# Talking about Movement - Task Perspective Elicits Corresponding Hand Movement Behavior

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In this study, speakers' hand movement behavior was investigated during different tasks on movement stimuli, which required either to describe aspects of the movement or to analyze the movement according to a model of motor skills (Meinel, & Schnabel, 1981). The 'Gesture as simulated Action' Model (GSA) (Hostetter & Alibali, 2008) suggests that the simulation of visual and motor imagery affects the activation of specific hand movements. The model distinguishes between motor and visual mental imagery and incorporates different levels of activation of the corresponding image. When the activation signal strength exceeds a threshold, speakers externalize mental simulations through hand movements. According to the GSA model, there are a number of factors influencing the strength of activation of a signal as well as the form and corresponding function of the movements. In addition to idiosyncratic factors these include context, verbal accessibility, familiarity with the image and type of imagery activated (motor or visual). Hand movements can also have different functions and corresponding forms. Adding to this hypothesis, the gestural point of view can also offer insight on the preferred mental imagery process. For Hostetter and Alibali (2008) the egocentric point of view is connected with activated motor imagery, while visual imagery activates the heliocentric point of reference. In the hand movement analysis according to NEUROGES (Lausberg, 2013) values specify the use of an egocentric or heliocentric point of view according to their function in the articulation process. To summarize, the GSA Model offers an approach to explain the way mental imagery and gestures are connected, while taking into consideration a variety of possible factors. Testing the gestural point of view, as described in the GSA Model offers a new approach to gestural analysis, while also providing information for the role of mental simulation in gesture production.

According to the GSA model, we expect that all persons display more movements reflecting an egocentric frame of reference while describing the performed action in contrast to free re-narrations and descriptions of flying objects.

Four tasks with different perspectives were developed and presented to participants. The first task for the participants was to re-narrate the short film to a second person immediately after

watching the film. Participants were then asked which motor skills are predominantly required and stimulated when performing a basketball free throw and a frisbee overhead "wrist flip". In the next task, participants were asked to describe the flight trajectory of the ball/disc. During the last task, participants were asked to describe the movement of a free throw/overhead wrist flip. The re-narration task did not require the participants to focus on specific aspects of the film. Thus, this task elicited a relatively natural and free choice of speech as well as hand movement behavior. (and provided a baseline for preferred hand movements.) The remaining three tasks addressed the same stimuli. However, the first task required abstract reasoning on the movements previously seen and transferring movement to abstract concepts. The next task was developed in order to achieve an explicit use of visual imagery whereas the last task primarily required the use of motor imagery, as the participants had to mentally execute the technique.

The stream of hand movement behavior was analyzed according to NEUROGES (Lausberg, 2013) using ELAN (Lausberg & Sloetes, 2009) as the annotation software. NEUROGES requires segmenting the ongoing stream of hand movement behavior and thus allows for a comprehensive examination of the repertoire of hand movements, without filtering according to the researchers' beliefs about which movements might be of interest. In the coding of Module I, the complex phase and the spatial target of the hand movement can be examined. These findings deliver the necessary information for Module III, where hand movements are segmented and denoted according to their function (Module III). For all categories the proportion of time (accumulated durations/minute) was calculated in order to avoid misinterpretations caused by the different duration of the tasks. The data was analyzed with repeated measures of variance using SPSS.

The Data Analysis showed no significant effect of the within-subject factors hand and sport discipline and the between-subject factor experience group. According to the analysis of the of the Function category, participants displayed more hand movements with an egocentric frame of reference in tasks requiring concrete reasoning of movement in contrast to other tasks. This egocentric frame of reference is associated with mental motor imagery, confirming the hypothesis and providing evidence for the GSA mechanism that underlies hand movements. In contrast, gestures that underlie a mento-heliocentric frame of reference are considered to be a product of mental visual imagery. The positive findings are in line with the GSA theory and suggest that the production of gestures follows the cerebral activation of the motor and visual imagery specifically. Further investigations of the neurophysiological parameters that underlie gesture production are suggested.