Freyd, J.J., The mental representation of action. The Behavioral & Brain Sciences, 1983, 6, 145-146.

Note: This is a commentary on Premack's "target" article, "The codes of man and beasts," published with the target article. The complete collection includes the target article (p. 125-137), "open peer commentary" (p. 137-158), "author's response" (p. 158-165), and a combined reference list (p. 165-167). Requests for the complete collection (Premack, D. The codes of man and beasts. The Behavioral & Brain Sciences, 1983, 6, 125-167) should be addressed to D. Premack, Department of Psychology, University of Pennsylvania, 3815 Walnut Street, Philadelphia, PA 19104.

The mental representation of action

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It seems quite plausible that the phylogenetic development of primate intelligence should include an increasing use of abstract versus imaginal mental codes. Also reasonable is Premack's proposal that language training enhances chimpanzees' ability to use the abstract code. However, some of the specific arguments that Premack offers in support of his hypothesis seem less straightforward than his main theoretical contribution. Premack attempts to distinguish the abstract code from the imaginal code in terms of the experimental tasks that the chimpanzees were asked to perform: he argues that some problems are solvable *only* by using the abstract code. The tasks requiring the abstract code are, not surprisingly, those on which only the language-trained chimpanzees perform well. Given that there is no control for numerous potential differences between the language-trained and the non-language-trained chimpanzees (such as motivational and attentional differences due to the extensive contact with trainers), it seems especially important to clarify a priori why a particular task needs a particular mental code as opposed to arguing for different codes based on the differential performance of the two types of chimpanzees. In this commentary I will argue that one class of problems, those involving the mental representation of *action*, which Premack argues can be solved only using the abstract code, are not, in fact, a priori necessarily solved by abstract thinking.

Premack mentions that the imaginal code is often defined in terms of some form (e.g., "second-order") of isomorphism between the mental representations of items and the items themselves (see Shepard 1975; Shepard & Chipman 1970), although he points out that he cannot use the traditional direct chronometric measurement of this isomorphism for his experi-

mental tasks. He argues that he can instead analyze "whether or not the nature of the material that is used in our tests lends itself to imaginal representation." This argument is applied in the case of the mental representations of actions, which, Premack argues, are not by nature imaginable. Thus, if a chimpanzee can solve a problem involving the representation of an action, the animal must be using an abstract code. For example, Premack claims that there is no way "of judging whether or not the relation between . . . *can opener* and *can* is 'the same as' that between *key* and *lock*" without using an abstract code, because there is no way to have an image of *opening* per se, only of individual instances of opening. Premack seems to be overlooking the fact that no single image can represent every member of a category even if the category is based on the static appearance of its items (such as the category "triangle"). What, then, is fundamentally different about the representation of an action? Why not imagine a generic case of "opening" as well as a generic case of "animal" or "triangle"? Similarly, if images of objects can be disambiguated with the addition of "markers" (as Premack proposes in response to Berkeley's classical argument regarding the inherent ambiguity of images), cannot images of actions be disambiguated in the same way?

It seems that one of the implicit assumptions so often made is that images, indeed mental representations in general, are *static*; yet there is good reason to question this assumption. The ability to think in images is usually thought to stem from the ability to perceive (see Shepard 1981). The importance of perceiving the *dynamic* aspects of stimuli has been recognized by many (see, for instance, Gibson 1966; Johansson 1975). It would make sense, then, for images naturally to be dynamic, not static. If this were the case it would be no more difficult to form and use an image of "opening" than of "animal." Premack might argue that the individual examples of an action such as opening are not similar to each other in appearance. This is true if by "appearance" one means something like a static snapshot. However, if one allows for an image that changes over time, one that represents the initial state (closed), the transition states (increasingly less closed), and the final state (open), then the appearances of a can being opened and a door being opened are similar; the physical changes are similar. One might even argue that dynamic images would be useful for representing objects as well as actions, for images that change over time could represent information about possible transformations that an object can undergo.

There is some experimental evidence that the mental representation of movement is an important organizing principle of cognition in humans. For instance, when subjects learn a new set of letterlike forms by watching them being drawn, their ability later to recognize slight distortions of those forms is highly influenced by the consistency of the distortions with the drawing method witnessed, suggesting that even the perception of static forms can be influenced by knowledge of dynamic process (Freyd 1982a). Zimmer (1982) extended those findings with a mental-imagery task in which he compared cases where subjects formed a "dynamic mental image" of a handwritten letter with cases where they formed a "static mental image" (to form a dynamic mental image of a letter, one imagines the letter being drawn). Zimmer found that subjects were better able to answer questions about the visual characteristics of a given handwritten letter in the former case. Thus, by forming an image of an *action*, individuals can improve their ability to describe the appearance of an item. In another set of studies subjects were asked to hold snapshots in memory (Freyd 1982b). They found it harder to reject distractors of the same scene shot later in time than distractors shot earlier in time, suggesting that people represent the motion implicit in a photograph. Similarly, when subjects are shown (with appropriate temporal intervals) a few static examples from an implicit path of motion, they form a related dynamic mental representation without the perception of movement (Freyd & Finke 1982). Moreover, the subjects' representations seem to have an associated momentum, for when subjects are asked to hold the last static example in memory, their memory tends to be distorted in the direction of the motion. These studies suggest that the mental representation of real-world actions can indeed have at least a second-order isomorphism with the actions themselves, in which case it seems that there are problems with Premack's classification of imaginal and abstract codes on the basis of tasks involving the representation of action. [See also R. N. Haber: "The Impending Demise of the Icon" *BBS* 6(1) 1983 (this issue).]

Appendix to "The mental representation of action":

"Freyd 1982a" is now: Freyd, J.J. (1983) "Representing the dynamics of a static form." Memory & Cognition, 11, 342-346.

"Freyd 1982b" is now: Freyd, J.J. (1983) "The mental representation of movement when static stimuli are viewed." Perception & Psychophysics, 33, 575-581.

"Freyd & Finke 1982" is now: Freyd, J.J., & Finke, R.A. (1984) "Representational momentum." Journal of Experimental Psychology: Learning, Memory, and Cognition, 10, 126-132.