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Spatial Language, Reference Frames and Alternative Models

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Introduction

Spatial language is usually taken to specify where one object (located object, LO) is located with reference to a second object (reference object, RO). Typically, accounts of the comprehension of spatial terms involve generating a reference frame on the reference object, and once a reference frame has been established, the direction from the RO to the LO can be mapped onto an existing spatial template for a particular spatial term (Carlson-Radvansky & Logan, 1997). In these accounts, information about the located object is usually not deemed relevant. However Burigo and Coventry (2004) found that the orientation of the located object affects the appropriateness of prepositions to describe where an object is located. They suggest that both the reference frames (on the RO and on the LO) are computed and they enter into conflict during the comprehension process (Burigo & Coventry, 2004).

The aim of the present study is to explore and test an alternative explanation of the orientation effect of the LO found by Burigo and Coventry (2004). In particular we consider the possibility that spatial language comprehension involves evaluation of the degree of informativeness and uniqueness of the spatial relation communicated (cf Coventry & Garrod, 2004). For example in a spatial language domain, “the cup is above the pen” provides information about the location of cup with respect to pen, but also information about the location of the pen with respect to the cup (e.g., it can be inferred that “the pen is below the cup”). When the cup is rotated such that the top surface of the cup points toward the pen, “the pen is below the cup” becomes misleading as the expression is false within the intrinsic frame. Furthermore, the rotation of the LO also introduces an alternative “above” relation to that specified in the sentence to be comprehended. We explore whether this explanation (consistent with conflicts between models within the mental model theory; Byrne and Johnson-Laird, 1989) provides a more adequate account of the orientation of LO effect than the conflicts between reference frames account provided by Burigo & Coventry (2004).

Empirical investigations

Three experiments evaluated the multiple descriptions conflict hypothesis using an acceptability rating task. Participants were asked to judge the appropriateness of a sentence (e.g.; The “LO” is preposition the “RO”) to describe the relative positions of objects in a scene which followed.

The first experiment replicated previous findings (Burigo & Coventry, 2004) employing objects with an intrinsic axis, without an intrinsic axis (e.g. a football) and objects with a non directional axis (e.g. an hourglass) as RO. Results showed a conflict between LO and RO when the setting of the scene allowed an alternative description to be generated.

Experiment 2 attempted to falsify the hypothesis that a reference frame of the LO could conflict with the reference frame of the RO by manipulating the orientation of both the LO and RO. Indeed, the data analysis did not reveal any interaction between the orientations of the two objects, suggested that the account of the effect provided by Burigo and Coventry (2004) is not supported.

Finally experiment 3 discounts an alternative explanation that the orientation effect could be associated with identification costs replicating the effect using polyoriented objects. Thus the results suggest that the orientation of the LO modifies the number of possible models (or spatial descriptions) that people can build, and the informative and uniqueness of the spatial description given determines how acceptable it is to describe a given scene.

Discussion

The results suggest that inference is key to establishing how appropriate a spatial description is to describe a given spatial scene. Furthermore, the results suggest that current mechanistic theories of the spatial language apprehension process need to be revised to take account of the building of alternative models in the scene being described.

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