Does Acceptable Noise Level Predict Hearing Aid Success?

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INTRODUCTION

Rationale

Audiologists and consumers both desire the ability to predict hearing aid success prior to purchase. Nabelek et al. (1991) hypothesized that a person who accepts more background noise will be more successful with hearing aids. To explore this, they developed the Acceptable Noise Level (ANL) test, which measures a person's acceptance of background noise.

An ANL score of 7 or less has been reported to predict hearing aid success with 85% accuracy (Nabelek et al. 2006). This prediction rule was based on logistic regression exploring the relationship between ANL scores and hearing aid success, when success was determined using a single question about hearing aid use.

Many researchers have studied the elements of hearing aid success and have generally found that hearing aid success is multi-dimensional, including, for example, hearing aid use, satisfaction, benefit, and quality of life.

The ANL test is gaining widespread popularity, however little research has been done to substantiate the accuracy of the prediction of hearing aid success.

Research Purposes

1. To substantiate the relationship between ANL score and hearing aid use as reported by Nabelek et al. (2006).
2. To assess the extent to which the ANL score predicts hearing aid success when success is quantified using other standardized outcome measures.

METHODS

Subject Description

- 50 subjects with sensorineural hearing loss
- Mean age: 68 years
- Range: 40 – 82 years
- At least 6 months of bilateral hearing aid experience

Composite Audiogram
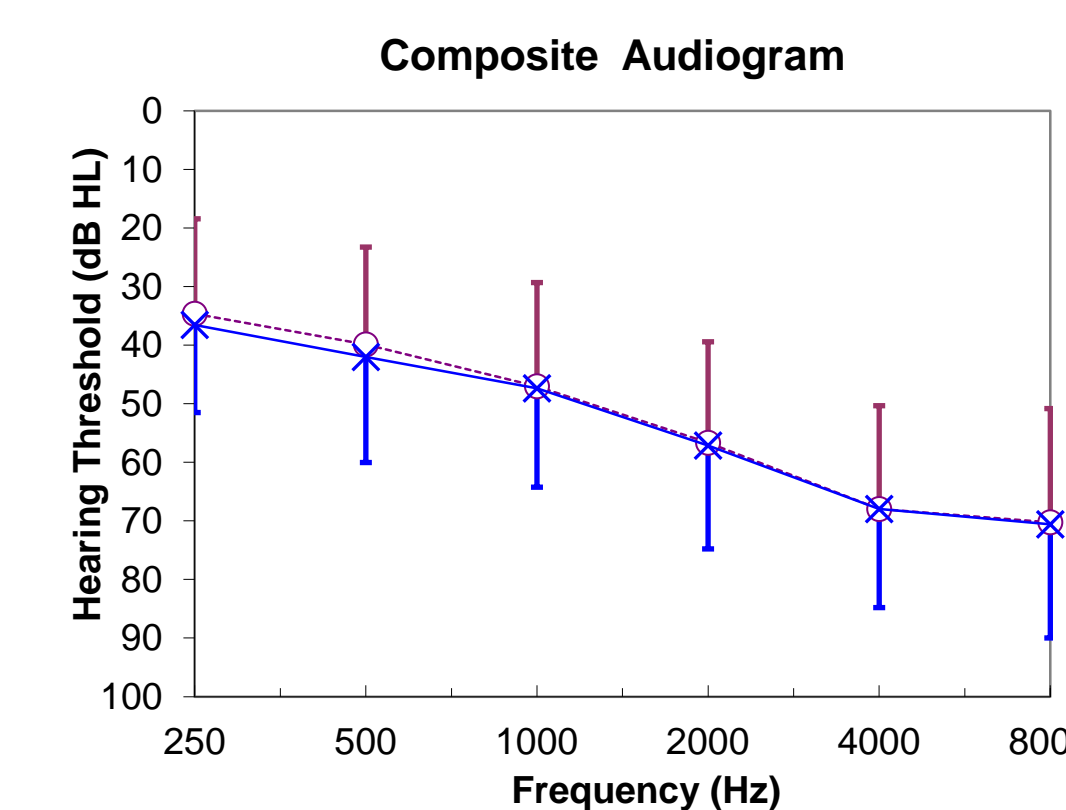
Predictor Variable

Acceptable Noise Level
- Stimuli: ANL Test CD (purchased from Frye Electronics)
- Condition: Unaided
- Instructions: Standard
- ANL score: Average of 2 measurements
- Predict success with hearing aids: ANL score of 7 or less

Independent Variables

Measuring Hearing Aid Success
- 5 standardized hearing aid outcome measures were used to explore the relationship with ANL scores.
- The findings of Nabelek et al. (2006) were displayed for comparison purposes.

OUTCOMES

Success Criteria
A criteria was set to determine hearing aid success for each of the 4 types of outcome measures.

1. Hearing Aid Use

Nabelek et al. (2006):
- Successful = Choose #1

How do you use your hearing aids?
1. I wear my hearing aids whenever I need them.
2. I only wear my hearing aids occasionally
3. I do not wear my hearing aids.

This study (Device Oriented Subj. Outcome: DOSO):
- Successful = Choose #1 (Closest to Nabelek's question)

In situations where you need to improve your hearing, how often do you wear hearing aids?
1. Always (100%)   3. Sometimes (50%)   5. Never (0%)
2. Usually (75%)   4. Rarely (25%)

2. Satisfaction

Satisfaction with Amplification in Daily Life Scale (SADL)
- Scored on a 7 point scale
- Scores of 5, 6, or 7 are associated with "satisfied" or "very satisfied" with hearing aids (Cox et al., 2001)
- Successful = Score of 5, 6, or 7

3. Quality of Life

Psychosocial Impact of Assistive Devices Scale (PIADS)
- Change in quality of life (QOL)
- Scored on a 7 point scale
- Scores of 1, 2, or 3 indicate a positive change in QOL
- Successful = Score of 1, 2, or 3

4. Benefit

- Measures reduction in problems
- Scored: Unaided (UA) minus Aided (A) = Benefit
  (Benefit/UA)*100 = Relative Benefit

Abbreviated Profile of Hearing Aid Benefit (APHAB)
- Subjective speech communication
- Successful = relative benefit >25% of unaided problems

Speech in Noise (QuickSIN)
- Objective word understanding
- Successful = relative benefit >25% of unaided errors

PROCEDURE

Questionnaire Administration
- All questionnaires were administered prior to speech testing
- Questionnaire order was randomized to minimize bias

Speech Testing Administration
- QuickSIN: 6 Lists Unaided, 6 Lists Aided
- Presentation Level: 50 dB HL
- Scoring: Number of target words incorrect
- Order was randomized to minimize bias

RESULTS

		Predicted Using ANL			
		Successful	Unsuccessful	Total	% Correct
Observed Outcome	Successful	Predicted Successful and Outcome Successful	Predicted Unsuccessful but Outcome Successful	# Observed to be Successful	% of Correct Successful Predictions
	Unsuccessful	Predicted Successful but Outcome Unsuccessful	Predicted Unsuccessful and Outcome Unsuccessful	# Observed to be Unsuccessful	% of Correct Unsuccessful Predictions
	Total	# Predicted to be Successful	# Predicted to be Unsuccessful	Total # of Subjects	% of All Correct Predictions

Outcome = Use (Nabelek et al. 2006)

		Predicted Using ANL			
		Successful	Unsuccessful	Total	% Correct
Nabelek HA Use	Successful	60	9	69	87.0
	Unsuccessful	20	102	122	83.6
	Total	80	111	191	84.8

Outcome = Use (DOSO)

		Predicted Using ANL			
		Successful	Unsuccessful	Total	% Correct
HA Use	Successful	26	14	40	65.0
	Unsuccessful	4	6	10	60.0
	Total	30	20	50	64.0

Outcome = Satisfaction (SADL)

		Predicted Using ANL			
		Successful	Unsuccessful	Total	% Correct
Satisfaction	Successful	25	14	39	64.1
	Unsuccessful	5	6	11	54.5
	Total	30	20	50	62.0

Outcome = Quality of Life (PIADS)

		Predicted Using ANL			
		Successful	Unsuccessful	Total	% Correct
Quality Of Life	Successful	23	12	35	65.7
	Unsuccessful	7	8	15	53.3
	Total	30	20	50	62.0

Outcome = Subjective Benefit (APHAB)

		Predicted Using ANL			
		Successful	Unsuccessful	Total	% Correct
Sub. Benefit	Successful	26	18	44	59.1
	Unsuccessful	4	2	6	33.3
	Total	30	20	50	56.0

Outcome = Objective Benefit (QuickSIN)

		Predicted Using ANL			
		Successful	Unsuccessful	Total	% Correct
Obj. Benefit	Successful	19	13	32	59.4
	Unsuccessful	11	7	18	38.9
	Total	30	20	50	52.0

DISCUSSION

Accuracy of ANL Prediction Using Multiple Outcome Measures
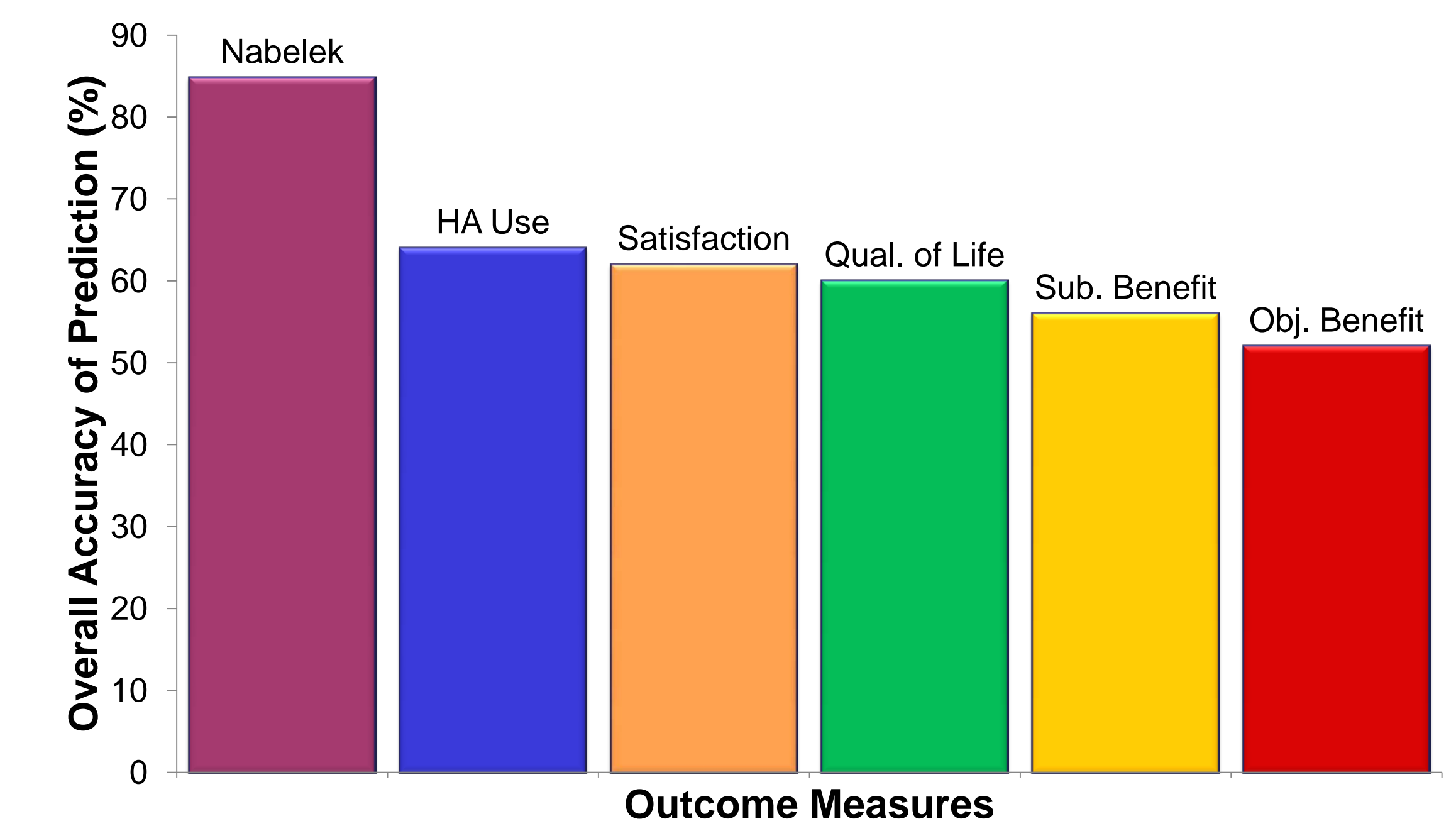
- The prediction accuracy scores ranged from 52 - 64%.
- The HA Use measure (64%) was the most similar to Nabelek's findings (85%).
- For every outcome measure, the "successful" predictions had a higher percentage of accuracy than the "unsuccessful" predictions.

CONCLUSIONS

Prediction of HA success based on ANL score was not very accurate in this study. The high success rate (85%) reported by Nabelek et al. was not substantiated.

However, the current study and the Nabelek et al. study were both retrospective studies. A prospective study is needed to conclusively test the effectiveness of the ANL score as a predictor of hearing aid success.

REFERENCES

Cox, R, & Alexander, G. (1995). The Abbreviated Profile of Hearing Aid Benefit. Ear and Hearing, 16(2), 176 – 186.

Cox, R., & Alexander, G. (1999). Measuring satisfaction with amplification in daily life: the SADL scale. Ear and Hearing, 20(4), 306-320.

Cox, R., & Alexander, G. (2001). Validation of the SADL questionnaire. Ear and Hearing, 22(2), 151-160.

Cox, R., Alexander, G., Xu, J. (2009). Development of the Device Oriented Subjective Outcome Scale (DOSO). Refereed poster at the Annual Meeting of the American Auditory Society, Scottsdale, AZ.

Day, H. & Jutai, J. (1996). Measuring the psychosocial impact of assistive devices: the PIADS©. Canadian Journal of Rehabilitation, 9, 159-168.

Etymotic Research. (2001). QuickSIN Speech-in-Noise Test Manual. Elk Grove Village, IL: Etymotic Research.

Frye Electronics. (2009). Acceptable Noise Level (ANL) Test. Tigard, OR: Frye Electronics, Inc.

Nabelek, A, Tucker, F, Letowski, T. (1991). Toleration of background noises: Relationship with patterns of hearing aid use by elderly persons. J Sp Hear Res, 34, 679-685.

Nabelek, A, Freyaldenhoven, M., Tampas, J., Burchfiled, S., Muenchen, R. (2006). Acceptable Noise Level as a Predictor of Hearing Aid Use. J Am Acad Audiol, 17, 629-639.

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