

## The relationship between co-thought gestures and co-speech gestures

David McNeill's idea that "speech and gesture are elements of a single integrated process of utterance formation" has influenced the gesture studies for many years, and it has been demonstrated that speech and gesture are temporally synchronized, they develop together in children, and they break down together in aphasia. However, people also move their hands spontaneously when they solve mathematics or spatial problems silently. The current study investigates the relationship between the silent co-thought gestures elicited in problem solving and the co-speech gestures in description tasks. The participants performed both problem-solving and description tasks. In the problem solving task, they were required to solve the classic Shepard-Metzler's (1971) mental rotation task without speaking. They were seated alone in an experimental room, and responded with two foot-pedals, leaving their hands free for spontaneous gestures. Their gestures were recorded by a hidden camera. In description tasks, participants were required to describe the motion of some geometric shapes in some animated cartoons, as well as to explain the meaning of some abstract concepts. The order of two tasks was counterbalanced. In description tasks, half of participants were required to describe stimuli to the experimenter face to face and their gestures were recorded by a camera presented in the room, and the other half of participants were told to describe to a tape-recorder and seated alone in the room, and their gestures were recorded by a hidden camera. Between these two sessions, participants had to complete some cognitive ability tests that lasted for about 1 hour. We analysed the correlation between the gesture frequency in the silent mental rotation task and in two description tasks. In the tape-recorder description group, there was a significant positive relationship between the number of gestures per trial in the mental rotation task and the gesture frequency of both the geometric shape motion description task and the abstract concept explanation task. In the face-to-face description group, there is no significant relationship between the gesture frequency in the mental rotation task and in the geometric shape motion or the abstract concept explanation task. We concluded that there might be some common mechanism underlying the production of co-thought gestures and co-speech gestures at least when there is less communicative demand. Thus, production of co-speech gestures is not only generated from "a single integrated process of utterance formation", but it may also involve processes that are inherently non-linguistic.