Nonuniformities in Self-Assessed Outcomes of Hearing Aid Use

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Abstract

Measures of outcome, following hearing aid fitting, that involve self-assessment procedures addressed to uses and benefits can produce nonuniform variations in results. These may be due to measurement system problems (noise, measurement error), or they may reflect systematic factors whose influence remains to be made more explicit. Examples are drawn from literature concerning the use and nonuse of hearing aids, the influence of counselling on the extent of hearing aid use, the time course of adaptation to hearing aid, nonuse and particular uses of cochlear implants, fitting of behind the ear versus in the ear, and one versus two hearing aids. It is argued that attention to contexts of fitting may help in interpreting inconsistent or unexpected results in this literature. Finally, a comment is made concerning self-assessment procedures that are tailored to individual circumstances rather than applied uniformly across different people.

Key Words: Hearing aid, hearing disability, hearing handicap, hearing impairment, outcome measures, self-assessment

Abbreviations: BTE = behind the ear; CIC = completely in the canal; HHIE = Hearing Handicap Inventory for the Elderly; ITE = in the ear

It is generally the case that in people with acquired hearing disorder, the greater the degree of hearing loss the greater the degree of experienced disability and handicap—the greater also is the likelihood that help will be sought, and that a hearing aid, or aids, will be increasingly relied upon. This broadly expectable uniformity between extent of loss, extent of difficulty, and extent of rehabilitative relief is, nonetheless, punctuated by nonuniformities. Any particular case of departure from expectation may be due to measurement error in a predictor variable or to some other source of noise in the data. But some cases may yield to explanations that call in the influence of factors that have not been explicitly counted in the research or clinical context. The purpose of the present paper is to consider some instances of nonuniform outcomes from studies using self-assessment procedures and to suggest explanations for those outcomes. In a sense, nonuniform outcomes are inevitable once the self-assessment methodology is brought to bear on outcomes measurement. But this is welcome because it represents a broadening of understanding about the range of influences affecting the experience of disability and handicap that self-assessments provide.

SCIENCE AND MEASUREMENT

Physical measurement is an inescapable part of life, and the evolution of science is also the history of more precise and valid measurement of properties of the world and the universe. Physical science predates the emergence of practices addressed to human behavior that are claimed as having the status of science. One key to the bid by psychology to scientific status was the increasing sophistication of formulae that expressed, in abstract, the links between measures of physical energy and observations of sensory functions, as in the study of psychophysics (Boring, 1950). It is the uniformitarian nature of a practice’s system of measurement that enhances any claim about its scientific stature. Even individual differences in psychophysical function are explicable as a set of surface variations deriving from underlying con-
stans. Biological variety is one essence of evolutionary transformation (Darwin, 1968/1859); hence, it can be expected to show up in the form of differences in measured characteristics across examples of the same feature of living objects.

Attention to nonuniform variation, in a specialized measurement field such as the outcome of hearing aid fitting, need not represent a flight from the principle of uniformity. Rather, such attention reflects sensitivity to the particular conditions through which those uniformities are filtered. What from one point of view looks like noise or measurement error in a set of data from another viewpoint is a source of variance waiting to be explained, once the particular conditions influencing a measurement outcome are more satisfactorily understood.

In this paper, examples are described that potentially illustrate that point. The examples are potential just because the data may not yet be secure enough to prove the case as argued. So much the better, in the sense that proposals are made that may stimulate more searching investigation to determine whether the hypothesized mechanisms really can explain nonuniformities in the measurement domain in question and/or see what other mechanisms may be contributing.

**OUTCOMES ASSESSMENT USING SELF-REPORT**

The idea of unexplained variance is heightened when results are considered that involve assessments of hearing function based on self-report. In one way, that is inevitable. Part of the argument about the value of self-assessment is that standard tests of hearing using tones or speech cannot capture the difficulties any particular individual encounters in the actual conditions of everyday life (Demorest and Erdman, 1984). The occurrence of only moderate (0.6–0.7) correlations between measured and self-assessed ability (e.g., High et al, 1964) can be taken as proof of this argument, rather than as a sign of measurement system failure (Schow and Gatehouse, 1990). Indeed, the further argument has been advanced (Hétu et al, 1988) that structured self-assessment is not specific enough to the situations and meanings for an individual; hence, the use of structured self-assessment instruments risks missing the nuances and details of that individual’s life circumstances. I will come back briefly to the question of structured versus open-ended self-assessment approaches in the final section of this paper. For the moment, I confine my attention to structured forms and to nonuniformities that arise for reasons that repay closer examination, even without altering the construction of a self-assessment instrument so as to tailor it to individual circumstance.

Most examples of nonuniformity relate to variation in the decision to use or not use hearing aids and to variations in the extent of the use of hearing aids, once acquired. Thus, the substance of the present paper is devoted to those issues. Briefer treatment is accorded thereafter to the question of both extraneous and intrinsic features that might affect preferences for different types and configurations of hearing aid fittings.

**PATTERN OF USE/NONUSE OF HEARING AIDS**

Absence of Service Seeking

Severity of hearing loss is not a certain guide to the occurrence of rehabilitation service seeking, and hence the uptake of amplification technology. The relationship is not clear-cut between either measured impairment level or self-assessed rating of disability/handicap and the obtaining of audiologic services (Davis, 1995). This is not to say that the relationship is haphazard; as stated in the introduction, in general terms, the incidence of service seeking does increase with an increased degree of hearing loss. But fewer people than may be supposed as likely to benefit from amplification technology, on the grounds of audiometric or self-assessed ability, proceed to take that step. There is, therefore, a nonuniformity between measures of hearing loss or its disabling and handicapping consequences and reports of the use of hearing aids. First, clarification is needed of terminology featured here and throughout this paper. The terms impairment, disability, and handicap refer to the World Health Organization scheme (1980), in which impairment is reflected in clinical tests of hearing using, for example, tones or speech; disability refers to actual difficulties in hearing in everyday settings; and handicap refers to disadvantages in everyday life flowing from disabilities (handicaps are sometimes conceptualized as nonauditory consequences of impairments).

It is not possible to specify exactly what distinguishes people who do from those who do not pursue rehabilitation for impaired hearing when levels of impairment across those two
groups are controlled. There are, nonetheless, indicators in the literature showing that family pressure is a critical factor. Some of this evidence is quite direct (Brink et al, 1996; O'Mahoney et al, 1996). Promptings by another family member, typically a marriage partner, but also adult children who may visit the family regularly, motivate the individual to seek a remedy for the problems routinely manifest in the domestic environment. Not the least of these problems is difficulty hearing television at a level that is tolerable to other members of the household. TV viewing was found in one study (Salomon et al, 1988) to be a significant element driving audiologic service seeking in older people and was reported as the most common hearing problem in new clients of a hearing clinic (Barcham and Stephens, 1980).

Prompts from others in a family will be less in evidence for people who live alone (prompting can still be done by visiting family members), and there is an indication in the literature (Vesterager et al, 1988) that the rate of service seeking is lower among those who live by themselves. Variable family circumstances probably have other effects, such as in patterns of hearing aid use once a device has been acquired, and in levels of experienced handicap, as discussed in more than one place later in the present paper. The above findings show the possibilities for systematic variation in demographic background of those more likely and those less likely to present themselves for rehabilitation services in the first place, even when audiometric characteristics may be otherwise similar. The message to be taken away at this point is that in the planning of service provision it will be advantageous to have reliable knowledge about the likely domestic/social backgrounds, hence the probable listening and communication needs, of potential users of that service.

**Variation in Extent of Hearing Aid Use**

Subsequent to acquiring a hearing aid there is considerable variation in the extent of use of this technology. Once again, part (but only part) of that variation is explained by the degree of hearing loss. Another factor that has been shown to affect the extent of hearing aid use is the occurrence, postfitting, of counselling about such matters as effective use of a hearing aid, adjustment to hearing problems in general, and likely difficulties associated with using hearing aids and how to deal with those difficulties (Brooks, 1979, 1989). This type of follow-up, which is a postfitting intervention, has several impacts (it seems that prefitting counselling [Norman et al, 1994] is not effective). One of those impacts repays comment and analysis here as an example of how an extraneous variable interacts with the more intrinsic one of hearing loss to generate this particular nonuniformity.

In the Brooks (1989) study, counselling was given to one subgroup of clients within about 1 month following the fitting of a hearing aid. Those counselled later reported significantly greater daily use of hearing aids than those who were not counselled—both groups being matched on all other relevant variables. The interesting further finding is that counselling was effective in raising use rates among those whose prefitting attitude to hearing disabilities showed (1) a preference for attributing disabilities to external factors ("my hearing is normal," "others mumble"); (2) a preference for downplaying social handicap; and (3) a heightened sense of the stigmatizing appearance of hearing aids. For those who were not counselled, and who endorsed similar attitudes prior to hearing aid fitting, aid use was significantly lower than among those who had also held such views, prefitting, but who received postfitting counselling. By contrast, those who were not counselled, yet who attributed difficulties to the internal factor of their own hearing loss and who conceded that they had social handicaps, later reported daily use rates that were closer to those of the counselled group. Finally, overall, those who reported lengthier daily use of hearing aids, whether in the counselled cohort or not, also reported that they had experienced greater family pressure about hearing problems.

An interpretation of these results (Noble, 1998) is that counselling alters the attributions people are able to make concerning the causes and consequences of listening and communication difficulties. From an initial position of construing those difficulties as due to external factors, counselling, postfitting, enables people to reconceptualize the cause and to attribute the difficulty more to the condition of their hearing and less to other people's poor diction (see Taylor and Fiske [1978] for a general analysis of the attribution phenomenon). Families may provide the equivalent effect to that of counselling in persuading the member with impaired hearing that this (the impairment) is the core of the communication problems experienced in the family. Family pressure, then, not only interacts with impairment level to increase the likeli-
hood of service seeking; it also acts to affect the extent of use of hearing aids following their acquisition.

These findings, more broadly, show that having a hearing impairment, of itself, is not guaranteed to provoke an attribution to the condition of one's hearing as the cause of the difficulties experienced in communication and listening. The link between one's hearing impairment and its consequences may need to be made explicit through the use of self-initiated or other persuasive tactics that allow a reconceptualization or reframing of experienced difficulties as being critically caused by the ongoing personal deficit in hearing. Those of us whose professional lives are taken up with hearing impairment and its effects may find it hard to appreciate that, except at the extreme limits of loss, people in general are not automatically going to interpret communication and listening problems as being due to an internal source.

The point to take away from the foregoing observations is that a person's move to seek rehabilitation services, and to maintain use of any prosthesis obtained, depends on perceiving communication difficulties as due to impaired hearing. In many cases, it may not be possible for the individual alone to accomplish the recognition of his or her hearing impairment as (usually) the cause. Advice and counsel from others, perhaps including information and education in the broadcast media about such reframing, may be needed in the case of people who do not get it (or do not accept it) in the form of feedback from their families.

Selective Nonuse

Deliberate behavioral intervention such as counselling or informal intervention such as family pressure interacts with the existence of a hearing loss to affect the steps someone will take in seeking and maintaining rehabilitative measures for that loss. Part of the variance in variable hearing aid use may thus be accounted for by these other behavioral factors. Nonuniformity still remains, however, in the connection between degree of hearing loss and extent of use of hearing aids. A further component of variance is the contexts in which hearing aids are worn and not worn. Although reports across individuals show different trends, the broad pattern that emerges from more than one study is one of decline in both reported and observed hearing aid use, within about 3 to 12 months following initial acquisition of the device (Kyle and Wood, 1984; Hickson et al., 1986; Ovegård and Ramström, 1994; Brooks, 1996). An explanation for this decline offered by Kyle and Wood (1984) is that users gradually discover the contexts in which the aid provides optimum advantage and selectively reduce wearing time in contexts that are unfavorable (e.g., contexts that are predictably noisy). There will also likely be selection by hearing aid users against contexts in which the aid is visible to others whose attitudes are feared to be stigmatizing. Public display of a hearing aid may be avoided for this reason, and some public occasions (e.g., dinner parties) may also likely be contexts of greater background noise. Sensitivity to stigmatization will thus interact in semipredictable ways with unfavorable acoustics.

All this makes for an interestingly complex story about factors other than sheer degree of hearing loss that constrain the selective reliance on personally worn systems of amplification. And as pointed out (Noble, 1998, Ch. 4) in discussion of the phenomenon of acclimatization (e.g., see Cox and Alexander, 1992; Gatehouse, 1992), selective targeted use of hearing aids will affect the time course and specificity of adaptation to amplified input signals. Thus, real-world studies of the acclimatization phenomenon may need to take account of the different patterns of use and nonuse that subsets of people come to adopt as the history of their experience in wearing hearing aids unfolds.

Selective Nonuse and Self-Assessed Handicaps

The foregoing discussion shows that selectivity in hearing aid use arises as a consequence of the experience of contexts in which such use is found to be worthwhile versus those in which it is not (or not so) worthwhile. What is judged worthwhile appears to be constrained not only by factors of acoustics but also by the factor of avoiding social stigma. The operation of such factors may in turn explain another nonuniformity: that observed in responses to repeated applications of Ventry and Weinstein's (1982) Hearing Handicap Inventory for the Elderly (HHIE). This self-assessment scale is very closely focused on the experience of social and emotional handicaps flowing from auditory disabilities. It has been used in various studies of outcomes of hearing aid fitting (e.g., Newman and Weinstein, 1988; Malinoff and Weinstein, 1989a, b; Taylor, 1993), and a finding emerging from this literature is that immediate and sub-
stantial reductions in HHIE scores (lower handicap), after 2 to 3 weeks of hearing aid use, are followed by an increase in scores after 3 months, then by stabilization of scores in subsequent months. These fluctuations in no way relate to measured hearing or aid benefit levels. Indeed, the HHIE has actually been shown in recent comparative investigations (Dillon et al, 1997; Gatehouse, 1997) to be relatively insensitive as a measure of hearing aid benefit.

The fluctuations in HHIE scores are nonetheless reliable, having been observed independently in more than one study (Malinoff and Weinstein, 1989a; Taylor, 1993). One way to explain them is by attention to the areas of inquiry of items constituting the HHIE. These may interact with the phenomenon of increasing selectivity of hearing aid use.

The HHIE addresses handicaps experienced in close social relations, such as family and others in the person’s immediate circle. Given what has been said above about the key role of other family members in motivating attendance at hearing clinics, it may be fair to conclude that the large, rather undifferentiated drops in HHIE scores, immediately postfitting, reflect the emotional relief experienced in that context once the significant step has been taken to acquire a hearing aid. Other literature (e.g., Jones et al, 1987) testifies to the length of time it takes for a person with progressive hearing loss in later life (the commonest cases in audiology clinics) to gather the resources and take the momentous decision to seek rehabilitative help. The circumstances within families, before that happens, can become fraught to the point of serious emotional distress all round (e.g., Hallberg and Barrenías, 1993; Hétu et al, 1987, 1993). Using the new hearing aid will likely be, at first, under optimum listening conditions at home, such as one-to-one conversation with a marriage partner or listening to TV. The benefit in most cases will be palpable and highly rewarding emotionally; the pressure within the family has been immediately reduced—thus, the early HHIE responses, postfitting, might be explained.

I further speculate that subsequent use of a hearing aid will be extended to a wider range of domestic contexts and to contexts beyond the home that inevitably involve both exposure to background noise and exposure to signs of stigmatizing attitudes from others. Such experiences will blunt any initial sense of euphoria, leading to modified appreciation of and expectation about the degree of relief the hearing aid offers. The sobering effect of these negative events could account for the return of self-assessed handicap levels, 3 months after initial fitting, to those approaching prefitting ones. As hearing aid use thereafter becomes increasingly selective, in consequence of the discovery of the variable advantages of aiding, handicap scores stabilize so as to reflect the somewhat tempered advantageous outcome that represents the longer term experience of the typical wearer. I reemphasize that this is a speculative account. To examine its explanatory worth, it would be valuable to check the time course of changes in self-assessed disability and handicap as a function of diary entries that record the history of hearing aid use patterns. In any such study, it will be useful to include more sensitive measures both of disability and of hearing aid benefit, as well as a measure of social and emotional handicap.

The pay-off from such an investigation is the improved appreciation of the limits on and circumstances of benefit that can be anticipated as a way to improve the quality of advice and assistance to new users of hearing aid technology.

**Signs of Selectively Different Use of Cochlear Implants**

The application of self-assessment methodology in the arena of cochlear implant fitting is somewhat limited, but certain nonuniformities that emerge from that literature are worth noting. The first outcome to be reported on actually relies on assessments by parents about their children’s performance, satisfaction with, and use/nonuse of implants. Studies by Cunningham and Stoeckert (1992) and by Kelsay and Tyler (1996) indicate that as typically, prelingually deaf children approach adolescence they start to reject the use of an implanted prosthesis, even though there is presumably no improvement in their hearing ability. This sort of outcome is consistent with one reported by Zwolan et al (1996), to the effect that adult users of implants who had been previously fitted with acoustic aids in early childhood had all but rejected reliance on such devices as they moved into and through high school.

Self-consciousness about using implant or other visible amplification technology, among young people exposed to adolescent peers, may hold part of the explanation for these effects. But a broader point also needs to be appreciated. The relative ineffectiveness, in open-set conditions, of even highly advanced aids to hearing, fitted to children with very early childhood deafness (Vidas et al, 1992), will actually add to the
stigma of using such technology in public. Later childhood or adolescent life is characterized by increasing independence from the family circle. While communication within that circle may have been considerably assisted by high-powered hearing aids or implants, part of their effectiveness is due to the routine and predictable nature of such communication in that context. By contrast, getting out into the noisy and much less predictable world that characterizes hanging out with teenage friends exposes the user to a far more challenging task in comprehension—hence, intelligible responding. It may be safer to reject the technology altogether than to risk the threats to self-efficacy that flow from being held as a communicatively incompetent hearing aid user.

Adoption of implant technology in adult life, even among those who had previously rejected at least conventional amplification earlier (Zwolan et al, 1996), may reflect changing values and priorities in terms of personal efficacy at a later stage of life development (Noble, 1998, Ch. 6). This point bears on another nonuniformity in the reported patterns of selective use of implants among adults pre- and postlingually deaf. While there may be limited scope for speech discrimination improvement among those with profound congenital or early childhood hearing loss, the implant can offer much improved audiability of environmental sounds in general. The enhanced feeling of security this improved audiability brings is reported consistently by such users (Wexler et al. 1982; Zwolan et al, 1996). An interesting contrast in implant use emerges from the literature, however. Reported use of a multichannel implant is high while driving a road vehicle among those for whom the device offers limited benefit in speech discrimination (Zwolan et al, 1996). But use of the same technology while driving is reported as positively avoided, among those deafened in later life, and for whom speech discrimination is a premium benefit of implantation (Kou et al, 1994). These quite different patterns of use may reflect, on the one hand, the prominence of feeling safe by being able to detect warning sounds while driving versus feeling frustrated in a circumstance that makes conversation more difficult (noisy background, lesser visibility of speakers' faces). More detailed investigation of these types of contrast will assist practitioners, hence users, in understanding the likely areas of advantage and disadvantage related to this type of amplification as a function of the causal conditions surrounding their hearing loss.

HEARING AID PREFERENCES

Behind the Ear versus In the Ear (versus Completely in the Canal)

There is a limited literature comparing preferences for different types of hearing aid architecture. One study assigned new clients of a state-funded service at random to behind the ear (BTE) versus the ear (ITE) configurations (May et al, 1990). Some preference for the ITE technology was expressed in terms of improved speech intelligibility in noise; neither configuration was rated highly in terms of appearance. On the face of it, BTE hearing aids are physically larger than ITE, yet they can be made less visible through the sheer fact of being positioned behind the ear. A recent study involving use of an extra-open, hence almost invisible, earmold assembly, coupled to BTE hearing aids (Noble et al, 1997), showed considerable user acceptance, with the comment made that the reduced visibility is a factor in favor of the new design. Comparative visibility of different types of hearing aid is unquestionably an issue implicated in stigma management (Brooks, 1994). And visibility emerges as a contributor in the complex of factors that go to make up satisfaction with amplification technology (Cox and Alexander, 1997).

The new generation of completely-in-the-canal (CIC) hearing aids may be expected to gain in popularity exactly because of radical reduction in visibility. The current paper is not the place to analyze stigma management (Goffman, 1963); it is enough to note that sensitivity to visibly stigmatizing signs is one of those factors that will interact with other variables to affect the selective use of hearing aids.

One versus Two Hearing Aids

Stigma management is also a factor in preferences for one over two hearing aids (Stephens et al, 1991). It is easier to conceal the presence of a single hearing aid. But the story is not simply one of control over personal appearance. Bilateral fitting of hearing aids is assumed to offer the advantage of improved binaural hearing, including better localization of external signals (Brooks and Bulmer, 1981). That advantage seems to vary, however, as a function of degree of hearing loss (Byrne et al, 1992). For people with lesser amounts of hearing impairment, a single hearing aid may yet enable binaural hearing, given that there is retained audiability of
sounds in the unaided ear. The advantage of not having both ears occluded may be what underpins a sense of externality and hence naturalness of the signal, factors that have prominence in people’s rated satisfaction with amplification (Kapteyn, 1977; Cox and Alexander, 1997).

INDIVIDUALLY TAILORED ASSESSMENT

All of the foregoing examples may lead to the conclusion that standardized forms of assessment, including self-assessment, may miss important individual differences. Thus, there is a risk that particular features of individuals who attend for clinical evaluation and assistance will be swamped by the generalities of a standardized method. Recent studies involving self-assessment have been designed to give weight to the needs of each particular person (Dillon et al, 1997; Gatehouse, 1997). In the case of Dillon et al (1997), the client nominates the listening or communication situations in which they seek help; the quality of outcome is then reflected in the degree to which such help has been provided by the rehabilitation intervention. Gatehouse’s (1997) approach is similar in spirit but more formal in execution. Standard listening contexts are presented to each respondent but the degree of exposure to each one and its importance for the individual are incorporated in the assessment profile. In addition, respondents nominate situations that are specific to them and that may not have been covered by the standard items. The approaches in both research projects have borne fruit in showing improved sensitivity to changes in disability at the individual level. Thus, the argument for assessment that is more finely tuned to the individual’s background and story is readily supported.

The examples and interpretations presented in this paper do not, as it happens, speak strongly one way or another to the issue of standardized versus particularized forms of self-assessment. What has been emphasized here is that variations in other conditions may influence outcomes that would be expected, on the face of it, only to be affected by the acoustics and psychoacoustics of the situation. On this basis, it may only require a better cross-tabulation of audiometric and self-assessed outcomes with other relevant (including nonaudiologic) measures, so as to improve the capture of variance affecting any individual case.

It is unquestionable, in conclusion, that self-assessment, as a procedure, whether highly standardized or subtly nuanced, is the methodology that has permitted extraneous effects on measured outcomes to be detected in the first place, even if imperfectly. Thus, the strong conclusion is that self-assessments addressed to various factors will continue to offer insights into the complex picture of hearing rehabilitation needs, alongside the knowledge gained from more purely physical kinds of measurement.

REFERENCES


