The Role of Gestures in Spatial Representations Derived from Route and Survey Texts

Tatsuki Takenaga (takenaga@p.u-tokyo.ac.jp)
Graduate School of Education, University of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan

Abstract

The goal of this paper is to investigate the role of gestures in conceptualizing. Participants listened to a text describing a fictional environment from the route perspective or the survey perspective and then explained the route and relative locations. Analysis of gestures during the explanation revealed that gestures assist in switching from the route perspective to the survey perspective and in conceptualizing. This result supports the Information Packaging Hypothesis.

Introduction

This paper investigates the underlying cognitive processes involved in relating spatial information from a verbal input to two output modalities (i.e., speech and gesture). Recently, researchers have begun to explore a possible cognitive function of co-speech gestures. The Information Packaging Hypothesis (Kita, 2000) is a theoretical possibility that has been proposed to explain how gesture and speech are produced. According to this hypothesis, gestures assist speakers to organize knowledge that is spatio-motoric in nature and convert it into a verbalizable form.

Some studies have provided supportive evidence for the Information Packaging Hypothesis. These studies have attempted to manipulate the difficulty of conceptualization while lexical accessibility remains constant. For example, Alibali, Kita, and Young (2000) found that children produced more gestures when the task required complex conceptualization. However, their task did not involve spatial representation or a change in representation. In order to investigate the conceptualization process in spatial representation, a spatial explanation task was used in this study.

According to the studies on large-scale spatial representations, two perspectives of spatial representation have been proposed—route perspective and survey perspective. Some studies have revealed that there exists a cost for switching perspectives from encoding to test (e.g., Shelton & McNamara, 2004). Conceptualization in large-scale spatial representation is considered to involve a switching of perspectives. If gestures indeed help in conceptualization, speakers should produce more gestures that are consistent with the perspective that the task demands, regardless of the language used. Furthermore, verbal descriptions of a fictional environment were used as stimuli in order to gain control over the amount of route and survey learning.

Method

Participants

Thirty-two native Japanese speakers (20 males, 12 females) participated in the experiment individually.

Materials

Two types of texts on a fictional environment were prepared. One was based on a route perspective and the other, on a survey perspective. The survey text first introduced the four major quadrants of the environment and then explained the individual landmarks. On the other hand, the route text immediately introduced the first landmark and revealed information on the overall layout of the environment in a stepwise manner. Further, the survey text employed canonical spatial terms such as south, while the route text used relative spatial terms such as on your left.

Explanation tasks

Participants were required to explain 15 pairs of landmarks (i.e., 9 route explanations and 6 relative location explanations). In the route explanation task, which demanded the route perspective, they were asked to give directions from one landmark to another. In the relative location explanation task, which demanded the survey perspective, they were asked to explain the relative locations of two landmarks.

Procedure

Half of the 32 participants were asked to listen to the route text, while the remaining half listened to the survey text. The participants listened to a specific text up to four times. They were asked to memorize the text as much as possible. After the encoding phase, they completed two types of explanation tasks (i.e., route explanation and relative location explanation). The order of the two tasks was counterbalanced over participants.

Gesture coding

Each gesture in the explanation tasks was classified under two modes of gestures. Objectification Mode Objectification mode gestures were characterized by using a 2D plane as if the speakers were outside the environment and responded from a survey perspective. Enactment Mode Gestures that appeared as if the speakers were within the environment and indicated directions from...
their own perspective (i.e., route perspective) were characterized as enactment mode gestures. Enactment mode gestures generally moved away from the speaker and used the entire 3D space (rather than a 2D plane).

**Results**

**Gestures during explanation tasks**

The proportion of responses accompanying one or more gestures was subjected to an analysis of variance with terms for text (route vs. survey) as a between-subjects factor and mode of gesture (objectification vs. enactment) as a within-subjects factor.

**Gestures in relative location explanation** According to the Information Packaging Hypothesis, the route text group should produce more objectification mode gestures than the survey text group with regard to relative location explanation. The main effects of the mode of gesture (\(F(1,30) = 38.60, p < .001\)) and text (\(F(1,30) = 9.28, p < .01\)) were significant. For the objectification mode gesture, the simple main effect of text was significant (\(F(1,30) = 11.18, p < .05\); see the left part of Figure 1).

**Gestures in route explanation** According to the Information Packaging Hypothesis, the survey text group should produce more enactment mode gestures than the route text group with regard to route explanation. The main effect of mode of gesture was again significant (\(F(1,30) = 21.51, p < .001\)). For the enactment mode gesture, the simple main effect of text was significant (\(F(1,30) = 5.13, p < .05\); see the right part of Figure 1). However, the effect of text was opposite of that expected.

![Figure 1: Proportion of responses accompanying one or more gestures in explanation tasks](image)

**Use of spatial terms during explanation tasks**

In order to control the language used between the groups, the spatial terms used in the explanation tasks were classified as canonical spatial terms (e.g., *east* and *west*) or relative spatial terms (e.g., *in front of you*).

For the relative location explanation task, the survey text group used more canonical spatial terms (\(M = 97\%\)) than the route text group (\(M = 79\%, F(1,30) = 4.79, p < .05\)). According to the lexical access hypothesis, the survey text group that used more canonical spatial terms should produce more objectification mode gestures. However, the result obtained was the opposite of that expected.

For the route explanation task, the route text group used more relational spatial terms (\(M = 84\%\)) than the survey text group (\(M = 12\%, F(1,30) = 63.61, p < .001\)).

**Further analysis of gesture and speech in route explanation**

The effect of switching perspectives was not detected in route explanation because most of the spatial terms used in the survey text group were canonical spatial terms. To provide further evidence for the Information Packaging Hypothesis, gesture production of participants who used only spatial terms were congruent with that of encoding phase was compared with that of participants who used both spatial terms (relative and canonical spatial terms) in route explanation. According to the Information Packaging Hypothesis, participants who use both spatial terms should produce more gestures than those who use only congruent spatial terms. The data from route text group supports this hypothesis (\(F(1,30) = 4.46, p < .05\)).

**Discussion**

Using a spatial explanation task, speech protocols were collected in which participants freely chose whether or not to produce gestures. When the route text group used canonical spatial terms, they produced more gestures than the survey text group or those who used only relative spatial terms. Moreover, while considering the mode of gesture, the gestures produced were consistent with what the task demanded rather than the spatial terms used.

These results support the Information Packaging Hypothesis that the gestures demanded by the task assist in conceptualization by switching perspectives when participants using spatial representation are incongruent with the demands of the specific task. However, in this study, the survey text group did not produce more gestures in route explanation. One possibility is that the survey text led to spatial representation with more fine-grained localization than the route text. Further experiments are required to confirm this possibility.

**References**

