Modeling Shifts of Attention During Spatial Language Comprehension

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Given the sentence "The apple (located object, LO) is above the table (reference object, RO).", how do we evaluate the acceptability of the spatial preposition *above* for describing the relation of the objects? Regier and Carlson (2001) proposed a cognitive model (the Attentional Vector Sum model, AVS) that computes a rating for how well a spatial preposition (e.g., *above)* describes the spatial relation between a RO and a LO. In line with Logan and Sadler (1996), the AVS model assumes a shift of attention from the RO to the LO. However, shifts of overt visual attention from the RO to the LO seem infrequent (Burigo & Knoeferle, 2015). By contrast, shifts in line with the mention of objects (from the LO to the RO) occurred frequently, suggesting they may be sufficient for understanding a spatial description. These findings are consistent with results on spatial relation processing suggesting a shift of covert attention from the LO to the RO (Roth & Franconeri, 2012). Accordingly, we propose the reversed AVS (rAVS) model in which attention shifts from the LO to the RO (instead of from the RO to the LO, see Kluth, Burigo, & Knoeferle, 2016). When assessed with the data from Regier and Carlson (2001) both models achieve a comparable fit. Given the indecisive outcome of the simulations, we next asked whether these two models are at all distinguishable. Due to the different mechanisms of the two models, we hypothesized that they each predict different ratings for specific RO-LO configurations. These predictions concern two effects on acceptability ratings: (1) the influence of the *relative* distance of an LO to an RO (defined as absolute distance divided by the dimensions of the RO) and (2) the influence of asymmetrical ROs. A subsequent analysis with the parameter space partitioning algorithm (Pitt, Kim, Navarro, & Myung, 2006) confirmed our hypothesized predictions for the rAVS model but not for the AVS model. Arguably then, deriving clear predictions from the mechanisms specified in the AVS model is difficult. We evaluated the predictions (1) and (2) by asking participants to rate critical object configurations. The results corroborate the effect of relative distance predicted by the rAVS model: LOs *relatively* close to an RO were rated higher than LOs *relatively* far from an RO (mean difference 0.078, 95% confidence intervals: 0.151, 0.007). However, the participants' rating of the asymmetrical ROs disconfirmed both models. LOs equidistant from the center-of-mass of the RO elicited unexpectedly distinct ratings (mean difference: 0.518, 95% confidence intervals: 0.619, 0.428). Thus, people's ratings were affected by the center-of-object of the RO (instead of the center-of-mass of the RO). This goes against previous observations (Regier, 1996; Regier and Carlson, 2001) claiming that people base their acceptability rating on the center-of-mass of an RO.

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