Lateralization of prosodic processing in individuals with unilateral brain damage

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Introduction: Linguistic prosody plays a relevant role in spoken language processing, including syntactic disambiguation in structurally ambiguous phrases. For instance, in coordinate sequences like (1a) and (1b) the intended reading (visualized by parentheses) is realized by a prosodic boundary (#) at the relevant structural position (Kentner & Féry, 2013).
Example 1:
(1a) (Name1 and Name2 and Name3): no internal grouping/ no prosodic boundary
(1b) (Name1 and Name2) # and Name3: with internal grouping/ with prosodic boundary
In German, prosodic boundaries are typically marked by three prosodic cues: the insertion of a pause at the boundary, lengthening of the element preceding the boundary, and a rise in f0 on the pre-boundary element (Kentner & Féry, 2013). A pause constitutes a very salient cue for identification of prosodic boundaries, whereas f0-rise and lengthening need to be present in combination to allow for boundary perception (Holzgrefe-Lang et al., 2016; Steinhauer et al., 2004). Persons with either left- or right-hemisphere brain damage (LHD, RHD) show impairments in identifying prosodic boundaries (e.g., Aasland & Baum, 2003), and their performance is affected by the presence/absence and strength of the different prosodic cues. Persons with LHD, but not the ones with RHD, rely specifically on the pause cue (Aasland & Baum, 2003). So far, only the influence of pause and lengthening on the performance of individuals with LHD/RHD was investigated, whereas the role of f0-rise has not been systematically studied in these populations. Additionally, the role of the two hemispheres for prosody is subject to debate and different theories on lateralization of prosodic processing, e.g., function-based (e.g., Van Lancker, 1980) or cue-dependent accounts (e.g., Poeppel, 2003), have been proposed. The latter would suggest that slow changing prosodic cues (e.g., sentence intonation) are mainly processed by the RH.
Aim: Our study aims to systematically assess the impact of three prosodic cues (pause, lengthening and f0-rise) on prosodic boundary identification in participants with RHD (PRHD) or LHD (PLHD) and a group of control participants (CP) without language impairment. By this, we aim to broaden our knowledge about the lateralization of prosodic processing.
Method: So far, n=44 participants took part in our study (n=20 PRHD, n=12 PLHD, and n=12 CP; planned sample sizes: n=20 per group). All participants were presented with audio stimuli (n=90) via headphones. The stimuli consisted of coordinate sequences in two conditions: (i) *with prosodic boundary (WPB)* and (ii) *no prosodic boundary (NPB)* (see Example 1). Participants performed an identification task and were to decide which condition each of the stimuli corresponded to by pointing to one of two pictograms (see Fig. 1). The recorded stimuli were manipulated with respect to their combinations and the strength of the different prosodic cues, resulting in a total of 7 levels of manipulations (Tab. 1 provides an overview of the manipulations).
Results and Discussion: Preliminary results suggest that overall accuracy is slightly lower in PRHD (73% correct) than in PLHD (76% correct) and CP (78% correct). Across all groups, accuracy in the WPB condition decreases with the reduction of the pause cue. PLHD show lower accuracies than the PRHD and CP in conditions with reduced temporal cues. Within participant groups, we find high inter-individual variation of prosodic perception abilities. Our results are partly in line with an ongoing systematic literature review on prosodic processing in persons with LHD and RHD (de Beer et al., in prep.), which reveals impairments in both groups depending on the strength of prosodic cues. Furthermore, regarding theories on lateralization of prosodic processing, our results suggest that both hemispheres are involved in processing of linguistic prosody, although to differential degrees depending on the type of cue, mostly in line with cue-dependent lateralization theories.

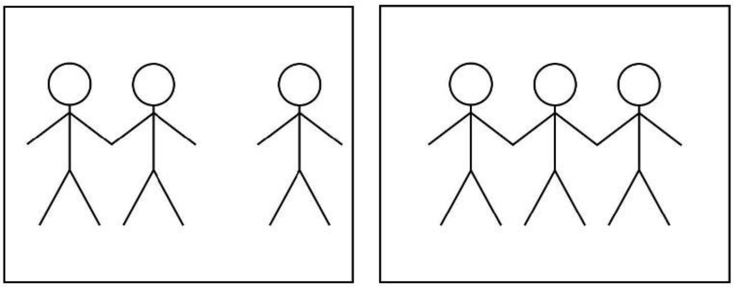

Figure 1: Pictograms for participants' identification of the two experimental conditions. Left = with prosodic boundary (WPB), right = no prosodic boundary (NPB).

Table 1: Manipulations of prosodic cues in audio stimuli.

Condition	Manipulation	Strengths of prosodic cues at Name2			N of stimuli
		Lengthening	F0-rise	Pause	
NPB	maxLR	max	max	min	15
	min3	min	min	min	15
WPB	max3	max	max	max	12
	maxLR	max	max	min	12
	maxL	max	min	min	12
	maxR	min	max	min	12
	min3	min	min	min	12

Note. NPB = no prosodic boundary. WPB = with prosodic boundary. max = maximum. min = minimum. L = Lengthening. R = F0-rise. 3 = all three prosodic cues.

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