Some Limitations of Evaluative Investigations Based Solely on Normed Outcome Measures

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Abstract

The present article argues that evaluative research in audiológic rehabilitation should be consistent with contemporary conceptual frameworks of rehabilitation. Moreover, comprehensive evaluative research investigations should include an evaluation of (1) the process of intervention and (2) the impacts and consequences of the intervention program. An approach to rehabilitation based on the principle that intervention should be viewed as a solution-centered problem-solving process is outlined. Then, three illustrative cases are described and compared from the perspective of traditional evaluative research paradigms and from the perspective that audiológic rehabilitation is a solution-centered problem-solving process. Some shortcomings of traditional approaches to evaluative research are discussed. Finally, some guidelines that could lead to the development of comprehensive evaluative research in rehabilitation are outlined.

Key Words: Aural rehabilitation, hearing aid, outcome measures, problem-solving process

Significant developments in the area of audio-signal processing and the miniaturization of electronic circuitry have made it possible to design new generations of amplification systems for persons with a hearing loss. Also, research in the area of auditory physiology and psychoacoustics has provided a more comprehensive understanding of the peripheral auditory processing disabilities that characterize sensorineural hearing loss (Skinner, 1988; Moore, 1997). These findings have contributed to the development of more accurate hearing aid prescription, selection, and fitting procedures (Skinner, 1988; Cornelisse et al, 1995; Cox, 1995; Mueller, 1998). These advances in knowledge and technology have also led to a significant increase in the options available for the management of hearing loss. A professional is now faced with many decisions when recommending a type and model of hearing aid; when adjusting the aid to meet specific, predetermined electroacoustic properties; and when selecting an appropriate hearing aid fitting procedure. As a result, there has been an increased need and interest in conducting investigations to evaluate the relative benefit of different amplification systems available to persons with a hearing loss.

In recent years, a number of outcome measures have been developed to evaluate various issues related to the benefit that hearing aids provide to different populations of persons with a hearing loss. Those outcome measures have focused primarily on the measurement of hearing abilities/disabilities. For example, a number of tests have been designed and used to measure speech perception performance in quiet or in various types of background noise (e.g., NST test: Resnick et al, 1975; SPIN test: Bilger, 1984; CST: Cox et al, 1987, 1988). Also, several self-report inventories that include a number of items that measure aspects of hearing disability have been used as outcome measures to evaluate the benefits provided by hearing aids (e.g., HHIE: Ventry and Weinstein, 1982; HAPI: Walden et al, 1984; CPHI: Demorest and Erdman, 1987; PHAP: Cox and Gilmore, 1990; PHAB: Cox and Riviera, 1992).
To be valid and clinically relevant, evaluative research on the benefits provided by hearing aids, or any other type of intervention strategy, must accurately reflect the overall goal of audiologic rehabilitation. A failure to do so will limit evaluative research pertaining to hearing aids to a form of product evaluation. There is no doubt that the evaluation of specific products or procedures is necessary. For example, it is important to determine whether one form of signal processing strategy is more effective than another type of signal processing strategy under some predetermined experimental conditions. Likewise, it is legitimate to investigate whether one hearing aid prescription procedure yields better speech perception scores than another prescriptive procedure under comparable experimental conditions. However, the results of those investigations fall short of the ultimate goal of evaluative research in rehabilitative audiology. In practical terms, dispensing audiologists and clients are not interested only in knowing which type or model of hearing aid performs better under certain experimental conditions. Rather, they want to know if a given intervention strategy, such as wearing a hearing aid, will be successful in solving the specific difficulties experienced by a client. Specifically, the professional needs to know if a given intervention strategy will result in a beneficial and satisfactory service for a particular client. The answer to these questions requires the use of research paradigms, outcome measures, and evaluation procedures that are more comprehensive than the results typically obtained from current experimental paradigms used to evaluate the benefits provided by hearing aids.

The purpose of the present essay is to demonstrate two important shortcomings observed in most contemporary investigations designed to evaluate the benefits of a treatment program based on the use of hearing aids. First, we argue that most current investigations are not consistent with contemporary models of rehabilitation, which state that the goal of rehabilitation is to alleviate situations of handicap. Second, we claim that the evaluation of hearing aid benefit is necessary but not sufficient for the purpose of evaluative research on the effect of intervention programs in audiologic rehabilitation. Specifically, comprehensive evaluative research paradigms must also include procedures to measure the impacts and consequences that an intervention program has on the participants.

During the past 2 decades, there has been an important evolution in our understanding of the goal of rehabilitation. The World Health Organization (WHO, 1980) classification of impairment, disability, and handicap triggered significant changes in our conceptualization of rehabilitation, particularly as it relates to persons with a chronic disorder. Over the years, the WHO classification has been refined (CSICIDH, 1991; WHO, 1997). Some authors have applied this conceptual framework of health to audiologic rehabilitation (Stephens and Hétru, 1991; Noble and Hétru, 1994; Stephens, 1996). As it relates to persons with a chronic hearing disorder, as is the case in most instances of a sensorineural hearing loss, it is generally accepted that the goal of audiologic rehabilitation is to resolve or alleviate situations of handicap rather than to eliminate or reduce hearing impairment or disorders. This definition of audiologic rehabilitation, as well as some fundamental principles of rehabilitation that underlie this goal, have brought about significant changes in the service delivery models used in audiologic rehabilitation. The current conceptualizations of audiologic rehabilitation require an accompanying paradigm shift in the approaches used to evaluate the effectiveness of intervention strategies in audiologic rehabilitation.

In previous publications, we presented and discussed some fundamental principles of intervention that should guide the elaboration of intervention programs for persons with a chronic hearing loss (Gagné et al, 1995; Gagné, 1998). They are: (1) the goal of rehabilitation is to alleviate situations of handicap, (2) rehabilitation is a process, and (3) intervention in audiologic rehabilitation should be considered a solution-centered problem-solving process. The scope of the present essay does not permit an elaboration of the implications that those principles of intervention also have on evaluative research (the reader is referred to Gagné et al, 1995; Gagné, 1998; Noble, 1999). Suffice it to state that evaluative research, and the outcome measures used, should be directly related to specific models of intervention. We have argued that the experimental research paradigms typically used to evaluate the benefits of intervention programs that incorporate the use of hearing aids are not consistent with contemporary frameworks of rehabilitation, nor are they consistent with the principles of intervention stated above. Specifically, we have shown that experimental paradigms based on randomized clinical trials are inconsistent with contemporary models of rehabilitation.

The next section outlines the process of intervention programs based on a solution-cen-
tered problem-solving approach. Then, three cases are presented to highlight the major features of the espoused intervention process. The section on traditional approaches versus a solution-centered problem-solving approach illustrates that, depending on the conceptual paradigm one selects to interpret the results, data obtained from the same three individuals might lead to different conclusions concerning the effects of an intervention program in audiologic rehabilitation. Examples are provided of research designs that can serve as a basis for comprehensive evaluative research paradigms that would be coherent with current frameworks of rehabilitation.

REHABILITATION AS A SOLUTION-CENTERED PROBLEM-SOLVING PROCESS

A situation of handicap occurs as a result of an interaction between a person's predicament and the demands of a given situation (Noble and Hétu, 1994; Noble, 1999). Predicaments can be defined as the sum of all pertinent aspects of client state including disorders, impairments, disabilities, resources, beliefs, perceptions, attitudes, aptitudes, lifestyle, and behaviors (Hyde and Riko, 1994). A recognition that the goal of audiologic rehabilitation is to alleviate situations of handicap implies that the major focus of an intervention program is to resolve specific problems encountered by a client in his/her everyday living activities. This premise implies that the description of a problem will be influenced by factors other than hearing impairment and disability. The context, including the physical and sociocultural environment in which problems exist in the client's daily life activities and the client's perceptions of those difficulties, is a key factor in the identification of all problems associated with a hearing impairment. Intervention programs based on the principle that the goal of rehabilitation is to alleviate situations of handicap must consider all of the relevant aspects of the client's predicament as well as the specific context in which a handicapping situation occurs. Accordingly, the objectives of an intervention program must be individualized and contextualized according to the client's predicament and the environment in which a situation of handicap occurs. Likewise, investigations designed to evaluate the effects of an intervention program in audiologic rehabilitation should also take into account the characteristics of the client and the environment in which the difficulties are experienced (Gagné, 1998).

Given the importance placed on both the client's predicament and the specificity of the context in which difficulties are experienced, it follows that the client, as well as the other persons involved in the situation in which a handicap is identified, must play an active role in all facets of the intervention program. Who else can accurately describe the difficulties experienced, the specific context in which those difficulties occur, and the outcome sought by taking part in an intervention program?

Investigators have shown that a person's awareness of having hearing difficulties and the impact of the impairment on that person's life are part of a process that evolves as a function of time (Hyde and Riko, 1994; Getty et al, 1995; Hétu, 1996). Hence, a person's predicament also changes as a function of time. This implies that the person's perception and description of the problems encountered due to the hearing loss as well as their reactions to those problems also change as a function of time (Gagné et al, 1995; Hétu, 1996; Gagné, 1998). Consequently, a person's rehabilitative needs and the solutions that may be applied to address those needs are not likely to be solved by a "one-shot" intervention program such as the use of a hearing aid. Intervention programs must be designed to resolve specific, well-defined situations of handicap over a relatively short period of time.

A situation of handicap is the result of a complex interaction between a client's predicament and the specific context in which problems are experienced due to hearing difficulties. Moreover, the client's state, and perception of his or her state, evolves as a function of time. It follows, then, that the goal of all intervention programs in audiologic rehabilitation should be to provide solutions to specific problems encountered by a client in a specific environment. Thus, it becomes clear that the client must become an active participant in all aspects of the intervention program. Viewed in these terms, an intervention program in audiologic rehabilitation can be considered as a solution-centered problem-solving process. The general sequence of events involved in problem solving are outlined in Table 1.

A solution-centered problem-solving process requires an active partnership between the client and the rehabilitation professional. Together they must address and negotiate all of the components of the problem-solving process.
Specifically, the client must be involved in the recognition, identification, and description of the difficulties experienced; the negotiation and definition of the objectives of the rehabilitation program; the identification, evaluation, selection, and implementation of the intervention strategy itself; the definition of the desired outcome including the criteria used to evaluate the outcome of the program; the identification of the positive and negative factors that contributed to the outcome; and the evaluation of the effects, impacts, and consequences of the rehabilitation program on the person's activities outside the clinical setting.

Generally, clients do not consult a professional because they want a hearing aid, although that may be what they claim. Rather, they are motivated to consult an audiologist because in certain situations they encounter problems due to their hearing difficulties and have a desire to overcome these problematic situations. Wearing a hearing aid may (or may not) be the best or most acceptable solution to the problems experienced by the client in a given situation. For example, a hearing aid may be a solution of choice if the problem relates to communication in a specific environment such as conversations in a quiet living room. However, the same solution (i.e., wearing a hearing aid) would be inappropriate if the client's main concern was to respond appropriately when the doorbell rings while he or she is sleeping. In this instance, a visual alerting system connected to a lamp in the client's bedroom would be better suited to resolve this specific situation of handicap. To claim that one solution can address all of the problems experienced by persons with a hearing loss places unreasonable expectations on the proposed solution and is unfair to the person to whom the solution is proposed.

A key component of problem solving is the definition of the specific objective of the intervention program. Defining the intended goal of an intervention program will not only serve to identify possible solutions to the problem, but will also provide a standard against which to evaluate the effectiveness of the solution retained to solve the specific problem. A well-defined goal will facilitate the completion of the remaining sequence of the problem-solving process. As it relates to outcome measures, the goal of the intervention program will provide a concrete and tangible criterion against which to evaluate whether the objective of the intervention program was reached. The attempted solution will be measured against a criterion that is concrete and relevant to the client's own desires and needs.

According to McKenna (1987), every intervention program should have specific goals (or objectives). Each specific objective should state clearly, in an unambiguous fashion and in quantitative terms, how the client will behave if the intervention program is successful. The specific objective should be formulated in a way that identifies (1) all of the individuals involved in the pursuit of the objective; (2) the role and responsibilities of each person involved in the intervention program; (3) the conditions under which the personalized and customized objective will be accomplished while taking into account the expressed needs, willingness, and capabilities of all of the participants; (4) the criteria that will be used to evaluate whether or not the objective has been reached; and (5) a time frame within which the objective should be reached. A fictitious example of an intervention objective is presented in Table 2.

Many aspects of the procedure described by McKenna (1987) are consistent with a framework of evaluative research based on a solution-centered problem-solving approach to rehabilitation. First, the procedures used to formulate objectives are systematic and clearly defined and address the specific needs of an individual client. Second, the client participates in the formulation of the objective as well as the definition of the desired

<table>
<thead>
<tr>
<th>Table 1 General Sequence of Events That Apply to Problem Solving in Audiologic Rehabilitation*</th>
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<tbody>
<tr>
<td>1. Recognize that there is a problem.</td>
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<td>2. Identify the problem.</td>
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<td>3. Describe the problem (analyze the situation).</td>
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<tr>
<td>4. Set objectives and define the desired outcome taking into account:</td>
</tr>
<tr>
<td>-the problem</td>
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<tr>
<td>-the person with a hearing loss</td>
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<td>-the context</td>
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<td>-the other persons involved in the manifestation of the problem.</td>
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<td>5. Identify possible solutions.</td>
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<td>6. For each solution identified, analyze and evaluate the implications of choosing that solution.</td>
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<td>7. Select one (or more) acceptable solutions.</td>
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<td>8. Implement the solution.</td>
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<td>9. Evaluate the effect of applying the solution (re: the objectives).</td>
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<td>10. Identify the factors that facilitated or constituted an impediment to the implementation of the solution.</td>
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<tr>
<td>11. Identify and evaluate the impacts and consequences of the intervention program.</td>
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*Adapted from Gagné, 1998.
outcome of the intervention program. Third, the statement of the objective constitutes a basis from which the outcome of the intervention program can be evaluated quantitatively. Specifically, the outcome will be determined by the answers to two specific questions: (1) Was the objective reached? and (2) To what extent? Viewed in this manner, the outcome measure is individualized and contextualized according to the specific situation of handicap for which the client sought rehabilitative services. Finally, this approach could be extended to include the client’s evaluation of the process of the intervention program as well as an evaluation of the impacts and consequences of the intervention program (see Gagne, 1998).

ILLUSTRATIVE CASES

This section provides three illustrative cases of how a solution-centered problem-solving approach can be applied to audiologic rehabilitation. Each case presentation will consist of (1) a general description of the client, (2) a description of the situations of handicap identified by the client and the negotiated intervention program selected to resolve specific situations of handicap, (3) the outcome of the intervention program, and (4) the impacts and consequences of the intervention program.

Table 2 Example of a Specific Objective for an Intervention Program in Audiologic Rehabilitation

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<thead>
<tr>
<th>Summary of the Problem</th>
<th>Objective of the Intervention Program</th>
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<td>John reports having difficulty understanding the professor in his psychology course, even when he sits in one of the front rows and wears his hearing aids. He reports that the course is given in a large lecture room that seats more than 100 persons. John has discussed this issue with his professor, who expressed a willingness to assist John in solving this difficulty.</td>
<td>John will be able to take his own class notes in his introductory psychology course. In order to achieve this goal, John will ask his professor to wear an FM microphone during the lectures. John will wear an FM receiver hooked up to his hearing aid via a direct-audio input. The objective of the intervention program will be evaluated by comparing John’s class notes to those of his professor. Together, John and his professor will evaluate John’s class notes, both in terms of the number of important points recorded in the notes as well as the accuracy of the information recorded. This evaluation will be conducted 3 weeks after John and his professor begin using the FM system.</td>
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Case 1: SR

General Description

SR is a 60-year-old, semi-retired business accountant, who is still very active in his community. At this point in his career, his work mainly involves meeting clients in his office at home, attending business lunches, and conversing with clients by telephone. He consulted his ENT because of tinnitus. The physician referred him to an audiologist for an evaluation. The results of the audiological tests revealed that SR has a bilaterally symmetric moderately severe high-frequency sensorineural hearing loss with no indications of a retrocochlear lesion. The client was provided with information concerning the prevalence and manifestation of tinnitus. This information was reassuring to him and diminished his anxiety concerning his tinnitus.

Situations of Handicap and Negotiated Goal of Intervention Program

When asked if there were specific instances in which he experienced problems due to his hearing difficulties, SR reported two problematic situations: (1) understanding some clients when he discussed their portfolio by telephone and (2) understanding his boss when they met for business lunches in a noisy sports bar owned by the boss’ son. SR expressed interest in solving both of these problems because he did not want to stop his part-time work. Several possible solutions were discussed with SR. They included wearing a hearing aid with a telecoil, using an amplification system for the telephone, changing the location of the meetings held with his boss, and a course in the use of appropriate communication strategies. SR was not receptive to the idea of suggesting a different location to meet with his boss. He claimed that his boss was very proud of his son and enjoyed taking friends and business colleagues to that specific sports bar. He feared that a request for a different meeting place would not be well received. SR was not very receptive to wearing a hearing aid; he claimed that his hearing difficulties were “not yet sufficiently important” for that type of intervention. He was more receptive to a hearing aid with a telecoil if it would improve his speech understanding over the telephone. However, he did not like the idea of wearing a behind-the-ear hearing aid. He would have preferred a completely-in-the-canal (CIC) hearing aid—similar to the one worn by his older brother-in-law.
Two solutions were agreed upon: (1) at home, SR would use a telephone with an amplification system and (2) he would purchase a CIC hearing aid. He would wear the aid during his business lunches with his boss.

**Results of Intervention Program**

One month after purchasing the hearing aid and the telephone amplification system, SR met with the audiologist to evaluate the effectiveness of the intervention program. According to SR, the use of a telephone with an amplification system was very helpful in solving the problem of telephone conversations for business matters. SR reported little improvement in understanding his boss when they met at the sports bar, even when he wore his hearing aid. He commented that the hearing aid amplified the level of noise in the bar.

**Impacts and Consequences**

SR does not wear the hearing aid regularly. However, he is very encouraged by the help provided by the telephone amplification system and indicated an interest in pursuing solutions to his hearing difficulties. The negotiated next steps in the intervention program include the following: SR will (1) organize his work schedule to maximize the number of meetings that can be held over the telephone rather than meeting in noisy restaurants, (2) register for a group communication strategy program in order to optimize audiovisual speech perception when he communicates in noisy environments, and (3) purchase an infrared system that he will use for watching television, a "new" difficulty identified by the client.

**Case 2: WC**

**General Description**

WC is a 72-year-old woman with a very active social life (e.g., bingo, bridge club, family dinners). Her husband died 8 months previously. Since then, she has become more aware of some difficulties she experiences because of her hearing loss. A close friend, who has been wearing a hearing aid for many years, recommended that she consult an audiologist.

**Situations of Handicap and Negotiated Intervention Program**

When asked to describe specific instances in which she experienced hearing problems due to her hearing loss, WC reported three specific situations in which she had difficulties: (1) when she attended her bridge club every Wednesday afternoon; (2) during weekly Sunday dinners with her two daughters, their respective spouses, and her six grandchildren; and (3) at the church bingo held on Monday evenings. Although several possible solutions were discussed, WC chose to purchase a CIC hearing aid (based on the recommendation of her friend who wears the same type of hearing aid). WC also agreed to take part in a 6-week group communication training program.

**Results of the Intervention Program**

WC visited the audiologist 2 weeks after completing the group communication training program. At that time, she had owned her hearing aid for approximately 10 weeks. She reported that wearing her hearing aid provided no substantial benefit in any of the three situations of handicap that she had previously identified.

**Impacts and Consequences**

WC has identified certain situations in which wearing her hearing aid seems beneficial. For example, she has reported that the hearing aid is helpful during one-on-one conversations with her daughters and grandchildren. However, for the time being, she limits wearing her hearing aid to situations where conversations take place in her home. More importantly, her conversations with other members of the group communication training program that she completed made WC more aware that her hearing loss is likely the cause of many of the difficulties she experiences at home and in social outings (e.g., telephone conversations, hearing the doorbell and other alarm systems, watching the television, face-to-face conversations with specific persons, while shopping, at church). Since undertaking her intervention program she is more frustrated by the effects of her hearing loss on her daily activities and has become more intolerant toward some persons with whom she interacts frequently. She claims that some family members and friends are not sensitive to the difficulties she experiences because of her hearing loss. WC has decided to register for the level II group communication training program. This program focuses on assertiveness training and the use of other coping skills. In addition, she has joined her local SHHH chapter and is becoming more involved in the activities of this group.
Case 3: NHA

General Description

NHA, a 75-year-old retired engineer, is a widower who has been living alone for more than 10 years. He has very few social activities other than going to church on Sundays and watching the television. His only regular visitors are his daughter and grandson who visit him every Sunday. Over the last few years, he has had many discussions with his daughter concerning his need to purchase a hearing aid to overcome his hearing difficulties. Until recently, he had maintained that his hearing loss was not sufficiently important to warrant wearing a hearing aid. However, his 6-year-old grandchild recently expressed a disinterest in playing their regular checkers game, stating, "He never hears anything I tell him." This instance was sufficient to trigger a visit to the audiologist.

Situation of Handicap and Negotiated Intervention Program

When asked to identify specific instances in which he experienced difficulties, NHA reported that the most important problem that he wanted to resolve was understanding his grandchild when they play their regular game of checkers on Sundays. NHA also acknowledged having some difficulty hearing the pastor during Sunday services. For his daughter, an additional problem was related to the television. According to the daughter, in order to understand the television, NHA had to set the volume unacceptably loud. After discussing several possible solutions for each of those three problems with the client and his daughter, it was agreed that NHA would purchase a hearing aid and would wear the aid when he attended church services, when his family visited him on Sundays, and also when watching television.

Results of the Intervention Program

After having worn his hearing aid for 1 month, NHA and his daughter met with the audiologist to evaluate the effects of the intervention program. He reported little benefit from wearing his hearing aid during church services. He did report some benefit from wearing the aid when he watches television. Specifically, he commented that wearing the hearing aid allowed him to lower the volume level of the television set. His daughter agreed with her father's assessment but claimed that he still did not understand everything spoken on the television. More importantly, NHA reported that since he started wearing the hearing aid, his grandson had resumed playing checkers with him. Moreover, the grandson had interacted more frequently with his grandfather. For this reason alone, NHA was very satisfied with the intervention program.

Impacts and Consequences

The daughter reported that the process of purchasing and wearing the hearing aid triggered her son to ask a number of questions about his grandfather's hearing problems. The child has become more aware of and sensitive to his grandfather's hearing difficulties and spontaneously started using a number of strategies that facilitated his interactions with his grandfather. For example, he always makes sure his grandfather can see him when he speaks to him. Also, NHA reported that he has started wearing the hearing aid in situations other than those identified in the initial intervention program. His daughter reported that her interactions with her father have improved significantly since he started wearing the hearing aid. Both the daughter and NHA agreed that there has been a noticeable reduction in the number of arguments they have since he wears the hearing aid. NHA expressed a desire to extend his participation in an intervention program in order to solve problems he experiences with hearing the doorbell and the telephone in certain situations as well as with his desire to understand the television more clearly. An intervention program was designed with NHA to address those three specific problems.

TRADITIONAL APPROACHES VERSUS A SOLUTION-CENTERED PROBLEM-SOLVING APPROACH TO EVALUATE THE EFFECTS OF AN INTERVENTION PROGRAM IN REHABILITATIVE AUDIOLOGY

The three cases presented in the previous section will serve to illustrate how the choice of a research design may influence the results of an evaluative research investigation in audologic rehabilitation. First, the data from the three cases will be interpreted from the perspective of a traditional evaluative research...
approach based on the use of a randomized clinical trial design. Then, the same data will be reinterpreted from a perspective that audiolgic rehabilitation constitutes a solution-centered problem-solving process. Finally, some shortcomings of traditional evaluative research paradigms will be highlighted.

**Traditional Approaches**

Imagine an investigation designed to evaluate the effects of wearing a hearing aid among elderly persons with a hearing loss. The selected research design consists of a randomized clinical trial. Three outcome measures are selected for the investigation. Assume that all three tests display desirable psychometric properties in terms of reliability, sensitivity, and specificity and that the construct validity of those tests has been shown to be satisfactory. The tests consist of (1) a speech perception test in quiet, (2) a speech perception test in noise, and (3) a self-report rating scale of hearing disabilities. Note that, according to the WHO (1980) classification of impairment, disability, and handicap, all three outcome measures selected constitute measures of hearing disabilities (Stephens and Hétu, 1991; Gagné, 1998; Noble, 1999).

Furthermore, assume that the hearing characteristics and the demographic profiles of the three cases described in the previous section are sufficiently similar for them to have been recruited to participate in the investigation and that the three persons were randomly assigned to the treatment group rather than to the non-treatment or control group. Finally, assume that all three persons were properly fitted with an experimental hearing aid according to some predetermined formula for hearing aid fitting. The subjects completed the test battery before they were fitted with a hearing aid (pretreatment condition) and 8 weeks after receiving their hearing aid (post-treatment condition). The pre-treatment tests were conducted without the hearing aid and the post-treatment tests were completed with the hearing aid.

Based on the above assumptions and the case descriptions provided, it is not unreasonable to expect the following results. First, on the speech perception test in quiet, all three subjects would show that the hearing aid provided some benefit. Second, on the speech perception test in noise, at best two of the subjects, SR and NHA, would show that the hearing aid provided a slight benefit. WC would have displayed no difference between her pre- and post-treatment scores. Third, the subjects' responses on the self-report inventory would reveal that SR reported no significant reduction in hearing disabilities as a result of the treatment program. This may be attributable, at least in part, to the fact that she does not wear the hearing aid regularly. WC's responses would reveal that she experiences more hearing disabilities at the time of the post-treatment evaluation than she had at the time of the pretreatment evaluation. This is due in part to her participation in a group communication training program. Conversations with members of the group have increased her awareness of some of the problems that she experiences due to her hearing loss. NHA would show no significant reduction in hearing disabilities as a result of the treatment program. His post-treatment responses might even have displayed a slight increase in the number of hearing disabilities experienced, mostly because his participation in the intervention program made him more aware of some of the problems he experiences due to his hearing loss.

An analysis of the results obtained from the three subjects would likely lead to the conclusion that the treatment program was not very beneficial. There is one exception: the benefit provided by the hearing aid for speech understanding in quiet. It is interesting to note that none of the three subjects indicated that they had difficulty understanding speech in quiet when they were asked to identify and prioritize situations of handicap that they wished to resolve. It is unlikely that averaging the results obtained from the three participants with those of the other subjects who would also have participated in the group design investigation would yield different findings concerning the benefits provided by a hearing aid. Averaging the results obtained from a larger group of subjects with a similar hearing loss would serve mostly to increase the variance in the data and thus make it even less likely that statistically significant or clinically relevant results would be obtained.

The hypothetical results presented above are similar to those typically observed when randomized clinical trials are used to investigate the effects of hearing aids among elderly persons with a hearing loss. Often, those investigations fail to provide results that reveal that hearing aids are beneficial to elderly persons with a hearing loss. At best, they show that the experimental treatment, in this case wearing a hearing aid, provided a small, statistically significant
benefit for some of the variables examined. Such results do not provide clear indications regarding the clinical implications of the findings (i.e., how substantial must the statistical difference be before it manifests itself as a clinically relevant benefit?).

The aforementioned assumptions, that the outcome measures used in the investigation displayed desirable psychometric properties and that the validity of the tests used was deemed to be satisfactory for the purpose of evaluative research, have not been incontrovertibly shown for any normative test currently used in audiologic rehabilitation. Also, in audiologic rehabilitation, the data reported from evaluative investigations based on randomized clinical trials are often quite variable, within both the experimental and control groups of subjects. Some subjects in the experimental group show a substantial degree of benefit while others report no benefit. In some instances, the results obtained from some subjects reveal a "negative" benefit relative to the initial hypothesis, which stated that the treatment program should reduce hearing disabilities. The three case examples presented were designed to illustrate this point. Hence, the results of evaluative investigations based on randomized clinical trials are difficult to generalize to the intended population.

Usually, in group experimental designs such as randomized clinical trials, the inclusion and exclusion criteria used to select subjects are relatively broad. They are mostly limited to specifying the age range and the degree and type of hearing loss of the subjects. Some investigators consider other variables such as whether the participants have had any previous experience with wearing a hearing aid as well as the type of residence they inhabit (e.g., personal residence vs a residential home). A number of important variables (predicaments) related to the subjects are not considered (e.g., whether or not they live alone, their cultural background, value system, attitudes, aptitudes, beliefs, motivation, and lifestyle; Gagné et al, 1995; Gagné, 1998). Consequently, the group data reported do not provide clinicians with sufficiently specific information to assist them when they have to consider whether or not a given treatment program may be beneficial for an individual client who experiences specific situations of handicap that are determined by that person's unique mosaic of predicaments as well as the physical and social environments that characterize his or her daily living activities.

EVALUATION OF THE EFFECTS OF AN INTERVENTION PROGRAM FROM A PERSPECTIVE OF REHABILITATION CONSIDERED AS A SOLUTION-CENTERED PROBLEM-SOLVING PROCESS

From the perspective that audiologic rehabilitation is a solution-centered problem-solving process, the information provided in the case descriptions presented lead to different conclusions and clinical insights than those obtained from the results of the investigation based on a randomized clinical trial. Given contemporary frameworks of audiologic rehabilitation, at least some aspects of the intervention program designed for each of the three clients would be considered successful.

The intervention program designed with SR addressed two specific objectives: improved communication in a noisy bar and improved telephone conversations for business purposes. Two different intervention strategies were retained: wearing a hearing aid and the use of a telephone amplification system. The client reported that wearing a hearing aid did not improve his ability to understand speech in a noisy bar. However, using the telephone amplification system substantially improved SR's ability to communicate by telephone for business purposes. More importantly, SR's participation in an intervention program had significant impacts and consequences related to the management of some of the difficulties he experienced due to his hearing loss. First, SR identified alternative strategies to alleviate a persisting situation of handicap. For example, SR modified his work schedule in order to optimize the number of business interactions that could be conducted by telephone rather than holding face-to-face meetings in noisy environments. By doing so, he reduced the occurrence of that specific situation of handicap. Second, the success he experienced with the telephone amplification system prompted SR to seek solutions for some of the problems he continued to experience. Specifically, he registered for a group communication training program in order to improve his ability to understand speech in noisy environments. Moreover, he sought a solution to another situation of handicap that he experiences (i.e., hearing the audio signal from the television set). Within a perspective that rehabilitation is a process and that the goal of an intervention program in rehabilitation is to help the client solve or alleviate specific situations of handicap, SR's
participation in the initial intervention program would be considered a success.

The intervention program designed with WC addressed three objectives: (1) improved communication at the bridge club, (2) improved communication during family dinners, and (3) improved communication at bingo. For all three objectives, the intervention strategy negotiated between WC and the audiologist was that the client would purchase and wear a hearing aid as well as participate in a group communication training program. As it relates to the objectives of the intervention program, WC reported no direct benefit from the intervention program. In fact, at the time of the postintervention evaluation, the problems she experienced overall because of her hearing loss were greater than they were before she consulted the rehabilitative audiologist. Nevertheless, WC’s participation in the intervention program made her more aware of the difficulties that she has due to her hearing loss, and she decided to pursue her process of rehabilitation by seeking other solutions to some of the situations of handicap that she had identified. Again, viewed from a perspective of contemporary models of rehabilitation, WC’s participation in an intervention program can be considered, at least in part, a success. As a result of taking part in an intervention program WC took some positive steps toward solving some of the difficulties she has due to her hearing loss.

The primary objective pursued by the intervention program designed with NHA and his daughter was to (1) improve communication between NHA and his grandson during their weekly game of checkers, (2) improve NHA’s ability to understand the pastor during church services, and (3) improve his understanding of the television. Although he does not wear his hearing aid regularly, the intervention strategy negotiated among the parties involved in the rehabilitation program did provide a substantial benefit for one of the identified objectives (communication with the grandson during their weekly game of checkers) and some benefit for another objective (better understanding of the television). Also, the intervention program had some important impacts and consequences for NHA and his family (e.g., fewer arguments between NHA and his daughter and increased awareness of and sensitivity to the problems associated with a hearing loss by the grandson). Finally, the act of participating in the intervention program was sufficiently positive for NHA to seek solutions to a persistent problem (watching television) as well as newly identified situations of handicap (hearing the doorbell and the telephone ring). There is little doubt that NHA, his daughter, his grandson, and the audiologist would all agree that the intervention program was successful.

SOME SHORTCOMINGS OF EVALUATIVE RESEARCH BASED ON RANDOMIZED CLINICAL TRIALS

Evaluative research based on randomized clinical trials fails to take into account some basic underlying principles of intervention programs in audiologic rehabilitation. First, those investigations fail to recognize that the ultimate goal of an intervention program is to eliminate or alleviate specific situations of handicap experienced by the participants. For example, it is unlikely that any normative self-report inventory (by definition scales of hearing disabilities; see Gagne, 1998) would include a question that would have been relevant for NHA (“How much difficulty do you have when you play checkers with your grandson?”). Yet, it was that specific situation of handicap that prompted NHA to seek audiologic rehabilitation services. Moreover, even if the treatment program did not have important ramifications for other aspects of his hearing disabilities, NHA was very satisfied with the outcome of his intervention program because it was helpful in solving the primary problem for which he sought rehabilitation services. Also, note that a question on hearing difficulties while playing checkers with a grandson would have been irrelevant for the other two participants because they did not report that they experienced that specific situation of handicap. In fact, for the other two participants, including such a question in a self-report inventory would have made the questionnaire less sensitive as an outcome measure (in psychometric terms). The goal of an intervention program is to identify and implement solutions to specific problems experienced by a client. Consequently, evaluative research should be designed to address the effects that the intervention program has on solving specific situations of handicap.

Conventional evaluative research paradigms based on randomized clinical trials fail to take into account the evolutionary process that an individual undergoes while taking part in a treatment program (Gagné et al., 1995; Gagné, 1998). Most studies assume that all variables, other than the specific treatment program, remain constant throughout the course of an
intervention program and that the results obtained during the post-treatment measurements can be attributed solely to the effects of the intervention program. The case presentations illustrate that a client's awareness and perception of the difficulties a person experiences due to their hearing loss can change during the course of the treatment program. For example, recall that WC reported a substantial increase in hearing disabilities during the post-treatment evaluation. In fact, the case presentations revealed that for all three persons, albeit to a different extent, the act of taking part in the intervention program modified their perception and their rehabilitative needs concerning the effects of their hearing loss on some aspects of their daily living activities.

In most traditional studies, post-treatment results that indicate an increase in hearing disabilities are interpreted as a negative finding. Rehabilitation is a process that evolves from the time the hearing impairment is acknowledged to the time when the individual has reached an optimal restoration of his or her normal life habits (Gagné et al, 1995; Gagné, 1998). Within this perspective, a post-treatment evaluation that reveals a greater level of hearing disabilities or an increase in the number of situations of handicap may be interpreted as an indication that the person has progressed in his or her ability to identify difficulties that are attributable to the hearing loss. An awareness of the difficulties due to one's hearing loss is an important step in the rehabilitation process. Often, becoming aware and recognizing that some difficulties are attributable to one's hearing loss serves as a trigger for a client to seek professional services in order to resolve those problems. This should be considered as a positive consequence of taking part in an intervention program.

Finally, in most traditional evaluative investigations the findings reported rarely extend beyond an analysis of the results obtained from the outcome measures used to evaluate the effectiveness of the treatment program. Specifically, they fail to consider that taking part in an intervention program is always accompanied by some impacts and consequences for the client. In this context, impacts and consequences refer to changes in attitudes or behaviors that occurred as a result of taking part in an intervention program even though those changes were not specifically targeted in the objective of the program. Often the impacts and consequences of an intervention program constitute an important determinant of whether or not a client will maintain the behaviors modified or adopted during the course of an intervention program. In some cases, the impacts and consequences may be positive. The three case presentations illustrate this point. For example, as a result of taking part in an intervention program SR sought additional audiologic rehabilitative services to resolve other situations of handicap that he experienced; WC identified some situations in which wearing her hearing aid was beneficial to her, and NHA and his daughter reported that they had fewer arguments.

In some cases, the impacts and consequences of taking part in an intervention program may be negative and sufficiently important for the client to choose not to follow through with the intervention program even though the objectives, in terms of benefits, of the intervention program were reached. For example, wearing a hearing aid may provide a client with substantial benefits in terms of facilitating conversations in a given situation. However, having to wear the hearing aid in that situation may have a negative impact on the person's self-esteem. The negative impact of wearing the hearing aid on the client's self-esteem may be sufficiently important for that person to decide not to wear the device (Hétu, 1996). In this instance, the decision not to wear the hearing aid is not related to the benefit provided by the aid. Rather, it is related to the negative impact that wearing a hearing aid had on the individual.

Identifying and documenting the reasons that motivate a person to pursue or not to pursue an intervention program can provide information that is very important in terms of evaluative research. For example, it may make it possible to determine whether a client's non-compliance with the negotiated intervention strategy is due to factors related to the process of implementing the strategy (e.g., the person had not learned how to use and maintain the hearing aid properly); the benefit obtained from implementing the strategy (wearing the hearing aid did not resolve the situation of handicap for which it was intended); or some negative impacts and consequences of implementing the intervention strategy (e.g., the stigma attached to wearing a hearing aid). Likewise, it is of interest to document positive impacts and consequences of an intervention program. For example, a client may report that wearing a hearing aid did not solve only the situations of handicap addressed by the intervention program but that it was also helpful in facilitating communica-
tion in other situations that were not specifically addressed in the intervention program. This information may provide investigators and clinicians with insights concerning effective intervention strategies for other clients with similar difficulties. Comprehensive evaluative investigations should include procedures that make it possible to evaluate the effects of an intervention program beyond the measurement of outcome and include procedures that will make it possible to obtain information concerning the impacts and consequences of the intervention program. Typically, this type of evaluation is not incorporated into evaluative research designs based on randomized clinical trials.

SOURCES OF INSPIRATION FOR THE DEVELOPMENT OF COMPREHENSIVE EVALUATIVE RESEARCH PARADIGMS

The efforts of our research group have focused primarily on the identification of aspects of audiologic rehabilitation that should be considered in evaluative investigations of the effects of audiologic rehabilitation. We have elaborated a framework for evaluative research in audiologic rehabilitation (Gagné, 1998). In previous reports we have proposed a framework and procedures that could guide the development of evaluative research paradigms that are based on current underlying principles of rehabilitation and are consistent with a perspective that audiologic rehabilitation should be viewed as a solution-centered problem-solving process (Gagné et al, 1998). We have concluded that evaluative research in audiologic rehabilitation requires the use of single-subject experimental designs that make it possible to evaluate quantitatively the effects of an intervention program as it relates to its effectiveness in resolving specific situations of handicap. Also, we maintain that qualitative research methods (i.e., open-ended interviews) are best suited to documenting certain aspects of evaluative research. Specifically, open-ended interviews can be used to identify specific situations of handicap, evaluate the process of the intervention program, and evaluate the impacts and consequences of the intervention program.

PILOT INVESTIGATION

Recently, we collected preliminary data to examine aspects of evaluative research based on a solution-centered problem-solving process (Gagné, 1997; Gagné et al, 1998). The participants retained for the investigation were all elderly individuals who sought rehabilitation services from a government-funded rehabilitation center in Montréal. All of the participants owned a hearing aid. However, none of them had any previous experience with assistive listening devices (ALDs). For this study, all of the intervention programs negotiated between individual clients and the audiologist consisted of using an ALD to solve a specific situation of handicap that they had previously identified. Specifically, the ALDs consisted of either personal listening systems (i.e., infrared amplification systems for the television) or alerting devices (i.e., for the doorbell, telephone, fire or smoke alarm). Those devices were provided at no cost to the participants through a government-funded program. Ten clients of the rehabilitation center who met the inclusion criteria and agreed to participate in the study were selected for the investigation.

First, participants were asked to describe, in their own words, specific situations of handicap that they experienced and for which they chose to participate in an intervention program (see section A of Table 3). As stated above, in all cases the negotiated intervention strategy consisted of acquiring, installing, and using an ALD. Second, each participant was asked to complete a questionnaire for every situation of handicap identified. The questionnaire consisted of seven questions (see section B of Table 3). Questions 1 to 6 were completed before the intervention program was initiated as well as 1 and 3 months postintervention. Question 7 was completed only during the two postintervention test sessions. For each question, the participant was asked to provide a response on a visual analog scale that extended from 0 to 100. Third, each time the questionnaire was administered, the participant also took part in an open-ended interview. The recorded interview, conducted after the questionnaire was completed, was used to provide qualitative information concerning the ratings provided in the questionnaire. The interview also included questions on the following topics: the factors that prompted them to seek rehabilitation services and the factors that facilitated or constituted an impediment to the client in pursuing the negotiated intervention program. In addition, during the final postintervention interview, completed 3 months after the end of the intervention program, the participants were asked to report all of the positive and negative impacts and consequences associated with the intervention program.
Table 3  Questionnaire Used in a Pilot Investigation Designed to Evaluate the Effectiveness of Assistive Listening Devices in Solving Specific Situations of Handicap*

A. Describe (in your own words) the problem that you wish to resolve.

B. Questionnaire

1. At the present time, how often does this problem occur?

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2. At the present time, how serious is this problem for you?

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3. At the present time, what are the effects of this problem on your quality of life?

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4. At the present time, what are the effects of this problem on your ability to live autonomously at home?

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5. At the present time, how important is it for you to solve this problem?

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6. At the present time, to what extent do you think that the ALD is going to solve this problem?

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7. At the present time, to what extent did the ALD solve this problem?

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*The questionnaire is a liberal translation of a questionnaire originally prepared in French. The English version of the questionnaire is deemed to be accurate by the authors.

The limited quantitative data collected from 10 participants did not make it possible to evaluate the psychometric properties of the questionnaire used (e.g., in terms of test–retest reliability). However, a careful examination of the results revealed some inconsistencies between the quantitative ratings provided by some elderly participants and the comments they provided when they were asked to qualify and expand on their responses during the interview portion of the investigation. Also, the information obtained from many of the participants suggested that there was some confusion between the question related to the frequency of the problem (question 1) and the importance of the problem (question 5). Specifically, some participants were unable to differentiate the meaning of those two questions. Moreover, many of the participants had difficulty providing a rating for the questions related to the effects of the problem on their quality of life (question 3) and the effects of the problem on their ability to live at home autonomously (question 4). Note that the objective of that particular investigation necessitated the inclusion of questions 3 and 4.

An analysis of the information obtained during the interviews revealed that all of the participants were able to identify specific situations of handicap that they experienced because of their hearing loss. Also, as it related to acquiring and installing the ALD they had received, all of the participants were able to report their personal experience concerning the process of intervention. In fact, more than half of the participants required assistance from a professional, friend, or family member to install the ALD they had acquired. A similar proportion of the participants required training and practice
sessions to learn how to operate the infrared amplification system they received. All of the participants were able to report some impacts and consequences of having completed the intervention program. As with the case presentations, in the present investigation more than half of the participants sought additional rehabilitation services to address other situations of handicap that they experienced in their daily living activities.

Overall, the results of the pilot study suggested that it is both possible and valuable to conduct evaluative research designed to investigate the effectiveness of an intervention program conceived to address specific situations of handicap identified by the participants. Moreover, the investigation revealed the importance of including procedures such as open-ended interviews that make it possible to evaluate the process of intervention, specifically as it related to the ability of the participants to comply with the requirements of the intervention program. For example, the results indicated that more than half of the participants required assistance to install and learn to use and operate the infrared amplification system they had received in order to improve their ability to hear the television. Also, the investigation revealed that documenting the impacts and consequences of an intervention program constitutes an important dimension of comprehensive evaluative research. For example, four participants reported that the infrared system they received was very effective in resolving the difficulty they experienced while watching the television. However, none of them used it all of the time. Two of the participants stated that the headset they received with the system was uncomfortable. Also, they reported that they removed their headset after wearing it for about 1 hour because it was too warm for their ears. Two other participants did not use the infrared system with the headset when they expected visitors or a telephone call. They reported being concerned that they would not hear the doorbell or the telephone ring. The procedures used in the investigation made it possible to identify factors that deterred the participants from conforming to the negotiated intervention program. It is unlikely that this type of information would have been obtained had the research design only included quantitative outcome measures.

The pilot investigation also revealed that the questionnaire used to quantify the aspects of the situations of handicap identified by the participants and the effects of the intervention program was not satisfactory. Specifically, in terms of psychometric properties the questionnaire did not meet the standards required for evaluative research. More work is needed to develop a questionnaire that will make it possible to quantify those important aspects of evaluative research. Also, some work is required to identify procedures that will make it possible to convert the qualitative information obtained from the open-ended interviews into quantitative data that can be used for the purpose of data analysis and generalization (see Gagné et al., 1995; Gagné, 1998).

**OTHER PROMISING SOURCES OF INSPIRATION**

At the present time, we know of no studies that have been conducted in audiologic rehabilitation based on the principles of evaluative research that we have described. However, investigators in other areas of rehabilitation such as occupational therapy (Law et al., 1990, 1994) and psychology (Barlow and Hersen, 1984; Siegel and Spradlin, 1985; Kiresuk et al., 1994) may provide some insight into how to design investigations that meet the requirements of evaluative research, that are consistent with contemporary conceptual frameworks of rehabilitation, and that display robust psychometric properties (Gagné, 1998). In particular, the Goal Attainment Scaling procedure described by Kiresuk et al. (1994) provides a source of inspiration for the collection of outcome data that are compatible with the model of evaluative research espoused in the present article. The procedures developed by these investigators indicate that it is possible to collect data related to individualized intervention programs that are reliable and valid (Cardillo and Smith, 1994a, b; Smith and Cardillo, 1994).

In rehabilitative audiology, there have been some attempts to modify aspects of evaluative investigations in order to be more consistent with some aspects of the principles of rehabilitation outlined in the introduction. The work of Dillon et al. (Dillon, 1999; Dillon et al., 1991a, b, 1997) and the work of Gatehouse (1999) are good examples of how experimental research designs have been adapted to take into account specific situations of handicap experienced by the clients. In those approaches, the benefits provided by an intervention program are measured as a function of the objectives or situations of handicap identified by the participants (see Dillon, 1999; Gatehouse, 1999). Investigations com-
pleted by Gatehouse (1997, 1999) have shown that it is possible to obtain data with the Glasgow Hearing Aid Benefit Profile that produce results that are reliable and valid (Gatehouse, 1999).

CONCLUSION

In order to be valid and clinically relevant, research paradigms used to evaluate the effects of intervention programs in audiologic rehabilitation must be consistent with the underlying principles and conceptual models of intervention in audiologic rehabilitation. The main objective of the present essay was to illustrate that the research designs based on randomized clinical trials that are currently used for evaluative research in audiologic rehabilitation are seldom consistent with current conceptual models of audiologic rehabilitation based on resolving specific situations of handicap. Consequently, the results of those investigations are of limited value. First, they limit the clinical application of the results produced by those investigations. Second, they severely constrain the ability of clinicians and researchers to demonstrate the true value of the services they provide to clients. Moreover, they fail to accurately promote the competency and credibility of rehabilitative audiologists and severely limit the credibility of the profession to persons who pay for those services, including government agencies, insurance companies, and clients who require audiologic services. The three cases described here illustrate this point very well. It was demonstrated that a traditional evaluative research paradigm would not have revealed the true benefits of the intervention program that each of those persons completed.

To respect the principles of evaluative research discussed in the present essay, drastic changes must be made in the way that evaluative research is conceived of and conducted. One important challenge for the research community resides in the development of research paradigms that are not only consistent with contemporary models of intervention but also experimental designs that produce data that display robust psychometric properties in terms of reliability, validity, sensitivity, and specificity (see Gagné, 1998). Also, to be clinically useful the data available from evaluative research investigations must be generalizable to a large segment of the population with relatively similar predicaments and with similar situations of handicap. A major challenge for the research community resides in identifying procedures that will make it possible to regroup data obtained from single-subject experimental designs into relevant categories that are representative of an intended population in order to generalize the findings obtained from individual participants to a wider segment of that population (Demorest and Erdman, 1994; Gagné et al, 1995). Also, for the purpose of generalization, another challenge resides in identifying procedures that will make it possible to convert data obtained with qualitative research methods (i.e., interviews) into indices that can be quantified and analyzed systematically.

Researchers involved in evaluative research are encouraged to consider the use of research paradigms that will (1) be consistent with contemporary models of rehabilitation, (2) include research methods that produce data that are psychometrically sound, and (3) make it possible to truly evaluate the effects of different intervention strategies in solving specific situations of handicap experienced by clients who seek rehabilitation services. Also, investigators should consider research protocols that will make it possible to evaluate the role and the effects of an intervention program on the process of intervention for each individual who participates in the investigation. Finally, evaluative research investigations must include procedures to measure the impacts and consequences that occur as a result of taking part in the specific intervention program under investigation.

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