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**Validation of the SADL Questionnaire**  
**[Articles]**

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**Abstract** [TOP](#)

**Objective:** To cross-validate the psychometric characteristics of the Satisfaction with Amplification in Daily Life (SADL) questionnaire ([Cox & Alexander, 1999](#)), and to explore the SADL's construct validity.

**Design:** Thirteen private practice Audiology clinics each distributed SADL questionnaires, by mail, to 20 adults who had recently obtained hearing aids. The completed questionnaires were returned to a central site and subject anonymity was assured. There were 196 usable responses.

**Results:** Psychometric characteristics of the items were found to be very similar to those reported previously. Thus, the internal validity of the instrument was strongly supported. The assumption that the SADL quantifies satisfaction by assessing its components was evaluated by examining the relationship between SADL scores and scores on a traditional single-item satisfaction measure. A logical and statistically significant relationship was seen between the two measures, thereby supporting the construct validity of both types of data. For private-pay clients, satisfaction scores were very similar to the interim norms published by [Cox and Alexander \(1999\)](#). However, clients whose hearing aids were partly or fully purchased by insurance or benefits programs tended to be more satisfied than interim norms for third-party pay clients derived 5 yr ago. For most types of clients, there was a tendency toward more satisfaction in the Negative Features subscale than observed in our previous research.

**Conclusions:** Both construct and internal validity of the SADL questionnaire were supported by this research. The previously published interim norms appear to be mostly appropriate for private-pay clients, but might require adjustment in the Negative Features subscale. Further research is needed to explore the relationship between satisfaction and device purchase issues (third-party versus private pay).

Development and initial evaluation of the Satisfaction with Amplification in Daily Life (SADL) Scale have been

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previously reported in detail (Cox & Alexander, 1999). Briefly, the inventory was developed to quantify overall satisfaction with hearing aids and to provide a profile showing satisfaction in each of four major satisfaction domains. It was developed in several stages. First, the elements that are most important to satisfaction for most people were elucidated using structured interviews. The most important elements were further assessed using a questionnaire that was completed by hearing aid owners. Trial satisfaction items were designed for each important content area and a 25-item satisfaction questionnaire was disseminated to another group of hearing aid owners. Results were obtained from 257 individuals. These data were analyzed to generate the final questionnaire. The final product is a 15-item scale with four subscales. Each item is scored on a 7-point category scale. The questionnaire yields a Global satisfaction score and a profile of subscale scores which address Positive Effects, Service and Cost, Negative Features, and Personal Image.

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This paper reports further investigation of the SADL questionnaire. Issues addressed include construct validation, cross validation, item refinement, and evaluation of interim norms.

### Construct Validation [TOP](#)

Historically, hearing aid satisfaction has been measured using a single-item omnibus question such as how satisfied are you with your hearing aids? Although this approach has provided useful data for research and quality control applications, it is not very helpful to the practitioner because it does not provide any key to the problems the client is experiencing and, therefore, it does not facilitate the process of solving or addressing these problems. The SADL was developed with the intention of providing not only an overall index of satisfaction, but also a profile that can be used to identify problem areas. Thus, the SADL attempts to quantify satisfaction with hearing aids through measurement of the underpinnings or basic properties of satisfaction.

Because the word satisfaction is not used anywhere in the inventory, it is reasonable to question whether the scores actually quantify satisfaction. The first goal of the present study was to address this question by exploring the relationship between SADL scores and a conventional single-item overall satisfaction index. If we determine that the SADL scores are related to the single-item scores, this bolsters the construct validity of both measures. At the same time, through closer inspection of the relationship between the single-item scores and SADL subscale and/or item scores, it is possible to develop a fuller understanding of the ways in which clients interpret the single-item question and the significance of their responses to it.

### Cross Validation [TOP](#)

The items for the SADL were selected on the basis of both theoretical and statistical considerations. Statistical data were obtained from a heterogeneous group of hearing aid wearers comprising private practice, community clinic and third-party pay (VA hospital) clients. Item statistics and factor structure figured importantly in item selection criteria.

The second goal of the present study was to subject the SADL to cross validation by collecting data on a new sample of clients and repeating the item and factor analyses, in addition to comparing the satisfaction scores with those obtained from the original group. A certain amount of shrinkage or reduction, is expected in statistical properties such as internal consistency reliability, and factor loadings (Allen & Yen, 1979). However, it is important to confirm that the basic structure of the measure is replicable from one sample to another.

### Item Refinement [TOP](#)

One item in the SADL queries the client's opinions about the cost of the hearing aids. This item is only applicable for individuals who have a financial stake in the instruments. It was our intention that all remaining 14 items would be applicable for all hearing aid wearers. Clinical experience with the SADL has revealed that two of the items were unintentionally worded in a manner that does not seem applicable to some hearing aid wearers even though the underlying theme of the item is relevant to them. The third goal of this study was to explore the consequences of making slight modifications in wording for these two items. The intention of the modifications was to change the problematic wording while retaining the original theme of the items.

Item #7 (Are you bothered by an inability to turn your hearing aids up loud enough without getting feedback [whistling]?) has become obsolete for some clients. The theme of this item is feedback but, because many current hearing aids (developed mostly since the original data were collected) do not have a volume control, the theme was often subverted by the reference to turning up the hearing aids. To refine this item, it was reworded as follows: Are you bothered by an inability to get enough loudness from your hearing aids without feedback (whistling)?

Another problem was found in item #11 (How helpful are your hearing aids on MOST telephones with NO amplifier or loudspeaker?). This question is intended to determine whether the client is helped by the hearing aid to use the telephone successfully. We found that unilaterally aided clients who choose to use the telephone on the unaided ear were sometimes in a quandary about how to respond. This item was reworded as follows: Are you bothered by an inability to get enough help on the telephone with your hearing aids?

## Evaluation of Interim Norms [TOP](#)

To facilitate interpretation of SADL responses, [Cox and Alexander \(1999\)](#) provided a set of interim norms for Global and subscale scores. The norms include a mean value for each of the SADL scores. In addition, the typical range of scores (from the 20th to the 80th percentile) is provided. Two sets of norms were computed, one for private-pay clients and the other for those who received their hearing aids through a third-party payment scheme. The final goal of this study was to evaluate the accuracy of the interim norms by comparing them with the results obtained from a new group of hearing aid wearers.

## Method [TOP](#)

The SADL questionnaire comprises 15 items and returns four subscale scores and a Global score. The Global score is obtained by computing the mean score across all 15 items. The subscale scores are also computed using the mean of the relevant items. Briefly, the four subscales are:

- \* Positive Effect: Improved functioning in psychoacoustic and psychologic realms (six items).
- \* Service & Cost: Dispenser competence and hearing aid value (three items).
- \* Negative Features: Impact of potentially unpleasant aspects of hearing aid use (three items).
- \* Personal Image: View of the self as a hearing aid wearer, both internal and externalized (three items).

The version of the SADL used in this study was changed from that reported by [Cox and Alexander \(1999\)](#) in three ways: 1) two items were slightly reworded (described above); 2) all items were written assuming binaural hearing aids, i.e., hearing aids instead of hearing aid(s); 3) a single-item satisfaction measure preceded the 15 SADL items (see [Appendix](#)).

The data reported in this paper were generated as part of a research project that had a parallel goal of comparing conventional and digital/programmable hearing aid types. The outcome of this parallel goal is not of interest for this paper but the goal must be briefly mentioned to explain the sampling procedure. Conventional hearing aids were defined as those in which all adjustments are achieved with dispenser-adjusted potentiometers. Programmable/digital hearing aids were defined as those which incorporate a mechanism for adjusting their performance using microcomputer technology operated by the dispenser.

## Procedure [TOP](#)

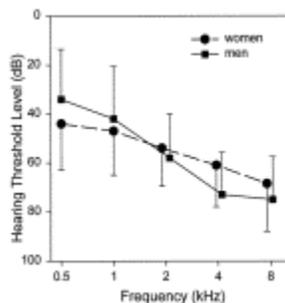
This was a multi-site study involving 13 private practice Audiology clinics. The SADL was distributed to a sample of clients who had received new hearing aids at least 3 mo before the start of the study. To select the study sample, the participating audiologists worked backward through their cases starting 3 mo earlier, on February 1, 1999. Subject inclusion criteria were: at least 21 yr old; adult onset hearing loss; bilateral hearing loss (not necessarily symmetrical); essentially sensorineural hearing loss; fitted with similar type hearing aids bilaterally which they used for at least 3 wk; and, English language and reading ability. No CROS, BICROS, or external auditory input configurations were allowed in the subject group. Hearing aid experience was not considered: subjects could be experienced or first-time hearing aid users.

Using these guidelines, each participating audiologist selected a total of 20 potential subjects. They were the 10 consecutive clients before the start date who had been fitted with conventional hearing aids and the 10 consecutive clients before the start date who had been fitted with instruments in the programmable/digital category. Each potential subject received a letter from their audiologist asking them to complete the questionnaire. A package of hearing aid batteries was included as an incentive/payment. The completed questionnaire was returned in the mail to a central office. The subject was urged to provide candid responses and was assured that his/her audiologist would not be informed about the responses of any individual client.

## Subjects [TOP](#)

One hundred and ninety-six of the 260 potential subjects returned usable, completed questionnaires. There were 103 men, 79 women, and 14 who did not report gender. [Figure 1](#) shows the composite audiograms (including both ears) of the men and women subjects. Mean monosyllabic word discrimination scores were 82% for women and 78% for men. Mean ages were 72 for women (range 38 to 97) and 69 for men (range 23 to 98).

Figure 1. The composite audiograms (including both ears) of the subjects.



The median time since fitting for the rated hearing aids was 10 mo. The most recently fitted devices were 3 mo old, and six fittings were more than 4 yr old. Distributions of device styles and reported daily use are given in [Table 1](#). Most subjects (77%) self-assessed their unaided hearing difficulty as moderate or moderately-severe. Fifteen percent reported their unaided hearing difficulty as severe. The rest reported their own unaided hearing difficulty as mild with the exception of one individual who reported none.

TABLE 1. Distribution of hearing aid styles and reported daily use for 196 subjects

| Style Distribution | Daily Use Distribution |            |
|--------------------|------------------------|------------|
|                    |                        |            |
| BTE                | 20%                    | <1yr 4%    |
| ITE                | 33%                    | 1-3yr 10%  |
| ITC                | 27%                    | 4-6yr 18%  |
| CIC                | 20%                    | 8-10yr 68% |

BTE = behind-the-ear; ITE = in-the-ear; ITC = in-the-canal; CIC = completely-in-the-canal.

Table 1. Distribution of hearing aid styles and reported daily use for 196 subjects behind-the-ear; ITE = in-the-ear; ITC = in-the-canal; CIC = completely-in-the-canal

## Results [TOP](#)

As described in detail by [Cox and Alexander \(1999\)](#), the SADL items are scored on a 7-point scale with higher numbers representing greater satisfaction. Thus, the Global and subscale scores range from 1 to 7. The single-item omnibus satisfaction score was determined using a 5-alternative response scale as shown in the appendix. These responses were scored with very satisfied = 5 and very dissatisfied = 1.

## Item Refinement [TOP](#)

Data for the two reworded items were explored through inspections of item mean scores and response distributions, percent missing, and correlations with other items. Data for the reworded version of item 7 (bothered by feedback) were very similar to that expected for the original wording and there were only 3% missing responses. This reworded item was judged to be completely acceptable and the modified wording is recommended for use in the SADL questionnaire.

In contrast to the positive results for item 7, data for reworded item 11 (telephone use) did not suggest an improvement over the original wording. The mean score was significantly higher than that of the original item, and further analyses, in addition to comments written by subjects, pointed to the conclusion that the item was not interpreted in a consistent way (more information below). The rewording of this item did not solve the problems with it and the modified wording is not recommended for use in the SADL questionnaire.

## Cross-Validation [TOP](#)

### Factor Structure [TOP](#)

The original development of the SADL was guided by several objectives. These included a relatively short scale to optimize clinical utility, items addressing content areas that are known to be important to hearing aid satisfaction, and a profile of scores to promote the analytic/diagnostic use of the data. The items were chosen using evidence of four underlying content domains that comprise the subscales ([Cox & Alexander, 1999](#)). Although the internal consistency of items was a consideration in composing the subscales, striving for internal consistency did not supersede the aim of including a sufficient diversity of items to reflect the multidimensional nature of the satisfaction experience. This approach to scale development resulted in some subscales with relatively low internal consistency. Nevertheless, based on the data obtained in the development studies, each subscale was assumed to explore a specific satisfaction domain and to be different from each of the other subscales.

It is important to assess the validity of these assumptions about the structure of the final questionnaire. This can be done by performing factor analysis and item analyses on a set of data obtained from a new sample of subjects. Accordingly, principal components analysis was carried out on the SADL data (minimum eigenvalue was set equal to 1.0), with subsequent varimax rotation. The results showed strong parallels to those of the original data. Four

factors were found to account for 59% of the variance.

**Table 2** shows the loadings of each of the items on the rotated factors, with loadings less than 0.43 suppressed. Comparison of **Table 2** with results published for the same items by [Cox and Alexander \(1999\)](#), Table 3) reveals that the loadings were very similar for all items except number 14 (reasonable cost), which is discussed further below. This substantial replication of the original factor structure provides strong evidence for the validity of the SADL inventory.

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| Item  | Factor 1 | Factor 2 | Factor 3 | Factor 4 |
|---|----------|----------|----------|----------|
| 1. Hearing aid is comfortable                                   | 0.82     |          |          |          |
| 2. Hearing aid is easy to use                                   | 0.78     |          |          |          |
| 3. Hearing aid is reliable                                      | 0.75     |          |          |          |
| 4. Hearing aid is easy to clean                                 | 0.72     |          |          |          |
| 5. Hearing aid is easy to store                                 | 0.68     |          |          |          |
| 6. Hearing aid is easy to handle                                | 0.65     |          |          |          |
| 7. Hearing aid is easy to adjust                                | 0.62     |          |          |          |
| 8. Hearing aid is easy to wear                                  | 0.58     |          |          |          |
| 9. Hearing aid is easy to take out                              | 0.55     |          |          |          |
| 10. Hearing aid is easy to put in                               | 0.52     |          |          |          |
| 11. Hearing aid is easy to use when you telephone               | 0.48     | 0.45     |          |          |
| 12. Hearing aid is easy to use when you are using the telephone | 0.45     | 0.42     |          |          |
| 13. Hearing aid is easy to use when you are in a noisy area     | 0.42     | 0.39     |          |          |
| 14. Hearing aid is easy to use when you are in a quiet area     |          |          | 0.40     | 0.37     |
| 15. Hearing aid is easy to use when you are in a public place   |          |          | 0.38     | 0.35     |

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Table 2. The loadings of each of the 15 items on the four factors extracted from the data. Loadings less than 0.43 are not shown.

Thirteen of the 15 items loaded unambiguously on the factor that comprised the corresponding SADL subscale. The two items that did not conform entirely to the predicted results were #11, the reworded telephone item, and #14, the reasonable cost item. As shown in **Table 2**, item 11 loaded, as predicted, on the Negative Features subscale. However, it also loaded even more strongly on the Service and Cost subscale. We postulate that the ambiguity occurred because the new wording enough help on the telephone was interpreted by some subjects as enough help *with* your hearing aids when you telephone the dispenser and by some subjects as enough help *from* your hearing aids when you are using the telephone. The latter interpretation was the one intended. The dual loading shown in **Table 2** suggests that this item was interpreted in different ways by different subjects.

The original loading on the Service and Cost subscale ([Cox & Alexander, 1999](#)) for the reasonable cost item was 0.71, whereas in the current study, the reasonable cost item did not load strongly on any factor. The highest loading for reasonable cost (0.28) was on the Service and Cost subscale, as predicted. However, roughly similar loadings ranging from 0.23 to 0.25 were seen on each of the other subscales as well. This outcome indicates that, in this group of subjects, the amount paid for the hearing aid was related about equally to all the domains of satisfaction.

The value of Cronbach's coefficient alpha for the SADL Global score was 0.82. **Table 2** shows the value of Cronbach's coefficient alpha for each SADL subscale score. The alpha values for Positive Effect and for Negative Features were essentially identical to those observed by [Cox and Alexander \(1999\)](#). For the two other subscales, shrinkage of alpha values was seen. For the Service and Cost subscale, alpha decreased from 0.61 to 0.43. It seems likely that the change in response behavior to the reasonable cost item, described above, could be responsible for much of this difference. For the Personal Image subscale, alpha decreased from 0.56 to 0.46. It is not clear what precipitated this change, other than sampling error, because in terms of mean scores and variability, as well as principal components analysis, the items in the Personal Image subscale produced very similar data in both studies.

### Comparison with Norms [TOP](#)

[Cox and Alexander \(1999\)](#) developed interim norms for the four SADL subscales and the Global score. Two sets of norms were proposed: one for individuals who paid for their own hearing aids and the other for those whose hearing aid was provided by a third-party payer. The data for the third-party payer norms were based on responses from VA Medical Center Audiology clients. The data for the private-pay norms were derived from two private-pay clinics.

Private-Pay Subjects: In the current study of 196 subjects, 128 were private pay and 26 were in the third-party payment group (but were not VA patients). Thirty subjects fell in between, with some of the funds being derived from a third party, and some being privately paid. The remaining 12 subjects did not choose to reveal the payment information. **Figure 2** shows a comparison of the private-pay interim norms ([Cox & Alexander, 1999](#)) with the mean scores from the 128 private-pay subjects in the current study.

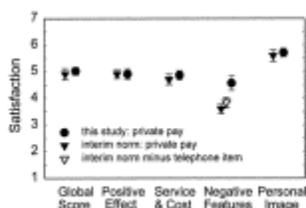


Figure 2. Comparison of the private-pay interim norms ([Cox & Alexander, 1999](#)) with the mean scores from the 128 private-pay subjects in this study. Data are shown for the SADL Global score as well as for the four subscale scores. Bars indicate the 95% confidence interval for each mean.

\* The filled circles depict the mean scores for the current study. The 95% confidence interval is also shown for each mean. The Negative Features subscale mean score is based on two items: the telephone item was deleted because of its anomalous data, described above.

\* The filled triangles depict the private-pay norms from [Cox and Alexander \(1999\)](#) with 95% confidence intervals shown. For the Negative features subscale, the original norm is given as the filled symbol and the norm with the telephone item deleted is given with the open symbol. For the Negative Features subscale, therefore, a direct comparison can be made between the filled circle and the open triangle.

Inspection of [Figure 2](#) reveals that mean scores from the current study are essentially identical to the corresponding interim norms for three subscales and for the Global score. However, there is a significant difference between the interim norms and the current study for the Negative Features subscale, even when the absence of the telephone item is taken into account. Overall, subjects in the current study gave a higher score to the Negative Features domain, indicating that these issues were less disturbing to them.

Third-Party Pay Subjects: [Figure 3](#) shows a comparison of the third-party pay interim norms ([Cox & Alexander, 1999](#)) with the mean scores from the subjects in the current study who did not pay the full cost of their hearing aids.

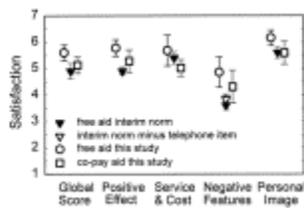


Figure 3. Comparison of the third-party pay interim norms (Cox & Alexander, 1999) with the mean scores from the subjects in the current study who did not pay the full cost of their hearing aids. Data are shown for the SADL Global score as well as for the four subscale scores. Bars indicate the 95% confidence interval for each mean.

\* The open circles depict the mean scores for the current study for the 26 subjects who did not pay any of the cost. The 95% confidence interval is also shown for each mean. As with [Figure 2](#), the telephone item was deleted from the Negative Features subscale mean.

\* The open squares depict the corresponding data for the 30 subjects who paid some, but not all, of the cost of their hearing aids.

\* The filled triangles depict the third-party pay norms and 95% confidence intervals from [Cox and Alexander \(1999\)](#). For the Negative Features subscale, the original norm is given as the filled symbol and the norm with the telephone item deleted is given with the open symbol. For the Negative Features subscale, therefore, a direct comparison can be made between the three open symbols.

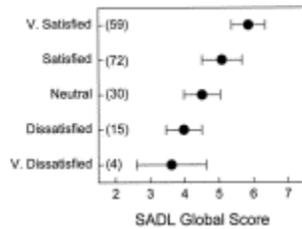
In [Figure 3](#), compare the satisfaction derived from free hearing aids in our previous study (triangles) and in the current study (circles). The means from the current study are significantly higher (more satisfied) in all subscales except Service and Cost, where they are equal. In contrast, the mean satisfaction from the co-pay aid in the current study (squares) was not significantly different from that for the free aid in the previous study (triangles) for any subscale.

In other words, subjects in the current study who paid some but not all of the cost of their hearing aids responded similarly to VA patients reported by [Cox and Alexander \(1999\)](#). Subjects in the current study whose hearing aids were fully reimbursed by a third party were significantly more satisfied in most categories than were the VA patients reported by [Cox and Alexander \(1999\)](#).

## Construct Validity [TOP](#)

[Figure 4](#) depicts the relationship between the SADL Global scores and the single-item satisfaction scores. The filled circles depict the mean Global score corresponding to each single-item category. There is a monotonic relationship between the two types of satisfaction scores. For each one-category increase in single-item score, there was an increase in mean Global score of roughly 0.6. It is interesting to note the trends in the verbal correspondences between the two satisfaction scales. For the typical subject, a SADL Global score of 4.0 corresponded to dissatisfied on the single-item scale, whereas a SADL Global score of 5.9 corresponded to very satisfied on the single-item scale. The other points of correspondence were: neutral = 4.5 (SADL), and satisfied = 5.1 (SADL). For both satisfaction measures, there were few occurrences of the lowest possible scores. SADL Global scores of 2 or less were not observed in this group of subjects, and very dissatisfied was selected by only four subjects.

Figure 4. Relationship between the SADL Global scores and the single-item satisfaction scores. Bars show 1 SD in SADL Global scores. Numbers in parentheses indicate the number of subjects in each response category.



The linear correlation coefficient computed between the single-item scores and SADL Global scores was 0.76. This is indicative of a modestly strong relationship between the two types of scores, but not as strong as we might expect given that both scores are intended to be measures of hearing aid satisfaction. Some reduction in strength is due to inherent random error in both types of scores. This limits the correlation that can empirically be determined between them. Statisticians have devised a method that allows us to estimate the strength of the relationship that could exist between the two measures if they could be made perfectly reliable (Nunnally & Bernstein, 1994, page 257). The computation of the estimated maximum correlation coefficient requires that we have access to estimates of the reliability of each of the two measures. Cox and Alexander (1999) reported the test-retest correlation of the SADL global score to be 0.81. We did not have an estimate of the reliability of the single-item satisfaction score, but for illustration purposes we assumed it to be the same as the SADL global score (0.81). Using these values, the estimated maximum correlation between the single-item and SADL Global satisfaction measures is 0.94. This result suggests that the relationship between single-item satisfaction and SADL Global scores would be rather strong if random errors were eliminated.

Another way to explore the relationship between the single-item satisfaction measure and the SADL scores, is to assess the contribution of each of the SADL subscale scores to the single-item score. To pursue this line of inquiry, a stepwise multiple regression analysis was performed with the four SADL subscales as predictors of the single-item scores. The results indicated that three of the four SADL subscales made significant contributions to the single-item score. The SADL Positive Effect score accounted for 44% of the variance in single-item scores. The SADL Service & Cost subscale accounted for a further 15%, and the SADL Negative Features subscale added a further 3%. Altogether, the SADL subscales accounted for 62% of the variance in single-item scores.

It is interesting to note that the SADL Personal Image subscale did not make any contribution to the single-item satisfaction scores. In other words, when these subjects responded to the single-item satisfaction question, they did not consider their satisfaction in the Personal Image domain. Instead, they responded mostly based on the psychoacoustic and psychologic improvements in functioning that they attributed to the hearing aid. Issues of dispenser competence and value for money were also factored in. Finally, unpleasant aspects of hearing aid use also made a small independent contribution.

## Discussion [TOP](#)

This study reinforced the validity of the SADL questionnaire by showing that a previously untested sample of hearing aid wearers provided scores that were substantially similar to those found with the original subjects reported by Cox and Alexander (1999). In addition, through comparison of two different satisfaction measures, new insights have been gained into this type of hearing aid outcome.

The attempt to generate reworded versions of two items was partly successful. Based on these results, we recommend adoption of the new wording for item #7 (Are you bothered by an inability to get enough loudness from your hearing aids without feedback [whistling]?). However, there are no recommended changes for item #11. Several other (unpublished) attempts have been made in our laboratory to generate appropriate wording for the item querying telephone use. None of these efforts has seemed to improve on the original wording. This item is problematic for clients who already communicate well on the telephone without their hearing aids and, therefore do not need additional assistance in this situation. We are continuing to explore approaches to managing the ambiguity of the item for those clients.

## Cross Validation [TOP](#)

Table 2 shows very good replication of the original factor structure and factor loadings for the SADL items. This is strong evidence in favor of the validity of the questionnaire. Internal consistency was high for the Positive Effect subscale but low for the Service and Cost and Personal Image subscales and moderate for the Negative Features subscale. These results are not surprising based on the values determined by Cox and Alexander (1999) in the questionnaire development studies, and on the known likelihood of shrinkage in psychometric properties in a cross validation study. Low internal consistency for the Service and Cost and Personal Image subscales partially results from the relatively few number of items in these subscales, but also reflects the fact that the items in a given subscale, although all relating to a common area, explore rather different facets of that topic.

One of the most provocative results of this study is the unexpectedly weak and diffuse factor loadings for the

reasonable cost item. In the original development of the SADL, the cost item clustered with items relating to service. However, in this study, responses to the cost item were not strongly related to any single content area but were weakly related to performance and image issues as well as to service issues. The bases for this different result across our two studies is not obvious, but it might be a byproduct of the difference in the range of the cost continuum in each study. The data reported by [Cox and Alexander \(1999\)](#) were collected from a convenience sample of hearing aid wearers which is assumed to reflect the demographics of hearing aid sales in 1993 to 1995. Such a sample would be expected to consist mainly of wearers of conventional hearing aids with a small sprinkling of high-end programmable devices. In contrast, the sample for the current study was deliberately constructed of roughly equal numbers of subjects wearing conventional and high-end programmable devices. As a result, there was a much larger variance across subjects in the amount paid for the instruments. Even subjects who elected not to purchase high-end devices were fitted with amplification in a system where those devices were available. In this milieu, the amount clients chose to invest in the hearing aids might have interacted with satisfaction in ways that are not fully understood at this time. Further study of the relationship between payment status and satisfaction is clearly called for.

Despite the puzzling outcome for the reasonable cost item in this study, hearing aid cost continues to be a very salient issue for hearing-impaired individuals. We are not recommending any change in the use of this item in the SADL.

### Comparison with Norms [TOP](#)

With one notable exception, the satisfaction of subjects in this study who paid privately for their hearing aids was about the same as reported by [Cox and Alexander \(1999\)](#) for private-pay subjects. The exception was in responses to the Negative Features subscale. As [Figure 2](#) illustrates, the mean score for the Negative Features domain was significantly higher in the current study, indicating greater satisfaction. The most obvious explanation would invoke the different types of hearing aids used in the two studies. Recall that the design of the current study emphasized inclusion of programmable/digital instruments whereas few of these were included in Cox and Alexander's norm group. It would be reasonable to hypothesize that this technology change might explain the difference in scores for the Negative Features subscale. However, examination of the data failed to substantiate this hypothesis: the difference in the Negative Features subscale could not be explained in terms of either the technology level or the style of hearing aids.

Perhaps this apparent improvement in Negative Features scores was precipitated by an overall shift in clinical practice away from linear processing and toward compression processing that occurred in the roughly 4 yr that elapsed between the hearing aid fittings that were evaluated in the two studies. Additional research is needed to explore this topic, and to determine whether a modification of the interim norms is indicated.

Further evidence of the ubiquitous and enigmatic effects of payment issues is seen in the data shown in [Figure 3](#). Here, we are comparing interim satisfaction norms based on responses from VA patients (who receive their hearing aids without charge, as part of veterans benefits) with data from other individuals (from the current study) who received their hearing aids without charge, but who were not VA patients. Overall, subjects from the current study who received free hearing aids were significantly more satisfied than the VA patients in three of the four subscales. On the other hand, the co-pay subjects (who made some investment in their hearing aids but did not pay the full cost) gave responses that were not different from those of the VA patients.

This outcome is puzzling. Does it suggest that the source of the third-party payment is also a variable that is associated with satisfaction? Perhaps VA patients see themselves as having made a co-payment for the hearing aids with their taxes and military service. Perhaps a hearing aid paid for by employment or insurance benefits seems more free than one paid for by taxpayers. More research is needed to address these questions because the effects are of considerable importance to health-care policymakers, clinicians, and researchers. Consumer satisfaction is assuming an increasingly important role in evaluating the effectiveness of health-care regimes. Any associations of satisfaction with nontreatment variables (such as source of payment) should be considered in such evaluations. Furthermore, the efficacy and effectiveness of new hearing aid devices is routinely measured using subjective measures such as the SADL. The results of this study suggest that careful attention should be paid to equalizing the payment variable across experimental conditions.

### Construct Validation [TOP](#)

As illustrated in [Figure 4](#), there was a logical, monotonic relationship between the single-item satisfaction data and the SADL Global scores: Individuals who yielded higher SADL Global scores also typically reported higher overall satisfaction on the single-item scale. This finding supports the assertion that the SADL questionnaire measures satisfaction even though the word satisfaction is not mentioned in the items. There were relatively few subjects who reported very low satisfaction on either scale. On the single-item scale, 73% of the subjects claimed to be either satisfied or very satisfied, whereas 10% were either dissatisfied or very dissatisfied. This outcome is similar to data reported by [Kochkin \(1997\)](#) for hearing aids 1 yr old or less. Kochkin noted that 71% of respondents were very satisfied or satisfied and 7% were dissatisfied or very dissatisfied. Thus, it appears that the overall satisfaction of subjects in this study was similar to that generally reported for recently acquired hearing aids.

The pattern of responses illustrated in [Figure 4](#) suggests that the lowest scores are generally reserved for relatively

unusual circumstances, and this points to a need to examine these cases carefully when they occur in a clinical setting. Based on the correspondences seen in [Figure 4](#) between the SADL and single-item data, a SADL Global score of 4 or less should be regarded as indicative of dissatisfaction.

Close examination of the relationships between SADL subscale scores and single-item scores revealed that the Personal Image domain did not appear to make an independent contribution in determining responses to the single-item overall satisfaction scale. On first impression, this might seem surprising because concerns about appearance and what others will think is often identified as a major variable in determining whether individuals will seek help from a hearing aid (e.g., [Franks & Beckmann, 1985](#); [Garstecki & Erler, 1996](#)). To understand this outcome, it is necessary to recall that the subjects were established hearing aid wearers. As such, they have often already reached an acceptable level of comfort with the threats to self-esteem that are addressed in the Personal Image subscale. We have observed elsewhere that most individuals who present as hearing aid candidates have relatively high expectations in the Personal Image domain ([Cox & Alexander, 2000](#)). It is possible that subjects with low expectations in the Personal Image domain seldom reach the point of becoming hearing aid candidates.

Given that relatively high satisfaction scores on the Personal Image subscale are typical for established hearing aid wearers, it is particularly important for practitioners to take note of a low Personal Image score whenever this occurs and to attempt to redress this situation through additional audiologic rehabilitation management. Clients with low satisfaction in the Personal Image domain are probably likely to abandon amplification.

### Unique Contribution of the Single-Item Scale [TOP](#)

The results of this investigation indicate that, for the typical hearing aid wearer, the responses to the SADL questionnaire provide much of the information obtained in the single item overall satisfaction scale, as well as some information that the single-item data does not usually incorporate. Further, the questionnaire generates a profile of responses that can be used as a guideline for improving satisfaction levels. The SADL questionnaire offers an attractive combination of data that is accessible and useful to the practitioner while at the same time allowing the type of outcome quantification that is valuable to an outcomes management program. It is logical, therefore, to ask whether there is any incentive to administer a single-item satisfaction measure in addition to the SADL.

A review of the data revealed that there can be occasions when the single-item score provides unique and essential information. It does this by exposing potentially disastrous concerns that are, for this client, not related to the issues addressed in the standard items of the SADL. An example is illustrated in [Figure 5](#). In this figure, the gray bars show the range of typical responses and the circles show the mean response for each of the SADL scores, based on the interim private-pay norms published by [Cox and Alexander \(1999\)](#). The triangles depict scores from one subject. This subject's profile of subscale scores falls completely within the typical range which would lead us to expect her to be fairly satisfied with the fitting. Based on the Global score of 4.73 and the correspondence between single-item scores and SADL global scores ([Fig. 4](#)), we would predict this subject's overall satisfaction to be between neutral and satisfied. Instead, she reported being very dissatisfied. Written comments revealed that this response was due to the fact that the hearing aids were a poor fit, even after several remakes. She wrote It seems as if they were made for somebody else.

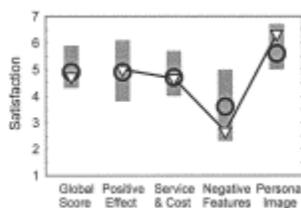


Figure 5. SADL scores from one individual who was very dissatisfied on the single-item scale. The gray bars and circles show the range and mean, respectively, of typical responses for each of the SADL scores, based on the interim private-pay norms (Cox & Alexander, 1999).

Two previous unpublished studies in our laboratory have shown that comfort in the ear is strongly associated with the Positive Effect subscale. Concerns in this domain will usually be reflected in that subscale. Apparently the subject illustrated in [Figure 5](#) had an unusual type of difficulty. In this type of situation, the nonspecific single-item scale can serve as a safety net to capture significant problems that might otherwise not be reflected in the data.

Presentation of the single-item scale before the SADL items consumes minimal additional time. The results of the single-item score and SADL global scores can be compared by scoring software to determine whether there is an incongruity. Current estimates suggest that this will occur less than 1% of the time. However, for that one in a hundred fittings, the safety net provided by the single-item score could be an essential factor in the success of the follow-up management. This will be especially the case if the SADL data are collected by mail rather than in a face-to-face meeting.

### Conclusions [TOP](#)

This study has generally reaffirmed the characteristics of the SADL questionnaire that were reported by [Cox and Alexander \(1999\)](#). The ability of the SADL to quantify satisfaction through assessment of its components has also

been supported. Slightly modified wording has been developed for item #7 and adoption of this new wording is recommended. Further, it is recommended that clients who hear well on the telephone without a hearing aid should omit item #11 which queries telephone use.

The interim norms published by [Cox and Alexander \(1999\)](#) were validated for private-pay clients in all domains except Negative Features. The data from this study suggest that the Negative Features norm might require upward adjustment in the future, possibly because a marked change in device technology in the past few years has resulted in greater satisfaction in this domain.

Continuing research will be directed toward developing a method to compare the Global SADL score with response to a single-item satisfaction index as a cross-check for undetected satisfaction problems. In addition, further study of the associations between satisfaction and third-party versus private payment for the device is called for.

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## Appendix: Single-item Satisfaction Scale [TOP](#)

Overall, how **satisfied** are you with the hearing aids you obtained from our clinic? (check one)

- Very Satisfied
- Satisfied
- Neutral (Neither satisfied nor dissatisfied)
- Dissatisfied
- Very Dissatisfied [\[Context Link\]](#)

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