

Title	図を用いた対面対話における手の動きの観察的研究
Author(s)	遠藤, 勉
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# An Observational Study of Hand Movements over Diagrams in Face-to-face Dialogue

Tsutomu Endow

School of Knowledge Science,  
Japan Advanced Institute of Science and Technology

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We often use diagrams in a face-to-face dialogue, and when the diagram is within our reach, it is hard to resist using our hands over the diagram. The purpose of this study is to clarify the functions of hand-movements in the context of face-to-face dialogue involving a diagram.

Research of diagrammatic reasoning in logic and artificial intelligence has emphasized that a diagrammatic representation is effective means for communication. Research in non-verbal communication discusses the function of body movements and their relations to accompanying speech. However, little is known about what happens when a diagrammatic representation is integrated into a face-to-face spoken dialogue rich in these non-verbal means, namely, when a diagram displaces the “gesture space” in McNeill’s sense. This is the main question of this research project.

Thus, this study is concerned with face-to-face dialogues involving three different kinds of representational means, namely, speech, diagrams, and hand movements over diagrams. We collected data on such dialogues in the following way. A pair of subjects were given a pen, a map, and a question sheet. The map was incomplete, and the question sheet list sentences that supplement the missing information. The task of the pair of subjects was to collaborate each other to complete the map by adding seven buildings and one road to the map. The subjects’ hand-movements and speech were videotaped and the speech was transcribed later. We recorded a total of 6 dialogues conducted by different pairs.

In this process, we found that fingers, when integrated with diagrams in spoken dialogues, can be put into surprisingly diverse communicative uses, including:

**Pointing** One uses a finger to denote elements in the diagram, such as individual marks, lines, letters, and other shapes.

**Designation** One uses a finger to designate a particular point or area in the diagram; the difference from pointing is that the designated point or area apparently constitute no apparent symbol unit in the graphic.

**Transparent drawing** One moves a finger to draw a shape over the diagram, which serves as a temporal “transparent” icon on the graphic; it functions just like a usual icon to denote a road, a building, and some other object.

**Icon substitution** One uses a finger as a temporal physical icon on the diagram, which functions just like a usual icon; the difference from the transparent drawing case is that a finger serves as a meaningful icon in this case rather than as a drawing tool of a transparent icon. And this icon is easily erasable.

**Animation** One moves a finger over a graphic to express a movement in the region represented by the diagram; for example, a tracing movement along a road icon expresses a movement of a truck along the corresponding road.

**Auxiliary focusing** One moves a finger to highlight particular features of the diagram, such as drawing a “transparent” diagonal line to show two icons are diagonally placed on a figure, or tracing two curves at the same speed to show that the two curves are of the same length.

**Supposition flagging** One uses a finger to stand for a supposition or premise made in a dialogue over the diagram, where the finger’s placement on the graphic indicates whether the supposition or premise is “alive” at a given time; note that the information indicated in this case is about the dialogue process itself, rather than the topic of the dialogue.

In this thesis, we will start with discussing each of these communicative uses of over-graphic fingers in detail, showing actual examples drawn from our dialogue data. We will thus demonstrate how much contribution a finger makes to the diversity of media integration in a spoken dialogue involving a diagram.

Among the different uses listed above, the last one, namely, the supposition flagging, is presumably the least intuitive, and one might even doubt its very existence. Thus, we will use the second half of our thesis to report on our study focused on this alleged function of fingers. Explicitly stated, the supposition-flagging function of a finger can be expressed in the following way:

If a dialogue participant places a finger on a diagram at the time a supposition or a premise is stated, then the finger stands for the supposition or premise in the subsequent dialogue in the sense that the finger’s staying in the same place indicates that the supposition or premise is still effective in the dialogue, while the finger’s removal indicates that the supposition or premise is no longer effective.

Now, our dialogue data contain a number of instances where two fingers are used at the same time in a special way: one finger (called “P-finger”) is originally placed on a diagram when a participant states a supposition or a premise; while this finger still stays in the same spot, the other finger (called “C-finger”) is placed on a different spot in the diagram while a participant utters another sentence. If our hypothesis is true, the original premise or supposition made in such an instance must be effective when the second sentence is uttered, so that the original supposition or premise must stand in the premise-consequence relation or the supposition-consequence relation to the content of the second sentence.

We exploited this fact in verifying our hypothesis. We randomly selected 15 out of 28 instances involving P- and C-fingers, and assessed, for each instance, whether the proposition stood for by the P-finger serves as a supposition or premise for the proposition stood for by the C-finger. The assessment on 11 instances were straightforward since the accompanying speech contained such explicit cue-phrases as “ba,” “to,” “nara,” “tara” (rough equivalents to “if...then” in English) that signal the supposition-consequence or premise-conclusion relation. The other four cases were not as easy to estimate, and we asked 5 independent subjects to listen to them in an experimental setting. At least 4 out of 5 subjects judged positively on 3 instances out of 4. With the exception of a single instance, then, our analysis indicates that the supposition or premise stood for by a P-finger is effective when the proposition stood for by a C-finger is uttered. We may take this fact as an evidence to the existence of the supposition-flagging function of a finger over a diagram.