussed earlier in this paper, disconfirmation was not predictive of satisfaction itself. Disconfirmation did influence intention to return. The author suggested that due to the technical nature of health care services, patients may not feel competent to judge service quality of medical personnel. This finding further confirmed Williams (1994) prediction that patients may not register valid opinions. It could be the case that patients have a wider zone of

indifference than that illustrated in studies of consumer satisfaction (Woodruff et al., 1983). As mentioned earlier, these findings confirmed that patient satisfaction influences intention to return to the provider. This author summarized that affect is the primary determinant of satisfaction and repeat patronage. The affective response comes not only from the provider but also from all personnel involved in the service delivery, including office staff. From this perspective, the cognitive process of perceived quality of the encounter seems to be of less importance than affect in the health care service setting.

Alford's results shed light on the differences that might be necessary in modeling satisfaction in health care settings versus satisfaction with consumer products. Alford's work has direct relevance to hearing aid dispensing since much of this work is done within medical settings. In applying the expectancy-disconfirmation model to health care it would seem important to include affect in the model to account for the patient's reaction to the personality and style of the provider. This concept is further developed below.

Thompson and Sunol (1995) published an important and useful review of literature in the field of patient satisfaction. Their goal was to clarify definitions and to illustrate practical models of the relationship between expectations and satisfaction. Additionally these authors aimed to identify the influential personal and social variables and to consider the special context of health care. This article served to bridge theory and data from the consumer environment to that of the health care environment.

Thompson and Sunol reviewed articles from a variety of disciplines considered contributory to patient satisfaction. These included psychology, sociology, social policy, health care services and management, and marketing. With regard to expectations research, they noted

distinct differences in the focus of interest and the desired goal from work in each of these disciplines. These differences are summarized in table 2:

Table 2. Contribution of various disciplines in patient satisfaction research

Discipline	**Focus of Interest in Expectation Research**	**Basis for Expectation**
Psychology	Influence on behavior	Beliefs, evaluations of beliefs
Sociology	Formulation of predictions for social interaction	Construction of reality through the development of causal networks
Marketing	Segment market sectors	Market created materials
Biomedical	Rule out placebo effect in treatment	Symptomatic and physiological changes experienced by patients
Health Care Management	Quality assurance, continuous quality improvement, achievement of patient satisfaction	Preferred or anticipated outcomes, based on personal or knowledge of others' experiences

The hearing aid fitting environment encompasses components of each of the disciplines described above. Thomson and Sunol's exploration of these topics offers valuable insight into the development of an appropriate model for this subject. Their article went on to describe the evolution of several models used to study satisfaction. Based on these models they proposed a model that would facilitate future research of the expectation/satisfaction relationship in the context of healthcare. These authors pointed out that the comparison of perceived outcome to initial expectations is a cognitive process. However, there is an affective component to

satisfaction as the experience of satisfaction/dissatisfaction itself is emotional in nature. Therefore, they argue, an ideal model will include both cognitive and affective components.

The model proposed by these authors is known as the Assimilation-Contrast Model of Satisfaction and is shown below in figure 2:

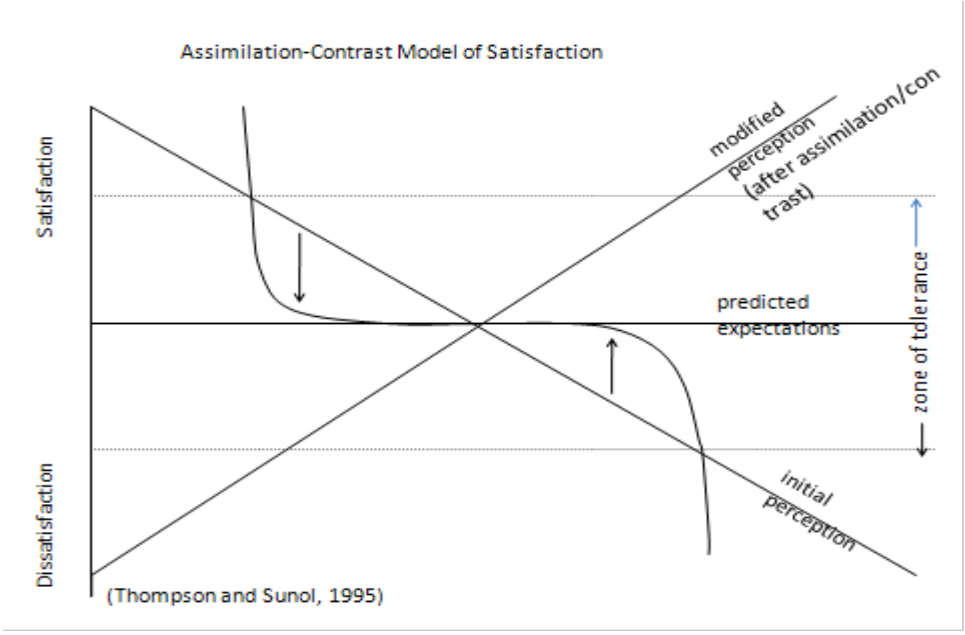

Figure 2: Assimilation/contrast model of satisfaction

The concept of Assimilation-Contrast comes from the psychology literature. This refers to a tendency for people to adjust their perceptions towards their expectations. This adjustment is known as the Assimilation effect. At some point, when the perception is greatly different from the expectation, people begin to exaggerate the large variation between the two. This is known as the Contrast effect. The area of assimilation can be likened to our earlier concept of the zone of indifference, as described by Woodruff (1983). Thompson and Sunol's proposed model therefore

includes one axis addressing the initial perceived perception and another axis for the modified perception. This modified perception occurs after the Assimilation or Contrast effect takes place. The model defines satisfaction and dissatisfaction under the disconfirmation paradigm. Satisfaction is shown on the vertical axis when perceptions exceed expectations and dissatisfaction is shown along the continuum where perceptions are below expectations. As can be seen in figure 2, satisfaction is achieved in cases where either initial or modified perceptions exceed expectations. Note that the expectations addressed in this model are described as predicted expectations. The authors differentiated between types of expectations, noting that predicted expectations refer to realistic, practical, or anticipated outcome, based on what users actually believe or deduce they should receive from health care services. This type of expectation is in contrast to others such as Ideal Expectations, Normative Expectations, or Unformed Expectations. Thompson and Sunol felt that this model represented three important components of the satisfaction response. These components include the cognition-affect factor, the assimilation-contrast effect, and the concept of the zone of tolerance.

In addition to modeling the components of satisfaction, Thompson and Sunol's review addressed factors that influence the development of expectations in health care settings. These influences are categorized as personal or social influences. The personal influences include factors such as patients' needs, values, health care experiences, information, moods and emotions, and perceived consequences of outcomes. In the social context, factors such as sociodemographics, equity, social norms, and task requirements have been documented. The authors additionally proposed that the healthcare environment is distinct from other contexts. In comparison to other consumptive experiences, the relationship with the service provider can be

much longer, and may be more affective in nature. For example, a consumer involved in a car purchase is not likely to feel the same emotional involvement as a patient seeking cancer treatment. Moreover, the motivation to access healthcare is usually driven by a need versus a desire.

Thompson and Sunol concluded with recommendations calling for the development of questionnaires specifically aimed at measuring expectations in healthcare. Moreover, they suggested that research exploring the expectation-satisfaction relationship be conducted across a variety of health care contexts. In regard to their first recommendation, researchers in Audiology have developed at least one psychometrically sound instrument with which to measure patient expectations (Cox, 1999). This tool will be addressed later in this paper. With regard to Thompson and Sunol's call for further research across health care contexts, there have been a number of such studies across medical fields including optometry, dentistry, pharmaceuticals, internal medicine, hospital care, and many others (Ammentorp, Mainz, & Sabroe, 2006; Kravitz, 2001; Kumar et al., 2007; Newsome & Wright, 2000; Pager, 2004; Staniszewska & Ahmed, 1999). These studies will be reviewed later in this paper.

2.2.1 Summary of the Expectancy-Disconfirmation Paradigm

A number of theories have been put forth to explain the relationship of expectancy disconfirmation and satisfaction. These have come from the consumer and the patient satisfaction literature. Table 3 summarizes some of the various theories and constructs discussed in this review. All of the theories listed here have relevance to the expectancy-disconfirmation

paradigm. Of note, authors have used various terminologies to refer to models which share common constructs as noted in Table 3.

Table 3. Theories with relevance to the expectancy-disconfirmation paradigm

Theory	**Constructs addressed**
Theory of Cognitive Dissonance (Thompson & Sunol, 1995)	Expectations, perceptions of attribute performance, assimilation effects, contrast effects
Expectancy Value Theory (Fishbein & Ajzen, 1975)	Expectations, belief strength, attribute evaluation
Theory of Expectancy Disconfirmation (Oliver, 1980)	Prior expectations, perceptions of product or service attributes, satisfaction
Fulfillment Theory (Linder-Pelz, 1982b)	Satisfaction, expectations/rewards desired, rewards received
Equity Theory (Linder-Pelz, 1982b)	Perceived equity, inputs, outputs, social comparisons, satisfaction
Discrepancy Theory (Linder-Pelz, 1982b)	Expectations, perceptions, satisfaction

2.3 METHODOLOGICAL CONSIDERATIONS IN PAST RESEARCH

Early work in the expectancy-disconfirmation paradigm was focused on satisfaction with consumer products. Later, the model was applied to service encounters across a variety of industries. Since the process of hearing aid dispensing combines both product and service components it is worthwhile to consider this model from the service perspective as well.

Yuksel and Yuksel (2001) provided a thorough critique of the expectancy-disconfirmation paradigm in the context of hotel and travel services. These authors explored challenges and limitations of the paradigm in response to its wide acceptance and application in the hospitality and tourism industry. In this industry, as in service encounters, the product is generally experiential in nature. The outcome is essentially the positive or negative memory that is left from a travel or restaurant experience. Though not perfectly paralleling the service and product components of a hearing aid fitting, this information is useful as it highlighted a number of relevant methodological considerations. Specifically, conceptual and operational challenges relating to the expectancy-disconfirmation paradigm are summarized.

These authors question some of the assumptions and/or definitions applied by researchers in the field in previous studies. For example, they question whether consumers do have clear expectations of products/services on which a disconfirmation could be based. Furthermore, they explore which types of expectations consumers use in determining satisfaction (e.g., predictive expectations vs. values, desires, or ideals). Other conceptual challenges include participants' interpretation of expectation questions. If some respondents focus on personal importance (this is not important to me so I don't need to rate it accurately) of the probed

attributes while others respond from the ideal performance perspective (what would be the best performance for the most people), survey data may not be valid. The authors gave several other examples of these conceptual challenges and then moved on to consider operational challenges. The operational challenges focus on logistical implementation of the research designs used in the field. For example, should expectations be solicited prior to or after the service experience? How can we control for response bias in survey data?

Some of the methodological challenges raised in this article, and throughout this paper, remain unresolved in the disconfirmation literature. Others have been explored by authors in various fields with potential solutions or explanations. Table 4 and Table 5 summarize the challenges and provide considerations that may be useful in addressing these challenges in the context of hearing aid dispensing. Considerations to address each challenge have been taken from existing disconfirmation and/or hearing aid literature.

Table 4. Conceptual challenges and considerations in hearing aid disconfirmation research

Concept	Conceptual Challenge	Considerations
Pre-purchase Expectation	Without expectations, disconfirmation cannot occur. How realistic would it be to expect patients/clients to have firm expectation of all attributes prior to fitting commitment? Does the model apply across all consumptive situations?	Cox and Alexander (2000) and Kochkin (2007) data show that people have measurable expectations of hearing aids from family and friends. Schum (1999) showed that inexperienced users not only have expectations but show a significant variation in expectation level.
Meaning of Expectations	Would an expectation question signify the same meaning to everyone? E.g., Affective issues, personality, prior experiences… "do I deserve this outcome because I paid for the device.."	Vestergaard (2006) gives specific guidelines on use of questionnaires with higher face validity for new hearing aid users. Spreng and Page (2003) suggest anchor terms for attribute performance based on Additive Difference Model.
Single or Multiple Comparisons	Does customer satisfaction come from disconfirmation of expectations alone?	Thompson and Sunol (1995) and Cox (2000) show direct effect of perceived outcome on satisfaction. Perceived outcome/satisfaction relationship and/or direct expectation to perceived performance effect (Spreng & Droge, 2001)
Logical Inconsistency	Would meeting low expectations generate satisfaction as the model predicts? Why do customers report overall satisfaction when their ratings indicate service performance falling short of their initial expectations?	Need to target outcome at a high level of performance. Satisfaction with information plays a role in overall satisfaction (Spreng & Droge, 2001)
Disconfirmation Process	Does the model apply across all consumptive situations? Does evidence from studies using video cameras apply to hearing aids?	Data across health care and product/service delivery have validated the model, (Linder-Pelz, 1982;Newsome & Wright, 1999). Hearing Aid delivery represents elements of consumer and patient product and service delivery

Table 5. Operational challenges and considerations in hearing aid disconfirmation research

Operation	**Operational Challenge**	**Considerations**
Timing of the Expectation Measure	Before or after the delivery experience? i.e. "What do you expect..?" vs. "How does the outcome compare to what you expected..?"	Zwick, et al. (1995) explored foresight vs. hindsight response bias and recommend expectation measure prior to product delivery to avoid hindsight bias.
"I have a high Expectation norm"	If scores on expectations are consistently high, outcome may never exceed them	Cox and Alexander (2000) showed wide variability in expectation levels across new hearing aid users. Otherwise, would need to manipulate Expectations and/or performance in lab environment.
Possibility of misleading conclusions	Would meeting a high expectation with a high performance and meeting a low expectation with low performance signify equal satisfaction in each case?	Need to look for disconfirmation in the positive direction. Fishbein and Ajzen (1975) data show a "zone of tolerance" when performance just meets expectation. Satisfaction is not increased in this "zone of tolerance." Direct performance/satisfaction relationship (Spreng & Droge, 2001)

Table 5 (continued)

Operation	**Operational Challenge**	**Considerations**
Dual Administration and possibility of response-tendency bias	Answering the same set of questions twice might bore the respondents, what is test-retest reliability on questionnaires?	Cox and Alexander (2000) data and Mormer, Kasewurm, and Palmer (2006) showed good test-retest reliability on expectation questionnaires. Could use a measure of response bias likelihood as per Cox (2007).
Data collected in Lab vs. Field	Field study of new hearing aid users won't be able to control and/or manipulate expectations or perceived outcome. Risk lack of variability across expectations and/or outcome.	Lab study affords ability to manipulate expectations and/or outcome. Could use groups of high vs. low expectation and do quantitative analysis. Doesn't generalize to hearing aid users' need for adaptation over time. Field study- less control over expectation variability, but better generalization to population

As seen in Table 4 and 5, a variety of methodological issues surround the construct of disconfirmation. Various approaches to the operationalization of disconfirmation have discrepant results when used to predict satisfaction. One such study involved an empirical investigation of five methods of operationalization of disconfirmation (Spreng & Page, 2003). Each method was applied in a study of students receiving advising services. Additionally, two of the methods were used and compared in a laboratory study of adult users of a camcorder. The laboratory study involved the carefully controlled manipulation of expectations and performance. The results

showed that across the studies (laboratory vs. field) and across the product/service categories, one method did appear to work better than others. This method is referred to as the Additive Difference Model (ADM*)*. This method is a subjective measure in which participants are asked to report on the difference between what was expected and what was received. Anchor terms for attribute performance using the ADM method might include: "exactly as I expected/ extremely different than I expected." Respondents are then asked to describe the discrepancy as either good or bad. This measurement is very close to the conceptual definition of disconfirmation in that the size of the expectation- performance difference is elicited and then evaluated. Other methods assessed in this study were better (explained more of the variance in satisfaction) in either the product or service components of the study, however the ADM method worked well in both product and service categories. These findings have important implications for methodological issues in studying the disconfirmation effect on satisfaction with hearing aids. Since hearing aid fitting satisfaction is based on the perception of performance in the service and product categories, such research should use the methodology most appropriate for both. Another feature of the ADM method of operationalization is that it is consistent with hindsight bias thought to be experienced by consumers in the field (Zwick et al., 1995).

2.4 EXPECTANCY- DISCONFIRMATION IN HEALTH CARE

The dispensing of hearing aids contains elements of both consumer and patient domains (Wong et al., 2003). The hearing aid itself is a product, but it is seldom purchased off the shelf. The

audiologist plays an important role in the success of the hearing aid fitting by providing expertise, information, supportive counseling, and service. It is likely that hearing aid users, as a group, would have various views of themselves as consumers vs. patients depending on the setting in which the hearing aids are dispensed. Some hearing aids are dispensed within medical settings such as a doctor's office or hospital. Others are dispensed from a private practice setting that may look like a sales focused storefront or a department store unit. Within the hearing aid literature, users are variably referred to as patients, clients, or consumers. In any case, this blending of consumer and patient user characteristics leaves open the question of how and which variant model of expectancy-disconfirmation is most appropriate to explain hearing aid satisfaction. As mentioned earlier, there is probably variation in the expectation/satisfaction relationship associated with different categories of products and services, and with delivery environments (Sitzia & Wood, 1997; Thompson & Sunol, 1995).

As will be explained later, Humes (2006) noted that hearing aid satisfaction probably results from a complex interplay of a variety of factors. These might include severity of hearing loss and perceived handicap. These factors would not come into play in a strictly consumer focused model, but would in the patient satisfaction domain, where an impaired body system is the primary motivating factor in service or product seeking behavior. In addition to seeking improved communication across a variety of listening challenges, the prospective hearing aid user is assessing factors such as cosmetics, comfort, relationship with provider, ease of access to service, and perceived value (Abrams & Hnath-Chisolm, 2000; Kochkin, 2007). These attributes of the hearing aid experience extend beyond those typically seen in a pure product purchase or in a purely medical service environment, and may require a model that combines elements common

to both of these areas. From that perspective it is worthwhile to look at ways in which the basic expectancy-disconfirmation model has been applied to a variety of health related disciplines. Towards this end, an attempt was made to search the literature from health related disciplines where products are integral to the treatment process. Specifically, the search for this literature began with a focus on professional services thought to share common elements with Audiology and hearing aid dispensing. Other criteria for this search included service characteristics such as: product could be purchased *off the shelf*; requires active patient compliance for successful outcome; involves some third party reimbursement; requires ongoing maintenance; affects personal image; and involves a high level of expense. As the search progressed, it became clear those disciplines thought to be most like Audiology did not have published literature in which the expectancy-disconfirmation paradigm was addressed. For example, no such studies were found in areas such as wheelchair fitting or Orthodontics, though each of these fields has addressed issues of expectations. Therefore the search was expanded to include health care contexts that did not necessarily parallel Audiology per se. Professions such as Dentistry and Pharmacy were found to have used the expectancy-disconfirmation approach to understanding patient satisfaction. Similarly, many related articles in internal medicine, vision correction, and inpatient hospital satisfaction were found. Articles from other related disciplines were included if their contents appeared to offer meaningful contributions to application in hearing aid fitting. Table 6 summarizes the health related services reviewed and the relevant elements in each field/service. The final column in Table 6 indicates whether the expectancy-disconfirmation paradigm has been expressly studied in the context of that discipline.

Table 6. Aspects of various health services compared to hearing aid dispensing

	Buy Off Shelf	Requires High Patient Compliance	3rd Party Reimburse-ment	Ongoing Maintenance	Personal Image	High Out of Pocket Expense	Expectancy/Dis confirmation Literature found?
Hearing Aid Fitting	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**MINIMAL**
Orthodontics	NO	YES	YES	YES	YES	YES	NO
Dentistry	NO	YES	YES	YES	YES	YES	YES
Vision Correction	NO	YES	YES	NO	YES	YES	YES
Pharmacy	YES	YES	YES	NO	NO	YES	YES
Wheelchair Fitting	YES	YES	YES	YES	YES	YES	NO
Ped Hospital Care	N/A	YES	YES	YES	N/A	NO	YES
Primary Care Office Visits	N/A	N/A	YES	NO	N/A	N/A	YES
Cardiac Care	NO	YES	YES	YES	NO	NO	YES
Emergency Department	NO	YES	YES	N/A	N/A	YES	YES

The next section of this paper reviews, when available, examples of the application of the expectancy-disconfirmation paradigm across the settings noted in Table 6. Literature from Dentistry offers some good examples of such an application. Newsome and Wright (1999a, 1999b, 2000) provided a broad review of the way patient satisfaction had been perceived in the dental literature since the 1980's. At that time, dental researchers had focused on the role of patient perceptions of dental service attributes and on the socio-demographic factors contributing to satisfaction formation. These authors drew from the expectancy/ disconfirmation literature to explore the construct of patient satisfaction. Newsome and Wright (2000) conducted a pilot study to investigate how patients evaluate dentists. They aimed to refute the notion that satisfaction with dental services can be explained simply as an aggregate reaction to patients' perceptions of dental service attributes. In particular, the attributes they addressed were: technical competence, interpersonal factors, convenience, costs, and facilities. Notably, all of these factors are important to satisfaction with hearing aid dispensing services (Cox & Alexander, 2000; Kochkin, 2005a). Newsome and Wright used qualitative research methods to gather their data. They recruited participants into focus groups that were systematically interviewed regarding previous dental visits. Through open ended questions participants were probed on their opinions on past visits and the process of judging dental care received. Interviews were tape recorded and transcribed for analysis. Analysis involved the coding of interview transcripts into thematic concepts. The results were displayed as a *code map* used to further examine the content.

These authors reported an array of findings in regard to various attributes of the dental care experience. One prominent finding, consistent with that addressed previously in this paper (Alford, 1998; Williams, 1994), relates to the assumption that patients use perception of

technical competence as a factor in judging satisfaction. In this study, patients tended not to believe in the legitimacy of their own evaluation of dental skill. One theme that did recur throughout the study interviews was that of the relationship with the dentist. This was expressed using words such as trust, faith, and confidence, or the lack thereof. In line with the disconfirmation theory, analysis of the focus group data did reveal consistently that disconfirmation of patient expectations does take place. This finding was based on repeated references to what patients expected prior to visits and their judgments of the perceived outcome. A number of participants reported dissatisfaction when office procedures or outcomes did not match pre-visit expectations. In those cases, the participants were directly questioned as to whether they would have been more satisfied if better information had been available from which to form more accurate expectations. In addition to demonstrating the disconfirmation effect this study revealed the role that patient attribution makes in satisfaction formation. Attribution refers to the source of which the patient ascribes the outcome. For example, some participants reported unsatisfactory outcomes but general satisfaction with the dentist. This occurred when the concepts of duty and culpability were taken into account. In other words, the patient may blame him or herself when an outcome is less than desired. In such a case, overall satisfaction may remain positive. On the other hand, when a patient believed the dentist to be culpable for the failure of a desired outcome, satisfaction was reduced. Other perceptions considered by participants in this study included the dentists' and staffs' attitudes and behaviors, cost factors, and physical characteristics of the office. The authors concluded that patient evaluation of dentists is a complex process that includes patient perceptions and expectations and

beliefs. These authors went on to tout the potency of qualitative methodology in exploring the topics around patient satisfaction.

Staniszewska and Ahmed (1999) had previously used a qualitative approach to define satisfaction with inpatient and outpatient care of cardiac patients. Their study explored the concepts of patient expectations and satisfaction from the patient perspective. These authors used a Content Analysis technique applied to interviews with patients before and after care. The authors felt that efforts to elicit satisfaction ratings should not use closed set response formats. Alternatively, as they probed satisfaction via interviews, participants described their experiences in their own natural language. As such, the term satisfaction was not used by the interviewer. Interviewers asked patients to describe their experience of care. This technique was drawn from Williams (1994) who stressed that closed set questionnaires could limit patients' responses and could obscure patients' true desires and values. Interestingly, during the post care interviews, it was noted that patients tended to describe their care by comparing it to their initial expectations. They rarely used the word "satisfaction." Though not empirically supporting the expectancy-disconfirmation model, this study corroborated some of the types of expectation reported in the literature (e.g., expectations of the doctor's affective behavior; expectations of outcome, expectations of nurses' advice and information giving) (Thompson & Sunol, 1995). Additionally, the evaluative process of comparing experience to expectations was illustrated. Participants were noted to consistently express their opinions of the treatment experience in terms of how it compared to their initial expectations. It could be useful to incorporate techniques such as Content Analysis in future studies of hearing aid satisfaction.

Thompson and Yarnold (1995) tested the disconfirmation paradigm in the context of perceived waiting time in a hospital Emergency Department. Unlike other service attributes waiting time is easily quantified in hours and minutes. Thus, there is little subjectivity in assessing the expectation or the actual outcome in this context. These authors proposed that, based on the expectancy-disconfirmation model, patients who waited longer than expected in the emergency department would be dissatisfied. Those whose wait matched their expected waiting time would be satisfied and those whose wait was shorter than expected would be the most satisfied. Telephone follow up surveys were conducted on patients who had been seen at a community hospital Emergency Department, two to four weeks previously. These authors used a subjective disconfirmation technique. As such, during the telephone interview patients were asked if the time they waited to be seen by the doctor was shorter than expected, as expected, or longer than expected. They also were asked to describe their emergency department experience as poor, fair, good, or excellent. Consistent with the disconfirmation paradigm, patients in this study were least satisfied when waiting times were longer than expected, were relatively satisfied when waiting times were as expected, and were highly satisfied when waiting times were shorter than expected. The size and direction of disconfirmation had a greater influence than the wait time itself. However, it is possible that the reported disconfirmation was influenced by the experience itself, as per Zwick (1995) and Yuksel (2001). There are other factors that influence the satisfaction of an emergency department visit, however those factors were not considered in this study.

Vision correction is an area that draws many parallels to hearing aid dispensing. For one, satisfaction is derived from perceptions of both service and product. Another common

feature of hearing aid fitting and vision correction is the application of both objective and subjective measures of function used in both professions. Visual acuity testing in optometry parallels audiometric testing in audiology. Each of these procedures is a quantitative measure of sensitivity and acuity. Similarly, patient concern, individual needs, and subjective reports of function are primary factors in treatment plans for both of these professions. Pager (2004) measured the contributions of patient understanding, expectations, and ultimate outcome versus expectation-discrepancy in the formation of patient satisfaction with cataract surgery. This research was conducted on patients who were scheduled for cataract surgery at a private hospital in Sydney, Australia. Preoperatively, participants had their visual acuity measured, and visual function assessed via the VF-14 questionnaire. The VF-14 questionnaire is a widely used instrument that provides an index of functional visual ability (Cassard et al., 1995). After completing the VF-14 describing current function, subjects were asked to again complete the questionnaire rating their expected postoperative function for each of the items. Additionally, participants were shown a video explaining either the anatomy of cataract or the procedures conducted during cataract surgery. Neither of these videos contained content that was meant to influence expected outcome. One month postoperatively, these subjects were asked to answer the questions on the VF-14 and to rate overall satisfaction with the procedure. In addition to the post-operative data described above, these subjects were asked to rate their degree of understanding of the cataract procedure. Analysis of these data was conducted via correlations and multiple regression analyses. Spearman correlations were used to assess the relationship between overall satisfaction and expected or achieved visual function. Multiple regression was used to measure the contribution of postoperative function, improvement, and expectation-

outcome discrepancy (disconfirmation) toward predicting satisfaction. Additionally, t tests were used to compare the measured outcomes from the groups exposed to the different informational videos and no difference between groups was measured. A multiple regression of the significant predictors of patient satisfaction was conducted. Expected improvement, actual improvement, and expectation-outcome discrepancy (disconfirmation) were all moderately correlated with satisfaction, supporting earlier findings in the consumer model that satisfaction is complex and multidimensional (Cadotte et al., 1987; Linder-Pelz, 1982; Tse & Wilton, 1988). Of note, when controlling for all other factors the expectation-outcome discrepancy was the significant independent determinant of patient satisfaction. In this condition, neither actual improvement nor actual outcome in visual function significantly correlated with overall satisfaction. If visual function after cataract surgery is thought of as a *product*, these results run counter to Tse and Wilton's 1988 findings of the direct influence of perceived product performance in satisfaction. The difference here might be explained by the conceptual differences between the purely consumer/product focused versus patient/treatment focused models. In any case, the results of the cataract study support the applicability of the expectancy-disconfirmation model to visual correction via cataract surgery. This study might offer an appropriate design model for a similar study with hearing aids.

It is reasonable to draw parallels from cataract surgery and visual function to hearing aid fitting and auditory function. Similarly, pharmacy services and products are congruent with elements of audiology services and hearing aids. Ho et al. (1997) applied the disconfirmation model to satisfaction with Over-the-Counter (OTC) medications. These authors further expanded on the expectancy-disconfirmation model by explaining factors such as product ambiguity,

involvement, and perceived risk in the formation of the satisfaction response. These factors are described below.

Product ambiguity refers to the acknowledgement that consumers have no prior experience with some products or brands on which to accurately base reasonable expectations. Particularly in the case of unfamiliar products or services, they will have inaccurate or poorly informed expectations about brand or product attributes. The most accurate means of discerning product performance is via knowledge or familiarity with that product category, usually through one's own experience (Sujan, 1985). Without product knowledge or prior experience it may be difficult for consumers to evaluate quality and or performance, particularly in products or brands having disparate or noncomparable attributes. New medications, like first time hearing aid fittings or cataract surgery, can be thought of as highly ambiguous transactions. Note that the lack of experience on which to base expectations was noted earlier by Thompson and Sunol (1995).

The next factor described by Ho et al. is referred to as product involvement. This refers to the extent to which consumers assign greater or lesser personal relevance or importance to certain product categories. The motivation to pursue relevant information about a product or brand is higher when there is a high level of involvement. Therefore more highly involved consumers are generally more knowledgeable. One study on this topic found that more highly involved consumers apply more complex rationalization when a product fails to meet expectation (Somasundaram, 1993). Ho et al. (1997) purported that both ambiguity and involvement would influence perception of performance.

Perceived risk is defined as the perception that a choice may result in an outcome that is less than desirable. As such, perceived risk is closely related to involvement. Generally, consumers seek purchases with the intent to lower the overall perceived risk of product use. Based on work in Prospect Theory it appears that consumers who have incurred prior losses will tolerate less risk as they face prospective purchases (Kahneman & Tversky, 1979).

Ho et al. (1997) considered that consumer decisions involving one's health would necessarily be highly involved and often ambiguous, and that an individual's perceived risk would be a salient factor in the evaluation of health related products. Earlier studies have shown that in high ambiguity/high involvement situations, the effects of expectation and disconfirmation should be great (Yi, 1993). Risk perception can be magnified under such conditions. Based on these premises Ho et al. tested six different hypotheses measuring the influence of expectations on satisfaction, either directly or indirectly. Data were collected using questionnaires aimed at quantifying five different constructs in a modification of the expectancy-disconfirmation model. These constructs included expectation, disconfirmation, perceived performance, consumer satisfaction, and perceived risk. These authors used structural equation modeling (SEM) in an attempt to test relationships between the measured constructs. The SEM method tests relationships via model paths and allows for an overall test of model fit, using both multiple regression and factor analysis (Hair, Anderson, Tatham, & Black, 1995). The results of this analysis showed that these authors' model, which included the perceived risk factor, had a very high Goodness of Fit Index (GFI) of .955. Additionally, all of the model paths had significant values in the expected direction, confirming the hypotheses for the relationship between expectations and the other constructs. This model was accurate in predicting the

relationships between the constructs, confirming that this variation of the expectancy-disconfirmation model successfully predicted satisfaction when applied to OTC drugs. One interesting aspect of the methodology used in this study relates to the measurement of disconfirmation. These authors measured the disconfirmation subjectively, by asking participants to rate the level at which product performance met the pre-purchase expectation. Actual pre-purchase expectations (foresight expectations) were not directly measured. Recall that, according to Zwick, direct measure of disconfirmation, whereby expectation is measured prior to purchase and performance is measured post use, yields a more objective (though not necessarily valid) measure, as the influence of hindsight bias is minimized (Zwick et al., 1995). This question of methodology is yet unresolved, as there seems to be a tradeoff between validity of the measure and generalizability of the results.

Kumar et al. (2007) studied the association of consumer expectations, experiences (perceived outcome), and satisfaction with newly prescribed medications. Additionally, they examined the relationship of satisfaction and intent to continue use of medication. This study showed a clear application of the expectancy-disconfirmation model. The study used surveys administered prior to patients' purchase of a new medication and then one month after medication use. The first survey probed medication related expectations. The post-use survey was used to evaluate the medication experience, satisfaction, and intent to continue use. The disconfirmation was measured as the difference between the subjects' expectations of the prescribed medication and their reports on the medication experience. The patient's report of the medication experience conceptually parallels the performance outcome described previously in some of the consumer/product focused studies. In this study the authors measured expectations

and experience via a questionnaire they created and tested in a pilot study. Satisfaction was measured via a previously developed and tested instrument known as the Treatment Satisfaction Questionnaire for Medications (TSQM). These authors used a combination of Structural Equation Modeling (SEM) and factorial analysis to analyze the effect of the disconfirmation on satisfaction. Interestingly, they did not find a significant interaction effect between expectations and experiences and satisfaction. The authors recognized that this could have been due to very similar expectation and experience scores. In other words, subjects in this study seem to have had very accurate expectations of the medication experience they would encounter. As a result of that accuracy expectations for this sample were generally met, and a disconfirmation effect was not observed. These authors did not provide subjects with specific medication information prior to the measurement of expectations. However, the subjects demonstrated realistic expectations that were realized after the medication use. The authors recognized some design limitations in this study that could have explained these unexpected results. Most of these explanations focused on possible response biases and the timing of survey administration. This article illustrates some of the design challenges in a study of this nature. One such issue relates to the need to establish a wide enough range in values for expectation, performance, and satisfaction scores in the study sample in order to establish correlational relationships. Another problem in this study was that surveys were given to patients to fill out at home or on the internet. There was no verification that the expectation questionnaires actually were completed prior to beginning use of the medication. The authors suggested that the lack of disconfirmation could have been due to participants answering the expectation questionnaire after they had already experienced the medication effect. Both the Kumar et al. (2007) and Ho et al. (1997)

studies offer good examples of the application of the disconfirmation model and possible pitfalls to avoid in the design process.

Since the provision of audiologic care falls within the category of health care service it is appropriate to include a review of the disconfirmation model as applied to physician office visits. As the physician and patient share the mutual goal of optimizing the patient's health, the audiologist and patient share the mutual goal of optimizing the patient's communication potential. One study used telephone interviews to patients who had recently visited their primary care physicians (Baron-Epel et al., 2001). These authors were most interested in examining patients' selection of, and continuity with, primary care physicians. In addition to looking at participants' perceived expectations of their physicians they also measured intention to change physician. The relevance of this work relates to the relationship between the caregiver and the patient, a known factor in satisfaction with audiology services (Kargas & Doyle, 1996). Further relevance is found in this study's focus on the patient- physician relationship. This relationship has been identified as a determinant of patient compliance which is one of the goals of achieving satisfaction (Garrity, 1981). These authors conducted telephone interviews of patients who had seen their primary care physicians within the prior two months. Respondents were asked to report on the initial expectations of the physician visit and the perceived fulfillment of expectations. The expectations were focused on 11 attributes drawn from literature on the patient-physician relationship. Following the expectation questionnaires subjects were asked to rate their satisfaction with the visit globally, and on a variety of aspects. Analysis was conducted via calculation of Spearman's Rho rank correlations between satisfaction and perceived fulfillment of expectation (disconfirmation). For attributes where the perceived fulfillment of

expectation was very different from the expectation (large negative disconfirmation) there were no significant correlations with satisfaction. Some attributes (e.g., diagnosis of the problem; preventive health care counseling; answering questions) did show a statistically significant correlation between the disconfirmation and satisfaction; however the strength of association was small. These authors did find that the correlation between perceived fulfillment and satisfaction was much higher than that between disconfirmation and satisfaction, particularly in attributes reflecting patient-physician communication (e.g., answering questions; listening to problems; explanation and discussion). To summarize, this study did not strongly support the expectancy disconfirmation relationship demonstrated in the consumer model. The variable described as fulfillment (perceived performance) explained more of the satisfaction variable than the disconfirmation itself. The discussion that follows the data analysis in this article brings to light a number of potential limitations in directly applying these results to the patient- physician experience in the United States. Notably, this study was conducted in Israel where medicine is socialized and patients have less choice and /or ease in choosing or changing physicians. As such, there is a much lower rate of registered patient complaints regarding physicians in Israel versus the United States (22% versus 52%) (Shuval, 1992). Further, the study authors point out that, in general, the consumer role is not parallel to that of a patient role. Where the patient role has traditionally been one of passivity, the consumer role implies a degree of power in decision making. Particularly when patients are sick they may take on a less evaluative stance toward the care giver and could express greater levels of satisfaction. This explanation supports the prediction of Thompson and Sunol (1995) described earlier in this paper. It is possible that the application of the expectancy-disconfirmation model may not be fully appropriate for predicting

satisfaction in the patient-physician experience, particularly when it is not evaluating a product or service outcome.

A recent study conducted in Denmark further explored the relationship between the fulfillment of expectations and satisfaction with pediatric medical care (Ammentorp et al, 2006). In the pediatric context patient satisfaction is based on feedback from parents of patients. As per Sitzia and Wood (1997), these authors addressed patient priorities in their expectancy-disconfirmation model. Prior research conclusions in this area had supported the importance of the caregiver communication and information sharing role in the formation of patient satisfaction (Ammentorp et al., 2006; Homer et al., 1999). As such, the authors adapted Oliver's (Oliver, 1993) model to address this as a patient priority. Additionally, based on Thomson and Sunol (1995), they included other experiences and patient characteristics as contributions to satisfaction. The resulting model (Figure 3) was tested in this study.

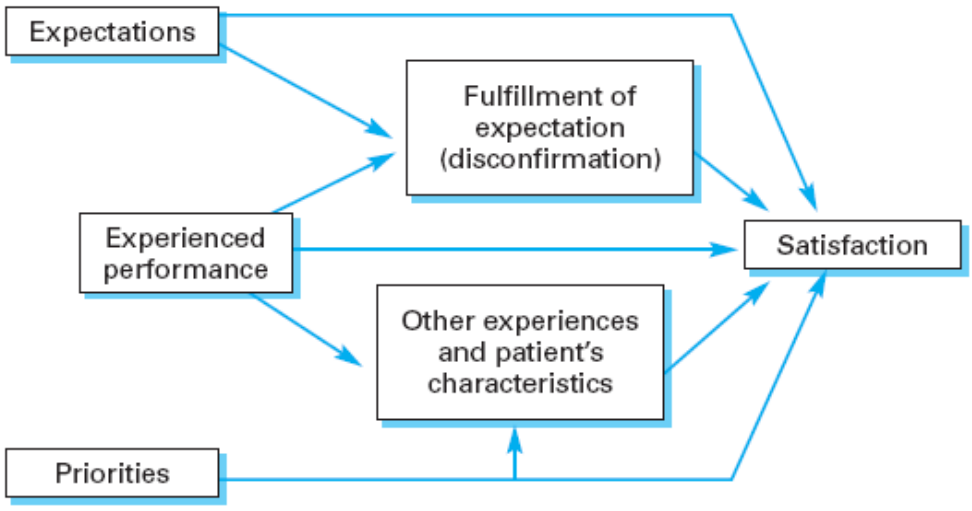

Figure 3. Relationships of expectations and priorities to satisfaction

Surveys were used to measure expectations and priorities for parents whose children were admitted as inpatients in a pediatric hospital unit. Follow up surveys were administered after discharge to assess experienced performance and satisfaction. Correlations were calculated between scores for disconfirmation (fulfillment of expectation) and satisfaction. The authors reported that a significantly high correlation between disconfirmation and satisfaction was observed, indicating that parents who were highly satisfied had a proportionately positive disconfirmation of the experience. Additionally, regression analysis was conducted with high priorities/low priorities and satisfaction/dissatisfaction as dependent variables. As per the model, certain patient characteristics and priorities were better predictors of satisfaction than others. For example, having confidence in the doctors was associated with having an above average satisfaction score. Other priorities associated with high satisfaction included the opportunity to get answers to questions and behaviors of nurses and physicians.

To summarize, these authors found that the patient's (parent's) confidence in the caregiver and approval of the caregiver's behavior made significant contributions to the level of satisfaction with the care given. Additionally, results were consistent with the disconfirmation model. These findings support the affective component described earlier, suggesting that a model used to predict hearing aid satisfaction should likely include an element representing the patient's perception of the clinician's behavior.

As can be seen from review of the above studies, evidence in the health care literature implicates disconfirmation as a factor in satisfaction. Clearly satisfaction is multidimensional and the design of research in this realm must be carefully formulated. Table 7 summarizes the aims, methods, and conclusions of the articles discussed above.

Table 7. Expectancy-Disconfirmation research on satisfaction in health care

Study	Product/Service	Aims	Issues Addressed	Method	Conclusions
Alford (1998)	dental services	What are the roles of perceived provider affect, attributions of the health care provider, and disconfirmation with the service encounter in a health care setting?	Difference in contribution to disconfirmation in health care vs. consumer setting.	lab study; videotaped patient scenarios	perception of provider affect is strongest predictor of satisfaction and intention to return
Ammentorp et al. (2006)	pediatric inpatient care	Examine relationship between fulfillment of expectations and satisfaction for parents' of pediatric inpatients	Parental/patient priorities may influence satisfaction.	survey of priorities, pt. characteristics, and expectations upon admission, survey of experienced performance and satisfaction post discharge; correlational study	significant correlation between disconfirmation and level of satisfaction; confidence in caregiver and access to information from caregiver strongly influenced satisfaction
Pager (2004)	cataract surgery	What is the contribution of patient understanding, disconfirmation, and percieved outcome to satisfaction?	influence of information, level of expectation, outcome	conducted in field, correlational study of each factor with satisfaction	Disconfirmation was the significant independent determinant of patient satisfaction.
Ho et al. (1997)	OTC drugs	What influences play a role in health related products vs. consumer products?	product ambiguity, involvement with product, perceived risk	Structural equation modeling, data collected in field.	Model including product ambiguity, involvement, and perceived risk showed very high goodness of fit index.

Table 7 (continued)

Study	Product/Service	Aims	Issues Addressed	Method	Conclusions
Kumar et al. (2007)	prescription medications	Test disconfirmation model on patient satisfaction with prescribed medications, effect of disconfirmation on satisfaction	design challenges e.g., expectations and experience levels were consistent across participants, leaving little disconfirmation	Pre-purchase and post purchase surveys. Structural equation modeling/ factorial analysis, data collected in field.	No significant interaction effect between expectations, experiences, and/or satisfaction. DID NOT find disconfirmation, so could not measure effect of disconfirmation to satisfaction.
Baren-Epel, Dushenat et al.(2001)	primary care physician office visits	Is disconfirmation related to satisfaction and intention to return to primary care physicians?	consumer vs. patient role, potential differences in socialized vs. privatized medical systems	telephone interviews post physician visit.	relationship between perceived performance and satisfaction stronger than disconfirmation and satisfaction
Thompson and Yarnold (1995)	Emergency Department waiting time	determine the association of patient satisfaction with waiting time perceptions and expectations	application of the disconfirmation paradigm in the service encounter setting of a hospital emergency department	Telephone interviews after the service encounter. Analysis via optimal data analysis software yielding predictive value of the model	Greatest satisfaction resulted when waiting times were shorter than expected, less satisfaction when results were same as expected. Results support the disconfirmation paradigm.
Newsome and Wright(2000)	dental services	determine if disconfirmation of expectations play an important role in formation of dental patient satisfaction	attributional concepts of "duty" and "culpability"	Qualitative study using focus group interviews with code mapping of interview content	Dental patient satisfaction is more complex than just perception of outcome, and includes expectation and belief components.
Staniszewska and Ahmed (1999)	care of cardiac patients	explore concepts of expectations and satisfaction from patients' perspective	variability of expectations across patient groups	Content Analysis of interviews via coding and classification of terms	Identified types of patient expectations as: predicted expectations; normative expectations; unformed expectations

2.5 EXPECTATION/SATISFACTION RESEARCH IN AUDIOLOGY

The last section of this paper reviews some of the explorations into hearing aid expectations and/or satisfaction within the audiology literature. Authors have explored this topic from a variety of perspectives. Some of this literature has focused on describing levels of satisfaction among new and experienced hearing aid users and/or analysis of the factors that most strongly contribute to satisfaction (Bentler, Niebuhr, Getta, & Anderson, 1993; Brooks & Hallam, 1998; Hosford-Dunn & Halpern, 2001; Humes, 2003; Kochkin, 2005b). These studies have used a variety of methodologies and focused on an array of factors such that no consistent evidence of any predictive factor(s) in satisfaction has emerged. Additionally, the psychometric properties of some of the satisfaction instruments used in these studies have not been tested adequately. Valid comparison of results across studies is thus challenging. This review is focused mainly on articles addressing the relationship of expectations and satisfaction in hearing aids. For an extensive review of the hearing aid satisfaction literature in the last twenty five years see Wong (2003).

A few studies have examined the relationship of hearing aid expectations to satisfaction (Cox & Alexander, 2000; Jerram & Purdy, 2001; Kochkin, 2005b; Schum, 1999; Vestergaard, 2006). Wong's (2003) review of the hearing aid satisfaction research directed future research towards the extensive theoretically based literature in both consumer and health care satisfaction. Since then, two published studies have been drawn from the theoretical basis of the expectancy-disconfirmation paradigm to examine satisfaction with hearing aids (Wong, 2004; Wong, Hickson, & McPherson, 2009). The above mentioned articles will be discussed in more detail in

the section that follows. Review of these articles will bring to light methodologies and measurement instruments used in the investigation of hearing aid expectations, outcomes, and the expectation/satisfaction relationship.

Schum (1999) investigated the relationship between expectations and benefit, an outcome that is related to, but not the same as, satisfaction. This work included an analysis of the variability across patients' expectations for hearing aids. The author created a tool called the Hearing Aid Needs Assessment (HANA) in order to explore the relationship between expected and perceived hearing aid benefit. The HANA probes patients' ratings of communication difficulty across a variety of listening conditions. This tool was meant to be used as a companion instrument with the Hearing Aid Performance Inventory (HAPI) (Walden, Demorest, & Hepler, 1984). The HAPI is a survey meant to capture patient self-report of hearing aid benefit. Items on the HANA were derived from the HAPI so that comparison of pre-purchase needs and post-fit benefit could be achieved. This instrument was administered on new and experienced hearing aid users. Users were asked to rate their pre-purchase and expected communication performance in a variety of listening situations. Eleven listening situations were grouped into four subscales describing the communication conditions as follows: speech in quiet; speech with no visual cues; non-speech material; and speech in noise. Because this study was focused on benefit versus satisfaction the questions probed only the communication domain and did not address other product attributes such as expected cost, service, or cosmetics. Hearing aid benefit is known as a related, but separate, dimension of hearing aid success (Jerram & Purdy, 2001). A three point scale (hardly ever, occasionally, frequently) was used for responses. Though not directly measuring disconfirmation, Schum's analysis revealed a number of findings relevant to that

topic. Expectation of post fit performance was rated by both experienced and inexperienced hearing aid users. Experienced users had significantly higher expectations than new users in three of the four subscales (speech in quiet; speech with no visual cues; non-speech material). For the speech in noise subscale expectations of experienced and new users was the same. Additionally, this author noted significant variation between subjects on expectation ratings, as demonstrated by relatively large standard deviations. This finding could have implications for future studies designed to test the expectation -satisfaction relationship. This author compared expectations to the report of benefit (perceived performance). The data showed that overall expectations were higher than the self-reported benefit. From the standpoint of the consumer model of satisfaction, this illustrates a negative disconfirmation in this sample of hospital hearing clinic patients. Additionally of interest, the author administered the expectation questionnaire to office patients who were seeking information about possible hearing aid fitting. Eventually these subjects divided themselves into groups of purchasers and non-purchasers. Analysis of the expectation level data from each of these groups showed no significant differences. This point may be useful in understanding that high expectations alone may not directly explain hearing aid purchase behavior or satisfaction. In general, expectations were not highly correlated with perceived benefit in this study, leading the author to conclude that the ultimate success of a hearing aid fitting cannot be predetermined by needs or expectations. From the disconfirmation perspective, the lack of correlation between expectations and benefit (perceived performance) argues that future studies may need to create a range of disconfirmation with which to test correlations with satisfaction. The author summarized that clinicians need to focus more on establishing realistic expectations for potential users in all listening situations. He concluded that

the factors most important to hearing aid success are probably more related to patient counseling and management issues than to other predictive variables. This view supports the notion that hearing aid satisfaction is not strictly parallel to consumer satisfaction per se.

Cox and Alexander (2000) explored aspects of hearing aid expectations and the expectation/satisfaction relationship. One goal of this study was to establish reality based norms for post-fit expectations of hearing aid attributes. This was accomplished by asking experienced users to rate aspects of hearing aid performance, service, and cost on a seven point scale. This scale was referred to as the Expected Consequences of Hearing aid Ownership (ECHO). This study included an analysis of demographic variables related to the participants and no effect was found for the demographic variables. Of note, one group of participants was veterans who did not pay out of pocket for their hearing aids. Significantly, their responses to the hearing aid performance questionnaire were no different than that of users who had purchased their hearing aids at a typical retail price. This study established a reference point toward which clinicians could adjust naïve patient expectations via counseling.

Another aim of this study was to compare expectations of first time users to the reports of perceived hearing aid performance by experienced users. By comparing novice and experienced users on these scales this study clearly demonstrated that novice hearing aid users did not have realistic expectations about hearing aids across the four assessed domains. To further probe the use of expectation ratings, these authors measured the test-retest reliability of participant responses on their expectation questionnaire. The results showed that prospective hearing aid users' expectations of hearing aid attributes are relatively stable during the period before the

hearing aid is dispensed and used. This finding was later demonstrated (Mormer et al., 2006) using a different expectation instrument.

The last phase of Cox's study involved an investigation of the relationship between expectation level and satisfaction level, as measured by the ECHO and the Satisfaction with Amplification in Daily Life (SADL) questionnaire (Cox & Alexander, 1999). Specifically, these authors were looking to see if high expectations were directly associated with high satisfaction, low satisfaction, or were unrelated to satisfaction. This relationship was explored in four domains of hearing aid use. In the Positive Effect domain a moderate positive correlation was found, indicating that those participants with higher Expectations for psychological and psychoacoustic benefit from the hearing aid tended to show higher satisfaction after being fit. The other domains under investigation included Service and Cost, Negative Features, and Personal Image. No clear correlation between expectation and satisfaction was demonstrated in these domains. Though the authors controlled for a variety of factors that could have influenced group results, this study did not include verification of amplification characteristics in the hearing aids worn by participants. This would be an important factor to address in future investigations of the expectation-satisfaction relationship. This research made an important contribution to the understanding of the expectation-satisfaction relationship in a number of ways. The ECHO tool made it possible to document the unrealistic expectations of naïve hearing aid users. The development of the ECHO and the SADL, and the well designed and tested rating scales associated with each, provided a valid means by which to operationalize these concepts. The authors' analysis of naïve users' expectation across domains showed clear differences in means, however means based on global scores across domains appeared quite similar. This study

illustrated the importance of assessing expectations in a variety of hearing aid attributes rather than based on a global expectation score.

Cox and Alexander (2001) further contributed to the methodology of hearing aid satisfaction research when they explored the relationship between SADL scores and a traditional single-item satisfaction measure. This investigation was partially motivated by the fact that the word "satisfaction" is not actually used anywhere in the SADL questionnaire. The authors conducted a multi-site study and collected data from a large group of patients. Subjects recorded SADL ratings along with the single-item rating and the correlation computed between the two measures was strong (.76). The authors noted that though the SADL provides much of the information obtained in the single-item measure, there were subjects from whom the single item measure yielded otherwise undetected dissatisfaction. In other words, in the absence of an overall single-item probe, aspects of the hearing aid experience may not be addressed when a multi-item questionnaire is used. This could happen if the subject is greatly dissatisfied with the fit of the earmold in the ear, an item that is not addressed in the SADL. Based on the findings of some subjects showing a high Global SADL score, yet a low single-item satisfaction measure, the authors pointed out the importance of the use of a single-item overall rating as a "safety net" in outcome measurement. This "safety net" approach should be considered in future studies of satisfaction.

Hosford-Dunn and Halpern (2001) studied the psychometric properties and validity of the SADL for use in private practice settings. The SADL had been normed using mainly older, predominantly male respondents from Veteran Affairs Medical Centers and community clinics. These authors argued that for full utility this instrument needed to be tested with different patient

populations and in different service delivery contexts. Towards that end, Hosford-Dunn and Halpern collected SADL measures on a large group of recently fitted hearing aid patients in a private practice setting. Analysis of their data showed good agreement with those of the original Cox and Alexander (1999) data on this instrument. This report confirmed the psychometric properties of the SADL as a viable tool to document hearing aid fitting satisfaction in the general hearing aid user population.

The same authors (Hosford-Dunn & Halpern, 2001) reviewed a number of hearing aid satisfaction studies and then examined a large set of variables and their influence on satisfaction via the SADL. In their review of satisfaction studies, they reported that a number of variables seem to affect satisfaction domains but that the precise nature of the effect is unclear. Their study aimed to identify the effects of a group of independent variables on the SADL scores. These authors hoped to establish relationships between given variables and the SADL such that fitting profiles could potentially serve as predictors of hearing aid satisfaction. The variables examined were described as falling into extrinsic and intrinsic groups. Intrinsic features were those that related to subjects themselves such as age, degree of hearing loss, monaural versus binaural, years of hearing aid experience, etc. Extrinsic variables were features of the hearing aids themselves such as technology level, style, number of channels, price, etc. These authors did not report a clear pattern of effects on variables that could accurately predict SADL measures due to the highly complex interactions. Their results suggest that the construct of hearing aid satisfaction is multidimensional and highly complex. A few patterns of variable influences did emerge from the study. For example, satisfaction did vary systematically with hearing aid style, with greater satisfaction reported by users of smaller instruments. Satisfaction was generally

lower for older patients and for listeners with greater difficulty in telephone use. Of note the lower satisfaction for older patients could have been mainly due to reduced auditory benefit in general. The report of lower satisfaction in the older subject group is contrary to Ross et al.'s (1995) findings that older respondents showed greater positive response bias. Based on Hosford-Dunn and Halpern's (2001) findings they were not able to develop a model for clinical predictions of SADL outcome but instead encouraged further research to complete a predictive model. These authors hoped that the SADL could serve as a "basis for development of such a predictive model of hearing aid fitting success."

Jerram and Purdy (2001) evaluated possible predictor variables on three measures of hearing aid outcomes on a group of new and experienced hearing aid users. The outcome measures included daily hours of use, self-reported benefit, and satisfaction. The satisfaction measure used was a single item satisfaction rating across a 20 point rating scale with descriptors ranging from very, very dissatisfied to very, very satisfied. The predictor variables these authors measured included adjustment to hearing loss, attitudes towards hearing aids, and pre-fit hearing aid expectations. Additionally, the subjects used a variety of hearing aid technology options e.g., wide dynamic range compression (WDRC); multiple memories; multiple microphones, etc. and 41% of the patients wore monaural versus binaural hearing aids. Regression analyses were used to look for effects of the demographic, hearing aid features, attitudes and expectations, and adjustment variables with the outcome measures of hours used, benefit, and satisfaction. A number of observations regarding the effect of expectations were reported in this study, however the authors noted that tests of the reliability of the expectation questions used were only moderately good. One result was that higher expectation scores predicted greater hearing aid

benefit in both noisy and quiet situations. These results were not consistent with those of Schum (1999) or of Seyfried (1990). Satisfaction was not directly related to expectations or to a number of other variables, but was related to aided benefit in both quiet and noisy situations. Subjects with higher pre-fitting expectation and better personal adjustment as measured by the Communication Profile for the Hearing Impaired (CPHI) (Demorest & Erdman, 1987) used their hearing aids more. Since hours of use were associated with satisfaction in this study there may be an indirect relationship between higher expectations and higher satisfaction. The finding of a relationship between hearing aid benefit in a variety of situations and satisfaction was consistent with earlier conclusions of Kochkin (1996).

These authors concluded that the influence of high expectations on benefit suggested pre-fit and follow-up counseling may be beneficial in improving outcomes. Specifically they suggested that expectations could be raised via counseling when indicated. Based on some of the consumer research reviewed earlier, this approach may not necessarily yield higher satisfaction (Spreng & Droge, 2001) In terms of methodology, these authors noted that the single item satisfaction scale may have obscured satisfaction responses across hearing aid fitting attributes. They suggested that future research should use a differentiated satisfaction scale such as the SADL.

Another relevant study, addressing hearing aid expectations, was published in 2003. Bentler et al. designed a study with the purpose of investigating the effect of technology labeling on a variety of self-report and behavioral hearing aid outcome measures. This study was conducted shortly after hearing aids using digital technology were introduced in the market. The authors were particularly interested in finding out whether hearing aid patients' outcomes would

be biased by the digital labeling, or if outcomes with digital hearing aids were truly improved when compared to analog hearing aids. As such, the study involved the manipulation of patient expectations. In addition to nationally available hearing aid marketing literature, the authors supplied manufacturer designed product literature to participants' prior to the hearing aid fitting. This marketing information served as a placebo to increase the participants' expectations of the digital hearing aids. Participants were divided into two groups for the study. One group wore each of two digital hearing aids for one month each, believing that the hearing aids were switched from analog to digital after one month. The other group wore the same digital hearing aid for the two month duration, also believing that the aids were analog instruments for one of the months. Outcome measures for the two groups reflected better performance for the condition when patients thought they were using digital hearing aids. The authors concluded that these findings reflected a positive bias that was inferred from the digital label. Though not directly exploring hearing aid expectations, this study has relevance to the topic by demonstrating the effect of both national media advertising and clinician supplied instrument information on patient expectations. Additionally this study demonstrates the potential manipulation of expectation via labeling and information, a method that could be adapted to a study of the expectancy-disconfirmation paradigm applied to hearing aid fittings. This study further substantiates findings of both Kochkin (2007) and Cox (2000) showing the availability of general hearing aid information and its impact on the formation of hearing aid expectations. This impact can drive expectations in either positive or negative directions, depending on the content and/or source. Given the evidence for both indirect and direct effects of expectations on outcomes (Cox & Alexander, 2000; Jerram & Purdy, 2001; Spreng & Droge, 2001), future studies on hearing aid

expectations and/or outcomes might need to consider participants' exposure to prior hearing aid information.

The first extensive review of research in hearing aid satisfaction, from the 1980's on, was conducted by Wong, Hickson, and McPherson (2003). Across all the studies reviewed, a variety of factors were found to be related to satisfaction. These factors included experience, personality, daily hours of use, hearing aid type, listening demands, and hearing aid problems. As shown in articles reviewed in this paper, causal and interactional relationships have not been clearly established. Methodological issues have arisen across many of these studies and answers to similar research questions have not been consistent in this literature. These authors reviewed 45 studies on hearing aid self-report outcomes including satisfaction. They concluded that, other than hours of use, no intrinsic factors have consistently been demonstrated to influence benefit or satisfaction. After conducting this far-reaching review, Wong et al. recommended that further work in this area should draw from the vast literature in consumer and healthcare satisfaction. They pointed out that hearing aids fall into both of those categories (See Wong et al., 2003 for a more extensive review of general expectation and satisfaction research).

Wong et al. (2004) followed up on the above recommendation and explored the relationship between hearing aid expectations and post-fit satisfaction in a sample of first-time hearing aid users in China. One goal of this study was to determine the level of expectations among users and whether the level of expectation varied systematically across hearing aid attributes such as service, performance, and cost. This study used both open-ended questions and questionnaires with predefined situations to elicit the level of patient expectations and satisfaction. Subjects rated expected levels for Hearing Ability and Dispenser Service on a 0 -

100 scale, with 0 indicating no expectation of performance and 100 meaning extremely good expectation of performance. Opinions of expectation seemed to be elicited with no prior hearing aid counseling or education provided. By eliciting open ended information about hearing aid expectations this study uncovered a broad array of specific listening situations with which users hoped to get help and a variety of hearing aid related problems they did or did not anticipate encountering. In addition to analyzing the level of expectation across hearing aid attributes, this study looked at the relationship between expectation levels for these different attributes. Correlations that ranged from moderate to high (r = .40- to .86) were reported among expectation levels of all Hearing Ability items and among Dispenser Service items. It should be noted that these correlations were derived via a Pearson product- moment correlation coefficient, which assumes the use of an interval scale. The 0-100 scale used by the author was not described as interval in nature.

Another goal of this study was to determine whether expectations have an impact on satisfaction in general, and for specific hearing aid attributes. Post fit satisfaction was measured at 3 months. Correlations between expectations and satisfaction were not found to be significant for either specific attributes or for composite scores across attributes.

This study was aimed at further documentation of the relationship between expectations and satisfaction. Specifically, the author was looking at correlations between high expectations and high satisfaction. The expectations elicited in this study were not influenced by any pre-fitting counseling or education and therefore may not have been realistic expectations for users to have. One recommendation that emerged from this study was to look toward consumer models of satisfaction to better explain the expectation-satisfaction relationship.

To further investigate the expectation/satisfaction relationship, Wong et al. considered the association between disconfirmation and post-fit satisfaction. This was the first time that the concept of disconfirmation was applied to the study of hearing aid satisfaction. The author described a positive disconfirmation as the perception that hearing aid performance was better than initially expected. The results of this study were reported as a poster presentation at the American Auditory Society in 2004, and later in print in 2009. As reported above, the findings of this study showed that pre-fitting expectations did not directly affect post-fitting satisfaction, but a positive disconfirmation was associated with greater satisfaction. The suggestion resulting from this study was that future research into hearing aid satisfaction should consider the effect of disconfirmation on satisfaction. No such research, focused on hearing aid satisfaction has been published since that time.

The utility of self-report hearing aid outcome measures will be germane to future research addressing satisfaction. Vestergaard (2006) investigated aspects of self-report measures of benefit and satisfaction. Specifically, he looked at whether results of such measures change over time and at the validity and relationships within a variety of self-report outcomes. The measures studied were as follows: Glasgow Hearing Aid Benefit Profile (GHABP)(Gatehouse, 2000); Auditory Lifestyle and Demand (ALD)(Gatehouse, 1999a); International Outcome Inventory for Hearing Aids (IOI-HA)(Cox, Alexander, & Beyer, 2003); Hearing Aids Performance Questionnaire (HAPQ); and the Satisfaction With Amplification in Daily Life (SADL) (Cox et al., 2003). With regard to a longitudinal effect, Vestergaard (2006) found that first time users who reported hearing aid use for greater than four hours per day showed improved outcome on the GHABP and IOI-HA. For the SADL and HAPQ no such longitudinal

change was observed. These different findings among the scales could be due to differences in the content of the items in these scales. The author noted that the GHABP and the IOI-HA address general aspects of hearing aid performance and satisfaction whereas the SADL and HAPQ probe performance in more specific listening situation. Additionally, study results showed that listeners with higher auditory demands showed lower ratings on the self-report outcomes.

In assessing the validity of the self-report outcome measures Vestergaard (2006) noted some issues with convergence, content, and face validity across items in the measures. Of note, the author concluded that self-assessment tools addressing specific listening challenges are not feasible early in the post-fit time frame, as subjects may not be able to appreciate the attributes being probed. Self-assessment tools of a more general nature show greater stability over time, possibly due to better face validity.

Vestergaard's findings have relevance to future research of the expectancy-disconfirmation model. By examining specific characteristics of a variety of outcome measures, this article serves as a guide to the tools most appropriately used to operationalize constructs in the model. The findings of divergent outcome from high versus low auditory demand groups further supports the notion that expectations may play an important role in the hearing aid outcome process. Data on the impact of daily use on longitudinal changes in self-report outcome point out the need to consider factors such as hours of use and time frame of satisfaction measurement. Finally, this author concurred with Wong (2004) that future studies of self-report outcomes should consider the role of expectations.

Wong et al (2009) published data from a study designed to explore hearing aid satisfaction via the expectancy-disconfirmation perspective. The study was conducted on new hearing aid users in Hong Kong. In this study data were collected on self-perceived and objectively measured hearing aid performance. Measures, obtained using one instrument, were made regarding expectations, performance, disconfirmation, and satisfaction. Correlation coefficients across outcomes demonstrated that positive disconfirmation is related to satisfaction with both specific and general attributes of service. These authors measured disconfirmation subjectively by asking participants to rate how current function/service compared to prior expectation of function/service. The authors found a lack of direct relationship between expectations and satisfaction. They explain this lack of relationship as being consistent with products that are durable and high-involvement in nature. As explained by Thompson and Sunol (1995), durable, highly involved products are more receptive to outcome than to pre-purchase expectation. High involvement products are those for which the consumer is actively engaged in selecting and using the product (e.g., adjusting settings). It is unclear whether hearing aids can be considered as such, since the specific product itself is often chosen and fitted by a professional. The authors concluded that disconfirmation is a "relevant factor in determining satisfaction, and that it is correlated more strongly with satisfaction than expectation alone." The majority of participants in this study were fit monaurally with analog hearing aids. Results may have been different if the sample had been binaural digital users. As noted earlier in this literature review, given the cultural differences between the population addressed in this study and that in the United States, it is questionable whether these findings would be replicable in a sample of American first time hearing aid users. The data on expectations and disconfirmation

collected in this study showed wide variability across participants. These data are consistent with the earlier cited findings of Cox and Alexander (2000) showing variability across pre-purchase expectation levels of first time hearing aid users.

A study of hearing aid outcomes was ongoing at the Indiana University for several years (Humes, 2006). These researchers set out to explain the vast differences in outcomes observed by similarly appearing older adult hearing aid users. This study necessarily required a review of the variety of hearing aid outcome measures available at the time this work was undertaken. These authors have collected data on 173 similarly aided older users across twenty different outcome measures. The outcome measures initially crossed several domains, including hearing aid usage, subjective benefit, hearing aid satisfaction, and Speech Recognition performance. These data were then analyzed for redundancy to assess which measures were ultimately necessary to yield a comprehensive assessment of hearing aid outcome. The goal was to identify outcome measures within a variety of domains that would be useful for a factor analysis aimed at explaining individual differences in outcomes. A few satisfaction focused instruments have been included in this ongoing study. These have been the SADL (Cox & Alexander, 1999), one section of the Glasgow hearing Aid Benefit Profile (GHABP) (Gatehouse, 1999b), and the MarkeTrack IV satisfaction survey (Kochkin, 1996). Ultimately the domains at which these authors arrived included hearing aid use time, speech recognition, and hearing aid benefaction. The use of the word benefaction was meant to represent a combination of hearing aid benefit and satisfaction. Data derived in this domain cannot therefore be directly related to satisfaction alone. Interim conclusions from this study suggested that 40-50 percent of the variance in the above named domains can be explained by performance on a variety of measures. In the benefaction domain,

one measure of expectations (ECHO) (Cox & Alexander, 2000) was identified as a predictor variable, accounting for 13.5 percent of the variance in that domain. Among other predictor variables in the domain, higher expectations were associated with greater self-reported benefaction. These authors continue to collect data to better identify those predictors of positive hearing aid outcomes.

Though not directed specifically at hearing aid satisfaction, Cox et al. (2007) conducted a relevant study assessing the contribution of several different factors to self-reported hearing aid outcomes. This study addressed the factors of personality, along with expectations and other related predictor variables in hearing aid outcomes. The personality measure included a set of questions aimed at assessing a subject's tendency toward socially desirable responses (SDRS-5). These authors studied two groups of patient related variables. The first group of variables related to personal issues such as personality, audiometric results, and hearing problems. The second group of variables related to amplification characteristics of the user's hearing aid. In this field study, subjects were drawn from patient populations in eleven different hearing aid dispensing sites across the United States. Some of the sites were Veteran Administration sites, in which case patients would not have paid for their hearing aids. Some of the sites were private practices where patients would have self-paid for all or part of the hearing aid costs. A variety of pre-fit measures were obtained on the subjects. These included personality measures and hearing aid expectation measures. Of note, these authors included the SDRS-5 questions so that data from them could be analyzed later to study whether a response bias was present. Associations among the pre-fit variables were assessed via correlation coefficients. Participants, who were higher in Agreeableness and Conscientiousness, and lower in Neuroticism, were more likely to

demonstrate higher expectations for their hearing loss. Notably, these data demonstrated that personality characteristics of hearing aid candidates were more predictive of self-reported hearing problems and expectations than severity of hearing loss itself. Additionally, with regard to outcome measures, personality, per se, was not generally associated with self-reported hearing aid satisfaction. Specifically, there was a weak association of personality with self-image in that patients with higher response bias (greater desire to please) reported greater satisfaction on the Personal Image subtest of the SADL. These data should be considered in future studies using expectation and/or satisfaction measures. The socially desirable response bias has been minimally addressed in hearing aid satisfaction research despite the heavy dependency on self-report measures.

Following the pre-fit measures, subjects were fit with hearing aids that were considered most appropriate for their hearing losses. At six months post-fit, subjects completed a variety of outcome measures aimed at assessing residual hearing problems, benefit, satisfaction, and daily hours of use. Of interest, the authors noted that results from among these outcome measures were not highly correlated. In other words, several of the self-report outcome measures thought to address the same outcome domain yielded different results. For example, the Abbreviated Profile of Hearing Aid Benefit (Cox & Alexander, 1995) and the Hearing Handicap Inventory for the Elderly (Ventry & Weinstein, 1982) were both administered. These two questionnaires were found to yield a correlation coefficient of $r = .58$, a moderate association. This finding poses a challenge for future researchers when considering which outcome measures validly represent the targeted outcome component(s).

Outcome components used in the analysis of the data from this study were derived via a principal components analysis. The process of principle components analysis was used to distill data from the large number of self-report measures into three elements contributing most significantly to the variance of the outcome data. The three derived generic components were device merit, success in daily life, and amplification acceptance. Overall, data from measures of personality were not strongly predictive of subjective fitting outcomes, nor were the traditionally administered verification measures of hearing aid function. After complex analysis of the extensive data collected in this study the authors concluded that a substantial proportion of variance in self-report outcome measures could not be explained by these patient- related and/or hearing aid- related variables. This article was useful in demonstrating the use of an instrument designed to measure an individual's tendency towards socially desirable responses on self-report surveys. This trait was associated with the personality measure of Agreeableness. The trait was found to have more influence on self-reports of pre-fit hearing problems than on post-fit hearing aid satisfaction. There was a small but significant association of this Response Bias score with the Personal Image subscale of the Satisfaction with Amplification in Daily Life (SADL) score. Generally, the authors pointed out the need for further research into possible precursors of hearing aid success and/or satisfaction. As noted above, it would seem important to address possible response bias in studies measuring satisfaction via self-report instruments.

The call for research to "explore the relationship between expectations and outcome, especially including satisfaction" (Cox et al., 2000) has been answered by a number of the articles summarized in the last section of this paper. A chart showing the highlights of these studies is shown in table 8.

Table 8. Studies on expectations/satisfaction in the Audiology literature

Author(s)/Year	Question(s)	Subjects	Measures Used	Conclusions
Schum,1999	Is there a relationship between communication needs/expectations and hearing aid benefit?	Adults age 21-93 in University Hospital setting	1. Hearing Aid Needs Assessment 2. Hearing Aid Performance Inventory	1. new users have unrealistic expectations 2. no strong correlation between expectations and benefit
Cox & Alexander, 2000	1. What are realistic expectations?	60-89 years old; 139 experienced users	Expected Consequences of Hearing Aid Ownership (ECHO) and Satisfaction in Daily Life (SADL)	collected reality norms on hearing aid attributes from experienced users
	2. Do first time users hold realistic expectations?	67 naïve users (mainly male)		naïve users have unrealistically high expectations, based on reality norms
	3. Are expectations of first time users stable?	57 from question #2		expectations remain fairly stable over time

Table 8 (continued)

Author(s)/Year	Question(s)	Subjects	Measures Used	Conclusions
	4. Are pre-fit expectations related to post-fit satisfaction?	43 from question #2		moderate correlation between expectations and satisfaction in Postive effect domain
Hosford-Dunn & Halpern (2000)	Validation of psychometric properties of Satisfaction in Daily Life (SADL)scale	375 patients in private practice	SADL	confirmed psychometric properties of SADL in private practice setting vs. clinic and VA setting
Hosford-Dunn & Halpern (2001)	What is the predictive validity of 44 variables on the SADL scale?	375 patients in private practice	SADL	following variables most related to higher satisfaction: 1. patient age 2. years of hearing aid experience 3. hours of use per day 4. percieved difficulty PTA 5.pure tone average 6. hearing aid style 7. hearing aid technology 8. hearing aid cost

Table 8 (continued)

Author(s)/Year	Question(s)	Subjects	Measures Used	Conclusions
Jerram & Purdy, 2001	What is the influence of technology, demographic factors, and pre-fit expectations, attitudes, and adjustment to hearing loss on hearing aid outcome?	new and experienced users from 12 private and 7 public hospitals in New Zealand; ages 31-88	1. single item satisfaction question 2. daily hours of use question 3. modified APHAB (Cox & Alexander, 1995) 4.expectation questionnaire (Seyfried, 1990)	1. higher hours of use per day related to higher satisfaction 2. multiple memory hearing aids associated with higher benefit and satisfaction 3. better pre-fit expectations related to benefit in easy and difficult listening situations

Table 8 (continued)

Author(s)/Year	Question(s)	Subjects	Measures Used	Conclusions
Bentler et al., 2003	What is the impact of digital labeling on outcome measure?	40 older adults (means age = 67 years	1. probe microphone measures 2. Hearing in Noise Test (HINT) (Soli & Nilsson, 1994) 3. CUNY sentence test 4. Abbreviated Profile of Hearing Aid Benefit (APHAB) 5. Glasgow Benefit Inventory (GBI) 6. Client Oriented Scale of Improvement	Labeling of newer technology raises expectations and perceived outcome e.g., serves as a placebo
Wong, 2003	What conclusions can be drawn from the past 20 years of hearing aid satisfaction research?	Review of literature	N/A	1.hours per day use correlates with greater satisfaction 2. further research should draw from consumer and healthcare satisfaction literature

Table 8 (continued)

Author(s)/Year	Question(s)	Subjects	Measures Used	Conclusions
Wong 2004	Do expectations have an effect on satisfaction?	43 first time users in China	1. Hearing Aid Outcome Questionnaire 2. Expectation rating 3. Satisfaction rating 4. Open ended questions	1. no correlation between expectations and satisfaction 2. should explore perceived performance (disconfirmation) in relationship with satisfaction 3. questionnaire results from Chinese subjects was equivalent to those in Western studies
Wong 2004b	Explored the relationship between satisfaction and expectation, performance, benefit, and disconfirmation.	36 first time users in China	IOI-HA PHAB	better performance and higher positive disconfirmation associated with greater satisfaction
Wong et al, 2009	What is the relationship between expectation, perceived performance, disconfirmation, and satisfaction?	42 First time users in China	Profile of Hearing Aid Consumer Satisfaction (PHACS)	link between performance and satisfaction, and disconfirmation and satisfaction

Table 8 (continued)

Author(s)/Year	Question(s)	Subjects	Measures Used	Conclusions
Humes, 2006	What factors account for individual differences in hearing aid outcome?	173 older adults	1. GHABP 2. Daily Use questionnaire 3. HAPI 4. SADL 5. MarkeTrak Survey (Kotchkin 1993) 6. Speech Recognition 7. ECHO	higher expectations associated with greater self-reported *benefaction*(see Humes, 2006)
Cox, 2007	Which patient and hearing aid variables contribute to hearing aid outcomes?	205 older subjects from 11 clinics	1. Personality measure 2. ECHO 3. HHIE 4. APHAB 5.Hearing Disability Rating 6. Response Bias	1. personality traits associated with self-report outcomes 2.reported hearing problems and previous hearing aid experience associated with successful fitting

2.6 CONCLUSION

Extensive theoretical and empirical support for the expectancy-disconfirmation paradigm has been published across a number of consumer and health care contexts. This paradigm has not been applied to the understanding of hearing aid satisfaction in the United States. In the study of satisfaction with hearing aids there has not been consistency in the instruments used, and the dimensions of hearing aid satisfaction have not been uniformly defined or probed. Some instruments measured various dimensions of the construct of expectations (e.g., expectation prior to contact with the professional versus expectation following initial counseling/information session). Similarly, measurement of expectations and satisfaction has probed a variety of hearing aid fitting attributes such as size or stigma, while others have explored expectations and satisfaction with speech understanding in noise or on the telephone. Attempts to derive a composite analysis based on these studies would be misleading, due to the inconsistencies in construct definition and measurement. None of these studies were conceived or designed based on a theoretically sound and empirically tested conceptual model. Of note, a few of these studies have identified the Hours of Daily Use variable as one associated with satisfaction (Humes, 2006; Jerram & Purdy, 2001; Wong et al., 2003). This finding might reflect Woodruff et al's (1983) model of the zone of tolerance in that the response to satisfaction within the zone of tolerance is a desire for continued use of the product. It would seem that a model pertaining to hearing aids would need to include elements from both the consumer and patient satisfaction domains. Additionally, elements from both the product and service contexts will be relevant.

In summary, the expectancy-disconfirmation model, when applied with the use of validated measurement instruments, should provide a legitimate approach to explore the relationship of hearing aid expectations and satisfaction. Before addressing questions related to increasing satisfaction with hearing aids, the first question should be: Can the expectancy-disconfirmation model predict satisfaction in hearing aid users? Issues such as the influence of disconfirmation for service and disconfirmation for product will need to be considered. The issue of response bias, inherent in all self-report measures would seem important to address as well. Methodological issues aside, testing of the expectancy-disconfirmation model in this context should take the Audiology discipline one step closer to understanding and improving user satisfaction with hearing aids.

3.0 RESEARCH QUESTIONS AND METHODS

3.1 OBJECTIVES AND AIMS

This study applied the expectancy-disconfirmation model to first time hearing aid users in an attempt to better elucidate the role of disconfirmation in hearing aid satisfaction. This was done by examining the relationship of disconfirmation and satisfaction, across product and service elements. The expectancy-disconfirmation model, as demonstrated across a variety of goods and services, suggests that the difference between users' experience and prior expectations of the hearing aid fitting should predict the level of satisfaction post purchase. Based on the review of gaps and inconsistencies in our understanding of hearing aid satisfaction the following research question was posed: Does disconfirmation of expectations predict satisfaction in first time hearing aid users? Also, given the varying findings on the role of performance in satisfaction, what is the contribution of performance and disconfirmation (Drew & Bolton, 1991; Wong et al., 2009)?

As noted by Sukarom (1999), much of the work in the expectancy-disconfirmation framework has focused on satisfaction in either a given product or service encounter. Given the relatively rare application of the model to consumer encounters incorporating both of these components, the contribution of these variables together is not well

understood. The second aim of this study was to explore the contribution of disconfirmation for product and disconfirmation for service elements of the hearing aid purchase experience in formation of the satisfaction rating.

A third aim of this study was to explore the influence of response bias in self-report hearing aid measures. The use of self-report measures, for both assessment and outcome purposes, has become increasingly popular over the past two decades. As described throughout the literature review, and as noted by Cox and Alexander (2007), response bias could potentially influence results across all types of self-report hearing related measures (Drew & Bolton, 1991) . This topic is germane to future research in this area, as well as to clinical applications of self-report instruments. Questions related to the Socially Desirable Response set were addressed through a progression of questions, each addressing more specific information. This topic was initially approached by asking whether the Socially Desirable Response Set has an influence on self-report hearing aid measures used to measure performance, disconfirmation, and satisfaction. It would be useful for both clinicians and researchers to be aware of such a response bias when using these instruments. Since performance, disconfirmation, and socially desirable response tendency have all been identified as playing a role in satisfaction ratings, all three of these constructs were then examined for their contribution to the satisfaction response. Finally, this study examined the extent to which this potential response bias moderates the relationship of performance and disconfirmation with satisfaction.

Other questions addressed the equivalency of the multi-item measures of performance with single-item probes of the same constructs. In bringing together customer satisfaction literature and audiology literature, it is clear that each field uses a different approach to the

instrumentation used for self-report ratings. Whereas the audiology literature almost exclusively uses multiple item questionnaires to assess dimensions of the patient experience, the single-item rating of 0-100 is commonly seen in the customer satisfaction literature (Drew & Bolton, 1991). The equivalency of these measures will be explored as a methodological question applicable to further studies in this area.

In summary, this study attempted to provide empirical evidence that the expectancy-disconfirmation paradigm can appropriately be applied in the study of hearing aid satisfaction. Once that is established, the model can serve as a framework from which many other questions can be addressed.

This study addressed the following specific questions:

1. Does disconfirmation predict satisfaction in first time hearing aid users?
2. How is hearing aid satisfaction influenced by disconfirmation for the product and service elements of the purchase?
3. What is the influence of response bias on self-reported measures of hearing aid performance, disconfirmation, and satisfaction?
4. What are the influences of perceived performance, disconfirmation, and response bias on satisfaction?
5. Is the influence of disconfirmation and perceived performance moderated by response bias?

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3.2 METHODS

3.2.1 General Research Design

This study used cross-sectional surveys of hearing aid users to explore the relationship between disconfirmation and satisfaction after hearing aid purchase. Measures addressed the four constructs of the expectancy-disconfirmation paradigm: expectations, performance, disconfirmation, and satisfaction. A measure of Socially Desirable Response Set was included in the survey questions. Participants were first time hearing aid purchasers who had owned their hearing aids for at least four to twelve weeks. Subjects were informed that their responses would remain anonymous and that their dispensing clinician would not have access to their responses on the survey instrument. This was done to encourage subjects to be candid in their responses. Subjects answered questionnaires designed to measure perceived performance, subjective disconfirmation, and hearing aid satisfaction across a variety of fitting attributes. A measure of socially desirable response tendency was obtained from each participant so that the influence of this characteristic on self-report hearing aid outcomes could be examined. The project used a disconfirmation measurement instrument created by combining a well-known self-report measure of hearing aid performance (APHAP) with a widely accepted disconfirmation measurement probe. In addition to the multiple item self-report measures used to assess performance, disconfirmation, and satisfaction, each of these constructs was probed via a single item measure. The multiple item hearing aid disconfirmation instrument and the single item

measures of performance, disconfirmation, and satisfaction were examined for test-retest reliability during the data collection.

Recognizing the trade-off between generalizability and control of variables, a field study approach was chosen for this project. Videotaped or role play scenarios and/or laboratory manipulation of expectation and/or performance have been used extensively in satisfaction research (Alford, 1998; Bitner, 1990; Churchill & Surprenant, 1982; Jayanti, 1996). These methods do not appear appropriate for the product and service components of hearing aids. This is partly because hearing aids, unlike cameras or dental services, require an adjustment period before a valid satisfaction response can be assessed. Additionally, due to the complexity of the hearing aid fitting process, it would not be possible to expose participants to an appropriately fit instrument, and to elicit valid performance or satisfaction self-reports in one or two laboratory sessions.

Data for this study were collected in the field, from participants who had self-purchased their hearing aids from an audiology clinic. This situation captured disconfirmation and satisfaction outcomes in the most natural setting, as has been modeled in satisfaction studies in the consumer literature. The field study approach and the measurement of subjective disconfirmation should yield findings that are highly generalizable to the typical hearing aid consumer population.

3.2.2 Variables and Operationalization

3.2.2.1 Perceived Performance

In this study, perceived performance was operationalized via a tool called the Abbreviated Profile of Hearing Aid Performance (APHAP) (Cox & Alexander, 1995). This instrument was derived from a longer (66 item) instrument developed to quantify users' self-reported communication performance with hearing aids. That longer instrument was known as the Profile of Hearing Aid Performance (PHAP) (Cox & Gilmore, 1990). Attributes addressed in the PHAP included the positive effects of improved speech communication and the negative effects of objectionably amplified environmental sounds. The listening environments addressed in the PHAP were based on both theoretical research and on data of Walden et al (1984), defining three broad listening environments to which adult listeners are typically exposed. These environments include 1) speech at normal conversational levels with full visual cues and minimal background noise (e.g., one on one, face to face conversation in quiet), 2) reduced speech cues due to lower intensity, room reverberation, distance from signal, and/or reduced visual cues (e.g., listening in large audience), and 3) high environmental noise conditions, full visual cues, and high signal level (e.g., cocktail party conversation). The original PHAP inventory contained 66 items. The items were organized into four scales, each addressing one of the listening environments described earlier, and the fourth addressing negative reactions to amplified environmental sounds. The subscales were named: Easy Communication, Reverberant Conditions, Background Noise, and Aversiveness of Sounds. Respondents are presented with statements describing their aided communication abilities or perceptions of sound in daily activities. A

seven point response scale captures how frequently the statement is perceived as true by the listener. Responses are anchored at one end with “Always” and at the other end with “Never.” Corresponding percentages are shown with each answer choice to further clarify the descriptors along the scale. Corresponding point values run from one to seven. During development of the instrument, the PHAP was administered to two groups of older adult hearing aid users with mild to moderate hearing loss. Psychometric properties of the instrument were tested and internal consistency, test-retest reliability, and critical differences were found to be acceptable and similar to data from other self-assessment measures of hearing aid performance.

Cox and Alexander (1995) developed and evaluated a shortened version of the PHAP and called it the Abbreviated Profile of Hearing Aid Performance (APHAP). This instrument contains twenty-four questions, each falling into one of the four subscales described in the PHAP above. The APHAP yields moderate to high correlation coefficients on test-retest administration across each subscale and globally (.67- .81) (Cox & Gilmore, 1990). Score distributions on the APHAP norm sample show that standard deviations on the subscales are relatively large, suggesting respondents use a wide range of the response choices (Cox & Alexander, 1995).

In the present study, the APHAP items and scale were used as one means to operationalize the perceived performance component of the disconfirmation model. APHAP item ratings served as a reference point against which expectations were compared for the disconfirmation measure (described below). Global performance values were calculated, as per author instructions, by calculating the mean performance rating across all items. Additionally, a single item measure of perceived hearing aid performance was included in the data collection instrument. This measure was based on the model of consumer ratings on product and/or service encounters and on patient

satisfaction study methodology (Like & Zyzanski, 1987; Wong et al., 2004). Participants rated the overall performance of the hearing aid on a scale of 0-100 (0= lowest performance, 100= best performance) on the single item question. A sub-question in the study explored the equivalency of the APHAP measure and the single item Performance measure. This question has not been previously addressed in the literature. The APHAP questions, and single item performance measure can be seen in the appendix. The appendix also includes the APHAP-based and single-item disconfirmation measure.

3.2.2.2 Disconfirmation

As described in the literature review, there are a variety of approaches to the measurement of disconfirmation. In the present study the disconfirmation construct was operationalized as the subjective discrepancy between participants' perception of hearing aid performance and service compared to pre-purchase expectations. The specific listening situations were taken directly from those probed via the items on the Abbreviated Profile of Hearing Aid Performance instrument (APHAP) (see above). The methodology for measuring disconfirmation was modeled on that used and/ or described by several authors including Oliver (1980), Spreng and Page (2003), Tse and Wilton (1988), Hudak et al (2004), and Cadotte, Woodruff, and Jenkins (1987). In this approach participants are asked to make a subjective assessment of whether, and to what degree, performance is better or worse than their expectation. In the present study, after rating aided communication performance on the APHAP items, subjects were asked to rate how the performance compared to their pre-purchase expectation. Responses were recorded using a seven point scale anchored at one end with "it is worse than I expected" (negative disconfirmation) and

at the other end with “it is better than I expected” (positive disconfirmation). The midpoint on the seven point scale was labeled as “It is just as I expected.”(simple confirmation). One limitation inherent in this approach is the potential for censored data at the lower and upper bounds of the disconfirmation rating. For example, if a participant responds to the performance probe with the highest value of performance (e.g., with my hearing aid I am NEVER able to follow the conversation in a grocery store) it is very unlikely that the same participant would respond to the disconfirmation question with a response indicating that this performance is BETTER THAN I EXPECTED. In the unlikely event that the data are skewed to the lower and upper bounds of the performance question, this limitation may present a problem in the data analysis. This instrument is shown in the Appendix along with the performance questions from the APHAP. Since this disconfirmation instrument has not previously been used or tested, the current study included a measure of test-retest reliability on this instrument.

Data from the Disconfirmation measure included a global score, as derived from mean disconfirmation ratings across the APHAP items. Disconfirmation for product and disconfirmation for service elements were measured via single item ratings targeting each of these areas. Data from the disconfirmation measures were used in the main research questions exploring the relationship between disconfirmation, perceived performance and satisfaction. Also, these data were used in the questions assessing the influence of socially desirable response set on self-reported disconfirmation for hearing aid product and services. In sub-questions, data from the APHAB-based disconfirmation instrument and data from the single item measure of overall disconfirmation were used to assess inter-test equivalency.

3.2.2.3 Satisfaction

The construct of satisfaction was operationalized via Cox and Alexander's (1999) Satisfaction with Amplification in Daily Life (SADL) scale. This instrument was developed as a means to capture the multidimensional construct of hearing aid satisfaction via a self-report questionnaire. The items included in the SADL were derived from prior data (Hawes, Durand, & Clark, 1985; Kochkin, 1992) and from interviews with individuals who had owned hearing aids for at least one year. The sample of interviewees were aged 60 and above and they displayed a range of hearing losses and configurations from mild and flat to moderate and sloping. After identifying the elements of satisfaction, interviewees were asked to report on the importance of individual items listed. The authors analyzed the importance ratings to determine if there were substantial differences in importance between the items. Additionally the authors used a principal component analysis to determine whether the items could be grouped into related clusters. This analysis identified four factors that, taken together, accounted for 68% of the variance in importance ratings. Thus, four hearing aid satisfaction domains were identified in the development of the SADL. The final version has 15 items across these domains. The SADL authors omitted some of the original 25 items that resulted from the subject interviews. These omissions were based on a priori goals for the final SADL instrument. These included a relatively short scale with items yielding a mean score closer to the middle, and a wide distribution of responses. The final version of the instrument includes 15 items sorted into four domains. The domains are: Positive Effect, Service and Cost, Negative Features, and Personal Image. The SADL scale uses a seven category rating of satisfaction with descriptors ranging from "not at all (=1) to "tremendously" (=7). Of note, the descriptors used in this rating scale

have been studied and empirically shown to represent approximately equal intervals between descriptors (Cox & Alexander, 2001). The descriptors are shown in the SADL instrument in the appendix. These descriptors show strong consistency in interpretation and clear semantic distinctions when rated by subjects.

Tests re-test reliability and norms for Global and Subscale scores were previously established. Norms for the SADL were developed and the results are shown in Table 9.

Table 9. Original norms for the SADL global and subscales for ages 60-75 years

Score	N	Mean	SD	20th	80th	Application?
Global*	44	4.9	1.0	4.2	5.9	Third-party pay
Global	53	4.9	0.8	4.3	5.6	Private pay
Service and Cost*	101	5.4	1.2	4.5	6.5	Third-party pay
Service and Cost	142	4.7	1.2	4.0	5.7	Private pay
Positive Effect	257	4.9	1.3	3.8	6.1	All patients
Negative Features	256	3.6	1.4	2.3	5.0	All patients
Personal Image	103	5.6	1.1	5.0	6.7	All patients

** The "reasonable cost" item is omitted.*

These norms were further refined in a later study by (Hosford-Dunn & Halpern, 2000) when data across a wider age range was collected. As stated earlier, standard deviations on the SADL normative data were relatively wide, demonstrating variability across the response range. Similarly, Kochkin (1997) reported normative data for a large group of typical hearing aid owners in the United States. Responses on his measure of satisfaction fell across a range from very dissatisfied to very satisfied. These data showed wide variability across the range of responses, further suggesting that responses to the satisfaction measure in the proposed study could be predicted to show sufficient variability to yield a significant correlation.

In this study, data from the SADL was based on Global scores derived from the mean scores across items, as per author instructions (Cox & Alexander, 1999). A single item measure

of overall satisfaction, using a 0-100 scale, was included as part of the satisfaction data collection. These data were used in a sub-question comparing the Global SADL score with the single item satisfaction measure.

3.2.2.4 Response Bias

A variety of response biases can threaten the validity of self-report surveys. Foremost among these biases is the tendency for some individuals to respond with answers that make them look good rather than reporting true feelings or observations (Cox et al., 2007; Steenkamp, De Jong, & Baumgartner, 2010). As described in the literature review, the Socially Desirable Response Set (SDRS) construct refers to the degree to which a respondent is likely to respond with answers that make him or her appear in a positive light. Measures of SDRS are used to control for this bias so that response validity can be maximized. A number of SDRS measurement instruments have been developed, validated, and used in survey research, particularly in the psychology and marketing fields. According to Steenkamp et al. (2010) the most frequently used measure of SDRS in marketing research is the Marlow-Crowne *Socially Desirable Response Set Measure*. The original form of this scale has 33 items. A shortened form of the scale, known as the SDRS-5 was developed and validated on two groups of outpatients across a wide age range. These subjects did not display any psychopathology (Hays et al. 1989). The items in the shortened version of the measure (SDRS-5) were chosen because they had the highest item—total correlation. Internal consistency reliability was established via the use of Cronbach's alpha and the intraclass correlation between items across two samples of patients was calculated. These values were compared to the longer Marlow-Crowne instrument and it was determined that the

shorter test is nearly as reliable as the longer version. Test retest reliability was established with the administration of the SDRS-5 to a group of older adults two times, separated by a one month interval.

The development of the SDRS-5 was aimed at providing a reliable instrument with which clinicians could quickly evaluate whether survey data were likely to be influenced by the respondents' tendencies toward socially desirable behavior. Respondents rank each of five items related to his/her relationships with others. The responses are scored dichotomously as either true or false; however the response options span a five point scale ranging from *definitely true* to *definitely false.* The expansion of response options was implemented in view of the difficulty respondents have in choosing between the dichotomous True/False options. Scoring converts the most extreme response in a given direction to a score of 1, indicative of socially desirable responding. In this study, the SDRS-5 instrument was scored according to the authors' instructions. Each of the five items in the scale had a possible value of 1 or 0, with 1 indicating the trait of socially desirable responding. Though the instrument itself (see Appendix) asked participants to respond along a continuum from 1-5, only the extreme values at the positive end were actually scored as a 1. All other values were scored as a 0.

As noted in the literature review, the SDRS-5 was used by Cox et al. (2007) to explore the relationship of response bias with a number of personality and pre-fitting variables (see literature review page 81). In this study the SDRS-5 questionnaire was used as a means to explore the role of socially desirable response bias in self-reports of perceived performance, disconfirmation and satisfaction measures. Results of the SDRS-5 were used in the analysis of

these measures to assess the influence of socially desirable response tendency on hearing aid outcome questionnaires and to look at the influence of this response bias on the relationship of disconfirmation, performance, and satisfaction. Table 10 below shows each construct and its associated instrumentation:

Table 10. Study constructs and related instruments for operationalization

Construct	Instrument
Performance	1. APHAP-Global
	2. Single Item Performance Overall
Performance for Product	1. Single Item Product Performance
Performance for Service	1. Single Item Service Performance
Disconfirmation	1.Disconfirmation-Global
	2.Single Item Disconfirmation-Overall
Disconfirmation for Product	1. Single Item Disconfirmation -Product
Disconfirmation for Service	1. Single Item Disconfirmation - Service
Satisfaction	1. SADL- global
	2. Single Item Satisfaction - Overall
Response Bias	1. SDRS-5

3.2.3 Data Collection Procedures

3.2.3.1 Recruitment

Subjects were recruited from new hearing aid patients at the Audiology Center at the University of Pittsburgh Medical Center. First time hearing aid users were mailed surveys, with an invitation to participate in the study. Surveys were mailed only to private pay patients.

3.2.3.2 Subjects

Participants had purchased hearing aids in the four to six week period prior to completing the survey. Eligible participants were 18 years of age or older and spoke English as their primary language. No attempt was made to exclude any subject based on given hearing loss or hearing aid variables other than the fact that they purchased a hearing aid within the above time frame.

3.2.3.3 Procedures:

As noted above, survey instruments were mailed to eligible participants, in paper and pencil form, 4-6 weeks after the initial hearing aid delivery. The disconfirmation instrument included the performance measure (APHAP) which served as the reference point for the disconfirmation response. Participants were asked to respond to the survey items and to return the surveys as soon as they were completed. Stamped and preaddressed return envelopes were supplied to each participant.

The initial plan was that survey responses would be obtained from participants during the four – twelve week time period following the hearing aid dispensing appointment. The rationale for using this time period came from data by Humes et al (2002) showing that satisfaction ratings obtained relatively soon after initial fitting remained stable within the first year. More specifically, Humes found significant correlations between satisfaction measures obtained at 1 month, 6 months, and 12 months after initial fitting. In an earlier study (Humes 2001), hearing aid users responded to a satisfaction survey addressing a variety of fitting attributes four weeks post fitting. These responses (excepting one item) were not significantly different from the norms for the MarkeTrak V satisfaction survey obtained on 524 consumers who had owned

hearing aids between three and twelve months (Kochkin, 2000). As later described in the results section, some surveys were returned later than 12 weeks after the hearing aid fitting. Participants who completed the study received a generic gift card in appreciation of their time and effort.

In the initial phase of data collection, participants who returned completed surveys were asked to complete the same survey a second time, one to two weeks later. This continued until 30 participants had completed the survey twice so that test-retest reliability on the disconfirmation measure could be measured.

3.2.3.4 Sample size determination

According to Green (1991) the determination of required sample size should be based on the expected effect size (level of correlation sought to detect), alpha level, number of predictors, and desired power. An alpha level of .05 was used in this study. Effect size was estimated, based on earlier studies in the disconfirmation/satisfaction literature, when possible. For the disconfirmation/satisfaction relationship questions prior studies had yielded coefficients ranging from .4 to .8. (Ammentorp et al., 2006; Hudak, Hogg-Johnson, Bombardier, McKeever, & Wright, 2004; Tse & Wilton, 1988; Wong et al., 2009). The number of predictors varied for each question and is shown below, in the detailed data analysis for each question. Based on these factors a sample size of 100 subjects was initially planned to achieve over 80% power to detect a moderate coefficient of .4, in each of the main questions. A preliminary analysis was completed after data from 60 participants were collected. Based on the strong correlations and large effect sizes observed, data collection was discontinued. The observed power for each question was at least .999.

3.2.4 Data collected

The following data were obtained from each participant.

1. Demographic data from each participant included age and gender, as well as categorically coded income level and education level. These data were used for descriptive purposes and were not examined specifically in relation to satisfaction outcomes in this project. This sample was representative of typical private pay hearing aid users in an urban Medical Center setting. As such, it was expected that the age range would be limited to approximately age 60-90, and that the range for hearing aid cost would largely be limited to one or two price categories used at the recruitment site.
2. Performance as measured by the Abbreviated Profile of Hearing Aid Performance (APHAP):
    a. Global score on the Abbreviated Profile of Hearing Aid Performance (APHAP)
    b. Single-item rating of hearing aid performance
3. Disconfirmation:
    a. Global Disconfirmation was calculated as the mean of the disconfirmation scores for all items of the APHAB.
    b. An overall disconfirmation rating, obtained from the single item measure of disconfirmation for the hearing aid fitting.
    c. Single-item ratings of disconfirmation for the hearing aid performance and disconfirmation for service.

d. Global Disconfirmation from the APHAP, as described in item **a** above, was obtained a second time and was used to assess test retest reliability (further detail below). Similarly, the disconfirmation ratings described in **b** and **c** above were collected a second time for test-retest reliability analysis.

4. Satisfaction as measured by the Satisfaction with Amplification in Daily Life (SADL):
    a. Global Satisfaction was calculated as the mean of the scores for all items rated in the Positive Effects (PE), Service and Cost (SC), Negative Features (NF), and Personal Image (PI) subscales. Of note, one question in regard to telephone use was left out of the calculation if the participant noted no difficulty on the telephone without hearing aids.
    b. Overall Satisfaction rating on the single-item satisfaction for hearing fitting measure.

5. Socially Desirable Response Tendency as measured by the SDRS-5:

    A total SDRS-5 score was calculated for each participant. Scoring was based on the author's directions. Responses at the extreme of the scale were scored 1, while all other responses were scored 0. These scores were then transformed to a 0-20 range.

The table below represents the constructs, operationalization, data collected, and questions for which data were used in the study.

Table 11. Coding of data from each measurement and study question

Construct	Instrument	Code	Value	PRE-Q	Ques 1	Ques 2	Ques 3	Ques 4	Ques 5	SubQu A	SubQu B	SubQu C
Performance	**1. APHAP-Global**	**Pg**	1-7				√	√	√	√		
	2. Single Item Performance Overall	**Po**	0-100							√		
Performance for Product	**1. Single Item Product Performance**	**Pp**	0-100									
Performance for Service	**1. Single Item Service Performance**	**Ps**	0-100									
Disconfirmation	**1.Disconfirmation-Global**	**Dg**	1-7	√	√		√	√	√		√	
	2.Single Item Disconfirmation-Overall	**Do**	0-100	√							√	
Disconfirmation for Product	**1. Single Item Disconfirmation - Product**	**Dp**	0-100	√		√						
Disconfirmation for Service	**2. Single Item Disconfirmation - Service**	**Ds**	0-100	√		√						
Satisfaction	**1. SADL- global**	**Sg**	1-7		√	√	√	√	√			√
	2. Single Item Satisfaction - Overall	**So**	0-100									√
Response Bias	**SDRS-5**	**SDR**	0-20				√	√	√			

3.2.4.1 Management of missing data

Participants occasionally left survey questions blank, resulting in missing data points. Any participant survey containing responses to at least 75% of the survey questions was included in the analysis.

3.2.4.2 Descriptive data

Data from each of the measures described above was used to calculate the mean, median, standard deviation and range. These values provided a summary of the distribution of the participant self-report ratings across constructs.

3.3 SPECIFIC RESEARCH QUESTIONS AND ANALYSIS

3.3.1 Pre-study question

Do repeated administrations of the APHAP-based Hearing Aid Disconfirmation measure, and single-item measures of overall disconfirmation, disconfirmation for product, and disconfirmation for service, yield equivalent results?

Data from 30 subjects were used to answer this question. An Intra-Class Correlation (ICC) was calculated with variables being Disconfirmation Score (Global and single-item

overall, single-item product, and single-item service) and test occasion (first and second) as shown in the table below.

Table 12. Pre-study question constructs, instruments, codes, and values

Construct	Instrument	Code	Value
Disconfirmation **Tests**	1.Disconfirmation-Global- Time 1	**Dg1**	1-7
	2.Single Item Disconfirmation-Overall Time 1	**Do1**	0-100
	1. Single Item Disconfirmation -Product Time 1	**Dp1**	0-100
	2. Single Item Disconfirmation – ServiceTime 1	**Ds1**	0-100
Disconfirmation **Retests**	1. Disconfirmation -Global-Time 2	**Dg2**	1-7
	2.Single Item Disconfirmation-Overall Time 2	**Do2**	0-100
	1. Single Item Disconfirmation -Product Time 2	**Dp2**	0-100
	2. Single Item Disconfirmation - Service Time 2	**Ds2**	0-100

Null Hypotheses:

1 H0: ρDg1,Dg2=0

2 H0: ρDo1,Do2=0

3 H0: ρDp1,Dp2=0

4 H0: ρDs1,s2=0

This question addressed test-retest reliability for the disconfirmation measures used in the study. Of note, test re-test reliability had previously been established for the performance and satisfaction measures and was not specifically re-evaluated in this study.

3.3.2 Main research questions

The table below shows the construct, instruments, data code, and possible values for data used in the main questions:

Table 13. Main research questions constructs, instruments, codes, and values

Construct	Instrument	Code	Value
Performance	**1. APHAP-Global**	**Pg**	1-7
	2. Single Item Performance Overall	**Po**	0-100
Performance for Product	**1. Single Item Product Performance**	**Pp**	0-100
Performance for Service	**1. Single Item Service Performance**	**Ps**	0-100
Disconfirmation	**1.Disconfirmation-Global**	**Dg**	1-7
	2.Single Item Disconfirmation-Overall	**Do**	0-100
Disconfirmation for Product	**1. Single Item Disconfirmation -Product**	**Dp**	0-100
Disconfirmation for Service	**1. Single Item Disconfirmation - Service**	**Ds**	0-100
Satisfaction	**1. SADL- global**	**Sg**	1-7
	2. Single Item Satisfaction - Overall	**So**	0-100
Response Bias	**1. SDRS-5**	**SDR**	0-20

3.3.2.1 Question #1

Does global disconfirmation predict global satisfaction in first-time hearing aid users?

Power : With the sample size of 59 and alpha=.05 the observed power for this question was >.999.

Independent Variables: 1. Dg1

Dependent Variables: 1. Sg1

Regression Equation: $Sg= b_0 + b_1 Dg + E$

rediction: b1>0

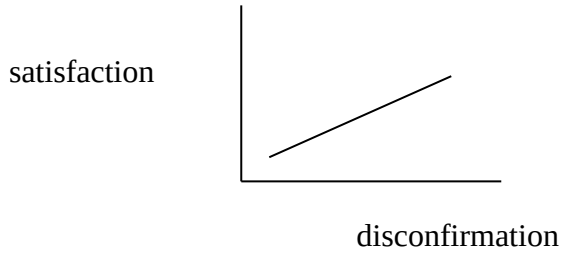


Figure 4. Predicted regression line question 1

Data for this question came from the global scores of the APHAP-based disconfirmation measure and from the global scores of the SADL measure. This question addressed the underlying motivation for this research project. It explored the relationship between disconfirmation and satisfaction. It was hypothesized that higher levels of positive disconfirmation would be associated with higher levels of satisfaction, as has been shown in the consumer and health care literature. Results for this question were intended to demonstrate whether the expectancy-disconfirmation model of satisfaction offers a valid framework from which we can further explore and understand hearing aid fitting/purchase satisfaction.

3.3.2.2 Question #2

How is overall hearing aid satisfaction influenced by disconfirmation for product and disconfirmation for service elements of the purchase?

Power: With a sample size of 60 and alpha = .05 observed power for this question was > .999

Independent Variables:

1. Dp
2. Ds

Dependent Variables: 1. Sg

Regression Equation: $Sg=bo+b1Do_p+b2Do_s+E$

Prediction: b1 >0; b2 >0;b1≠b2

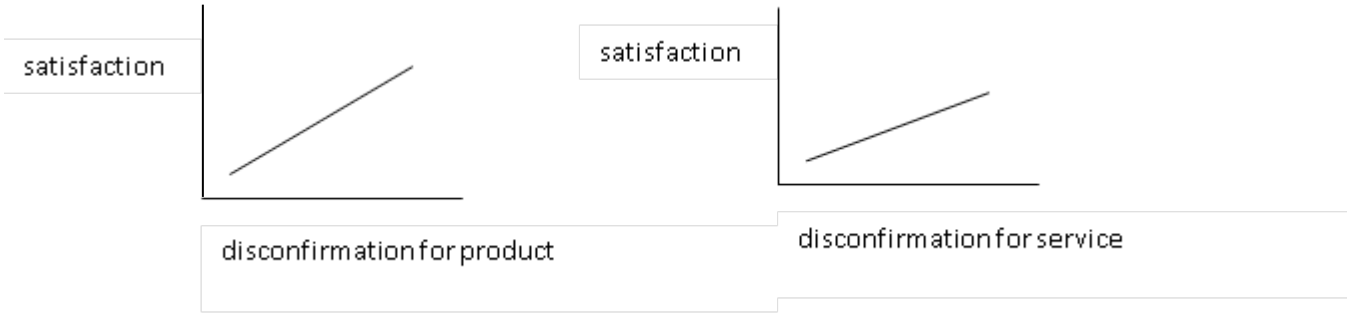


Figure 5. Predicted regression lines for question 2

Data for this question came from the single-item measures of disconfirmation for product, disconfirmation for service, and global hearing aid satisfaction as measured by the SADL. This question explored the contribution of disconfirmation for the hearing aid product and disconfirmation of the related services to global hearing aid satisfaction. It was predicted that as disconfirmation for these elements increased, so too would satisfaction. It was not clear from the literature which of these areas would be more likely to show a greater contribution to satisfaction.

3.3.2.3 Question #3

What is the influence of Socially Desirable Response Set on self-reported measures of hearing aid performance, disconfirmation, and satisfaction with hearing aids?

Power: This question involved one independent variable, socially desirable response set, and its influence on three different dependent variables. The original estimate of power, with a sample size of 100, medium effect size, and alpha = .05, was .99.

Independent Variables	1. SDR
Dependent Variables	1. Pg 2. Dg 3. Sg
Equations:	$Pg= b_0+b_1SDR+E$ $Dg= b_0+b_1SDR+E$ $Sg= b_0+b_1SDR+E$
Prediction:	b1>0 for each equation

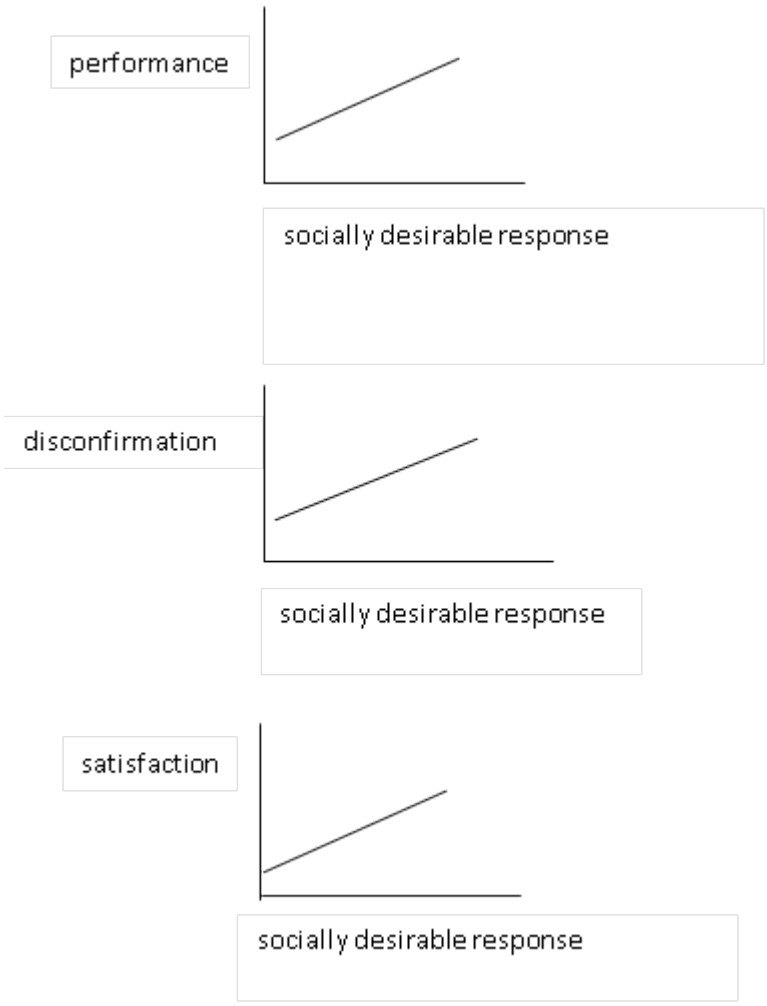


Figure 6. Predicted regression lines for question 3

Data for this question came from scores on the SDRS-5 instrument and from global APHAP, global disconfirmation, and global SADL scores. This question explored whether higher levels of socially desirable response tendency are associated with higher self-reported

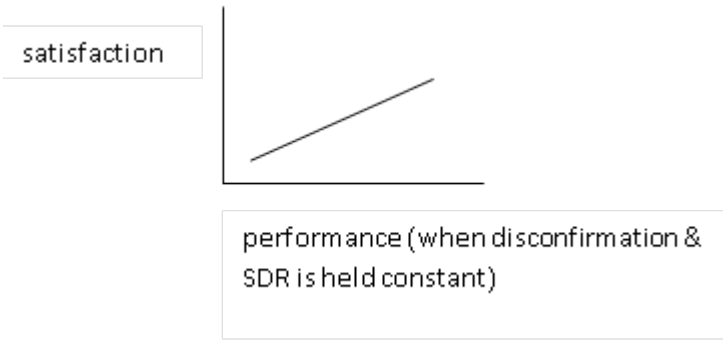
ratings on hearing aid performance, disconfirmation, and satisfaction. It was predicted that higher SDRS-5 scores would be associated with higher global scores on the APHAP, disconfirmation measure, and SADL.

3.3.2.4 Question #4

What are the influences of perceived performance and disconfirmation on satisfaction, controlling for socially desirable response set?

Power: With an N= 58, a large effect size, and alpha=.05 power was > .999.

Independent Variables	1. Pg 2. Dg 3. SDR
Dependent Variables	1. Sg
Equation: Prediction: b1>0, b2>0,b3>0; b1<b2, b2>b3	Sg= bo+b1Pg+b2Dg+b3SDR+E



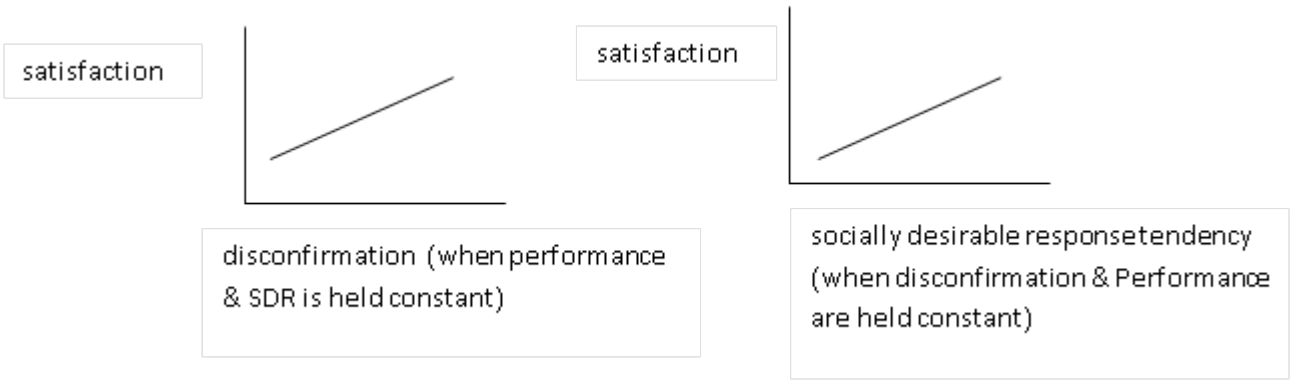


Figure 7. Predicted regression lines for question 4

Data for this question came from the APHAP and global disconfirmation measure, and from the SDRS-5 measure and global SADL score. This question included the perceived performance construct to assess its contribution towards satisfaction, along with the contribution of disconfirmation. Adding the SDRS-5 data into this equation allowed for these variables to be assessed while taking into account contribution of the socially desirable response tendency. It was predicted that higher perceived performance and positive disconfirmation would be associated with higher rated satisfaction. It was predicted that higher socially desirable response tendency would be associated with higher satisfaction.

3.3.2.5 Question #5

Does socially desirable response tendency moderate the influence of disconfirmation and perceived performance on satisfaction?

Power: This question involved 2 variables and 3 covariates. With the large effect size and alpha =.05, the sample size of 58 yielded a power of >.999.

Independent Variables

1. SDR X Pg

	2. SDR X Dg
Covariates	1. Pg
	2. Dg
	3. SDR
Dependent Variable	1. Sg
Equation:	Sg=b0+b1Pg+b2Dg+b3SDR+b4SDR*Pg+b5SDR*Dg

Prediction (main effects only): b1>0;b2>0b3>0;b4>0;b5>0

Figure 8. Predicted regression lines for question 5

This question explored the extent to which socially desirable response tendency moderates the performance/satisfaction relationship and the disconfirmation/satisfaction relationship. It was difficult to predict the outcome of this question though it seemed that higher socially desirable response levels would strengthen the relationship between disconfirmation and satisfaction and between performance and satisfaction. Thus an interaction effect of socially desirable response tendency was expected.

3.3.2.6 Sub-Questions:

The following sub-questions explored the equivalence of the single-item measures of overall performance, overall disconfirmation, and overall satisfaction with the multiple-item measures.

A . Are scores from a single- item overall Performance rating equivalent to the Global APHAP score?

Independent variables: 1. Po1
Dependent Variable 1. Pg
Equation Po=bo+b1Pg+E
Prediction: b1>0

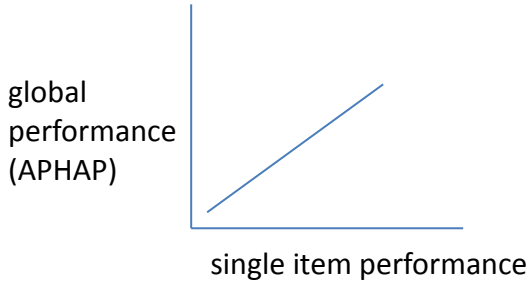


Figure 9. Predicted regression line for sub-question A

B. Are scores from a single-item overall disconfirmation rating equivalent to the APHAP-based global disconfirmation score?

Independent Variable 1.Do1
Dependent Variable 1.Dg
Equation Do=bo+b1Dg+E
Prediction: b1>0

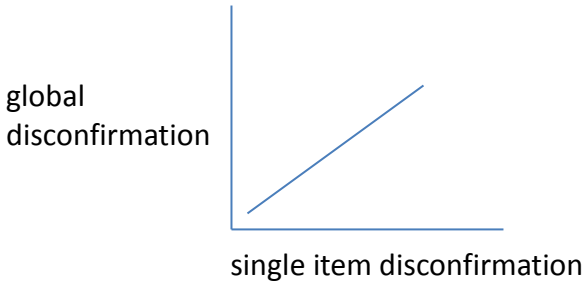


Figure 10. Predicted regression line for sub-question B

C. Are scores from a single-item overall satisfaction rating equivalent to the SADL global satisfaction score?

Independent Variable	1.	So1
Dependent Variable	1.	Sg
Equation	So=bo+b1Sg+E	
Prediction:b1>0		

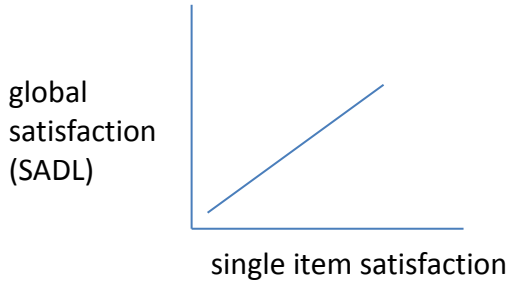


Figure 11. Predicted regression line for sub-question C

4.0 RESULTS AND CONCLUSIONS

4.1 RESULTS

4.1.1 Descriptive statistics: participant demographics

The time elapsed between the hearing aid fitting and mailing of the outcome measurement instruments to participants ranged from 4-6 weeks. Completed questionnaires from participants were received across a range from 10- 56 days after mailing, with a mean of 23 days.

Surveys were mailed to 215 potential participants. The response rate was 31%. Data were analyzed from 67 participants. Missing data from some participants resulted in varied N's for individual analyses. The sample included 29 females and 35 males. Data on participant age are shown in table 14.

Table 14. Age data for participants (n=64)

Mean	70.7 years
Median	69.0 years
Standard Deviation	10.95
Range	50-93 years

Information on participants' level of education is shown in Figure 12. Note that a majority of participants reported completing grade 12 or higher, with almost 30% of participants reporting an advanced degree beyond 4 years of college. The relatively high level of education of this sample probably represents the patient population at the University Medical Center from which the hearing aids were fit and purchased. Additionally, it is possible that the relatively high level of education seen in the sample is more heavily weighted by those individuals who completed and returned the surveys.

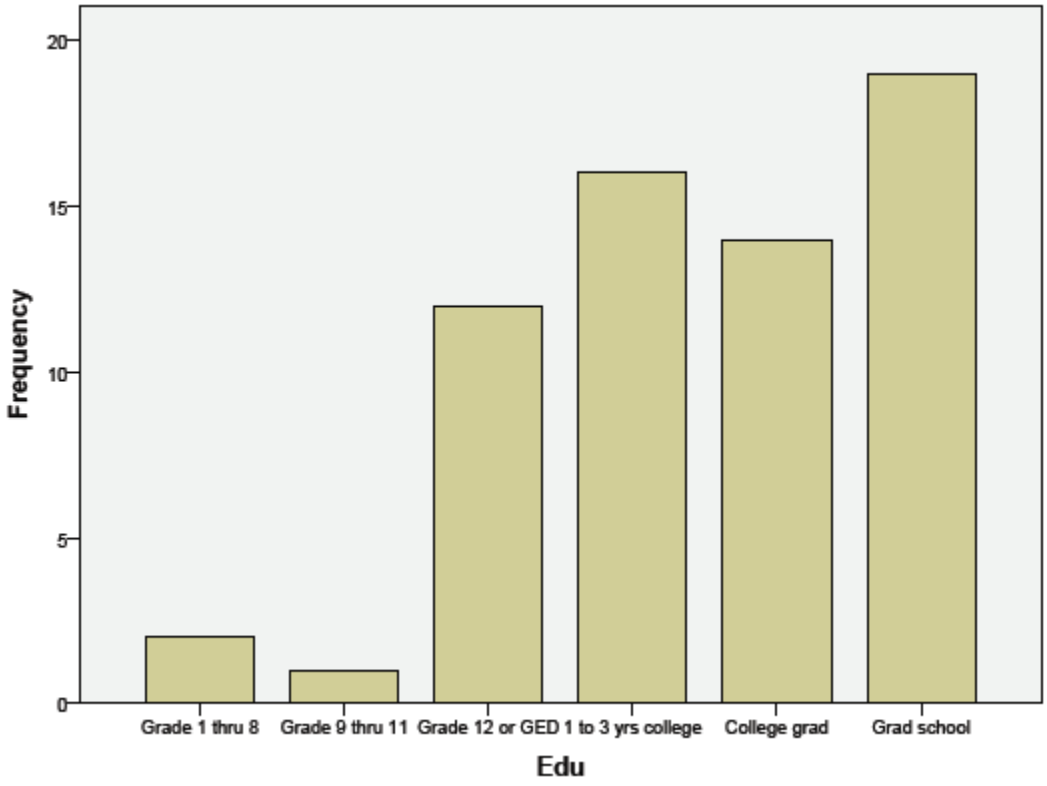


Figure 12. Distribution of participants by highest grade of school completed.

Household income was reported in 12 categories ranging from less than $10,000 per year to $150,000 or higher per year. As shown in Figure 13, the participant sample was heavily weighted toward the higher income categories. This weighting likely reflects both the high level

of education in the sample and the perception of hearing aids as a relatively high cost consumer item.

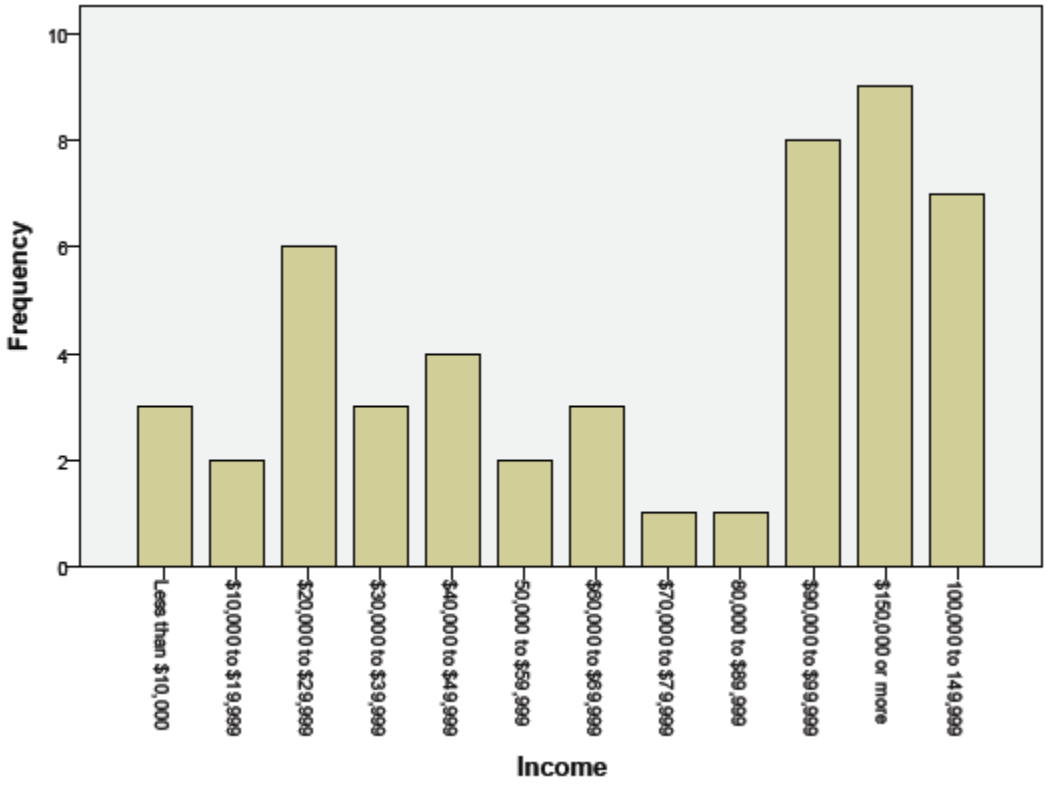


Figure 13. Distribution of participants across categories of household income

4.1.2 Descriptive statistics: measurement instruments

The distribution of responses to individual questions on the APHAP instrument and the SADL instrument were similar to those found in earlier publications (Cox and Alexander, 1995; Cox and Alexander, 1999), showing normal distributions and expected variability. Responses on the

APHAP-based disconfirmation measure were normally distributed as well. Table 15 shows the mean, median, standard deviation, and range of scores on each of these instruments.

Table 15. Descriptive statistics for responses across measurement instruments

		APHAB Global score	Global discomfirmation	SADL total score	SDRS-5
N	Valid	63	63	64	66
	Missing	5	5	4	2
Mean		5.03	4.28	5.0711	5.51
Median		5.13	4.04	5.0714	4.0000
Std. Deviation		.74626	1.069	.80149	6.33006
Range		2.13-6.22	1.89-6.96	3.33-6.47	0-20

4.1.3 Pre-study question: Test-retest reliability on disconfirmation measures

Intraclass correlation coefficients (ICC) were used to assess the test-retest reliability of the disconfirmation measures. The measures evaluated included the APHAP-based disconfirmation measure and the single item measures of disconfirmation for fitting, product, and service.

Correlation coefficients, reflecting the relationship between Time 1 and Time 2 administration of the Disconfirmation instruments, are shown in Table 16. Due to missing responses from some participants, the test re-test data on global disconfirmation were based on N=26, versus the originally planned sample size 30.

Table 16. ICC coefficients on T1-T2 disconfirmation responses

Variable	ICC Coefficient	N
Global disconfirmation (mean of APHAP- based items)	.76	26
Single item disconfirmation for fitting	.70	30
Single item disconfirmation for product	.64	30
Single item disconfirmation for service	.58	30

Cronbach's Alpha was used to measure internal consistency reliability of the APHAP-based disconfirmation items, yielding a coefficient of .87.

4.1.4 Results of analysis on specific research questions

Linear regression analyses were conducted on data relating to each of the main research questions and the results are described below. In all cases where significant effects were found, scatter plots of the data were examined and the assumption of linearity appeared to be met. Further results and explanation of individual analyses follows.

4.1.4.1 Q1: Global disconfirmation predicting satisfaction

Question #1 was designed to determine the extent to which global disconfirmation predicts satisfaction ratings in first time hearing aid users. This analysis addressed the central research question being investigated: Does the relationship between disconfirmation and satisfaction in first time hearing aid purchasers fit the expectancy-disconfirmation model of satisfaction tested in other consumer and patient care contexts? A bivariate regression analysis was conducted,

where hearing aid satisfaction was regressed on disconfirmation and a significant model emerged with $F_{(1,57)} = 44.01$, $p < .01$, adjusted $r^2 = .43$). The predictor variable of disconfirmation yielded a beta of .52.

These results indicate that 43% of the variance in satisfaction is explained by level of disconfirmation, showing a large effect size (Cohen and Cohen, 1983).

4.1.4.2 Q2: Disconfirmation for product/service predicting satisfaction

Question #2 addressed the contribution of disconfirmation for product and disconfirmation for service as predictors of hearing aid satisfaction. Based on the moderate correlation (.557) of these two predictor variables, collinearity diagnostics were run. The resulting tolerance and VIF (variable inflation factor) values were not consistent with those seen in collinear variables. With these single item response variables entered into the model together, the model was significant with $F_{(2,57)} = 29.207$, $p < .01$, and adjusted $R^2 = .49$. Beta and *p* values of the variables are shown in table 17.

Table 17. Beta and p values for predictor variables, question 2

Predictor Variable	**Beta**	***p* value**
Disconfirmation product	.303	<.001
Disconfirmation service	.062	.312

Disconfirmation for product significantly contributed to the prediction of satisfaction, when adjusting for disconfirmation for service. Disconfirmation for service did not significantly contribute to the prediction of satisfaction, after adjusting for disconfirmation for product.

4.1.4.3 Q3: Influence of response bias on hearing aid measures

Question 3 addressed the influence of response bias on the performance, disconfirmation, and satisfaction measures. Response bias was represented by the SDRS-5. Responses on the Social Desirability Response Set (SDRS-5) were skewed towards the lower end of the response range. Individual regression analyses were run, with each of the measures (APHAP, APHAP-based disconfirmation, and SADL) regressed on SDRS-5. In each of the three regressions no significant effect was demonstrated, as shown in table 18.

Table 18. Regression of performance, disconfirmation, and satisfaction on SDRS-5

Predictor	Adjusted r^2	F value	p value
Perceived Performance	.006	1.36	.248
Disconfirmation	.000	.990	.324
Satisfaction	-.004	.773	.383

These results did not demonstrate any significant effect of response bias (as measured by the SDRS-5) on self-report measures of perceived performance, disconfirmation, or satisfaction.

4.1.4.4 Q4: Performance/disconfirmation predicting satisfaction

Question 4 investigated the contribution of perceived performance and disconfirmation on satisfaction, controlling for socially desirable response set. Collinearity diagnostics were run on the variables of performance and disconfirmation. Tolerance and VIF values were not consistent with collinearity. Satisfaction was regressed on performance, disconfirmation, and socially desirable response set. The resulting model was significant, $F_{(3,54)} = 22.70$, $p < .001$., adjusted $R^2 = .53$. Beta, *p* values, and r^2 of variables are shown in table 19.

Table 19. Beta and p values for performance, disconfirmation, and response bias

Predictor Variable	**Beta**	***P* value**
Perceived Performance	.465	<.001
Disconfirmation	.362	<.001
Socially Desirable Responding	-.010	.517

Taken together, socially desirable responding, performance and disconfirmation accounted for 53% of the variance in satisfaction. After adjusting for all other variables in the model, performance and disconfirmation each showed a significant contribution to predicting

satisfaction. Socially desirable responding did not show a significant contribution to the prediction of satisfaction.

4.1.4.5 Q5: Interaction of response bias on prediction of satisfaction

This question examined whether the socially desirable response set moderates the influence of disconfirmation and performance on satisfaction. Satisfaction was regressed on disconfirmation and perceived performance with and without the variable of socially desirable responding as an interaction term. When the interaction terms were added into the model the r^2 change was .033, a very small change. Further data exploring a moderating effect of socially desirable responding on the prediction of satisfaction by perceived performance and disconfirmation is shown in table 20.

Table 20. Beta, t and p values for the interaction term of socially desirable responding

	Beta	**t**	**p value**
SDRS x Perceived performance	.048	2.026	.048
SDRS x Disconfirmation	-.011	-.735	.465

SDRS x perceived performance showed a significant interaction, with a small effect. SDRS x disconfirmation did not show a significant interaction.

4.1.4.6 Predicting multi-item questionnaire results from single items

The sub-questions investigated the equivalence of the single item measures of overall performance, overall disconfirmation, and overall satisfaction with the multiple-item APHAP and SADL based measures. These questions addressed whether participants' reports of performance, disconfirmation, and satisfaction via multiple item instruments could validly be captured via one single item question for each construct. To answer this question, each of the multiple item measures was regressed on its related single item measure to see how well one could predict the other. The results are shown in table 21.

Table 21. Data from regression of single item measures on multiple item measures

Variables	**R**	**Adjusted r^2**	**F**	**p value**	**beta**
global APHAP score regressed on single item performance	.57	.32	26.91	< .001	.03
global disconfirmation regressed on single item disconfirmation	.85	.71	148.89	< .001	.51
global satisfaction regressed on Single item satisfaction	.51	.25	20.85	<.001	.02

For each of the constructs tested above the model was significant. The single item perceived performance rating accounted for 32% of the variance in the global APHAP score. The single

item disconfirmation rating accounted for 71% of the variance in global disconfirmation. The single item satisfaction rating accounted for 25% of the variance in global satisfaction.

4.2 DISCUSSION

4.2.1 Pre-study question: Test-retest reliability on disconfirmation measures

The pre-study questions were intended to determine whether test-retest reliability on the APHAP-based disconfirmation instrument and on the single item disconfirmation measures could be demonstrated. As seen in table 16, responses from time 1 and time 2 on the APHAP-based disconfirmation were highly correlated ($p<.01$) on each of the measures tested. Calculation of the ICC includes analysis of both the relationship between values at Time 1 and Time 2, and the differences between responses at Time 1 and Time 2. Thus, the large ICC values (Cohen, 1988) demonstrated that responses at each administration were not only highly related, but very close in actual value. Internal Consistency Reliability on the APHAP-based disconfirmation measure was high, demonstrating the unidimensional nature of the underlying construct. The highest correlation was found on the APHAP-based global disconfirmation scores, contributing to the legitimacy of the instrument by demonstrating test-retest reliability. The single item disconfirmation responses yielded moderate- large correlations, with the lowest coefficient value coming from the disconfirmation for service item ($r=.58$). In addition to the pre-study question, test retest reliability on the APHAP items was measured. The results showed a large positive correlation between responses at time 1 and time 2 ($r=.80$, $p>.01$) as has been shown previously

by Cox and Alexander (1995). Thus, participants largely maintained their responses from test to retest. These data were taken from the global scores of the multi-item instrument and did not probe test-retest reliability in specific subscales of the instrument. Of note, the lower correlation seen in the disconfirmation for service item could indicate that this is a weaker construct in the hearing aid delivery context studied. In other words, it is possible that patients referred for hearing aid delivery do not think much about the service component they expect to receive as part of the hearing aid fitting experience. This could explain why reporting of the disconfirmation is not as stable as that of disconfirmation for the product or for the overall fitting experience.

4.2.2 Q1: Global disconfirmation predicting satisfaction

This question addressed the extent to which disconfirmation could predict satisfaction in the hearing aid purchase context. These results are consistent with those predicted for this question, providing evidence that the expectancy-disconfirmation model of satisfaction has relevance to first time hearing aid purchasers. More specifically, the model suggests that one unit of increase in disconfirmation yields a .5 unit of increase in satisfaction. The r^2 value obtained (.43) was consistent with those published by Wong et al. (2009) across several aspects of hearing aid service and performance (r^2= .32-.76) in Chinese users. This large effect (Cohen & Cohen, 1983) is similar to that (r^2=.31-.73) shown in earlier expectancy-disconfirmation research across contexts unrelated to hearing aids (Ammentorp et al., 2006; Hudak et al., 2004; Tse & Wilton, 1988). This finding provides a basis upon which to further look towards customer satisfaction

models to help us increase our understanding of hearing aid satisfaction. Additionally, this result gives us empirical evidence of the indirect importance of expectations in successful hearing aid adoption. Inherent in these results is the notion that level of expectation, and level of perceived performance, together contribute to the outcome of hearing aid satisfaction.

Some caveats are necessary in interpreting the strong predictive relationship demonstrated in this question. The analysis in this study did not allow for exploration of individual contributions of specific aspects of hearing aid disconfirmation. This would require analysis of the subscale data from the disconfirmation instrument. The subscales may point to specific areas of hearing aid performance for which appropriate expectations play a more important role in facilitating satisfaction. Examination of subscale correlations with satisfaction could be addressed in a future analysis of these data.

Another limitation in this study was that the order of the outcome measures presented in the survey was not counterbalanced. Thus it is possible that the order of the questions could have had a systematic effect on the responses. For example, participants were first asked the performance questions, focusing their attention on how the hearing aid performed across a variety of specific listening situations. The single item performance questions followed. It is possible that focusing attention on the specific listening situations could have influenced the responses on the single item performance questions. The satisfaction instrument followed the performance questions and the SDRS-5. It is possible that placement of the satisfaction instrument at the beginning of the survey might have captured higher or lower responses. These responses would have been free of any prior focused attention on specific listening situations in which the hearing aid performance was not optimal. In other words, it is possible that focusing

the participants' attention on specific listening situations could have prompted responses that were higher or lower than if the questions were otherwise ordered.

Use of the subjective disconfirmation approach could have yielded less valid disconfirmation data, than that obtained using an objective approach. The subjective method used inherently involves a memory of the expectation, which occurred prior to the hearing aid purchase. It is not known whether an objective measure of disconfirmation might yield a different outcome. Similarly, the operationalization of each construct can be questioned, and if implemented differently could yield a different outcome. A variety of methodological issues can be addressed in future studies.

This study did not specifically control for the hours of daily use of the hearing aids. Similarly, there was no assessment of the level of expectations each participant brought to the hearing aid fitting.

Lastly, the hearing aid delivery model needs to be considered in interpreting these data. This study was conducted in a university medical center setting, where many of the *customers* are referred by a physician to seek hearing aid follow up. The data might look different if collected from a sample of non-paying hearing aid patients such as veterans who are serviced through the VA Healthcare System. Similarly, patients in non-medical private practices may have different expectations which might lead to a different level of disconfirmation and/or satisfaction.

4.2.3 Q2: Disconfirmation for product and service predicting satisfaction

This question addressed the contribution of disconfirmation for product and disconfirmation for service components of the hearing aid delivery. The single item measures were used to address the constructs in this question. Together, the disconfirmation for product and disconfirmation for service accounted for approximately half of the variance in satisfaction. Of these variables, the disconfirmation for product appears to contribute most significantly to the satisfaction when both service and product are considered together. The question began to address the interwoven roles of product and service elements in the hearing aid fitting/purchase. Unlike other consumer and health service contexts, it is possible that hearing aid purchasers in a medical center venue may not formulate explicit expectations of the service they will receive. This may be related to the relatively young and unrecognized profession of Audiology. In other words, a patient referred for a hearing aid by his/her ENT may not anticipate that a professionally credentialed audiologist will provide a specific array of services related to the hearing aid. In contrast, he/she probably anticipates something about the service/affect of his/her dentist or lawn care provider, as has been shown in the disconfirmation literature (Alford, 1998). It is possible that this outcome might be different if this study were done in a private practice setting, unrelated to a medical center referral system. Those settings are likely to be chosen by the customer either based on advertising or word of mouth, possibly resulting in better developed expectations of service. As noted in the results of the pre-study questions, it may be that the construct of expectations of service in the hearing aid delivery context is not as well developed as is disconfirmation for

product. As with question #1 there is more to explore regarding the contributions of each of these predictors in this unusual context of product, service, and healthcare.

4.2.4 Q3-5: Influence and moderating effect of response bias

Questions 3-5 are grouped together here because all are related to assessing the influence and/or moderating effect of response bias, as measured by socially desirable response set. Does the socially desirable response tendency result in bias that systematically influences self-report hearing aid outcome measures? What are the contributions of performance, disconfirmation and socially desirable response set on satisfaction? How does socially desirable response set moderate the influence of performance and disconfirmation?

It was expected that the results of question #3, regarding socially desirable responding, would show that a higher level of response bias was associated with higher ratings on self-report measures of performance, disconfirmation, and satisfaction. The data did not support this hypothesis. The results showed no significant effect evident on any of the three self-report measures. This finding was consistent with results obtained by Cox et al (2007), and seems to confirm that response bias, defined by this particular instrument, does not diminish validity of the hearing aid outcome measures used. Of note, Cox et al (2007) used a slightly different scoring approach when they looked for an influence of SDRS-5 on hearing aid self-report. However, even with this difference in scoring the current study essentially replicates their finding of no influence from this particular response bias. There are a few possible interpretations of this finding. This bias has been demonstrated in self-report instruments in

other domains. Perhaps reports of hearing/hearing aid function and/or satisfaction, particularly after hearing aid purchase, have some immunity to socially desirable responding. This could be related to a possibly reduced zone of tolerance for hearing aid purchases than that seen in more typical consumer products. Additionally, interpretation of these results should not discount other sources of potential response bias that could influence the self-report measures. Other variables that were not measured in this study (i.e. personality, mental and physical health factors) could influence these outcomes. This finding did not support the hypothesis for this question, but it does offer an added level of cautious confidence in the results of self-report measures used in both clinical and research applications involving hearing aid outcomes.

The results of question #4 addressed the contribution of disconfirmation for product and disconfirmation for service in predicting satisfaction, controlling for socially desirable responding. Perceived performance, disconfirmation, and socially desirable responding together explained over 50% of the variance in satisfaction. However, once perceived performance and disconfirmation are accounted for, the contribution of socially desirable responding is not significant. This is not surprising given that there was no effect of socially desirable responding on any of the measures. The results do show that both perceived performance and disconfirmation make a unique contribution to satisfaction. The strength of the relationship appears to be roughly similar for each of these factors, however further analysis would be necessary to more accurately assess the distinct contribution of each of these variables.

Finally, consistent with the earlier findings related to socially desirable responding, there is a very weak moderating effect of the SDRS-5 on the prediction of satisfaction by perceived performance. In other words, for a hearing aid user with high perceived performance, the level of

socially desirable responding may have a bigger impact on satisfaction versus those with lower perceived performance. There was no moderating effect on prediction of satisfaction by disconfirmation. In general, socially desirable responding does not seem to play a role in satisfaction formation in the hearing aid context. As noted earlier, other forms of response bias may play a role and should be investigated in the future. This result can only be interpreted in the context of American culture. It is possible that a different result could occur if tested in cultures where individuals are less likely to question authority, or where behavior is more heavily dictated by social norms than in the United States.

4.2.5 Predicting multi-item questionnaire results from single items

Each of these single item measures had a large effect size, based on Cohen and Cohen (1983). Responses on the single item question on hearing aid performance serve as a strong predictor of the global APHAP scores. The single item measure regarding hearing aid disconfirmation is a strong predictor of the global disconfirmation score. Lastly, responses on the single item satisfaction question are a strong predictor of the global SADL score. This means that an increase in the score of the single item measure results in an increase in the global score in each of the measures. The strong predictive value of the single item measures for the multiple item measures increases the construct validity of both measures. Cox and Alexander (2001) showed a high correlation between a single item satisfaction question and the SADL (.76). The reported results on the satisfaction measures were obtained in a manner similar to the current study, except that the sample in their study included long time hearing aid users. The correlation for the

single item versus multiple item satisfaction measures was somewhat lower (.51) in the current sample than in their study.

Though these single item measures may capture the overall response level of the multiple item measures, they cannot provide the precision information useful in both research and clinical purposes. For example, a new hearing aid user may have one specific listening situation in which he does not perceive his hearing aid to perform well. This specific situation, and the appropriate adjustment, would not be identified in a single item rating of product performance. Similarly, subscale groupings in the multiple item measures will allow for more specific analysis of predictors of outcomes such as satisfaction.

4.3 CONCLUSIONS

Most prior studies of hearing aid satisfaction have analyzed the relationship between satisfaction and a number of variables that relate to hearing aid features or factors particular to users. This project approached the subject by studying users' internal experiences with hearing aid adoption, based on a consumer model of satisfaction. Following up on the work of Wong et al (2009), this study was the first research evaluating the expectancy-disconfirmation model of satisfaction in first time hearing aid users in the United States. The results of this study are consistent with those seen in the consumer and healthcare literature, confirming that the expectancy-disconfirmation model offers a legitimate prospective from which we can further study the components of hearing aid satisfaction. A disconfirmation instrument, based on the APHAB instrument,

demonstrated adequate test-retest reliability and internal consistency to serve as a valid data collection instrument for hearing aid disconfirmation. This instrument was used to demonstrate that as participants' disconfirmation increased in the positive direction, so did satisfaction. Hearing aid users with high expectations were likely to experience a smaller positive disconfirmation. Those hearing aid users with smaller positive disconfirmation were likely to demonstrate lower levels of satisfaction. It appears that disconfirmation of the hearing aid instrument's product performance may carry greater influence on satisfaction than does disconfirmation of the service provided around the fitting. Perceived performance of the hearing aid and global disconfirmation both seem to make a substantial contribution to satisfaction.

4.3.1 Future questions

This study has shown that the expectancy-disconfirmation model of satisfaction provides a valid framework in which to further explore, and hopefully improve, hearing aid satisfaction. As such, a number of questions regarding hearing aid satisfaction can now be addressed using this model.

1. When is the disconfirmation most important for achieving satisfaction in hearing aid users? For example, is disconfirmation an important predictor of satisfaction in hearing aid users 6 months or a year after purchase?
2. Do certain aspects of the hearing aid experience contribute more or less to the satisfaction outcome? That is, does disconfirmation as measured in APHAP subscales contribute differentially to satisfaction?

3. Does manipulation of expectation e.g., reducing negative disconfirmation improve satisfaction. If so, what are the most effective means by which to establish appropriate expectations?
4. Does the disconfirmation model predict satisfaction in other hearing aid delivery models in the United States such as the Veterans Affairs system or Vocation Rehabilitation programs, where patients do not pay for their hearing instruments? Similarly, might the service component play a larger role in determining satisfaction in a non-medical private practice setting, where expectations for service may be greater?

The answers to these questions should be of direct value to audiologists and hearing aid manufacturers in providing pre-fit product and service information to patients and to the public. Additionally, research within this framework might guide the allocation of hearing aid dispensing resources in the pursuit of improved patient/customer satisfaction.

APPENDIX

PARTICIPANT QUESTIONNAIRE

The questions below will ask you first to rate the performance of your hearing aid in a variety of listening situations. Then you will be asked to rate how the performance of your hearing aid compares to your expectations before the hearing aid purchase.

Please mark an X above the description that best describes your everyday experience when you are using your hearing aids. Notice that each choice includes a percentage. You can use this to help you decide on your answer. For example, if a statement is true about 75% of the time, circle "Generally" for that item.

Then you should mark an X above the number that best describes how your hearing compares to your expectation before you were fit with hearing aids. If you have not experienced the situation we describe, try to think of a similar situation that you have been in and respond for that situation. If you have no idea, leave that item blank.

Since getting my hearing aids:

1. **A. With my hearing aid(s) on: When I am in a crowded grocery store, talking with the cashier, I can follow the conversation**

Always (99%) Almost Always (87%) Generally(75%) Half-the-time (50%) Occasionally (25%) Seldom (12%) Never (1%)

B. Compared to my expectation, my hearing in the above situation is

(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)
Worse than I expected			Just as I expected			Better than I expected

2. **A. With my hearing aid(s) on: I miss a lot of information when I'm listening to a lecture**

Always (99%) Almost Always (87%) Generally(75%) Half-the-time (50%) Occasionally (25%) Seldom (12%) Never (1%)

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

3. A. with my hearing aid(s) on: Unexpected sounds, like a smoke detector or alarm bell are uncomfortable.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

4. With my hearing aid(s) on: I have difficulty hearing a conversation when I'm with one of my family at home.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____ _____ _____ _____ _____ _____ _____

(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)
Worse than I expected			Just as I expected			Better than I expected

5. A. With my hearing aid(s) on: I have trouble understanding dialogue in a movie or at the theater.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	Almost Always (87%)	Generally(75%)	Half-the-time (50%)	Occasionally (25%)	Seldom (12%)	Never (1%)

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)
Worse than I expected			Just as I expected			Better than I expected

6. A. With my hearing aid(s) on: When I am listening to the news on the car radio, and family members are talking, I have trouble hearing the news.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	Almost Always (87%)	Generally(75%)	Half-the-time (50%)	Occasionally (25%)	Seldom (12%)	Never (1%)

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Worse than I expected **Just as I expected** **Better than I expected**

7. **A. With my hearing aid(s) on: When I am at the dinner table with several people, and am trying to have a conversation with one person, understanding speech is difficult.**

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

8. **A. With my hearing aid(s) on: Traffic noises are too loud.**

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

9. A. With my hearing aid(s) on: When I am talking with someone across a large empty room, I understand the words.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

10. A. With my hearing aid(s) on: When I am in a small office, interviewing or answering questions, I have difficulty following the conversation.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

11. A. With my hearing aid(s) on: When I am in a theater watching a movie or play, and the people around me are whispering and rustling paper wrappers, I can still make out the dialogue.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

12. A. With my hearing aid(s) on: When I am having a quiet conversation with a friend, I have difficulty understanding.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

13. A. With my hearing aid(s) on: The sounds of running water, such as a toilet or shower, are uncomfortably loud.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

14. A. With my hearing aid(s) on: When a speaker is addressing a small group, and everyone is listening quietly, I have to strain to understand.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

15. A. With my hearing aid(s) on: When I'm in a quiet conversation with my doctor in an examination room, it is hard to follow the conversation.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

16. A. With my hearing aid(s) on: I can understand conversations even when several people are talking.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

17. A. With my hearing aid(s) on: The sounds of construction work are uncomfortably loud.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

18. A. With my hearing aid(s) on: It's hard for me to understand what is being said at lectures or church services.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

19. A. With my hearing aid(s) on: I can communicate with others when we are in a crowd.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

20. A. With my hearing aid(s) on: The sound of a fire engine siren close by is so loud that I need to cover my ears.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

21. A. With my hearing aid(s) on: I can follow the words of a sermon when listening to a religious sermon.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

22. A. With my hearing aid(s) on: The sound of screeching tires is uncomfortably loud.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

23. A. With my hearing aid(s) on: I have to ask people to repeat themselves in one-on-one conversation in a quiet room.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

24. A. With my hearing aid(s) on: I have trouble understanding others when an air conditioner or fan is on.

_____	_____	_____	_____	_____	_____	_____
Always (99%)	**Almost Always (87%)**	**Generally(75%)**	**Half-the-time (50%)**	**Occasionally (25%)**	**Seldom (12%)**	**Never (1%)**

B. Compared to my expectation, my hearing in the above situation is

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

25. Using a rating of 0-100, with 0 meaning poorest performance possible and 100 meaning best performance possible, how do your hearing aids perform in your daily listening activities: _____ *(Pp)*

26. Compared to my expectation, the performance of my hearing aids is:*(Dp)*

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**
Worse than I expected			**Just as I expected**			**Better than I expected**

27. Using a rating of 0-100, with 0 meaning poorest service possible and 100 meaning best service possible, rate the hearing aid services related to your hearing aid fitting and purchase:_____*(Ps)*

28. Compared to my expectation, the hearing aid services related to my hearing aid fitting have been:(*Ds)*

_____	_____	_____	_____	_____	_____	_____
(-3)	**(-2)**	**(-1)**	**(0)**	**(1)**	**(2)**	**(3)**

Worse than I expected	Just as I expected	Better than I expected

29. **On a scale of 0-100, with 0 being the worst possible performance and 100 being the best possible performance, rate the overall performance of your hearing aid fitting: _____*(Po)***
30. **Compared to my expectation, the overall performance with my hearing aid fitting has been: *(Do)***

_____	_____	_____	_____	_____	_____	_____
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)
Worse than I expected			Just as I expected			Better than I expected

31. **Using a rating of 0 to 100, with 0 being not satisfied at all and 100 being completely satisfied, rate your level of satisfaction with your hearing aid fitting:_____*(So)***

The next group of questions relate to some situations in which you might find yourself. Circle the number that represents how much each statement is TRUE or FALSE for you:

	Definitely True	Mostly True	Don't Know	Mostly False	Definitely True
32. I am always courteous even to people who are disagreeable	1	2	3	4	5
33. There have been occasions when I took advantage of someone	1	2	3	4	5
34. I sometimes try to get even rather than forgive and forget	1	2	3	4	5
35. I sometimes feel resentful when I don't get my way	1	2	3	4	5
36. No matter who I'm talking to, I'm always a good listener	1	2	3	4	5

Listed below are questions on your opinions about your hearing aids(s). For each question, please circle the letter that is the best answer for you. The list of words to the right gives the meaning of each letter. Keep in mind that your answers should show your general opinions about the hearing aids that you are wearing now or have most recently worn.	**A**	**Not at all**
	B	**A little**
	C	**Somewhat**
	D	**Medium**
	E	**Considerably**
	F	**Greatly**
	G	**Tremendously**
37. Compared to using no hearing aid at all, do your hearing aids help you understand the people you speak with most frequently?		**A B C D E F G**
38. Are you frustrated when your hearing aids pick up sounds that keep you from hearing what you want to hear?		**A B C D E F G**
39. Are you convinced that obtaining your hearing aids was in your best interests?		**A B C D E F G**
40. Do you think people notice your hearing loss more when you wear your hearing aids?		**A B C D E F G**
41. Do your hearing aids reduce the number of times you have to ask people to repeat?		**A B C D E F G**
42. Do you think your hearing aids are worth the trouble?		**A B C D E F G**
43. Are you bothered by an inability to get enough loudness from your hearing aids without feedback (whistling)?		**A B C D E F G**
44. How content are you with the appearance of your hearing aids?		**A B C D E F G**
45. Does wearing your hearing aids improve your self-confidence?		**A B C D E F G**
46. How natural is the sound from your hearing aids?		**A B C D E F G**
47. How helpful are your hearing aids on MOST telephones with *NO* amplifier or loudspeaker? (If you hear well on the telephone *without* hearing aids, check here ☐)		**A B C D E F G**

48. How competent was the person who provided you with your hearing aids?	**A B C D E F G**
49. Do you think wearing hearing aids makes you seem less capable?	**A B C D E F G**
50. Does the cost of your hearing aids seem reasonable to you?	**A B C D E F G**
51. How pleased are you with the dependability (how often they need repairs) of your hearing aids?	**A B C D E F G**

Age

What is your age? _____

Check the answer below that best describes you:

Sex

What is your sex?

- Male
- Female

Education completed

What is the highest grade or year of school you completed?

- Never attended school or only attended kindergarten
- Grades 1 through 8(Elementary)
- Grades 9 through 11 (Some high school)
- Grade 12 or GED (High school graduate)
- College 1 year to 3 years (Some college of technical school)
- College 4 years (College graduate)
- Graduate School(Advanced Degree)

Household Income

What is your total household income?

- Less than $10,000
- $10,000 to $19,999
- $20,000 to $29,999
- $30,000 to $39,999
- $40,000 to $49,999
- $50,000 to $59,999
- $60,000 to $69,999
- $70,000 to $79,999
- $80,000 to $89,999
- $90,000 to $99,999
- $100,000 to $149,999
- $150,000 or more

Thank you for your time in answering the survey questions. If you have completed the survey please place it in the stamped envelope provided, and mail it back to us. When we receive your completed survey we will mail you a $10.00 gift card. If you have any questions regarding this research study please call Elaine Mormer at 412-383-6610 or email emormer@pitt.edu.

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