Pragmatics of spatial language comprehension

Spatial prepositions like *in* and *on* are primary tools for describing spatial relations in English. However, their inventory is limited, and speakers must make generalizations about what kinds of relations can be described with the same spatial term [1,2]. Geometric approaches (GA) to the meaning of spatial prepositions propose that the relations between objects are characterized mostly by geometric features, such as direction and distance, with the information about objects and their functions having limited effect [3,4]. In contrast, functional approaches (FA) have argued that functional prepositions *in* and *on* encode rich information about the functions of objects, such as their mechanisms of containment and support [5,6,7]. These views generate distinct predictions: the FA predicts that speakers' intuitions about the acceptability of *in* and *on* depend primarily on the existence of functional relationships between objects, while the GA predicts these intuitions depend on whether a given spatial configuration is geometrically canonical. For example, GA predicts that a description of the type *X is on Y* should be equally acceptable for any objects X and Y as long as X is in a canonical location described by *on* (e.g. supported from below by Y and in contact with Y). If X is a non-canonical location (e.g. it is not in contact with Y), the description *X is on Y* should not be acceptable for any X and Y. On the other hand, FA predicts that the acceptability of *X is on Y* depends not just on the locations of X and Y, but on the properties of X and Y: if Y functionally provides support for X, then the exact configuration of X and Y plays a less important role.

Design. The experiment had a 2 (Scene Type) x 3 (Position) mixed (between/within subjects) design. Participants in the **Real Object** (N=100) condition viewed images of everyday objects, while the **Abstract Shape** (N=100) condition included images of two-dimensional geometric shapes, whose contours and locations matched the images in the Real Object condition. There was a within-subject manipulation of Position: the objects/shapes (for example, a Spanish dictionary on a lamp or a pink square on a green rectangle) appeared in either **Ideal, Competitor, or Distractor** configurations (Figure 1)**.** Ideal configurations depicted objects in the canonical locations described by *in* and *on* (e.g. the Spanish dictionary was supported from below by and in contact with the lamp). Competitor configurations depicted the same objects in non-canonical configurations, with a distractor object now occupying the canonical position (e.g. the Spanish dictionary was not in direct contact with the lamp, but a Calculus textbook was). In Distractor configurations, there was no relationship of containment and support between objects (the Spanish dictionary and the lamp were shown side by side). Each trial showed the same pair of objects across three configurations alongside a description (e.g. *The Spanish dictionary is on the lamp*), and participants had to select the images that fit that description.

Predictions. Both FA and GA predict that Ideal configurations will be acceptable examples of spatial relationships such as *The Spanish dictionary is on the lamp* or *The pink square is on the green rectangle* for both Real Object and Abstract Shape items The predictions of GA vs. FA differed in whether participants would consider Competitor configurations to be acceptable. According to the GA, only the Ideal configurations would be considered acceptable for both Real Object and Abstract Shape trials, as Competitor configurations are geometrically non-canonical. The FA, however, predicts that Competitor configurations will be acceptable in the Real Object condition: since participants have more information about the functional and force-dynamic relationships between the depicted objects, their exact geometric configuration should carry less weight. Therefore, according to the FA, there will be an interaction between Scene Type and Position, such that Competitor scenes will be selected more often in the Real Object condition.

Analysis. We fit a mixed effects logistic regression model with the image choice as the dependent variable, fixed effects of Scene Type and Position and a random intercept for trial number. We found a significant interaction between Scene Type and Position ($\beta = 1.3238$, $SE = 0.3788$, $t = 3.495$, $p = 0.0005$) such that participants selected more Competitor configurations in the Real Object condition.

Discussion. Participants' choices were significantly affected by the Abstract Shape vs. Real Object manipulation: participants were more likely to accept Competitor configurations in the Real Object condition, as predicted by the FA. This suggests that speakers rely on functional and force-dynamic relationships between objects – rather than the geometry of the scene alone – when interpreting *in* and *on*.

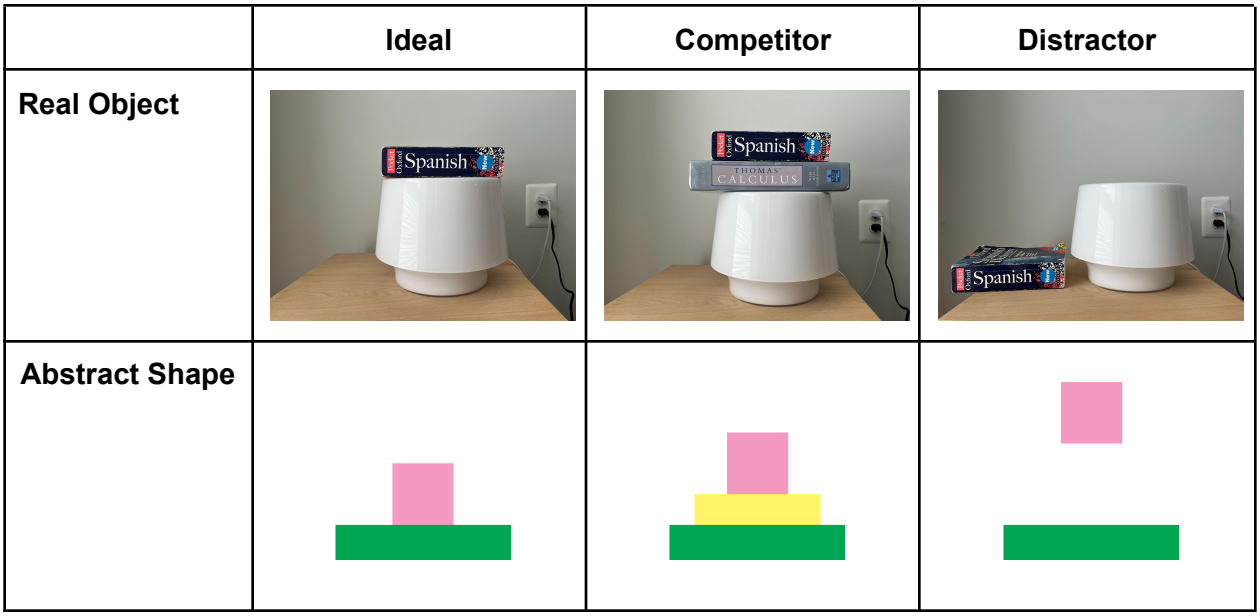

Figure 1. On each trial, participants saw three images in either the Real Object or Abstract Shape condition alongside a description (e.g. *The Spanish dictionary is on the lamp* or *The pink square is on the green rectangle*). Participants were asked to select all images that fit the description.

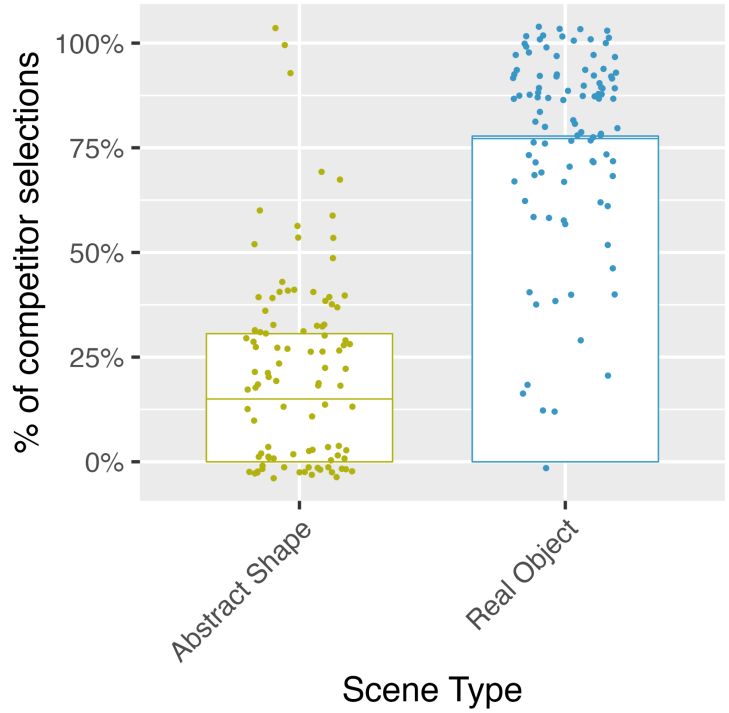

Figure 2. Competitor scenes were selected more often in the Real Object condition (for scenes such as *The Spanish dictionary is on the lamp*) than in the Abstract Shape condition (for scenes such as *The pink square is on the green rectangle*).

References. [1] Talmy, 1985. *Language Typology and Syntactic Description*. [2] Landau & Jackendoff, 1993. *Behavioral and Brain Sciences*. [3] Zwarts, 1997. *Journal of Semantics*. [4] Zwarts & Winter, 2000. *Journal of Logic, Language and Information*. [5] Landau, 2017. *Cognitive Science*. [6] Herskovits, 1986. [7] Coventry & Garrod, 2004.