

Simulating Speed in Language

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The embodied approach to language processing describes understanding sentences as the mental simulation of events being referred to, recruiting the same resources as those used in perception and action (e.g. Barsalou, 2008, Zwaan, 2004). It is now quite accepted that very concrete aspects of meaning, such as orientation (Stanfield & Zwaan, 2001) and direction of movement (Glenberg & Kaschak, 2002), are included in simulations, however there are other aspects of meaning not directly linked with perception and action that are less well understood. Recently, eye-tracking methodology has been utilized to investigate perceptual simulation in language processing (e.g. Spivey & Geng, 2000, Richardson & Matlock, 2007, Coventry, Lynott, Cangelosi, Monrouxe, Joyce & Richardson, 2010) with results suggesting that eye-movements behave in similar ways when both understanding language and perceiving events in the world.

The present research looks specifically at the representation of speed in language (e.g. walking vs. running). Speed should affect the nature of a simulation in one important aspect: its duration. Presenting results from an eye-tracking study, we provide evidence for the mental simulation of speed in language. Participants had to listen to spoken sentences describing fast or slow events (e.g. *The lion ambled/dashed to the balloon*) whilst being presented with corresponding visual scenes. Speed was either encoded in the verb of the sentence (e.g. *amble*, *dash*) or with an adverb (e.g. *slowly* or *quickly*). Each scene contained the subject of the sentence, the target and a distractor. Additionally, sentences had either a fast or slow speaking rate. This was introduced firstly to provide a manipulation check (as effects of this manipulation should be found) and secondly, to investigate the possibility of an interaction between speaking rate and event speed. Participants were instructed to click on the object referred to last in the sentence with the computer mouse and answer comprehension questions on filler trials (25% of all trials).

For sentences in which the speed of the verb was manipulated, we found a differential pattern of eye movements between fast and slow events but only in the slow speaking rate condition. For sentences describing slow events, participants' dwell time (total looking time) on the subject (e.g. *lion*) of the sentence was longer than that of fast events. Thus eye movements reflect the understanding of speed events being described in language in a similar way to viewing the same event in the real world. There were however, no differences between fast and slow events when speed was described using an adverb. This suggests that speed information contained in a verb may modify the described event via a different process to that of an adverb.

This research provides new evidence for simulation in language for speed. Speed is interestingly different from other investigated sensory-motor domains because of its temporal and therefore more abstract connotations.

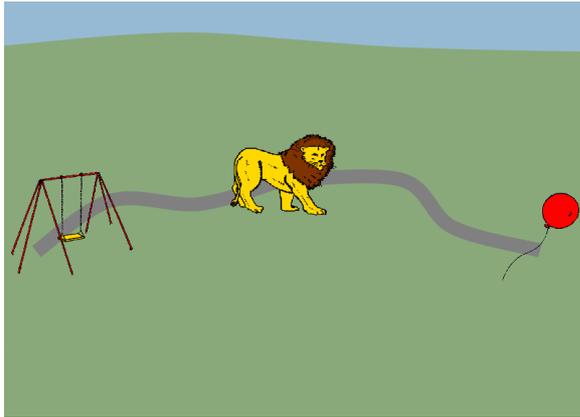


Figure 1. Example visual scene

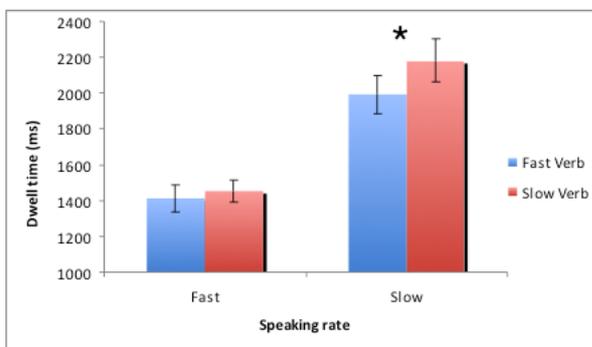


Figure 2. Verb sentences: Average dwell time on subject

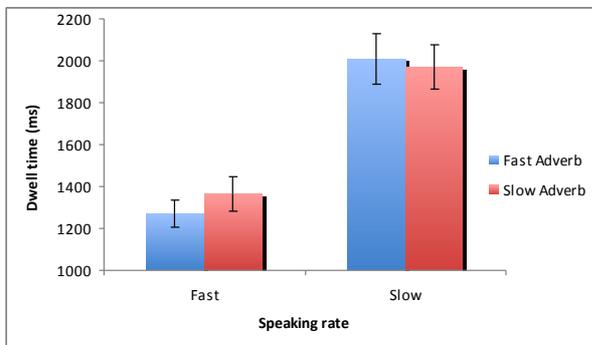


Figure 3. Adverb sentences: Average dwell time on subject

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