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Research report

# Make a gesture and I will tell you what you are miming. Pantomime recognition in healthy subjects

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ABSTRACT

The present paper deals with the question of how people recognize tool-use/transitive actions performed by others. The direct-matching hypothesis assumes that transitive gestures produced by others are recognized by directly activating the same gesture engrams used for making the gesture oneself. By contrast, the context hypothesis posits that the observation of the gesture alone is not sufficient, and that additional contextual information is necessary for recognizing the action. The aim of the present paper is to decide between these two hypotheses. To achieve this purpose, we asked healthy older adults (performers) to mime the use of tools (Experiment 1a). Performance was videotaped and presented to healthy younger adults (observers) in two conditions: (1) Naming the tool associated with the gesture made by the performer (naming condition); (2) Choosing the correct name from 10 alternatives (choice condition). Our results indicated that the performance in the naming condition was relatively poor, emphasizing that people are far from perfect at recognizing pantomimes without contextual information. We also found a great variability among observers, suggesting that the same gesture could evoke different tool-use actions. The performance was better in the choice condition. So, observers benefited from the introduction of tool names. This pattern of results could also be explained by a sequence effect, a lexical-decision effect or an item-selection effect. Experiments 1b and 2 ruled out these possibilities. In short, these points make it difficult to believe that people recognize the actions performed by others by directly activating gesture engrams. Our findings are more consistent with the context hypothesis.



## 1. Introduction

The present paper deals with the question of how we recognize tool-use/transitive actions performed by others. For the sake of clarity, we will use the term "observer" to refer to the individual who observes/recognizes the action and the term "performer" to refer to the individual who performs the action. Our understanding of the mechanisms involved in the

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recognition of transitive actions has mainly come from studies of pantomime tasks, which consist in asking the subject to pretend to use common tools[1] either on verbal command, on imitation or on visual presentation of tools. The pantomime task has contributed to important insights to the study of apraxia, a disorder of skilled movement and tool use. For instance, it has been found that production and recognition of pantomimes are impaired in parallel in patients with left parietal lobe lesions, whereas patients with lesions that are more anterior and do not involve the left parietal lobe only have difficulties in producing pantomimes (Heilman et al., 1982). On the basis of these results, it has been proposed that the left parietal lobe contains spatiotemporal gesture representations (hereafter called "gesture engrams"), which specify the timing, trajectory and content of the movement to be executed with a given action. It has also been suggested that transitive actions performed by others are recognized by *directly* activating the same gesture engrams used for performing the action oneself (Buxbaum, 2001; Buxbaum et al., 2005; Heilman et al., 1982; Rothi et al., 1991).

The idea that perception of motor actions can directly be linked to their execution has also been formulated in the context of imitation of meaningless gestures (Liepmann, 1908; Rothi et al., 1991). This hypothesis has however been challenged by studies demonstrating that in left brain-damaged patients replication of the hand positions on a manikin was as defective as imitation on themselves (Goldenberg, 1995; Goldenberg and Hagmann, 1997). Studies in child development have also shown that infants do not systematically imitate the observed movement, but rather the main goal extracted from the model movement (Bekkering et al., 2000; Wohlschläger et al., 2003). In sum, these findings suggest that imitating does not simply correspond to matching visual information with proprioceptive information. So, it is necessary to be careful with interpretations in terms of direct mechanisms.

The same care must be taken with the pantomime recognition task. More precisely, if transitive actions performed by others can be directly recognized, it remains to specify what is meant by "action". One possibility is that "action" means "movement", implying that an individual might be able to extract the key features of an observer movement, without recognizing the goal of the movement. This interpretation, which is very close to the hypothesis of a direct route for imitation mentioned above, suggests that the imitation and recognition of transitive, intransitive (salute, wave goodbye) and meaningless movements would be supported by the same mechanisms. However, this is highly unlikely, notably because it has been widely demonstrated that the imitation of these different types of movements can be impaired independently (e.g., Buxbaum et al., 2005; Goldenberg and Hagmann, 1997).

Another interpretation, which is closer to the one usually adopted in the literature (e.g., Buxbaum, 2001), is that "action" means "movement associated with a specific tool". This interpretation is quite logical since, in everyday life, we do not carry out a given action with only one kind of tool. For instance, knives, pizza wheels, scissors, tin-openers and rulers can be used for cutting bread, pizza, cloth, tins and paper, respectively. Moreover, the use of each of these tools involves very different arm movements and, as it is true that the same action cannot be associated with only one tool, and as a result, with only one arm movement, the same movement (e.g., vertical motion of the arm) can be executed for a wide variety of actions (throwing a knife, pounding a nail with a hammer, knocking at the door, ringing bells). Therefore, the hypothesis that transitive actions performed by others can be directly recognized necessarily implies that people directly recognize *the action performed by others with a specific tool*.

Along these lines, it can be hypothesized that the quality of recognition should be the same regardless of whether the individual is requested to discriminate or to name the tool whose use is mimed (the direct-matching hypothesis). Unfortunately, there is no study comparing these two methodological procedures (naming *vs* choice among alternatives). In fact, studies of pantomime recognition generally do not ask subjects to name the tool whose use is pantomimed. This is not surprising given that many subjects of these studies suffer from aphasia. Therefore, subjects are required to choose, among several pantomimes performed by the examiner, the one that best corresponds to the name of the action/tool (Buxbaum et al., 2005; Heilman et al., 1982; Rothi et al., 1986), or among several pictures of tools the one that best corresponds to the pantomime performed by the examiner (Rothi et al., 1985). Nevertheless, it is noteworthy that, in some works, subjects are asked to name the pantomime (e.g., Dumont and Ska, 2000; Negri et al., 2007). In this case, responses are scored as correct if the subject names the action (hammering), the tool whose use is pantomimed (you are using a hammer) or the object involved in the action (you are pounding a nail). Interestingly, Negri et al. (2007) requested patients without severe language impairments to name and those with severe language impairments to complete a multiple-choice task in which they had to indicate the picture (out of three) depicting the action pantomimed by the experimenter. In a way, this would suggest that the performance obtained in the naming and the choice condition is comparable. The present study can help us to know whether this is indeed the case.

The direct-matching hypothesis is not the only one able to predict performance in pantomime recognition tasks. Another possibility is that people infer from the observation of the performer's movements the possible "motion" of the tool whose use is mimed (e.g., the hand of the individual who performs the pantomime rotates, so the tool should be something whose use requires rotation). However, given that a great number of tools can correspond with the pantomime, people would need additional contextual information to recognize the pantomime (e.g., a choice among several alternatives). Put differently, the observation of the pantomime alone may not be sufficient. So, unlike the direct-matching hypothesis, the context hypothesis predicts that it is more difficult to name the tool whose use is pantomimed than to choose the correct name from a list of several alternatives.

[1] We follow the suggestion (Goldenberg and Hagmann, 1998; Ochipa et al., 1992) to use the terms "tool" for the implement which performs an action (e.g., a hammer) and "object" for the recipient of the action (e.g., a nail).