



# The personification of animals: Coding of human and nonhuman body parts based on posture and function



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## ABSTRACT

The purpose of the present research was to determine how humans represent the bodies and limbs of nonhuman mammals based on anatomical and functional properties. To this end, participants completed a series of body-part compatibility tasks in which they responded with a thumb or foot response to the color of a stimulus (red or blue, respectively) presented on different limbs of several animals. Across the studies, this compatibility task was conducted with images of human and nonhuman animals (bears, cows, and monkeys) in bipedal or quadrupedal postures. The results revealed that the coding of the limbs of nonhuman animals is strongly influenced by the posture of the body, but not the functional capacity of the limb. Specifically, body-part compatibility effects were present for both human and nonhuman animals when the figures were in a bipedal posture, but were not present when the animals were in a quadrupedal stance (Experiments 1a–c). Experiments 2a and 2b revealed that the posture-based body-part compatibility effects were not simply a vertical spatial compatibility effect or due to a mismatch between the posture of the body in the image and the participant. These data indicate that nonhuman animals in a bipedal posture are coded with respect to the “human” body representation, whereas nonhuman animals in a quadrupedal posture are not mapped to the human body representation. Overall, these studies provide new insight into the processes through which humans understand, mimic, and learn from the actions of nonhuman animals.

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## 1. Introduction

It is well known that humans possess the capacity for mimicry and imitation. Recently, the neural and cognitive processes underlying imitation (Iacoboni, 2005) and other higher-order processes, such as communication (Rizzolatti & Arbib, 1998), observational learning (Ray, Dewey, Kooistra, & Welsh, 2013; Stefan et al., 2005), and the understanding of other people's intentions and mental states

(Gallese, 2007), has been the subject of extensive study and theoretical consideration (see Rizzolatti & Craighero, 2004 for a review). With good reason, the focus of this intense research effort has been on the abilities of human's to imitate and understand the actions of other humans. The processes underlying the human ability to interpret, understand, and mimic the actions of nonhuman animals have received much more modest (and even incidental) consideration.

Although the processes underlying the understanding and imitation of nonhuman animal actions have received relatively little direct experimental attention, these abilities are a large and valuable component of human culture. From ancient historical celebrations to modern cultural

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performances, humans have incorporated the movement patterns of nonhuman animals into dances and festivities of all manners and purposes. Based on the general success of these endeavors, it is clear that humans have the capacity to imitate the actions of nonhuman animals and to understand the purposes of actions that are similar to the actions that we can perform (i.e., movements that are part of our action repertoire with effectors that are similar to our limbs). The goal of the present experiments was to establish some basic building blocks for a line of research that more directly investigates the human ability to imitate and understand the actions of nonhuman animals.

The human-to-nonhuman cross-species action co-representation has already been demonstrated because “mirror” neurons in the macaque brain become active when the monkey watches another monkey or a human experimenter perform a movement (e.g., Di Pellegrino, Fadiga, Gallese, & Rizzolatti, 1992). This human-to-nonhuman process, however, seems to be task- and species-specific. For example, it has been reported that dogs, but not chimpanzees, can understand communicative gestures such as object-directed pointing movements (Kirchhofer, Zimmermann, Kaminski, & Tomasello, 2012). Likewise, there is evidence that a similar task-specific nonhuman-to-human cross-species action representation capability exists (Kaiser, Shiffrar, & Pelphrey, 2012; Pinto & Shiffrar, 2009). Buccino et al. (2004) reported activation in areas thought to be components of the putative human mirror neuron system (MNS) and motor system while people observed the actions of nonhuman animals that humans can perform (e.g., a monkey or a dog biting). Interestingly, motor system activation was not as strong while the participants observed movements that are not typically part of the human action repertoire (e.g., dog barking). These data suggest that actions that can be completed by humans are matched on the human motor repertoire, whereas actions that are not part of the human motor repertoire may be recognized based on their visual characteristics and environmental effects.

Currently, it is unclear what visual information is necessary to recognize these nonhuman actions. In particular, it is not known how humans code, mimic, and understand: (1) actions that humans cannot perform with homologous body parts (e.g., a frog catching a fly with an extended tongue; but see Buccino et al., 2004, for some insights); and (2) actions that humans can perform, but with effectors that humans do not possess (e.g., a jellyfish using flexible extensions of its body to swim). To begin to address these questions, the present studies were designed to determine how humans code homologous body parts of nonhuman animals. Specifically, the approach for this initial foray into understanding how humans represent the body parts and actions of other animals consisted of an investigation of the manner in which humans code nonhuman body parts with respect to the representation of the human body. We chose to begin with this question because we reasoned that we must first understand how nonhuman body parts are represented before we can attempt to determine how humans represent the actions performed by nonhuman effectors that are, or are not, physical or functional analogues of human effectors.

The present studies are based on the substantial neuropsychological and neuroimaging evidence (see Peelen & Downing, 2007 for a review) that indicates that humans possess a body schema or representation in extrastriate (i.e., extrastriate body area – EBA) and other areas that is accessed to provide information about the relative and absolute location of different body parts in the world and to assist in the co-representation of another person's body and action (Bach, Peatfield, & Tipper, 2007; Reed, Stone, Bozova, & Tanaka, 2003; Thomas, Press, & Haggard, 2006). The behavioral effects resulting from access to such a human body representation and self-other matching have been revealed through a number of recent attention and compatibility studies. For example, Thomas et al. (2006) reported that the presentation of a spot of light on a specific part of another person's body facilitated the detection of somatosensory (vibration) stimuli presented on the homologous body part of an observer. Similarly, Bach et al. (2007) found that response times (RTs) for thumb and foot responses were shorter when targets were presented over the hands and feet, respectively, of a human model than when the targets were presented over another body part of the model. It was suggested that these body-part compatibility effects emerged because the presentation of a stimulus on another person activated or primed the body representation in the observer in a body-part specific manner. This body-part specific activation or priming subsequently increased the sensitivity of the somatosensory areas representing that body part (Thomas et al., 2006) and/or facilitated response programming processes in the areas of the motor system that code for that body-part (Bach et al., 2007). With respect to the larger context of human social behavior, it is thought that this body-part matching process facilitates mimicry and empathy by registering or mapping another person's body and experience against our representation of our own body.

The present studies employed an adaptation of the protocol of Bach et al. (2007) to determine if humans map the body parts of nonhuman animals onto the “human” body schema and how contextual properties, such as posture and action, might influence this mapping. It was reasoned that if humans access the human body representation in EBA when viewing nonhuman animals and map the body parts of the nonhuman animals onto the “human” body representation, then body-part compatibility effects (e.g., Bach et al., 2007) will be observed when humans view pictures of nonhuman animals. To this end, participants completed thumb-press or foot-pedal responses to red or blue targets, respectively, that appeared over different parts of human and nonhuman animal bodies. It was predicted that if the bodies in the images are mapped to the human body schema, then RTs will be shorter when the stimulus is presented on the compatible body part (e.g., a red stimulus on the forelimb) than on the incompatible body part (e.g., a red stimulus on the hindlimb). Alternatively, if the bodies in the images are not mapped to the human body schema, then the location of the stimuli will not influence RTs. Across the series of studies, the species and posture (i.e., bipedal vs. quadrupedal) of the animals as well as the action performed by a limb was varied to assess the influence of these

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