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Introduction: Individuals with relatively mild aphasic auditory comprehension impairments experience inordinate difficulty listening to speech in degraded listening conditions. In addition to difficulty with increased speech rate, reduced response times, and accents, the presence of background noise poses considerable difficulty for individuals with aphasia as noise levels increase (Healy et al., 2007; Kittredge et al., 2006). In degraded listening conditions, the visual modality becomes especially important for facilitating auditory processing (Jesse & Janse, 2012). Little information is available about the benefits of visual information for auditory processing in noise for individuals with aphasia. The purpose of this project was to examine the influence of increased noise and visual information for auditory processing in individuals with aphasia.

Methods: Participants included seven right-handed adults with chronic aphasia following left hemisphere stroke. Western Aphasia Battery-Revised (Kertesz, 2007) scores surpassed 7/10 in auditory comprehension subtests, suggesting relatively mild impairments. We also tested five individuals with no history of stroke. Hearing was within normal levels for all but two participants with unilateral high frequency hearing loss (See Table 1). All provided written informed consent to participate in this study.

Participants completed the Quick Speech in Noise (QSIN, Killion et al., 2004), a standardized audiological measure requiring sentence repetition (IEEE unpredictable sentences). In the standard auditory-only (AUD) condition, participants heard sentences spoken through headphones as signal-to-noise ratio (SNR) varied from 20-0 dB in five sentence blocks. In the experimental auditory+visual (AV) condition, participants could hear and see the speaker on a monitor. As the participants repeated sentences, the examiner marked each sentence for five key words. We calculated the number of key words repeated correctly across five SNR levels for AUD and AV conditions (max score = 40 per SNR). Distortions due to apraxia of speech were accepted as correct responses.

Results: Results are depicted in Figure 1. As expected, the aphasia group performed significantly lower than the controls across SNR levels ($F=8.37$, $p=.01$, partial $\eta^2=.46$), with performance declining as SNR approached 0-5 dB. Both groups showed a modality advantage in that performance in AV was significantly greater than AUD ($F=66.92$, $p=.00$, partial $\eta^2=.87$). Calculating the visual advantage (AUD-AV) across SNR levels, both groups showed similar levels except for SNR 0 where a significant between groups difference occurred ($t=2.36$, $p=.04$). In the AV condition, the control group experienced a 10.60 point advantage compared to the 2.57 point advantage for the aphasia group.

Conclusions: As expected, individuals with aphasia demonstrated considerable loss of information as SNR levels decreased (noise levels increased). The aphasia group performance faltered at SNR 5 dB whereas the controls declined at SNR 0 dB. At the most difficult noise level (0 dB), the aphasia group experience considerably less benefit from visual information than the control group. These findings suggest that the use of visual strategies to enhance auditory processing in degraded conditions may not be as effective as expected for individuals with aphasia and different compensatory strategies or intervention may be needed to engage visual information to support auditory processing.

References

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Table 1: Demographic and test data for aphasia participants and control group.

Participant	APH1	APH2	APH3	APH4	APH5	APH6	APH7	Controls
Aphasia Type	Cond-uction	Broca	Broca	Anomic	Broca	Broca	Broca	--
Gender	M	M	M	M	F	M	F	3M, 2F
Age (years)	48	65	58	64	50	58	55	34-65
Education (years)	20	16	12	14	15	11	17	12-15
Time post CVA (months)	13	57	52	14	54	25	72	--
Hearing Acuity	WNL	WNL	WNL	Left High Freq Loss	WNL	WNL	WNL	4 WNL; 1 Right High Freq Loss
WAB-R (max=100)	82.7	72.4	62.6	90.8	66.8	71.7	58.1	--
WAB-R Aud. Comp. (max=10)	9.05	8.6	9.05	9.7	7.1	9.85	6.95	--
QSIN Auditory (max= 240)	14	122	72	148	60	91	112	122-174
QSIN Aud/Vis (max=240)	17	146	95	161	68	107	131	143-195
QSIN AV-Aud Advantage	3	24	23	13	8	16	19	13-43

Figure 1: QSIN scores in Auditory (A) and Auditory-Visual (AV) Conditions for Aphasic and Control groups (max 40 per condition).