POSTER

The effect of a reference object's orientation on the apprehension of spatial terms

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Background

The interaction between spatial cognition and language is one of important issues in both cognitive science and artificial intelligence. For example, if an interactive human-like agent understands spatial terms in natural language like humans, it should simulate human behavior and cognitive processes as much as possible. Researches in artificial intelligence and linguistics have provided theoretical or computational model on the apprehension of spatial language. Cognitive psychology has empirically examined such theoretical or computational works and provided empirical data on the relationship between spatial cognition and language. A previous study on four Japanese projective spatial terms, mae, ushiro, hidari, and migi (similar to front, back, left, and right in English, respectively), found that the orientation of a reference object influenced the apprehension of the spatial terms dynamically in three-dimensional (3-D) space. However, it just compared the boundaries of the four terms to show the effect and did not examine on how the effect influences spatial categorical pattern of each spatial term. That is, it was insufficient to examine the effect of the reference object's orientation. In addition, it had problems from a methodological viewpoint and gave no detailed data for the application to human-like agents.

Method

The aim of this study is to examine how the effect appears in each of the four terms in 3-D space, and to provide detailed experimental data of them. We manipulated the orientation of a reference object's inherent front in a 3-D computer graphics (CG) space under three conditions (the 0, 90, and 180 degrees rotations of the reference object). We examined how the manipulation changed the reaction time of alternative judgments (yes/no) on whether the location of a located object with respect to the reference object was appropriate to a given spatial term. It was also examined how the manipulation changed the nine-scale acceptability ratings on how its location with respect to the reference object was appropriate to a given spatial term.

Results

Results indicated that the orientation of the reference object had influenced the spatial categorical patterns of the four spatial terms in the 3-D CG space. For example, when a reference object was facing away from participants (under the 180 degrees rotation condition), the spatial areas indicated by mae or ushiro was larger than under the 0 degrees rotation condition. In contrast, when a reference object was facing sideways to participants (under the 90 degrees rotation condition), the spatial areas indicated by hidari or migi was narrower than under the 0 degrees rotation condition.

Conclusions

These results suggest that our apprehension of spatial language are visually and dynamically influenced in 3-D space, and that it is inadequate to compute the apprehension of spatial language using only spatial positions and geometric properties of objects. The results also provided more detailed data for the application to the development or improvement of human-like agents that can understand Japanese spatial terms in 3-D space.

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