

An Alternative Explanation for Premack & Premack

When interpreting the results of experiments that test the cognitive abilities of infants, we must be careful not to attribute to them the cognitive abilities of adults. By merely mapping adult capabilities onto infants, we may provide explanations that, while in line with the understanding of those abilities in adults, do not properly describe the actual cognitive processes that are taking place. Refraining from this path is, of course, difficult to do; as adults, we understand our own cognitive processes well. Certainly, since we are dealing with human infants, we can assume that they will, at some point, develop in a very similar cognitive manner. However, we must constantly be aware that while the end result of human cognitive development is known, we still understand very little about the exact processes that allow an infant to develop cognitively into an adult, nor do we know the state of nor the innate abilities present in an infant mind.

With these cautions in mind, we can comment critically on the paper by Premack & Premack: *Infants Attribute Value± to the Goal-Directed Actions of Self-Propelled Objects*. The conclusions drawn from the experiments testing infant interpretation of simple visual action-reaction events, namely those that attribute to infants the ability to understand intention and goal-directed action, may be overzealous. Premack & Premack postulate that infants' abilities to modify their predictions of the outcome of events based on the intentionality of the objects involved is due to their ability to understand and recognize that intentionality. While this explanation is indeed plausible, it may rely too heavily on the expectation that such abilities will, at some point, develop in these infants.

I propose that, while the results of these experiments are indeed interesting and thought-provoking, they do not prove that such abilities are, in fact, present in these infants. Instead of attributing the results to an infant's ability to understand a high-level concept such as intentionality, we can look to two basic cognitive tools, the recognition of non-transverse events and physical predictability, both of which have been shown to be within an infant's capabilities, to explain the results of the experiments. A model using these basic cognitive tools does not rely on a differentiation between the events that is not physically present, and therefore is more plausible.

Premack & Premack, when analyzing the similarity of the events, do not explore their transversality.

“Structural regularities within a given ... class [of events] can be divided into two classes: transverse and non-transverse. Transverse relations arise when the elements of the model are positioned arbitrarily... non-transverse arrangements require careful positioning, as implied by the term ‘non-accidental.’” (Richards et. al. 1992)

An understanding of the concept of non-transverse features or events, however, is not required to recognize their existence. Infants can distinguish the figure of a triangle from the image of three randomly arranged lines, whose lengths are equal to those of the legs of the triangle. The former is a non-transverse object: The degrees of freedom of a triangle (measured in line angle and positioning) are much less than those of the randomly arranged lines. Once the position and angle of one line is given, the positions and angles of the other two lines are constrained. For the randomly arranged lines, each position and angle is independent of the others.

Given that infants have at least this level of ability distinguishing transverse from non-transverse objects and actions, we can contrast the event of *Caress* with *Hit* in the domain of transversality. To perform *Caress*, the velocity of the gray circle must be heavily constrained, given normal physical assumptions about the physical interaction of the circles. The velocity of the gray circle must therefore be special, whereas the velocity of the gray circle in the *Hit* event is far less special: There exist many velocities that would, according to basic physical rules, cause the same event. *Hit* is therefore a transverse event, while *Caress* is non-transverse.

We may similarly contrast *Help* and *Hinder*. The *Help* event requires the circles to travel at the same speed, in the same direction, touching each other, with the black circle above the gray one. The *Hinder* event merely requires that they appear at the same hole at the same time, for only a moment. *Help* is a non-transverse event; the degrees of freedom of the location, motion, and orientation of the circles, with regard to each other, are heavily constrained. *Hinder* is a transverse event: An infinite number of actions satisfy this event, as long as the given requirement is satisfied.

The value± label that Premack & Premack attribute to an understanding of intentionality can instead be explained by appealing to a basic recognition of non-transverse events (a capacity that infants have been otherwise shown to possess). Intentionality is not invoked in this explanation; actions are merely actions—the distinction between events is merely a recognition that some are special and others aren't. The dishabituation tests fit this explanation well. Since *Hit* is a transverse event, when presented after habituation to a non-transverse event (*Caress* or *Help*), an infant dishabituates, since the events are fundamentally different.

The *Hinder* event represents a visual scene that is entirely predictable based on an understanding of basic physical behavior of objects. Infants, when shown a moving object, expect the object to continue on its course until an external action causes it to stop or change its motion (Spelke 1990). Reexamining the *Hinder* event, we can explain the action of the circles based on a purely physical perspective, that would, using this expected understanding in infants, be entirely in line with the results. With *Hinder*, each circle moves independently. The black circle moves towards the hole in the wall, while the gray circle moves through it and comes to a halt on the other side of the wall. The gray circle, as the black circle is about to move through the hole, moves to block the hole, which (based on basic physical properties, i.e. one object cannot move through another object) causes the black circle to be unable to pass through the hole.

This description of the action in the scene attributes no intentionality to the circles' movements. While it is true that there is a coincidence regarding the simultaneous movement of both circles, on opposite sides of the wall, towards the hole, it is entirely possible to interpret this action as just that: coincidence. There is no need to rely on a higher-level explanation, based on the intentionality of the object, to understand the outcome of this event. Furthermore, it is, from an infant's perspective, an entirely uninteresting event: The actions of the circles are entirely predictable using basic physical beliefs about the world. There should be no reason to expect that this event should cause habituation to events other than those that physically resemble the *Hinder* event. The results of the dishabituation test (which uses a similar physically predictable event whose interpretation can be had without resorting to intentionality) are in line with this interpretation. The infant, already habituated on a physically predictable event involving the same circles, should be similarly habituated to the *Hit* event, since it is similar physically predictable event.

Response

There is no concrete reason why, given the data thus far collected, we should accept the explanation outlined above over the explanation put forth by Premack & Premack. To decide which explanation is actually correct, further experiments must be done. There are specific characteristics of each explanation that can be tested; a (hopefully) clear distinction should arise between these explanations that would allow us to choose the more correct one.

One course of action is to redo the experiments, this time making sure that the *Hinder* event is not physically predictable. This will counter one of the main arguments given above, that the infants' response to the *Hinder* event can be explained merely by its physically predictive nature. A proper *Hinder* event should impart the gray circle with the intentional quality that the *Help* event exhibits, in such a way that there is no possibility to explain the gray circle's actions as purely physical.

Premack & Premack propose one such event:

“We place the black circle in an enclosure containing not one exit but two. The black circle tries unsuccessfully to escape from the first exit, abandons its attempt, and moves in the direction of the second exit. ... The gray circle anticipates the black one and places itself in a blocking position at the second exit well before the black circle arrives.”

In this way, the gray circle, although performing the *Hinder* action, can only be seen as having intentionality. If the infant reacts in a manner similar to the previous results, than the explanation given by Premack & Premack, which claims that infants use value \pm , holds. If, however, the infant now changes his dishabituation, then there must be some other method used to differentiate *Hit* from *Hinder*.

The argument for basic level discrimination of transverse and non-transverse events is more difficult to debunk. Essentially, the experiment must be redone, this time using events that are all of the same level of transversality. Maintaining the current form of *Caress*, we can modify *Hit*, increasing its transversality: To perform the *Hit* action, the gray circle must travel on a marked path, which leads it to the black circle. The infant must be shown that the gray circle cannot perform the *Hit* action on the black circle the gray circle does not follow the marked path. Similarly, if the form of *Help* is maintained, then the *Hinder* event can be modified in such a way that a path must also be followed to properly perform the action. In this way, all of the events now are equally non-transverse.

Making these modifications to the events now allows us to perform the experiments without allowing infants to use the transverse qualities of the actions to distinguish among them. If the results of the modified experiments follow the previous results, than a more complex explanation, on the order of Premack & Premack, must be invoked. If, however, infants now show no particular preference for any event, than they are indeed making use of the basic recognition of non-transverse actions to distinguish the events.

References

- Premack, D. & Premack, A.J. (1997) Infants Attribute Value± to the Goal Directed Actions of Self-Propelled Objects. *Journal of Cognitive Neuroscience*, 9:6, pp. 848-856
- Richards W., Feldman J., Jepson A. (1992) From Features to Perceptual Categories. From D. Hogg & R. Boyle (Eds.), *British Machine Vision Conference*. Springer-Verlag.101-102.
- Spelke, E.S. (1990). Principles of Object Perception. *Cognitive Science*, 14, 29-56.