Gestures for Thinking and Explaining

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Introduction

Gestures are universal in speaking, yet occur in silent thought as well (McNeill, 1992). What kinds of gestures are used for each? To address this question, participants were videotaped while silently solving insight problems and while explaining their solutions. The content of the problems included spatial arrays and actions, conditions known to elicit iconic gestures (Goldin-Meadow, 2003). The expectation was that some problems would elicit gestures in the service of solving problems in the absence of speech or communication. The comparison of gestures elicited in problem solving to those accompanying communication of solutions should give insight into the kinds of gestures useful for thinking and those useful for communicating.

Method

Twenty-two Stanford undergraduates solved six spatial insight problems. Participants were videotaped both while silently trying to solve the problems (Solve) and while explaining the solutions to the camera (Explain).

Results

All deictic and representational gestures were counted. Beat gestures were ignored. As expected, most participants (M = 86.58%, SEM = 2.96) gestured while explaining the solutions. In contrast, during silent solution only two problems elicited gestures from a majority of participants (M = 62.75% SEM = 0.85). Notably, both of these problems have high spatial working memory (WM) demands, in contrast to the other problems.

A detailed analysis of the conceptual content was carried out for two problems: Maier's (1931) Two String problem (low spatial WM) and the Six Glasses problem (Ashcraft, 1994) (high spatial WM). Only those participants who correctly solved the problem were included for each problem. Each gesture was coded as one of three types. *Scene creation* gestures conveyed the spatial positions and properties of objects in the problem (e.g. pointing to the positions of two strings). *Enactment* gestures mimed actions the *person* would need to perform in order to solve the problem (e.g. simulating tying two strings together). *Action depiction* gestures portrayed actions of *objects* in the scene (e.g. modeling a swinging string).

During solution of the Six Glasses problem, participants produced significantly more scene creation than enactment gestures, $t(21) = 3.29$, $p < .01$ (see Figure 1). However, there was no difference in frequency of gesture by type while explaining the solution.

In contrast, for the Two String problem, participants gestured little during solution, and during explanation produced significantly more enactment gestures than scene creation gestures, $t(10) = 7.15$, $p < .001$, and than action depiction gestures, $t(10) = 6.47$, $p < .001$.

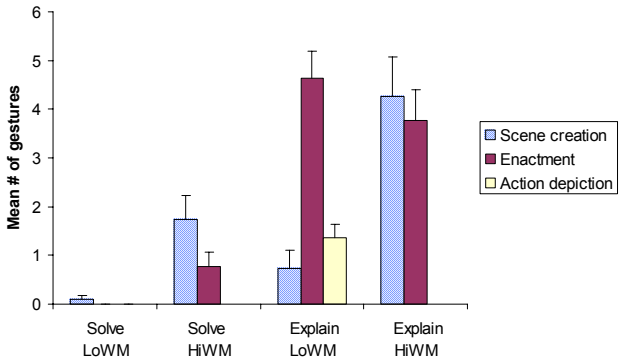

Figure 1: Mean number of gestures while solving and explaining high and low spatial working memory problems.

Discussion

Gestures during problem solving were intended for the gesturer, and were produced only when spatial working memory demands were high. Presumably, they served much like a diagram, to offload working memory. Although participants necessarily thought of the actions entailed in the solution, they did not enact the solution gesturally until they had to communicate the solution in speech. It is possible that solution enactment in explanation was meant to serve thought in the listener (i.e. the imagined audience for the videotape). However, it is also possible that solution enactment was simply unnecessary during the solution stage because the solutions entailed few steps, placing only a small load on working memory.

References

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