Multiple hearing aid programs in modern devices: Who uses them?

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Introduction

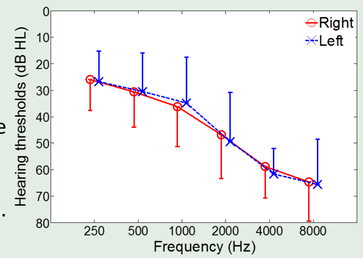
Some modern hearing aids (HA) apply automatic signal processing changes according to acoustic characteristics of the environment. This feature is intended to improve listening outcomes in a variety of complex acoustic scenarios without burdening the user with the need to manually access programs in different environments. Alternatively, some specialized signal processing strategies only can be accessed through manual selection of a dedicated program. These specialized programs often are found in the more advanced levels of hearing aid technology. Although some of these processing strategies have been demonstrated to be effective under certain real-world conditions, not all HA wearers use and benefit from multiple programs. It would be of benefit to better predict which patients might benefit from different types of programs. This research was designed to explore patient characteristics common to HA wearers who prefer to use specialized programs in daily listening and those who prefer mostly to use an automatic program.

The following questions were explored:

1. Are participant traits (measurable characteristics individual to each person) associated with choosing to use default automatic and specialized programs in daily listening?
2. Are these relationships different when using premium- and basic-feature HAs?

Methods

- **Participants**: 45 (15 F)
- **Age**: 61-81 (M=70.3)
- **Treatment:** 2 pairs each of premium- and basic-feature hearing aids (2 brands) were worn in 4 sequential blinded 1-month field trials.



- **Variables of interest:**
  - Participant traits (categories): Demographics, Personality, Unaided Hearing, Auditory Environment, Lifestyle
  - Program use: Proportion of time using programs – data logged for each trial and combined across brands.
- **Analyses:** Relationships between participant traits and proportion of time using the automatic program were investigated (Note: less time using the automatic program = more time using specialized programs) through exploration of scatterplots and correlational analyses (Pearson *r* except where indicated). The comparative strength of the relationships between each trait and program use with premium and basic HAs was evaluated using Steiger's Z test for dependent correlations.

Devices and Programs

Exemplars of premium-feature and basic-feature mini behind-the-ear thin-tube devices, commercially-released in 2011, were evaluated for each of 2 major brands. Participants were trained and instructed to select from among 3 programs using a wireless remote control or a button located on the HA as they went about their daily activities.

Program 1: "Everyday"

- Automatic/default program
- Fully automatic program with all feature settings as recommended by manufacturers for both technology levels.
- Premium – More sophisticated environmental classification and adaptation features, directionality, and noise reduction when P1 engaged.

Program 2: "Look and Listen"

- Manually accessible program
- Premium – Multi-channel adaptive directionality (Brand A); narrow beam directionality (Brand B)
- Basic – Single-channel fixed forward-facing directionality.

Program 3: "Speech Finder"

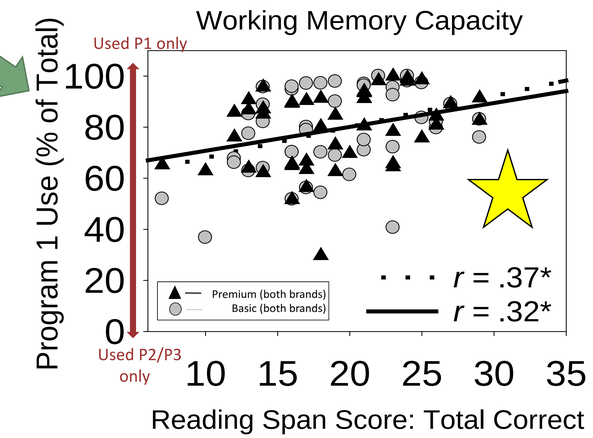
- Manually accessible program
- Premium – Front-null capable automatic adaptive directionality.
- Basic – Fixed omni-directional microphone.

Results

Demographics	Device	*r*	Z
Age	Basic	.07	-.19
	Premium	.1	
Gender (point biserial correlations)	Basic	-.01	.52
	Premium	-.07	
Working Memory Capacity ★	Basic	**.37***	.51
	Premium	**.32***	
HA Experience	Basic	ρ=-.08	-.16
	Premium	ρ=-.06	

*Significant at the .05 level

Personality	Device	*r*	Z
Extroversion	Basic	.18	.82
	Premium	.08	
Openness	Basic	-.04	-1.9
	Premium	.19	
Neuroticism	Basic	-.01	-.5
	Premium	.06	
Conscientiousness	Basic	-.1	-1.17
	Premium	.04	
Agreeableness	Basic	-.07	-.03
	Premium	-.06	



Unaided Hearing	Device	*r*	Z
Threshold (4Hz Avg)	Basic	-.12	-.28
	Premium	-.09	
Word Rec	Basic	.05	.17
	Premium	.02	
Problems: Communicating	Basic	-.23	-1.82
	Premium	-.02	
Problems: Aversiveness	Basic	-.2	-.91
	Premium	-.1	

Auditory Environment	Device	*r*	Z
Loudness	Basic	-.01	1.01
	Premium	-.13	
Diversity	Basic	.06	1.06
	Premium	-.07	
Noise/Quiet: No Speech	Basic	-.05	.01
	Premium	-.05	
Noise/Quiet: Speech	Basic	.16	.91
	Premium	.05	

Lifestyle	Device	*r*	Z
Employment	Basic	ρ=-.21	-1.52
	Premium	ρ=-.04	
Daily Activities	Basic	-.01	-.41
	Premium	.04	
Social Network Size	Basic	-.01	.38
	Premium	-.06	
Social Network Closeness	Basic	-.09	-.35
	Premium	-.05	

Q & A

1. Are participant traits associated with choosing to use default automatic and specialized programs?

- Of 21 traits, only **working memory capacity (WMC),** measured with a reading span task, demonstrated more than a weak relationship with proportion of time using the automatic program (with premium devices: $r = .32$; with basic devices: $r = .37$, both $p < .05$.) These medium positive relationships indicated that individuals with higher WMC tended to use the default automatic programs for a greater proportion of their total wear time compared to using the specialized programs, and those with lower WMC used the automatic programs less.

2. Are these relationships different when using premium and basic-feature hearing aids?

- **No.** Comparisons of regression lines showed no apparent differences between any relationships when using the premium- or basic-feature devices. These observations were confirmed statistically using Steiger's Z, which revealed no significant differences between the dependent correlations, all $p > .05$.

Discussion

Our results suggest that individuals with poorer WMC might utilize specialized programs more often. Some possible explanations are:

1) Those with poorer WMC were less able to benefit from the fast & dynamic signal processing of the automatic program. This is consistent with previous research demonstrating that hearing aid users with lower cognition received more benefit from slower signal processing (e.g., Gatehouse et al 2003, 2006).
2) Those with poorer WMC used the programs with less intent in specific situations, and tended to "surf" through the programs throughout the day. Thus using the specialized programs more often.
3) Those with poorer WMC observed and recalled differences between programs less effectively, and so continued to try the programs in various situations even if they did not work well for them before.

It also is worth noting that the more advanced features included in the default automatic and specialized programs did not impact how participants used the programs.

Future research should further investigate the basis of these relationships, and explore how measures of WMC might assist practitioners in prescribing cost-effective devices for patients with hearing impairment.

References

Gatehouse, S., Naylor, G. & Elberling, C., (2003). Benefits from hearing aids in relation to the interaction between the user and the environment. International Journal of Audiology, 42, pp.S77--S85.

Gatehouse, S., Naylor, G. & Elberling, C., (2006). Linear and nonlinear hearing aid fittings--2. Patterns of candidature. International Journal of Audiology, 45(3), pp.153–171.

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