Deviant processing of audiovisual stimuli in aphasia

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Introduction

During speech perception not only auditory but also visual information (seen speech) is processed (Rosenblum, 2008). Already in 1976 McGurk and MacDonald reported on the role of visual information in auditory processing. In their study subjects watched dubbed videos with non-matching auditory and visual information and had to report what they perceived. Instead of answering with the auditory (/ba/) or the visual (/ga/) component of the video, they mostly reported a fusion of both (/da/). This effect, called the 'McGurk effect', has been a strong argument for primary multimodal processing, which means that processing of both auditory and visual information occurs under all circumstances rather than visual information being a mere fall-back mechanism that only applies when needed.

The McGurk effect has been previously investigated in aphasic populations (Campbell et al., 1990; Klitsch, 2008). Klitsch (2008) compared the performance of a group of aphasic subjects to a group of age-matched non-brain-damaged control subjects. Participants had to watch a video and choose between three answer options: the McGurk-type answer, the auditory component or the visual component of the video. The response pattern (mostly McGurk type answers, followed by auditory and visual answers) did not differ significantly between the groups.

However this task was an offline measure and therefore provided limited information. In the current study we investigated audiovisual processing in aphasic and healthy listeners by combining offline scores with online reaction times. The aim was to find out whether audiovisual processing really does not differ between healthy and aphasic processing.

Procedure

The participants of the current study were three aphasic subjects and a group of fourteen non-brain-damaged control subjects within the same age-range. The aphasic subjects WB (male, 57 years, Wernicke's aphasia, 148 months post onset), EK (male, 48 years, amnestic aphasia, 16 months post onset) and JH (female, 51 years, mixed aphasia, 44 months post

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onset) all suffered from a deficit in the auditory analysis of speech, as measured with the nonword discrimination task from the Dutch PALPA Battery (Bastiaanse, Bosje, & Visch-Brink, 1995).

The current study employed a nonword identification task. The subjects watched videos of a speaker pronouncing a syllable. Afterwards they had to choose which of three written syllables matched the video. This task was carried out in three conditions: 'auditory only' (subjects could only hear the speaker), 'audiovisual' (the speaker could be heard and seen) and 'McGurk' (auditory /p/ dubbed onto visual /k/, expected percept /t/).

The material consisted of CVC(C) syllables that formed strings phonologically possible but non-existent in Dutch. All stimuli started with either /k/, /p/, or /t/. The written answer choices consisted of the target and two distractors (same rhyme as the target but different initial phoneme). They were presented simultaneously in a fixed arrangement, starting with /k/ on top, /p/ in the middle and /t/ at the bottom of the screen. Next to the answer patterns also the reaction times were recorded for all participants.

Results

The data of the aphasic subjects were analyzed individually and compared to the group of non-brain-damaged speakers. Table 1 provides an overview of the results. Generally the reaction times of all aphasic subjects were longer than those of the controls.

Initials	Auditory Only		Audiovisual		McGurk (per answer type)					
					McGurk (/t/)		Auditory (/p/)		Visual (/k/)	
	correct	RT	correct	RT	Amount	RT	Amount	RT	Amount	RT
WB	53%	2176ms	73%	1674ms	50%	2120ms	23%	2316ms	27%	2195ms
EK	59%	2718ms	76%	2516ms	18%	2119ms	46%	2020ms	36%	2297ms
JH	55%	2755ms	89%	2353ms	39%	2653ms	39%	2718ms	22%	2693ms
Controls (mean)	99%	1462ms	100%	1422ms	22%	2077ms	33%	1866ms	45%	1870ms

Table 1: Overview of the results

For the 'McGurk condition', it was analyzed which answer-type was dominant: the auditory component, the visual component or the fusion (McGurk) type. A Friedman Anova revealed significant differences between answer types for the non-brain-damaged control group ($X^2 = 30.964$, df = 2, $p < .001$). A post-hoc analysis showed the following hierarchy for the non-brain-damaged control group: most answers are of the visual, fewer of the auditory and the fewest of the fusion (McGurk) type. For none of the aphasic subjects, however, a difference between answer types was found.

The performance in the 'McGurk condition' was further analyzed with regard to the reaction times for each answer type chosen: There was a significant increase in reaction time for the control group whenever a McGurk type answer was chosen, while there were no influences of the chosen answer type on the reaction times of the aphasic subjects. These results are depicted in Figure 1.

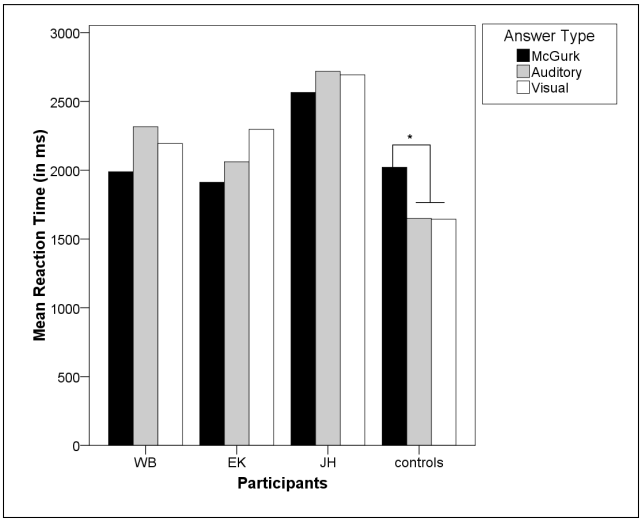

Figure 1: Reactiontime per answertype
$*$: Mann-Whitney test, $p<.05$

Discussion

In the current study we showed that the processing of audiovisual information was not only slower in three aphasic subjects but also differed qualitatively from the non-brain-damaged control subjects. For the control subjects reaction times differed depending on what answer type was chosen in the 'McGurk condition', while this was not true for either of the aphasic subjects.

The reaction time of the non-brain-damaged subjects was the largest when they gave a McGurk type response. This could reflect additional resources necessary when a fusion of auditory and visual information is perceived. According to Rosenblum (2008) subjects often recognize the mismatch and still experience the McGurk effect. This recognition of the mismatch could be slowing down the processing. It is possible that the aphasic subjects relied solely on automatic processing, not recognizing the mismatch, and therefore not showing a slow-down in processing compared to the other conditions. This hypothesis however still needs to be tested as in the current study we did not record whether subjects were aware of mismatches.

References

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