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Facilitation in variants of the nine-dot problem: Perceptual or cognitive mediation?

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A popular explanation for performance on the 9-dot problem derives from Gestalt laws of Pragnanz. Participants are unable to solve the problem because they fixate upon the square (Scheerer, 1963). Recent cognitive accounts cite the failure of instructions to go beyond the square as evidence against the fixation explanation. Weisberg & Alba (1981) argue that the experience of dot-to-dot drawing that people bring to the problem inhibits the consideration of hypotheses that involve lines beyond dots. Lung & Dominowski (1983) argue that the strategies employed in seeking solutions impose an inappropriate constraint that lines must turn on dots. In this paper, we investigate manipulations to the presentation of the problem which present difficulties for the cognitive accounts, and suggest at least a partial role for perceptual mediation in 9-dot performance.

Experiment 1

In Experiment 1, participants attempted either 9-, 11-, 12- or 13-dot tasks. Each participant had 10 one-minute attempts, indicating the starting point each time. After one trial the % of solvers was 73%, 60%, 50% and 0% for 13, 12, 11 and 9 dot conditions, respectively. Planned comparisons reveal that the 13 dot condition was significantly better than the 11 dot. A trend analysis indicates the proportion solving increased linearly with number of dots. After 10 trials the % of solvers was 90%, 80%, 93% and 0% for 13, 12, 11 and 9 dot conditions, respectively. Planned comparisons reveal that all extra dots conditions were significantly different from the 9 dot condition, but not from each other.

Whilst superior performance with additional dot variants is consistent with cognitive accounts of 9 dot performance, they cannot account for first trial differences. Solutions to all three problems require only dot-to-dot lines, and none of the problems require non-dot turning points. We suggest that the strong figural 'arrow-like' properties of the 13-dot problem guide participants to an immediate solution. We have additional evidence demonstrating that it is not simply the prominence of the starting point that determines performance on this problem.

Experiment 2

In Experiment 2, extra dots were provided as guides to potential turning points, but were not part of the problem requirements. Participants attempted an 11-dot problem which differed from that of Experiment 1 only in that the additional dots were not filled. Despite this minor change, only 33% of participants solved the problem after 5 trials. Under the cognitive accounts, performance on the 11-dot

problem in Experiment 2 should be identical to that of Experiment 1, since hypotheses concerning experience of dot-to-dot problems and constraints on non-dot turning points are unaffected by this minor presentational change. However, under the figural account, performance should be reduced since the square figure emerging from the problem will not match the arrow figure required of the solution.

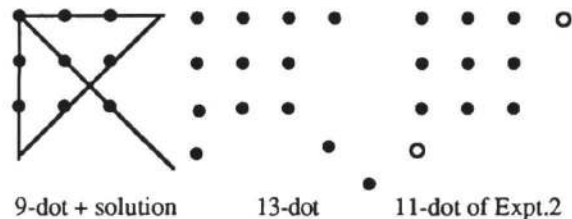


Figure 1. Variants of the 9-dot problem. The task is to draw four straight lines through all the dots, without lifting pen from paper. The solution is identical in all problems.

Summary and conclusions

We suggest that these results should encourage a re-evaluation of the role of perceptual characteristics in problem-solving generally, and in the 9-dot problem in particular. In the case of the 9-dot problem, the figural properties suggest an inappropriate solution. With the 13-dot problem, the good figure presented by the arrow shaped problem limits search for solutions to one that fits the figure. In the case of the 11- and 12-dot problems, participants explored a number of alternatives before finding one in which the figure prompted the solution. We do not claim that participants completing the 11, 12 and 13 dot problems in Experiment 1 experienced some kind of conscious 'insight'. Rather, we suggest that the solution in the 11-12- and 13-dot problems was perceptually available to participants. In Experiment 2, participants were less successful, because the search for solution paths was not constrained by a facilitating Gestalt of the problem array.

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