Dynamical Field Theory Predicts a Developmental Reversal in an A-not-B-like Task

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The A-not-B Error

Since Jean Piaget's observations of the A-not-B error in his own children, a great deal of scientific effort has been applied to understanding how the error occurs and how children overcome it. The error occurs when a young infant (around 10 months) watches a toy being hidden and then reaches for it. First the child retrieves the toy, hidden a few times at a location A. Then, when the toy is hidden at a new location B and the child must wait a few seconds before retrieving it, she will reliably *perseverate*, reaching to the old location for the toy (often with great frustration.) By about 14 months, infants no longer perseverate in this task.

Dynamical Field Theory And A-not-B

Dynamical Field Theory has been a source of many validated predictions of infant behavior in the A-not-B task (Thelen et al., 2001). These have included manipulations of age, number of practice trials, delays, spacing between target locations, and distinctiveness of hiding boxes. Field theory's lack of dependence on the object concept in conceptualizing the A-not-B error has led to demonstrations that the same patterns of behavior are evident even without a hidden toy, using only light-up buttons for example.

The field model accounts for the dynamics of the A-not-B task by postulating a nonlinearly interactive activation field isometric to the space in front of the infant (Erlhagen & Schöner, 2002). This field, with local excitation and distal inhibition, builds up activation into a peak that indicates where the baby will reach. It is driven by perceptual inputs as well as bias from motor memory of past reaches. Young infants differ from old in that they are less able to maintain a stable reach decision (a peak in the activation field) in the absence of a cue. Therefore, after a short delay, they forget the cue at B and reach to A because of motor memory from practice trials.

A New Task

The A-not-B task does not exhaust the dynamical possibilities that the field model is equipped to handle. Specifically, the A-not-B task does not lead to inhibitory competition between multiple peaks in the activation field. (The competition between a peak in activation and a peak in motor memory is of a different sort with different dynamics.)

A new task we are exploring consists of a cue at A, followed by a delay during which there is a "distractor" cue at B before the baby's turn to reach. We manipulate the duration and timing of the distractor within the delay, as well as the number of training A-trials before this test.

Predictions

Computer simulations of the model allow testing how changes in experimental conditions will affect behavior. More training trials lead to more perseveration to A. A longer distractor more effectively draws the infant to B. A later distractor is more effective because it occurs closer to when the infant may reach.

More striking predictions derive from the differing dynamics of the older versus younger infants. Since young infants cannot maintain a reach decision over a delay, a distractor that is too early is not effective, even if it is long. By the end of the delay, they forget B and are dominated by motor memory at A. Older infants do maintain stable decisions, so a distractor must compete against the cued, stable peak at A. Thus, for older infants, duration is crucial. In the case of a late, short distractor, old infants perseverate more than young—a reversal of the classical A-not-B effect. As illustrated in Figure 1, each condition follows a different dynamical "story," even if the resulting reach is the same.

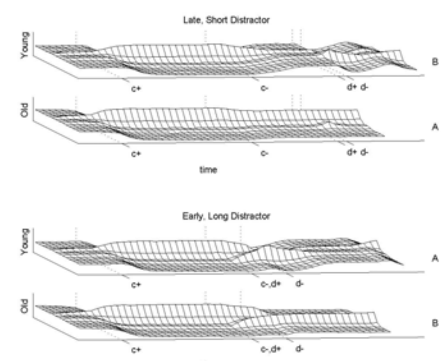

Figure 1: Simulations of four conditions. The first test-trial after 3 A-trials. (c+/c- is cue at A. d+/d- is distractor at B.)

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