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Comment on "Infants' Perseverative Search Errors Are Induced by Pragmatic Misinterpretation"

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Topál *et al.* (Reports, 26 September 2008, p. 1831) proposed that infants' perseverative search errors can be explained by ostensive cues from the experimenter. We use the dynamic field theory to test the proposal that infants encode locations more weakly when social cues are present. Quantitative simulations show that this account explains infants' performance without recourse to the theory of natural pedagogy.

In the past decade, there has been a proliferation of studies examining human infants' early understanding of social pragmatic communication (*1*–*4*). Topál *et al.* (*5*) extended this approach to the study of infants' early cognitive abilities using the Piagetian A-not-B paradigm (*6*). They showed that the presence or absence of ostensive communicative cues from the experimenter has a dramatic impact on infants' search errors: Without social cues, 10-month-old infants perseverate on 41% of the B trials; with social cues, they perseverate on 81% of the B trials. Topál *et al.* used the theory of natural pedagogy (*7*, *8*) to suggest that infants engage in a pragmatic misinterpretation in the A-not-B situation. In the presence of ostensive referential cues, infants form an interpretive bias on the A trials that "these types of A things go here." This leads them to misinterpret the social context on the B trials, and they reach back to A even when the toy is hidden at B.

In our view, the account Topál *et al.* (*5*) offer is limited in a fundamental respect: It does not connect social pragmatic interpretation to what is known about the role of perception, attention, working memory, action, and their underlying neural processes in the Piagetian A-not-B task. As such, this account cannot explain performance across the wide variety of versions of this task that parametrically manipulate task factors and affect these basic cognitive processes (*9*–*11*).

One theory that does connect with a process-based and neurally grounded perspective is the dynamic field theory (DFT). In a series of papers, Smith, Thelen, and colleagues (*10*, *11*) have shown that the DFT explains infants' performance in a host of studies on the A-not-B error. This theory offers a unified account of effects of cue salience, working memory development, and the dynamics of infants' moment-to-moment behavior in the A-not-B task. Although Topál *et al.* (*5*) cite this body of work, there appears to be a tension between the abstract and social nature of their account and the low-level mechanisms in the DFT. Thus, a fundamental question is "Can the influence of social cues be accounted for and mediated by low-level mechanisms?"

Figure 1 shows that the answer is "yes." We took parameters and simulation details from the dynamic field model used by Clearfield *et al.* (*9*) that predicted cue-salience effects, implemented the Topál *et al.* (*5*) procedure, and then varied the strength of the cuing input across conditions (from a value of 4 with the ostensive cues present to a value of 7 in the noncommunicative condition and 8 in the nonsocial condition) (see Fig. 1). Our hypothesis was that infants encode the location of the hiding event relatively weakly when richly structured social cues are present. This hypothesis is consistent with findings from Yoon *et al.* (*12*), who reported that infants encoded and remembered an object's position in the context of a socially unresponsive adult but failed to remember the object's position and instead encoded its features in response to a socially engaging adult. The left side of Fig. 1 shows data from Topál *et al.* across two indices of performance (top and bottom panels). The right side of this figure shows quantitative simulations of the DFT. The theory captures the details of infants' performance quite well. This is striking given that the parameters of the model were taken from another study with little modification.

The details of our parameter changes were as follows. Because Topál *et al.* (*5*) studied 10-month-olds and Clearfield *et al.* (*9*) modeled the behavior of 8-month-olds, we increased the neuronal resting level from –12 to –9 [consistent with past simulations; see (*11*)]. Next, we increased the strength of the task input from 2 to 6, because Topál *et al.* used distinctive hiding locations (buckets). Finally, we used a variable resting level: $h_{rest} + \eta$, $\eta \sim N(0,1)$. This helped capture the large variability across infants. Note that results were comparable with a fixed resting level, but the quantitative fits across conditions were not as good.

In summary, an existing formal theory of infant perseverative reaching—the DFT—can explain the pattern of results from Topál *et al.* (*5*) without recourse to the theory of natural pedagogy. Critically, this does not mean that social cues are irrelevant in the A-not-B situation. Rather, our work takes an important step toward grounding social cues in the real-time processes of perception, attention, working memory, and action (*13*, *14*). Certainly more work must be done to specify precisely how social cues affect infant cognition

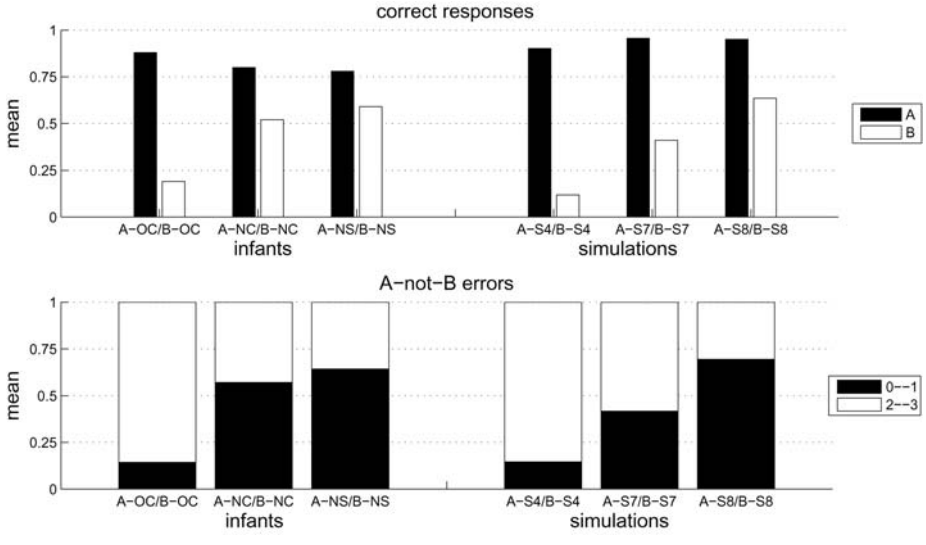

Fig. 1. Comparison between infants' performance from Topál *et al.* (*5*) (left) with simulations of the DFT (right). Infant conditions: A-OC/B-OC, ostensive-communicative; A-NC/B-NC, noncommunicative; A-NS/B-NS, nonsocial. Simulation conditions defined by stimulus strength: S4, weak cue; S7, strong cue; S8, strongest cue. (**Top**) Mean percent correct on the A and B trials. (**Bottom**) Percentage of infants/simulations making 0 to 1 or 2 to 3 errors on the B trials.

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(e.g., Is social communication in the A-not-B task distracting? Does it divert attention or gaze away from the object's location?). Moreover, it will be important to specify how the type of lower-level mechanisms captured by DFT lead to socially sophisticated abilities later in development.

Although our simulations might render the results of Topál *et al*. (*5*) less newsworthy—infants encode locations more weakly when they are engaged in richly structured social interactions—there are two important lessons. First, new alternative theoretical accounts should be held at bay until a specific question is answered: Can existing theories account for the new results? Second, it is important to move away from experiment-specific theories of how infants might be interpreting the world in favor of unified accounts based on known neural and behavioral processes. The DFT offers such an account, and the results reported here suggest this theory can provide a useful bridge from basic cognitive processes to social communication in context.

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