

Personality and the Subjective Assessment of Hearing Aids

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Abstract

Relatively little is known about the influence of patients' personality features on the responses they make to self-assessment items used to measure the outcome of a hearing aid fitting. If the personality of the hearing aid wearer has a significant influence on self-report outcome data, it would be important to explore the relevant personality variables and to be cognizant of their effects when using subjective outcome data to justify decisions about clinical services or other matters. This investigation explored the relationship between several personality attributes and responses to the Abbreviated Profile of Hearing Aid Benefit (APHAB). It found that more extroverted patients tend to report more hearing aid benefit in all speech communication situations. In addition, patients with a more external locus of control tend to have more negative reactions to loud environmental sounds, both with and without amplification. Anxiety also played a small additional role in determining APHAB responses. Although personality variables were found to explain a relatively small amount of the variance in APHAB responses (usually around 10%), these outcomes should alert practitioners and researchers to the potential effects of personality variables in all self-report data.

Key Words: Anxiety, benefit, disability, extroversion, hearing aids, locus of control, personality, questionnaire

Abbreviations: ANX = anxiety; APHAB = Abbreviated Profile of Hearing Aid Benefit; AV = APHAB subscale Aversiveness; BN = APHAB subscale Background Noise; EC = APHAB subscale Ease of Communication; EIP = extroversion-introversion preference; MBTI = Myers-Briggs Type Indicator; PO = belief in powerful others; RV = APHAB subscale Reverberation; Self = belief in internal control; SRT = speech reception threshold; STAI = State-Trait Anxiety Inventory

Despite our sophistication in computing important hearing aid fitting parameters such as audibility improvement, dynamic range compression, and appropriate maximum output, we still cannot predict with confidence how well anyone will react to amplification until he or she has had the opportunity to try it in daily life. Combine this situation with the stress on cost containment in the current health care climate and it is easy to understand why there is considerable emphasis on measuring the outcome of hearing aid fittings:

third-party payers want to maximize the return on their outlays, health care agencies want to evaluate the quality of their services, consumers want to know how their rehabilitation result compares to others, and so on.

The need to document hearing aid fitting outcomes has presented practitioners with a measurement dilemma. The ideal method for quantifying the hearing aid-specific fitting outcome would involve an objective test of aided performance (e.g., speech intelligibility) which could be accomplished in a clinical setting. However, to be suitable, such a test must be a fairly accurate predictor of the individual's performance with the hearing aids in his or her daily life. An objective outcome measure that fulfills this requirement has not been developed. Although it is true that objective clinical tests of auditory impairment are usually significantly related to

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self-assessed communication ability in daily life (patients with more impairment tend to report more disability), the relationship between disability and clinical impairment is not strong, and a large amount of variance in reported disability cannot be accounted for by clinical data (e.g., High et al, 1964; Weinstein and Ventry, 1983; Demorest and Walden, 1984; Gatehouse, 1994; Saunders and Cienkowski, 1996). Herein lies the dilemma. Should we conclude that the clinical objective tests (such as speech intelligibility) have failed to capture important elements of the demands of daily life communication and are, therefore, invalid? Or is it more likely that patient's responses to questions about their everyday communication abilities are heavily influenced by variables other than their actual performance with the hearing aid? Such variables might include aspects of the hearing impairment that were not accounted for in the hearing aid fitting (e.g., frequency or temporal resolution; Gatehouse, 1994) central auditory variables (e.g., Fire et al, 1991; Jerger, 1996), or psychological variables. In an attempt to address some of these concerns, this article reports an initial exploration of the relationship between psychological variables and self-assessed hearing aid outcomes.

It is not unreasonable to propose that the personality of the hearing-impaired individual might mediate self-reported hearing aid outcomes. The psychological literature provides evidence that certain personality variables are related to an individual's abilities to cope with stressful life events. Each individual tends to employ a particular "copying style" to deal with the unpleasant events of daily life. Some coping styles appear to be more effective than others in reducing the tension that is experienced by the individual. For example, the Environmental Docility hypothesis states that individuals with certain psychological features have a narrower range of adaptability to increased environmental demands and are more affected by environmental stressors (Morgan et al, 1984). Other research suggests that certain personality features may predispose an individual to encounter more stressful situations and/or to display more strongly negative reactions to stress (e.g., Bolger and Schilling, 1991). Based on these types of findings, it seems reasonable to suspect that an individual's coping style will have an impact on the effectiveness of his or her efforts to deal with an acquired hearing loss.

In addition to specific differences in the ability to cope with stressful events, individuals

also display differences in their tendency to be upset in general. Negative affectivity is a disposition to experience distress even in the absence of provoking events. Watson and Pennebaker (1989) found that self-report health measures reflect the negative affectivity status of the respondent. Other research has identified a repressive coping style in which an individual avoids experiencing distress despite the presence of provoking events. Denollet (1991) reported that the repressive coping style also was related to self-assessments in the health domain. These types of findings point to the possibility that an individual's predisposition to experience or avoid distress might impact his or her responses on a self-report of hearing aid effectiveness.

Several studies have investigated the relationship between personality variables and self-reports of hearing disability and/or handicap. Although a variety of psychological instruments has been used, the most fruitful studies have generally explored personality variables in three broad categories: anxiety/neuroticism, locus of control, and extroversion/introversion. The anxiety/neuroticism domain includes unpleasant feelings of tension, uneasiness, worry, nervousness, uncertainty, etc. Locus of control measures explore the individual's belief in his or her ability to have control over what happens to him or her. Individuals who generally believe that the advent of desired or undesired outcomes is contingent on their own behavior are said to exhibit internal control. A person who believes that other people or chance events or fate are responsible for what happens to him or her is exhibiting external control. The extroversion/introversion continuum describes the extent to which the individual's approach is directed outward (toward the environment) or inward (toward the self) when interacting with and interpreting actions and events.

Gatehouse (1990) found that hearing-impaired individuals who are more neurotic/anxious reported greater hearing disability, even after accounting for the effects of differences in impairment. In a subsequent study, Gatehouse (1994) again found that scores in the anxiety/neuroticism domain were related to self-assessed disability. However, after age and audiologic differences were accounted for, anxiety no longer made a significant additional contribution to disability self-ratings but still made a significant additional contribution to handicap self-ratings. Saunders and Cienkowski (1996) reported a significant relationship between anxiety and self-assessed hearing handicap. A

similar result was noted by Andersson and Green (1995).

Downs et al (1989) reported that self-assessed hearing handicap was related to introversion/extroversion scores for a group of hearing-impaired adults. A similar finding was reported by Saunders and Cienkowski (1996). Gatehouse (1990) also observed that a subject's position on the introversion/extroversion continuum was related to his or her reported hearing disability.

Hunter et al (1980) reported that elderly individuals with poorer self-rated hearing were more likely to have an external locus of control. On the other hand, Mulrow et al (1992) found no relationship between locus of control and hearing handicap reports in a group of elderly hearing aid candidates.

Aspects of personality have also been found to be related to loudness perception. Stephens (1970) reported that the slope of the loudness function was positively correlated with anxiety. Scott et al (1990) determined that locus of control was an important variable in promoting adequate coping with the aversive/unpleasant noises of tinnitus. Thomas and Jones (1982) reported that locus of control and introversion/extroversion were mediating factors in determining the uncomfortable loudness level for men and women.

As this review indicates, many studies have found a significant relationship between some aspect of personality and self-reported hearing disability or handicap. In general, personality attributes have been seen to make a modest but significant contribution to disability or handicap scores even after accounting for the effects of differences in audiologic impairment. Further, the relationships between personality and loudness perception suggest that personality variables might be predictive of individual reactions to the loudness of speech and environmental sounds. It seems an obvious extension of these observations to explore the effects of personality variables on self-assessed hearing aid outcomes. We need to know whether the personality of the hearing-impaired person is related to the extent to which he reports that a hearing aid facilitates communication and/or whether personality is a mediating factor in determining an individual's response to the increased loudness of amplified sound.

There is a scarcity of research that directly explored the relationships between personality and hearing aid outcomes. Gatehouse (1994) reported a significant relationship between

hearing aid benefit and scores on hysteria, obsession, and anxiety measured with the Crown-Crisp Experiential Index. In the same study, scores on hysteria, obsession, and depression were related to hearing aid satisfaction. Interestingly, neither benefit nor satisfaction was significantly related to objective hearing impairment. This work by Gatehouse provides further support for the notion that self-assessed hearing aid outcomes are affected by personality variables. Given the significance currently being placed on the results of self-assessed hearing aid outcomes, it is important to explore this matter vigorously; to gain an understanding of the particular personality traits that impact on subjective assessments of hearing aid fitting outcome; and, in the long run, to develop a method of incorporating this knowledge into our treatment of self-report data.

The present study examined the relationship between certain personality variables and responses to a widely used subjective instrument for quantifying hearing aid fitting outcome: the Abbreviated Profile of Hearing Aid Benefit (APHAB; Cox and Alexander, 1995). The APHAB was developed for clinical use with elderly hearing aid wearers and this group was the focus for the present study. Variables of age and gender were included in the study as well as personality variables because these have been identified in some studies as potentially related to the issue at hand. Gatehouse (1990) noted that gender affected the relative contributions of personality variables to reported disability, with personality playing a greater role for female respondents. Additionally, several studies have suggested that age is related to self-assessed handicap or disability with older subjects reporting a lower impact of hearing impairment (Gatehouse, 1990, 1994; Gordon-Salant et al, 1994).

METHOD

Subjects

Subjects were recruited using newspaper advertisements and through a review of clinic files. Because we wished to generalize the results of the study to a wide range of elderly hearing aid wearers, the main emphasis in recruitment was to obtain as widely representative a sample as possible. All individuals who had worn a hearing aid for a sufficient time to form an opinion about its performance were urged to participate, regardless of their hearing loss, gender, or

present hearing aid use status. The final group comprised 83 elderly individuals. They were mostly retired and in good health. The typical subject used two to three prescription medicines daily, lived with one other person, talked to three to four other people each day, left the house on errands or outings four or more times per week, and had some college education. Figure 1 depicts hearing aid history and other characteristics of the subjects. Figure 2 illustrates the composite audiograms of the men and women who participated.

Tests

Hearing Aid Outcome

Hearing aid fitting outcome was measured using the APHAB (Cox and Alexander, 1995). This is a 24-item self-assessment inventory that quantifies hearing disability both with and without a hearing aid. Thus, the instrument generates scores for aided and unaided listening. Also, the difference between aided and unaided scores is used as a measure of hearing aid benefit. The APHAB produces scores for aided listening, unaided listening, and benefit in each of four subscales:

- *Ease of Communication (EC)*: Effort to communicate in relatively easy situations.
- *Reverberation (RV)*: Problems communicating in reverberant rooms.
- *Background Noise (BN)*: Problems communicating in noisy situations.

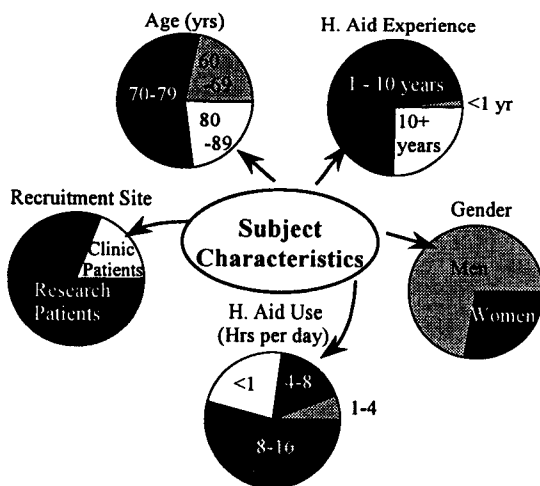


Figure 1 Distribution of subject characteristics including hearing aid experience and use, age, gender, and recruitment site.

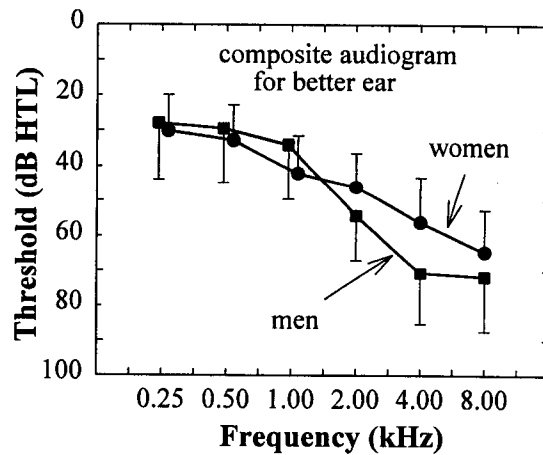


Figure 2 Composite audiograms of men and women subjects. Bars depict one standard deviation.

- *Aversiveness (AV)*: Negative reactions to environmental sounds.

Anxiety

Anxiety is often viewed as having two basic forms: state anxiety and trait anxiety. State anxiety encompasses temporary or transient feelings of worry or nervousness that occur as a result of particular stressful situations, such as taking a test or going to the doctor. Trait anxiety is a relatively consistent predisposition to experience feelings of worry, nervousness, apprehension, etc. in response to everyday situations. In the present study, anxiety was measured using the trait version of the State-Trait Anxiety Inventory (STAI), form Y-2 (Spielberger, 1983). We were attempting to capture the extent to which the hearing aid wearers were inclined to respond with anxiety on a frequent or daily basis. The STAI has been widely used in clinical and research applications in a variety of disciplines.

The trait-anxiety STAI comprises 20 statements such as "I make decisions easily," which are intended to assess how people generally feel. Subjects respond on a 4-point scale ranging from "almost always" to "almost never." Possible scores range from 20 to 80 with a higher score indicative of greater anxiety.

Extroversion-Introversion

Extent of orientation toward the outside world was measured using the extroversion-introversion dimension of the Myers-Briggs Type Indicator (MBTI), form G, revised (Myers and

McCaulley, 1985). The MBTI is a forced-choice inventory that yields scores for each of four theoretically independent dimensions. All possible combinations of orientations on the four dimensions yield a total of 16 possible personality types. In this study, our interest centered on the extroversion-introversion dimension only. The MBTI authors warn that this dimension should not be thought of as measuring shyness versus gregariousness in a social situation; rather, it is seen as a measure of an individual's general attitude toward the world in terms of a predisposition to be oriented outwardly (to people and objects) or inwardly (to ideas and concepts).

Form G (revised) consists of 94 items of which 21 comprise the extroversion-introversion dimension. In scoring the inventory, points are accumulated for both extroversion (E) and introversion (I). The pole (E or I) with the most points is the preferred mode of interacting with the world and the difference between E and I scores shows the strength of the preference. For this study, the predisposition toward outward orientation was determined by computing the preference score as described in the test manual (Myers and McCaulley, 1985, p. 9). In addition, if the direction of preference was toward introversion, the preference score was given a negative sign. Thus, a large positive score reveals a strong outward orientation and a large negative score reveals a strong inward orientation.

Locus of Control

The locus of control construct relates to an individual's general attitude about what makes things turn out well for him or her. People who tend to believe that their own actions are responsible for good (or bad) things happening to them are said to exhibit internal control. People who tend to believe that good or bad things happen as a result of the actions of powerful other people, or perhaps due to fate or chance, are exhibiting external control. The original locus of control psychological test was developed by Rotter (1966). Since then, locus of control measures have been studied for their explanatory power in a wide range of areas ranging from alcoholism to racial differences. To serve these diverse applications, many different locus of control questionnaires have been developed.

For the present study, the I, P, and C scales developed by Levenson (1981) were chosen as the locus of control measure. These scales measure locus of control as a multidimensional construct in which an individual obtains separate scores

for internal control (I), control by powerful others (P), and control by chance events (C). Each of the three scales consists of eight items presented in a Likert scale format. Each item is a statement such as "when I make plans, I am almost certain to make them work," and the subject chooses a response from a 6-point scale ranging from "strongly agree" to "strongly disagree." The potential scores on each scale range from 0 to 48. A high score on a scale reflects a tendency to believe in that source of control.

Procedure

The APHAB, a demographic questionnaire, and three psychological tests were administered to each subject in a single session. All were administered in paper and pencil format. Each standardized questionnaire was accompanied by its standard instructions. The demographic questionnaire was given first, followed by the APHAB, and then the psychological tests were given as a package in the order extroversion/introversion, anxiety, and locus of control. Audiograms were obtained for most subjects from clinic or laboratory records. For a few subjects, audiograms were measured during the test session. Eighty-six percent of the audiograms were obtained within 1 year of the questionnaire results. The rest were dated more than 1 year before the questionnaires were administered.

RESULTS

Representativeness of Subjects

Because we wished to generalize the results to a wide range of elderly hearing aid wearers, it was important to evaluate the extent to which the subject group appeared to be representative of hearing aid wearers and elderly persons in general. To address this issue, the audiogram, APHAB, and psychological results were compared with other data where possible.

Examination of the composite audiograms depicted in Figure 2 reveals that the configurations display the characteristic gender differences that were reported for elderly individuals by Jerger et al (1993): The thresholds for males are better in the low frequencies and poorer in the high frequencies than for females. The two mean audiograms intersect at a frequency of about 1500 Hz. These data support the conclusion that the subjects displayed the patterns of sensitivity impairment characteristic of their elderly counterparts.

The representativeness of the APHAB scores was examined by comparison with norms developed by Kochkin (1997) for an unselected group of 521 mostly elderly individuals who purchased hearing aids within the previous 2-year period and who chose to respond to a mailed survey. Figure 3 shows a comparison between Kochkin's norms and the data from this study. Means are shown for aided and unaided scores for each of the four subscales. For subscales RV, BN, and AV, both aided and unaided mean scores are very similar across the two groups. For subscale EC, the group from this study reported fewer aided and unaided problems than those in Kochkin's group. T-tests revealed that these differences were significant ($p < .01$) for both aided and unaided listening conditions. This indicates that the subjects in this study reported less strain than those in Kochkin's study when communicating in relatively easy listening situations. The basis for this outcome is not certain but it probably suggests that the extent of impairment was somewhat less in our subjects. Almost half of Kochkin's subjects self-reported their hearing loss to be severe or profound. Note that both Kochkin's data and the present study are based on subjects who chose to participate in a research project. It is unclear to what extent these subject groups are representative of all elderly hearing aid owners.

Anxiety levels in the subject group were compared with norms reported by Spielberger (1983) for typical men and women in the 50- to 69-year age group. The results are seen in Figure 4. The normative data show mean t-anxiety scores of about 30 for both men and women, with men scoring slightly higher than women.

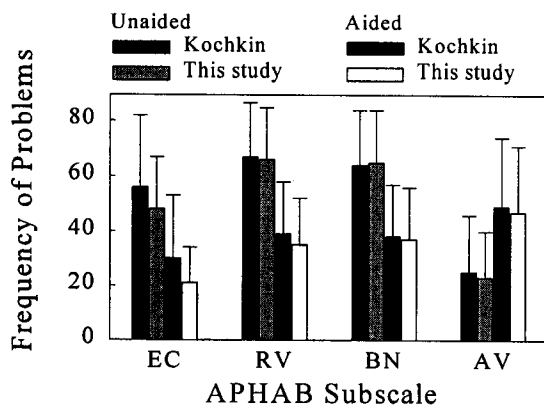


Figure 3 Mean scores for each APHAB subscale for subjects from this study and in norms reported by Kochkin (1997). Data are given for aided and unaided listening. Bars depict one standard deviation.

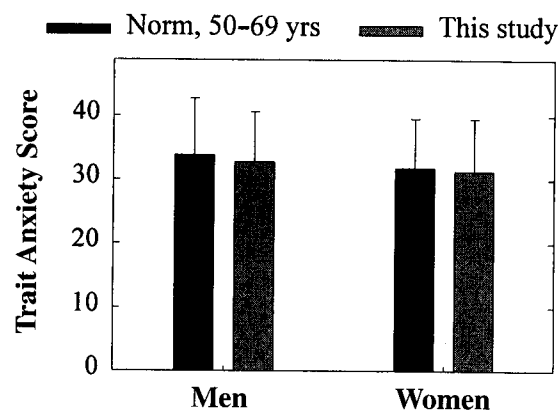


Figure 4 Mean trait anxiety scores for men and women from this study and in norms reported by Spielberger (1983). Bars depict one standard deviation.

Data from this study are almost identical to the norms, both in mean values and dispersion.

The means and standard deviations of extroversion and introversion preference scores in the population were reported by age group by Myers and McCaulley (1985). These scores depict the strength of each subject's preference for either extroversion or introversion. Figure 5 depicts the population means for the 60-year-plus age group compared with the corresponding data for the subjects in this study. Since the two subject sets appeared to exhibit somewhat different patterns, t-tests were performed to evaluate the differences. Results indicated that those subjects expressing a preference for extroversion were more strongly extroverted among the hearing aid wearers than among the normative elderly individuals ($p < .05$). However, hearing aid wearers who expressed a prefer-

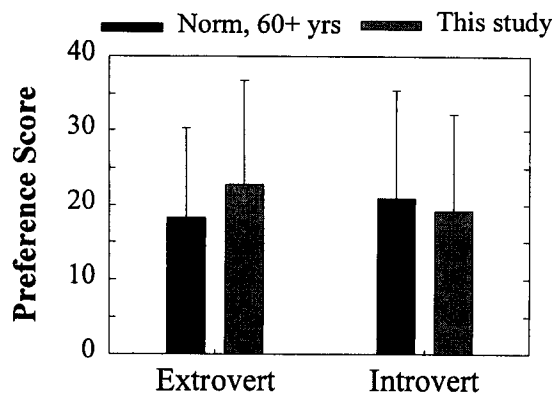


Figure 5 Mean preference scores for extroverts and introverts for subjects from this study and in norms reported by Myers and McCaulley (1985). Bars depict one standard deviation.

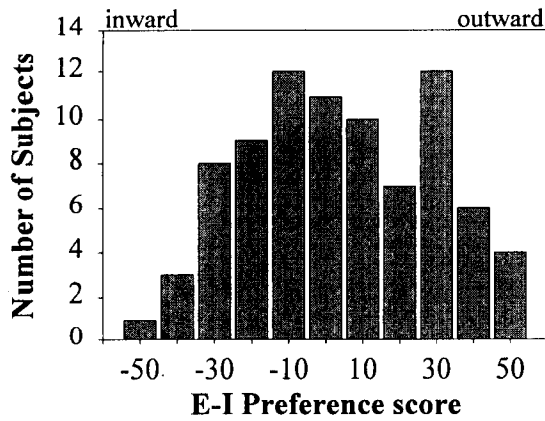


Figure 6 Distribution of extroversion-introversion preference scores. Negative scores reflect strength of introversion preference.

ence for introversion did not display a systematic difference from the normative group in the strength of the preference. Figure 6 illustrates the distribution of signed preference scores for our subjects. Positive scores indicate an outward orientation whereas negative scores indicate an inward orientation.

Figure 7 contrasts mean scores on the three locus of control scales for the hearing aid wearers with those for 503 typical adults (studies cited by Levenson, 1981). T-tests comparing mean scores indicated that the hearing aid wearers reported significantly stronger belief in internal control and significantly less belief in control by powerful others than the normative group

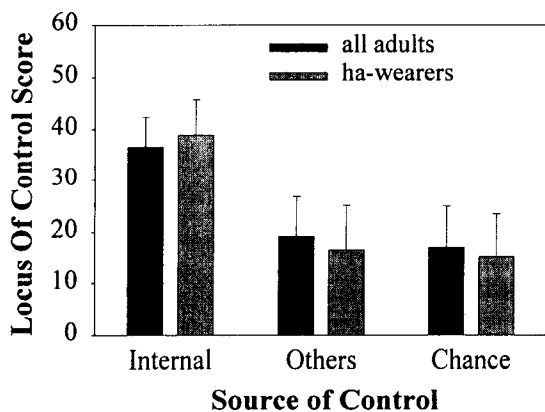


Figure 7 Mean scores on three locus of control scales reflecting belief in internal control (internal), control by powerful others (others), and control by chance (chance). Data are given for subjects in this study and for a composite group of typical adults.

($p < .01$). However, the two groups did not differ in extent of belief in control by chance or fate.

Relationships among Psychological Variables

Relationships among the five personality variables were evaluated through the computation of a correlation matrix shown in Table 1.

The strongest relationship among the psychological variables was between belief in control by powerful others and belief in control by chance or fate. Subjects who expressed a strong belief in control by powerful other persons were also likely to express a strong belief in control by chance or fate events. Less strong, but still significant, relationships were seen between anxiety and extroversion-introversion preference and between anxiety and control by powerful others. Persons with high anxiety scores were more likely to be more inward oriented (toward ideas and concepts) and to have greater belief in control by other persons.

Relationships between Personality and APHAB Scores

As noted above, it has been well established that extent of hearing impairment is related to self-reported disability. Thus, impairment would be expected to be somewhat predictive of APHAB scores. The main research question in this study centered on the extent to which personality variables, age, and gender make an additional contribution to the variance in APHAB scores beyond that provided by impairment data. This question was addressed using multiple regression analyses. In each analysis, the predictor variables were speech reception threshold (SRT), audiogram slope, age, gender, anxiety (ANX), extroversion-introversion preference (EIP), belief in internal control (Self), and belief in powerful others (PO). Belief in control by chance or fate was not entered as a variable in these analyses because of its relatively strong relationship with PO and the conceptual similarity between these two variables, which assess belief in different sources of external control.

Separate stepwise multiple regression analyses were performed for aided, unaided, and benefit data for each APHAB subscale. Results are summarized in Tables 2, 3, 4, and 5. Each table gives results for a different subscale. The tables indicate which variables were found to make a significant contribution to the prediction of each APHAB score ($p < .05$), the percent of variance

Table 1 Linear Correlation Coefficients Computed between Pairs of Psychological Variables

	<i>Internal Control</i>	<i>Control by Powerful Others</i>	<i>Control by Chance</i>	<i>Anxiety</i>
Extroversion-introversion preference	.14	.08	-.15	-.24*
Internal control		.08	.01	-.13
Control by powerful others			.38†	.22*
Control by chance				.04

†p < .01, *p < .05.

in APHAB score explained by that variable, and the direction of the relationship (+/-) between the variable value and the APHAB score. A positive direction indicates that higher variable values were related to higher APHAB scores. A negative direction indicates that higher variable values were related to lower APHAB scores.

To help interpret the tables, keep in mind that the unaided and aided APHAB scores reflect frequency of problems. Hence, a higher score is a more negative indicator. On the other hand, benefit scores for EC, RV, and BN show the amount of improvement with the hearing aid, so a higher score is a positive result. Finally, "benefit" on the AV subscale denotes an increase in the unpleasantness of sounds when they are amplified, as explained further below.

For subscale EC (see Table 2), only SRT was significantly related to the unaided score. Thus, in relatively easy listening situations, hearing impairment was the only variable among those assessed that was consistently related to communication disability without amplification. In aided listening, anxiety was related to the EC score but SRT was not. Hearing impairment (SRT) was also a significant predictor of bene-

fit on the EC subscale with more impaired subjects reporting greater benefit. However, note that outward orientation (EIP) was just as important as impairment in predicting EC benefit with more outwardly oriented subjects reporting more benefit.

Table 3 reveals that results for the RV subscale were quite consistent across aided and unaided listening as well as benefit. All three scores were significantly related to both hearing impairment (SRT) and outward orientation (EIP). In unaided listening, hearing impairment explained more variance and therefore should be thought of as the more important contributor to the APHAB score. However, for aided and benefit scores, outward orientation made a greater contribution than impairment. Note also that, in unaided listening, more outwardly oriented subjects reported more communication problems in reverberant situations, whereas, in aided listening, these same subjects reported fewer problems in reverberant situations. The overall result was that more outwardly oriented subjects reported more benefit from amplification in reverberant situations.

Table 2 Stepwise Multiple Regression Analyses for Subscale EC

<i>Subscale</i>	<i>Score</i>	<i>Variable</i>	<i>% Variance</i>	<i>+/-</i>
EC	Unaided	SRT	10	+
		Anx	5	+
	Benefit	SRT	8.5	+
		EIP	9.5	+

Results are given for separate analyses of responses for unaided listening, aided listening, and benefit (unaided-aided). Variables reported are those that made a significant contribution to prediction of the score. The table also shows the amount of variance in APHAB scores accounted for by variance in predictor variables and the direction of relationship (+/- = positive or negative) between the variables and APHAB scores.

Table 3 Stepwise Multiple Regression Analyses for Subscale RV

<i>Subscale</i>	<i>Score</i>	<i>Variable</i>	<i>% Variance</i>	<i>+/-</i>
	Unaided	SRT	17	+
		EIP	4.5	+
RV	Aided	SRT	5	+
		EIP	19	-
	Benefit	SRT	5	+
		EIP	20	+

Results are given for separate analyses of responses for unaided listening, aided listening, and benefit (unaided-aided). Variables reported are those that made a significant contribution to prediction of the score. The table also shows the amount of variance in APHAB scores accounted for by variance in predictor variables and the direction of relationship (+/- = positive or negative) between the variables and APHAB scores.

Table 4 Stepwise Multiple Regression Analyses for Subscale BN

Subscale	Score	Variable	% Variance	+/-
BN	Unaided	SRT	8.6	+
		Gender	8.4	M > F
	Aided	SRT	10	+
		Slope	8	+
		EIP	4	-
	Benefit	EIP	10	+

Results are given for separate analyses of responses for unaided listening, aided listening, and benefit (unaided-aided). Variables reported are those that made a significant contribution to prediction of the score. The table also shows the amount of variance in APHAB scores accounted for by variance in predictor variables and the direction of relationship (+/- = positive or negative) between the variables and APHAB scores.

The results for subscale BN, shown in Table 4, corroborated the significance of hearing impairment and outward orientation in contributing to APHAB scores and also introduced additional variables. Communication disability in noisy listening situations was significantly related to hearing impairment in both unaided and aided listening. However, it was also found that gender was predictive of the BN unaided score (men reported more difficulty than women) and audiogram slope was related to the BN aided score with greater slope associated with more difficulty. Since gender and audiogram slope are related variables, as shown in Figure 2, this outcome is consistent with the notion that subjects with steeper audiogram slope (regardless of gender) are likely to report more communication disability in noisy listening situations.

The effect of outward orientation on APHAB scores is again seen in the BN aided and BN benefit results. More outwardly oriented subjects reported fewer aided difficulties and more benefit from amplification, consistent with the findings for the RV subscale. It is interesting to note, however, that results for the BN subscale contrast with those for EC and RV in that hearing impairment (SRT or slope) was not predictive of amplification benefit. In other words, although the results verify that subjects with more impairment experience more difficulty understanding speech in noisy situations (both aided and unaided), they do not suggest that subjects with more impairment report consistently more or consistently less improvement in these problems with hearing aid use.

Table 5 Stepwise Multiple Regression Analyses for Subscale AV

Subscale	Score	Variable	% Variance	+/-
AV	Unaided	PO	10	+
		Age	6	-
	Benefit	PO	10	+
		Gender	9	M > F

Results are given for separate analyses of responses for unaided listening, aided listening, and benefit (unaided-aided). Variables reported are those that made a significant contribution to prediction of the score. The table also shows the amount of variance in APHAB scores accounted for by variance in predictor variables and the direction of relationship (+/- = positive or negative) between the variables and APHAB scores.

The pattern of results for the AV subscale (see Table 5) was quite different from that for the three subscales that focus on speech communication. Neither SRT nor slope (variables indicating hearing impairment) was predictive of any AV score. Instead, PO—a variable that was not related to scores on other subscales—is featured. Subjects who reported a stronger belief in the power of other people to control events tended to report more negative reactions toward environmental sounds in both aided and unaided listening. In addition, the aided AV score was the only APHAB score to be related to subject age. Older subjects reported less negative reactions toward amplified environmental sounds. Finally, the “benefit” on the AV subscale was related to gender. It must be remembered that the aversiveness of environmental sounds generally increases when amplification is used. Thus, the aided AV score is typically greater than the unaided AV score and the “benefit” score (unaided minus aided) is usually negative. The AV benefit score quantifies the increase in aversiveness that results from amplification. Table 5 indicates that men reported a greater increase in aversiveness than women when amplification was used.

DISCUSSION

This study produced clear evidence that there are significant relationships between personality and APHAB scores. Thus, it both confirms and extends previous reports that aspects of personality are associated with response patterns on self-assessment inventories.

Of the personality variables assessed, the introversion-extroversion dimension was clearly the most salient predictor of hearing aid benefit. More extroverted individuals reported greater hearing aid benefit in all three speech communication subscales, EC, RV, and BN. Examination of Tables 3 and 4 also reveals that there was a tendency for more extroverted subjects to report more problems in the unaided condition and fewer problems in the aided condition. The amount of variance in APHAB benefit scores that was attributable to variance in extroversion was about 10 to 20 percent. The relationship between extroversion and benefit was seen regardless of extent of hearing impairment and was strongest for the RV subscale. The strong outcome for the RV subscale might be understandable in terms of the content of the RV items since five of the six clearly refer to social/entertainment situations. Perhaps success in these situations is especially meaningful to more outwardly oriented individuals and this is somehow reflected in their responses to the APHAB items.

Among the other personality variables assessed, only anxiety made an additional contribution to self-assessed communication difficulties, and only in a strictly limited way: subjects with higher anxiety reported more communication difficulties in aided listening in the EC subscale. This outcome might be suggestive of volume-setting strategies used by the subjects. Since the EC subscale assesses rather favorable listening situations, most hearing aid wearers can obtain fairly good performance by choosing an adequate volume control setting. It is possible that more anxious listeners choose less hearing aid gain and, thus, do not obtain as much improvement in performance as hearing aid users who are less anxious.

The results for the AV subscale (see Table 5) indicate that the personality features associated with reactions to environmental sounds are different from those that are related to self-assessed speech communication difficulties. Although extroversion was strongly associated with self-assessed hearing aid benefit, it was not at all involved in the extent of an individual's negative reactions to amplified and unamplified sounds. Instead, PO was the most salient personality variable in prediction of aversiveness of sounds. Regardless of whether they are wearing a hearing aid, individuals who believe more strongly in the control of events by other people tend to report more negative reactions to environmental sounds. Note that PO was related to

aversiveness in unaided and aided listening but not in the amount of change in aversiveness when a hearing aid is used (i.e., AV benefit). This indicates that a stronger belief in control by others does not exacerbate negative reactions to amplified sound. In other words, individuals with higher PO scores are not different from others in terms of the extent to which amplification promotes or increases the unpleasantness of environmental sounds.

In summary, there appear to be two major personality attributes that influence responses to the APHAB items: (1) more outwardly oriented (extroverted) individuals report more speech communication benefit from their hearing aids, and (2) persons who feel more strongly that the rewards and penalties they receive are controlled by other people find environmental sounds to be more unpleasant, both with and without hearing aids. Trait anxiety level played a minor additional role, perhaps influencing hearing aid gain levels chosen in quiet environments. It is important to keep in mind that (consistent with other similar studies) the size of these effects is modest, rarely explaining more than 10 percent of the variance in APHAB scores.

The outcomes of this investigation also support previous research indicating that extent of hearing impairment is related to self-assessed speech communication disability. This is seen in the significant relationship between SRT and APHAB unaided scores on all three speech communication subscales (EC, RV, and BN). Impairment is also a significant predictor of disability when a hearing aid is worn in noisy or reverberant listening environments (RV and BN) but not in relatively easy listening environments (EC). We might speculate that hearing impairment was not predictive of aided communication disability on subscale EC because, in the relatively easy listening situations represented in this subscale, impairment can be largely compensated by turning up the gain of the hearing aid (this might be limited by feedback in persons with more severe hearing losses than represented in our group).

A significant effect of gender was seen both in speech communication disability in noisy situations (see Table 4) and in changes in unpleasantness of sounds after amplification (see Table 5). Specifically, men reported more communication difficulties in noise than women and men also reported a greater increase than women in aversiveness of sounds after amplification. However, it would be premature to conclude that hearing aid fittings are more problematic for men than

women. A unifying explanation for these outcomes might be found in the different impairment patterns of men and women shown in Figure 2. The apparent relationship between gender and communication in noise could actually be the result of differences between men and women in high-frequency audibility. This is supported by the finding (see Table 4) that persons with more sloping audiograms reported more difficulties than persons with flatter audiograms during aided listening in noise. Further, to compensate for a greater high-frequency impairment, it is likely that men are fitted with hearing aids having more extreme high-frequency emphasis. Instruments with more high-frequency gain are probably more often saturated by environmental noises and thus produce more objectionable distortion than those with less high-frequency emphasis. We could speculate, therefore, that persons fitted with more high-frequency emphasis hearing aids would be more likely to report a greater increase in aversiveness with amplification, regardless of gender. This hypothesis could not be tested in the present study because data were not available on individual hearing aid fittings. These considerations suggest that all of the effects of gender on APHAB scores are potentially the results of systematic differences in impairment between men and women. Further research should explore this issue.

It is interesting to note that the gender/slope variable was not a significant predictor of communication difficulties in reverberant situations (the RV subscale). This is consistent with findings in several studies suggesting that the effects of noise on speech understanding are different from those of reverberation (e.g., Nabelek et al, 1989; Helfer and Wilber, 1990; Helfer and Huntley, 1991). This outcome contrasts with several studies of objective speech intelligibility that indicated that the degrading effects of noise and reverberation are similar (Gelfand and Silman, 1979; Nabelek and Mason, 1981). Our study suggests that noise and reverberation might have different effects on everyday speech communication for persons with high-frequency hearing loss.

Finally, there was a significant relationship between age and aversiveness of amplified sounds that indicated that older subjects reported less unpleasant reactions to amplified sounds than younger ones. This outcome is quite surprising in view of the relatively restricted age range of the subjects (see Fig. 1). There are several possible explanations for this result. It is conceivable that older persons tend to be fitted with

less powerful hearing aids or that they employ less gain than younger patients. Alternatively, they might experience amplified sounds in a different way as a result of lifestyle differences: this would be consistent with the finding by Gatehouse (1994) that older persons reported less frequent exposure to potentially difficult situations. Also, after observing that older persons with a given hearing impairment report less hearing disability and handicap, Gatehouse (1991) speculated that older persons might have lower expectations than younger ones. If so, this might lead to older hearing aid wearers being less perturbed by amplified environmental sounds that are quite disturbing to younger hearing aid wearers. Again, more research is needed to clarify this issue.

The generalizability of the findings reported here is bolstered by the fact that the subjects in this study were basically similar in disability to elderly hearing aid wearers surveyed by Kochkin (1997). In addition, the males and females exhibited the typical audiogram configurations. Further, the personality profile of our subjects was similar to the elderly population in general in terms of the extent and dispersion of trait anxiety levels.

On the other hand, some intriguing differences were observed in the other personality dimensions assessed. Figure 6 illustrates that the group was fairly evenly split between inwardly and outwardly oriented individuals. However, those who displayed a preference for extroversion (outward orientation) were significantly more outward directed than the corresponding group in the general elderly population (Fig. 5). In addition, the locus of control data revealed that our subjects believed more strongly than their elderly peers in the importance of their own actions in producing desired outcomes. They also were less convinced of the power of other people to produce outcomes for them. What emerges from this is a portrait of individuals who tend to depend on information from the outside world and who are inclined to take the initiative to achieve a goal. Perhaps this kind of individual is more likely to seek a hearing aid when he/she has a hearing problem. It is also possible that this personality profile is more typical of persons who volunteer as research subjects. These are interesting speculations. However, the differences between our subject group and elderly persons in general should not be over-interpreted because, although the differences appear to be real, they are actually quite small in extent.

Practical Implications

The findings in this and previous investigations provide evidence that aspects of personality do help to determine responses to self-assessment inventories, including the APHAB. This means that when we use the APHAB (or any other self-assessment tool, either standardized or client-centered) to document the outcome of a hearing aid fitting, the data reflect, to some extent, psychological characteristics of the subjects that are independent of the merits of the hearing aid and the fitting strategy.

These results highlight the importance of proceeding with caution when subjective outcome data are applied to evaluate the success of a particular hearing aid fitting. For example, it might not be appropriate for a third-party agency to require that a fixed level of APHAB benefit be obtained before a hearing aid or fitting is judged to be successful, given that the amount of self-assessed benefit is determined in part by the patient's location on the extroversion-introversion continuum. Another currently important application of subjective outcome data is to compare different hearing aids in a clinical trial paradigm. Our results indicate that when the amount of benefit obtained from the compared hearing aids is central to the trial, the research design should control for extroversion and possibly also for trait anxiety. On the other hand, if the trial focuses on the efficacy of methods for limiting exposure to unpleasant or distorted sounds (e.g., compression limiting vs peak clipping), the subject groups should be balanced in terms of external locus of control. Incidentally, the outcome of this study also suggests that subject groups should be controlled for audiogram configuration and age.

The extent to which personality attributes impact self-assessment data should be more thoroughly investigated. This could be accomplished with greater accuracy in a prospective study that controls variables such as age, gender, hearing loss, and hearing aid fitting. We should also study the desirability and feasibility of devising additional items or a supplementary questionnaire that could be used to evaluate the personality attributes that are relevant to self-reports of hearing aid outcomes. The data generated by such a questionnaire would be valuable in at least two applications. First, they could be used to adjust hearing aid outcome scores such as those obtained on the APHAB to account for personality influences. Second,

knowledge of a patient's personality could be helpful in planning the most effective rehabilitation and counseling program. For example, the results of this study suggested that more anxious individuals might tend to use less than optimal hearing aid gain in quiet situations. If this is true, it would be appropriate to address this issue in an early stage of the fitting process for high-anxiety individuals.

In the meantime, we should not become unduly alarmed about the potential for personality variables to undermine the validity of self-assessment tools. Keep in mind that other types of outcome measures, such as objective speech intelligibility scores, are also affected by subject characteristics that are independent of hearing aids (e.g., cognitive effects and central auditory processing disorders). In addition, although the relationships between personality and self-assessment data are real, current indications suggest that they account for a relatively small proportion of the variance in self-report outcome scores. Much of the remaining variance presumably reflects the merits of the hearing aid and the fitting strategy and the extent to which they have met the needs of the hearing-impaired individual. Continued research will inevitably produce a clearer understanding of the variables impacting subjective assessment of hearing aid efficacy.

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