isting dynamical model (Schöner et al. 1997) to account for the processes related to the generation of motor output observed under the A-not-B paradigm.

This is not to say that the authors did not achieve success in the problem they considered: accounting for contextual variations in A-not-B outcomes during the age 7–12 months period. Indeed, they provided a quantitative framing of this problem that (1) reorganizes the range of A-not-B results; (2) holds the promise of making predictions of future experimental outcomes; and (3) is cast in a formal language where both the dynamics of mental life and observable behavior can be viewed in the same quantitative framework. The first and second achievements are tenets of good science, in general. The third is an achievement of a science where investigators consider that their subjects have minds, as well as bodies.

Is the concept of object a static construct? The second point of our commentary on Thelen et al.'s portrayal of the Piagetian concept of object is that it appears to have been misrepresented as a static mental structure. It is more reasonable to think of the object concept as representing a global variable that is subject to modulation by a number of sources of input. In Piaget's framework the development of object concept evolves over time through the integration and modification (e.g., assimilation, accommodation) of information coming from the interaction of the infant with the environment. This may also include information from multiple sources of sensory input from the environment, information that is a consequence of the infant's actions, and information available from past experience. In other words, the concept of object arises from the input of multiple, dynamically interacting sources of information. Therefore, we can conclude that Piaget's thinking on the concept of object, if not his general theoretical stance (e.g., see Fig. 11 in Varela 1989), was closer in spirit to the Thelen et al. framework than Thelen et al. have led readers to believe. Although Thelen et al. expressed their point of view with the help of sophisticated quantitative tools, when the Piaget and Thelen et al. approaches are considered together under a broadened view, we can see that the two approaches have common features.

Conclusion. Although there is no question that the Thelen et al. model works to account for the contextual variations in the data observed during ages 7 to12 months, these authors addressed phenomena that occur over a shorter-time scale than that in which Piaget and other developmentalists had interest. The model presented in the target article deals with shorter-term, trial-by-trial predictions. On the other hand, the concept of object is most clearly evidenced by the transition seen when a longer course of development is considered. As a result of the mismatch between the time scale of analysis that Thelen et al. were concerned with, and the time scale that was relevant for an understanding of object concept development, the challenge made by Thelen et al. to the concept of object seems misplaced. We conclude that when the concept of object is considered over the relevant developmental time scale, it, first, retains its usefulness for discussions on development, and, second, is not a static construct but instead evolves through the input from various dynamically interacting information sources.

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There may not be an A-not-B error

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Abstract: In the A-not-B situation children reach toward location A when the object is at location B. Researchers interpret this as an error. I question this interpretation. Reaches are inaccurate only if the intention actually is to obtain the hidden object. If this is not the goal, then reaching for A may be accurate and there may be no error to be explained.

In the A-not-B situation the youngest children do not reach for hidden objects. Between 7 and 12 months of age, children often reach toward A when the object is hidden at B. Finally, older children reach for the hidden object, regardless of its location. Piaget interpreted the first two actions as errors, and the third action as correct. As reviewed by Thelen et al. (2001, sect. 2.1), subsequent accounts of the A-not-B situation also interpret the child's behavior in the second stage as an error. Piaget did not test this interpretation, and his successors do not appear to have done so either. But reaching toward A (when the object is at B) is incorrect only if the child actually intends to reach toward B.

It is risky to assume that we know the goals of prelinguistic children. It is particularly risky to assume that a 9-month-old has the same goals as the experimenter. This may be an example of the psychologist's fallacy (James 1890/1950): the inappropriate assumption that the experimenter's view of the situation is the same as that of the subject. Consider mealtime. At any age, some food may fall to the floor. Adults always consider this to be an error, but children may not. When the child first learns to put food in his or her mouth the skill is poorly developed and food is dropped due to lack of skill; an error. In the mature child (as in the adult), food reaches the floor only by accident. However, in an intermediate stage (at roughly two years of age) the child sometimes intends that the food land on the floor. Adults consider this to be an error but the child regards it as a resounding success. To be sure, there is a developmental change in the child's ability to move food by hand. However, there is also a developmental change in the child's goals (these goal changes are reflected in the fact that we sometimes refer to the food as being dropped, and at other times as being thrown). Researchers appear not to have considered the possibility that a sequential change of goals may occur in the A-not-B situation.

Thelen et al. have sometimes characterized the pattern of reaching as "perseverative," rather than as an error. However, this does not resolve the issue. The model offered by Thelen et al. predicts a divergence between intention (goal) and action (outcome). For all intents and purposes, this is an error, as is shown by the fact that in section 2.1 Thelen et al. have contrasted "perseverative reaching" with "accurate performance."

Perhaps over the course of development children do not make mistakes in the A-not-B situation. Instead, developmental changes in reaching might be produced by developmental changes in the child's goals. Six-month-old children may not want to retrieve the hidden object; maybe they are interested only in having things that they can see. If so, then not reaching is correct at this stage. Between ages 7 and 12 months, perhaps children do not want to retrieve the hidden object at B but do want to reach to A (I don't know why a child might want to do this, but that does not invalidate the point: As any parent knows, a child's goals often differ from the parent's goals, and it is often difficult to understand why children want what they want). If so, then reaching to A would be correct, or accurate, and the model of Thelen et al. would not apply. It is certainly the case that children's behavioral goals change as they develop, and these different goals lead to reliable differences in behavior. The question, then, is whether there might be a regular progression in children's goals that could produce the developmental pattern of reaching reported by Piaget.

Students of the A-not-B situation (including Thelen et al.) offer

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no evidence that reaching is incorrect in the ordinary sense of being incompatible with the child's goals or intentions. Evidence might be sought in children's affect, and in their actions. For affect we might determine whether children act as though reaches to A are unsuccessful. Do they appear to be unhappy; do they fuss, or cry? Reactions of this type might be expected if children were attempting to recover the hidden object, especially given the frustration that could build up over a series of failures. If children are not disappointed, perhaps it is because they have not made any mistakes. Separately, behavioral evidence might be sought by examining reach trajectories. A child who begins to reach toward the wrong location may notice this and correct the trajectory online. Sasaki et al. (1995) have documented this with adults in ordinary situations, such as making coffee. A person who wants to add sugar may, by mistake, begin reaching toward the milk, then correct the error in mid-reach so as to arrive at the desired target. Similar corrections occur in infants (Sasaki et al. 1998). If the child intends to reach B, then on some reaches we might expect to see trajectory changes; an initial movement toward A followed by a correction and final arrival at B. A-not-B researchers do not appear to have examined the possibility of mid-course corrections.

Rather than creating models to explain assumed errors in the A-not-B situation, researchers might determine whether the reaching actually diverges from the child's intentions – that is, whether there is any error that needs to be explained. If reaching is accurate, then the phenomenon that needs to be explained is not the child's struggle to generate actions that match his or her intentions but, rather, changes in the child's goals or intentions as a function of development. In this latter case the model of Thelen et al., whatever its virtues, could not be correct because it would be attempting to explain the wrong thing.

Editors' Note: There is no Authors' Response to this commentary.

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Commentary on **Daniel S. Ruchkin, Jordan Grafman, Katherine Cameron, & Rita S. Berndt (2003). Working memory retention systems: A state of activated long-term memory. BBS 26(6):709–777.**

Abstract of the original article: High temporal resolution event-related potential and electroencephalographic coherence studies of the neural substrate of short-term storage in working memory indicate that the sustained coactivation of both prefrontal cortex and the posterior cortical systems that participate in the initial perception and comprehension of the retained information are involved in its storage. These studies further show that short-term storage mechanisms involve an increase in neural synchrony between prefrontal cortex and posterior cortex and the enhanced activation of long-term memory representations of material held in short-term memory. This activation begins during the encoding/comprehension phase and evidently is prolonged into the retention phase by attentional drive from prefrontal cortex control systems. A parsimonious interpretation of these findings is that the long-term memory systems associated with the posterior cortical processors provide the necessary representational basis for working memory, with the property of short-term memory decay being primarily due to the posterior system. In this view, there is no reason to posit specialized neural systems whose functions are limited to those of short-term memory buffers. Prefrontal cortex provides the attentional pointer system for maintaining activation in the appropriate posterior processing systems. Short-term memory capacity and phenomena such as displacement of information in short-term memory are determined by limitations in the number of pointers that can be sustained by the prefrontal controls system.

Hidden operators of mental attention applying on LTM give the illusion of a separate working memory

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Abstract: The authors' results support a functionalist conception of working memory: a manifold repertoire of schemes/schemas (long-term memory) and a small set of general-purpose "hidden operators." Using some of these operators I define mental (i.e., endogenous) attention. Then, analyzing two of the authors' unexplained important findings, I illustrate the mental-attention model's explanatory power. Multivariate methodology that varies developmental, task differences, and individual differences is recommended.

Ruchkin, Grafman, Cameron, & Berndt (Ruchkin et al. 2003) have made a very important contribution by showing that the activity and coherence dynamics in their results contradict conceptions of separate working memory (WM). Their data support a radically distinct, *deconstructed, decentralized, and functionalist* (what the authors call, on p. 711 of the target article, sect. 1.4, an "activation-proceduralist") conception of WM and cortical information processing. "Decentralized" describes an organization in which information does not move from one memory store to another but is mediated/carried by distinct collections of neurons, often distributed over the brain, that are cofunctional (vis-à-vis certain activities) and coactivated in some tasks. These semantic-pragmatically functional collections I call *schemes* or *schemas* (Pascual-Leone 1995; Pascual-Leone & Johnson 1991; 2004; Pascual-Leone et al. 2000). Schemes can be distinctly demarcated as causal determinants that *overdetermine* manifest performance, facilitating process and task analysis. Schemes overdetermine per-

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