# UC Merced
## Proceedings of the Annual Meeting of the Cognitive Science Society

**Title**
How Does Visual Similarity between an Object and the Ground Plane Effect on Understanding Spatial Relationships?

**Permalink**

**Journal**

**ISSN**

**Author**
Konieczny, Lars

**Publication Date**
2005

Peer reviewed

# How Does Visual Similarity between An Object and the Ground Plane Effect on Understanding Spatial Relationships?

**Takatsugu Kojima (kojima@cpsy.mbox.media.kyoto-u.ac.jp)**
**Takashi Kusumi (kusumi@educ.kyoto-u.ac.jp)**
Graduate school of Education, Kyoto University
Yoshida-honmachi, Sakyo-ku, Kyoto, 606-8501, JAPAN

## Introduction

Spatial templates, which represent the spatial category of a spatial term relative to a reference object visually, are applied to judge how well a spatial term describes the spatial relationship between objects (Logan & Sadler, 1996). Research has found that the presence of an extra object (a distractor) reduced the acceptability of the located object on spatial templates (Carlson & Logan, 2001). However, previous studies did not examine whether the visual similarity between the distractor and the ground plane on which it rests results in such a reduction effect.

We used ratings tests to examine the effect of the visual similarity between the distractor and the ground on the acceptability of spatial templates. In the experiment, we focused on how visually similar the distractor was to the ground. We manipulated the visual similarity between the distractor and ground at two levels (similar and dissimilar) and examined how the manipulation changed the acceptability ratings.

## Method

The stimuli were constructed using Open GL and were presented in a three-dimensional computer graphics (3-DCG) space. Basically, all the stimuli contained the ground, a red ball (the located object), and a green box (the reference object). The ground was divided into a $7 \times 7$ matrix that was invisible to the subjects. The ground surface was covered with a texture map that looked like an actual land surface. The Japanese sentences used in this experiment were "*Akai tama-wa midori-no hako-no ushiro (or mae )-ni aru*" ("The red ball is behind (or in front of) the green box"). The sentences and nine rating buttons ranging from 1 (least applicable) to 9 (most applicable) were presented in the lower part of the display.

Thirty-one native Japanese graduates or undergraduates evaluated how the display depicted the sentence, and clicked one of the nine rating buttons in three conditions for the distractor: the base, similar, and dissimilar conditions. Under the base condition, no distractor was presented. Under the similar condition, the distractor was a circular truncated cone mapped on the texture map on the ground. Under the dissimilar condition, the distractor was a yellow circular truncated cone. All the objects were presented on particular cells on the ground in each trial. In particular, six cells were defined as important cells for analysis. The participants participated in ten practical trials and then 94 experimental trials.

## Results and Discussion

We conducted separate one-way repeated-measures analyses of variance (ANOVAs) on the mean acceptability ratings with the same positions of the located object under the three conditions. We found significant differences on the six cells between the three conditions ($p<.01$). Fig. 1 shows the mean acceptability rating for each cell of the six cells under three conditions. From the results, we found that the visual similarity between the distractor and ground affects the acceptability of spatial templates.
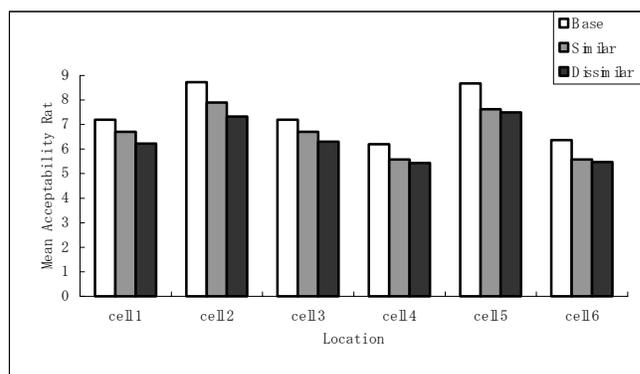


Fig. 1. Mean acceptability rating for six cells.

Carlson and Logan (2001) used letters as objects. Such characters do not bring as much visual information to our cognitive system as do various objects in the world. Since the function of the reference object affected the apprehension of spatial relations (Carlson-Radvansky, Covey, & Lattanzi, 1999), we presume that human spatial cognition computes not only the positions of objects, but also some of their properties, and such properties include knowledge about objects (e.g., function), as well as perceptual factors. That is, cognitive saliencies or similarities of objects play an important role in the apprehension of the spatial relationship by language.

## References

Carlson, L. A. & Logan, G. D. (2001). Using spatial terms to select an object. *Memory & Cognition, 29,* 883-892.

Carlson-Radvansky, L. A., Covey, E. S., & Lattanzi, K. M. (1999). "What" effects on "where": Functional influences on spatial relations. *Psychological Science, 10,* 516-521.

Logan, G. D., & Sadler, D. D. (1996). A computational analysis of the apprehension of spatial relations. In P. Bloom, M.A. Peterson, L. Nadel, & M. Garrett (Eds.), *Language and space* (pp.493-529). Cambridge, MA: MIT Press.