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How 7-month-olds interpret ambiguous motion events: Category-based reasoning in infancy

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ABSTRACT

This paper investigates the role of static and dynamic attributes for the animate–inanimate distinction in category-based reasoning of 7-month-olds. Three experiments tested infants' responses to movement events involving an unfamiliar animal and a ball. When either the animal or the ball showed self-initiated irregular movements (Experiment 1), infants expected the previously active object to start moving again. When both objects were moving together in an ambiguous motion event (Experiment 2), infants expected only the animal to start moving again. Initial looking preferences for each object did not influence results. When either the facial features of the animal were removed, or its furry body was replaced by a plastic spiral in an ambiguous motion event (Experiment 3), infants formed no clear expectation regarding future movements. Based on this set of findings we conclude that 7-month-olds flexibly combine information about the static and dynamic properties of objects in order to reason about motion events.

1. Introduction

Imagine the following situation: you leave two material entities in a closed room: a dog and a sausage. When you get back, only one of them is left. What happened? You probably infer that the dog swallowed the meat because you know that dogs are animals which are able to show self-initiated activity, and that sausages are their favourite food. By identifying a given entity as a member of a specific category, we gain access to broader representations. Such representations help us to make

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inductive inferences and to predict or explain natural events (Carey, 1985; Keil, 1989; Murphy, 2002). But how do we develop these representations, and when do we start using them in reasoning processes? Mounting evidence suggests that the very beginnings of this development can be traced back to a preverbal stage.

The present report investigates under what circumstances 7-month-olds show category-based reasoning and make inductive inferences related to a global animate–inanimate distinction. Studies focusing on the development of the concept of animacy have received much attention during the past 20 years, presumably because our intuitive expectations regarding how animate beings interact with their environment differ considerably from our expectations regarding inanimate objects. Hence, it is important to know at what age infants begin to distinguish between animate and inanimate entities, what type of information they refer to, and how they use corresponding categorical knowledge in reasoning contexts.

For a long time, developmental psychologists have tried to clarify whether a global animate–inanimate distinction is primarily perception-based or conception-based (see Mandler, 2004; Oakes & Madole, 2003; Pauen, 2000, 2002a; Quinn & Oates, 2004; Rakison, 2005a; Rakison & Poulin-Dubois, 2001 for different views on this issue). In this debate, conceptual representations typically refer to causal and functional properties which may or may not be perceived directly in a given situation (e.g. behavioural properties of an animal, or the function of an artefact), as opposed to perceptual representations which typically refer to information perceived directly in a given situation (e.g. the appearance of objects). Today, most developmental psychologists agree that all knowledge about a global animate–inanimate distinction is somehow grounded in perceptual experience – be it experience with what objects look like or how they behave. Furthermore, most researchers would probably subscribe to the view that even preverbal infants can learn about the causal and functional properties of objects. At what age they become able to combine and store different kinds of information related to a global animate–inanimate distinction in long-term memory and at what age they start using corresponding knowledge for reasoning processes is still a controversial debate. To deepen our understanding of the underlying problem, it seems helpful to frame the problem by referring to knowledge of the neuropsychological processes involved in object perception and object identification.

We know that visual information about objects is first processed in the primary visual cortex. After that, static information (i.e. information about the appearance of objects) passes along the ventral stream in the temporal lobe, whereas dynamic information (i.e. information about properties involving movement) is processed along the dorsal stream passing through the parietal lobe (Goodale & Milner, 1992; Milner & Goodale, 1995; Ungerleider & Mishkin, 1982). Both types of information as well as input from other modalities are combined in associative regions and are stored as categorical knowledge in the temporal lobe (Martin, Wiggs, Ungerleider, & Haxby, 1996). Once knowledge concerning a given class of objects has been established, the activation of specific aspects of the corresponding categorical representation (e.g. static cues related to the appearance of an animal) can lead to the activation of other aspects (e.g. dynamic cues related to the movement behaviour of this animal), thus providing the basis for category-based reasoning.

These insights lead to the question of how infants come to integrate information from both streams and how they form long-term associations between static and dynamic object properties (Johnson, Mareschal, & Csibra, 2001). The present report cannot answer this question based on neurophysiological data, but it will provide behavioural data relevant in this context. Hence we will adopt the terminology suggested by neuropsychological research and talk about how infants learn to combine static with dynamic attributes in order to show category-based reasoning (see also Rakison, 2004), rather than referring to the traditional distinction between perceptual and conceptual representations.

Before presenting our own studies in more detail, we first summarize empirical support for the early emergence of an animate–inanimate distinction from three major lines of work: (a) categorization studies testing infants' abilities to classify animates and inanimates based on static information of their appearance, (b) studies investigating what type of dynamic cues help infants to perceive a given entity as animate, and (c) studies testing how infants relate static and dynamic attributes. Following this summary, we point out the limitations of existing evidence and describe our own approach.