

Title	視線追尾データを用いた図的推論における思考対象の分析
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# Things people reason about in diagrammatic reasoning: an analysis based on eye-tracking data

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A diagram is a drawing which represents a target. Thus, there are at least two referents in diagrammatic reasoning. One is the diagram itself, and the other is that of target represented by the diagram. These two possible referents of reasoning, however, have rarely been differentiated in studies of diagrammatic reasoning. Although the importance of internal drawing and operating on diagrams has frequently been pointed out, there are not much empirical evidence for the existences of such reasoning. To fill the gap, we observed eye-movement of subjects during diagrammatic reasoning.

A transitive reasoning question named “three-term series problem” was given to the subjects. The problem consists of two premises and a question,

e.g. The first premise that : "A dog is cleaner than a cat",  
the second premise that : "A pig is dirtier than a cat", and  
the question : "Is a dog cleaner than a pig?"

Upon pressing button, the assumptions and question were given successively to subjects in voice. While a premise was given, a diagram representing the first premise appeared on a computer display. However, neither the experimenter nor the subject added second premise to the diagram. The diagram had a rule of meaning in vertical or horizontal directions and half the number of all diagrams had a rule of meaning in the other direction. We created a total of 48 transitive inference problems consisted of combination of 6 pair of a transitive relation

and 8 types of grammatical relation. Subject's fixation points on the displayed diagrams during problem solving was recorded by an eye-mark recorder.

Our hypothesis was as follows: if the subject internally use the diagram to solve the problem, the subject's eyes would scan either above, below, right, left of the diagram depending on type of the problem. In another word, their eyes would scan on hypothetical referent that had not been represented. Furthermore, we expected that such movements would be observed even when the Subject reasons about transitive relations such as "brighter-than" that are difficult to image visually or spatially.

Overall, the results of our observation can be divided into two broad classes. The first class is the cases where fixation points concentrated on the middle part of the diagram. The second class is the cases where fixation points spread beyond the middle part. In the second class of cases, the subject exhibited a very strong tendency to move their eyes back and forth between the actual graphical elements and the hypothetical drawing position.

These results suggests that not only the representation of target indicated by the diagram but also the representation of diagram itself was used for diagrammatic reasoning. Additionally, our experiment gives clear evidence for the existence of hypothetical drawing inference. Intuitively , this might come with no surprise, but its theoretical implications are significant. First, it provides empirical support to the processes postulated in previous studies of diagrammatic reasoning. Second, the concept of hypothetical drawing inference identifies the common structure of seemingly diverse processes thus postulated, and hence has a potential to make the existing accounts more accounts more systematic.