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From action to abstraction: Gesture as a mechanism of change

Susan Goldin-Meadow *

Department of Psychology, University of Chicago, 5848 South University Avenue, Chicago, IL 60637, USA

A R T I C L E I N F O

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A B S T R A C T

Piaget was a master at observing the routine behaviors children produce as they go from knowing less to knowing more about at a task, and making inferences not only about how the children understood the task at each point, but also about how they progressed from one point to the next. In this paper, I examine a routine behavior that Piaget overlooked – the spontaneous gestures speakers produce as they explain their solutions to a problem. These gestures are not mere hand waving. They reflect ideas that the speaker has about the problem, often ideas that are not found in that speaker's talk. But gesture can do more than reflect ideas – it can also change them. In this sense, gesture behaves like any other action; both gesture and action on objects facilitate learning problems on which training was given. However, only gesture promotes transferring the knowledge gained to problems that require generalization. Gesture is, in fact, a special kind of action in that it represents the world rather than directly manipulating the world (gesture does not move objects around). The mechanisms by which gesture and action promote learning may therefore differ – gesture is able to highlight components of an action that promote abstract learning while leaving out details that could tie learning to a specific context. Because it is both an action and a representation, gesture can serve as a bridge between the two and thus be a powerful tool for learning abstract ideas.

* Department of Psychology, University of Chicago, 5848 South University Avenue, Chicago, IL 60637, USA. Fax: +773 702 0320.
E-mail address: sgm@uchicago.edu

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In addition to his many other talents, Jean Piaget, the renowned developmental psychologist, was a superb observer. Piaget described the ordinary behaviors of childhood in exquisite detail, but his brilliance came in recognizing the significance of these behaviors for cognitive development. Piaget uncovered developmental milestones that have turned out to be robust across cultures and methods and, as a result, must be part of any comprehensive theory of ontogenetic change. As one well-known example, Piaget observed that, before age 7, children maintain that water poured from a tall, thin container into a short, wide container is no longer the same amount – these children are non-conservers. Once the ability to conserve liquid quantity has been mastered, children not only firmly believe that the amount of water does not change when it is poured, but they can provide coherent justifications for this belief. For example, to justify her belief in the conservation of liquid quantity, one conserver said, "Even though that one's taller and skinnier and that one's wider and smaller, they still have the same amount," thus making it clear that she understands how the height and width of the containers compensate for one another.

My goal is this paper is to focus on a behavior that Piaget saw, but did not consider significant – the spontaneous gestures that speakers produce when they talk. I argue that this behavior not only reveals important information about the steps learners take as they acquire a task, but also plays a role in facilitating those steps. The conservation task provides a nice illustration. The child just described, who justified her belief in the conservation of liquid quantity by describing how height and width can compensate for one another, gestured as she talked – she demarcated with her hands the width and height of the first (tall) container, and then demarcated the width and height of the second (short) container (see Fig. 1; Ping & Goldin-Meadow, 2008). This child conveyed compensation in gesture, thus reinforcing with her hands the salient aspects of her spoken explanation. Here gesture conveys approximately the same information as speech and, in this sense, can be safely ignored. But in the next example, gesture adds information to speech and thus enriches our understanding of the child's state of mind.

In this task, the child is shown two rows containing the same number of checkers; the checkers in one row are spread out, and the child is asked whether the two rows still have the same number of checkers. The child shown in Fig. 1, who had a firm grasp of conservation of liquid quantity, also understands conservation of number and says that the two rows still have the same number of checkers after one is spread out. When asked to justify her response, she says, "Because if we added them together, they would be the same number," an answer that relies on counting. At the same time, she displays a different principle in her gestures – the one-to-one correspondence between the two rows of checkers. She points at the spot where the first checker in row 1 was during the task; then at the spot where the first checker in row 2 was after the row had been spread out; then at the spot where the second checker in row 1 was; then at the spot where the second checker in row 2 was; and so on until she pairs up all of the checkers in row 1 with the checkers in row 2 (see Fig. 2; Ping & Goldin-Meadow, 2008). Her hands reveal knowledge (i.e., 1-to-1 correspondence between the rows of checkers) not found in her speech. In this instance, it does behoove us to take gesture seriously, which is my goal in this paper.

Gesture is an act of the body, and the body has been claimed to play a central role in cognition (e.g., Barsalou, 1999; Glenberg, 1997; Wilson, 2002; Zwaan, 1999). For example, previous motor experience can affect how language is understood and processed – playing hockey can enhance a person's ability to understand language about hockey, apparently because brain areas normally used to perform hockey-related acts become highly involved in understanding language about those acts (Beilock, Lyons, Mattarella-Micke, Nusbaum, & Small, 2008; see also Glenberg & Kaschak, 2002, Pulvermüller, 2005). The body not only affects how we interpret language, but also how we recall items and solve problems. For example, moving while encoding an action enhances recall of that action (Cohen, 1981; Engelkamp & Krumnacker, 1980; Saltz & Donnenwerth-Nolan, 1981), as does seeing someone else move (Cohen, 1981, 1983; Cohen, Petersen, & Mantini-Atkinson, 1987; Mulligan & Hornstein, 2003). As an example from problem solving, producing unrelated exercises between attempts at solving an insight problem affects solution times – adults who are given arm exercises that are compatible with the problem solution solve the problem more quickly than adults given exercises that are incompatible with the solution (Thomas & Lleras, 2009; see also Grant & Spivey, 2003; Thomas & Lleras, 2007).