Science AAAS

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

József Topál, *et al.*

Science **325**, 1624 (2009);
DOI: 10.1126/science.1173024

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

József Topál,[1]* Mária Tóth,[2] György Gergely,[2] Gergely Csibra[2]

Spencer *et al*. argue that infants' perseverative search errors cannot be ascribed to an interpretive bias induced by communicative cues as we proposed. We argue that their model leads to different predictions about infant behavior from those derived from natural pedagogy in certain situations and therefore fails to provide a viable alternative to ours.

The central thesis of Spencer *et al*.'s comment (*1*) is that infants' perseverative search bias in the A-not-B error task cannot be ascribed to an interpretive bias induced by communicative cues as we suggested (*2*). Instead, they propose that, if we assume that the social-communicative cues that are usually embedded in the task act as distracting stimuli that reduce the salience of the hiding location, the dynamic field theory (DFT) (*3*) provides a simpler explanation for infants' behavior. Although they claim to have reproduced our results in a formal simulation that applied this assumption, we argue on several grounds that the DFT account fails to provide a viable alternative to ours.

Communicative signals are ubiquitously employed by parents and developmental psychologists to direct infants' attention to objects of joint reference in triadic interactions (*4*). It would be baffling if these naturally and spontaneously employed communicative strategies normally resulted in the net reduction of "cue salience" of the indicated object, precisely the opposite effect of what the adults intend to achieve. On the contrary, numerous studies have shown that ostensive referential communication can facilitate learning about objects (*5*). It has also been demonstrated that a social-communicative context shifts infants' attention toward, and leads to better encoding of, the object's permanent features, such as its shape, at the expense of processing its transient features, such as its current location (*6*). It is this characteristic of the attention-modulating effect of communicative signals that predicted the reduction of perseverative bias as a function of the omission of communicative cues in the A-not-B task.

One could then argue that, by considering ostensive signals as distractors, Spencer *et al*.'s DFT simulation (*1*) successfully implemented the reduced attention to location information in response to the experimenter's communicative signals in the A-not-B task. However, because the DFT account considers cue saliency as a short-term factor in determining infants' responses, in certain situations it leads to different predictions from those derived from natural pedagogy. In particular, if ostensive communication is used during the A trials but not during the B trials, the DFT should predict less perseveration because communicative cues would not distract infants' attention from the object during the B trials. In contrast, the natural pedagogy account (*7*) predicts as much (if not more) perseveration in this situation as in the fully ostensive version because it derives the perseverative bias from infants' misinterpretation of the demonstrations during the A trials.

We tested these predictions on the DFT model of the task and with 16 10-month-old infants. As Fig. 1 indicates, we could not find any reduction in infants' tendency to reach back to the empty (A) location in the B trials, compared with our original results in the fully communicative task. On the contrary, infants showed somewhat fewer correct responses (14.4% versus 18.9%) in this new version of the task. This result gives further evidence for the proposal that infants' reaching back to the empty location in the B trials is a function of the type of context in which the A trials are presented. However, the DFT model behaved differently. Applying the stimulus strength parameters that Spencer *et al*. found to reproduce our earlier results, the model in the simulated ostensive-A/nonostensive-B condition ended up performing more similarly to the noncommunicative (NC) than to the ostensive communicative (OC) condition (31% versus 42% and 12%) (see Fig. 1). It is evident from the figure that the DFT simulation did not capture infants' performance in this situation.

Thus, we do not see any reason to accept that the DFT explains infants' performance in these versions of the task better than the theory that we advanced in (*2*). Nevertheless, we agree with Spencer *et al*. (*1*) in that all factors affecting performance, including the effects of social signals, should be grounded in real-time processes of memory, perception, attention, and action. However, not any model that implements these processes will do. We do not believe, for example, that it is justified to represent social interactions as attention-distracting factors in such models or that long-term memory of locations is primarily influenced by motor actions toward those locations. Thus, we persist in our view that the seemingly mistaken response called A-not-B error in infants is not (or at least not only) due to immature attentional and cognitive functioning but, paradoxically, may be indicative of the early emerging sophisticated social competence in our species that involves preparedness for learning from others through communication (*7*, *8*).

[1]Research Institute for Psychology, Hungarian Academy of Sciences, Budapest H-1132, Hungary. [2]Central European University, Budapest H-1051, Hungary.

*To whom correspondence should be addressed. E-mail: topaljozsef@gmail.com

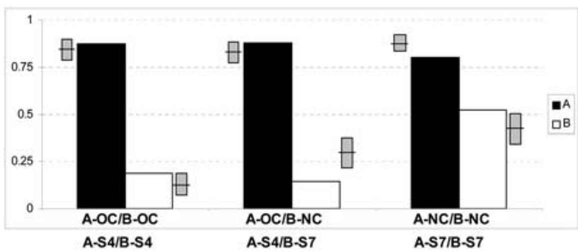

Fig. 1. Comparison between 10-month-old infants' performance (black and white columns) and simulations of the DFT (gray box plots) in three contexts/parameter settings. Infants' behavior in the condition in which object hidings in the A trials were complemented with ostensive communicative cues, while the B trials were demonstrated in a noncommunicative context (A-OC/B-NC, middle), was more similar to the fully ostensive condition (OC, left) than to the noncommunicative condition [NC, right; data from (*2*)]. The simulations in all three conditions were performed by the code provided by J. Spencer and E. Dineva. We ran 25 times 100 runs with each parameter setting. Box plots indicate the whole range of values (minimum to maximum) of the 25 simulations. The horizontal lines indicate average performance values.

References and Notes

1. J. P. Spencer, E. Dineva, L. B. Smith, *Science* **325**, 1624 (2009); www.sciencemag.org/cgi/content/full/325/5948/1624-a.
2. J. Topál, G. Gergely, Á. Miklósi, Á. Erdőhegyi, G. Csibra, *Science* **321**, 1831 (2008).
3. L. B. Smith, E. Thelen, R. Titzer, D. McLin, *Psychol. Rev.* **106**, 235 (1999).
4. R. Bakeman, L. B. Adamson, *Child Dev.* **55**, 1278 (1984).
5. L. J. Moses, D. A. Baldwin, J. G. Rosicky, G. Tidball, *Child Dev.* **72**, 718 (2001).
6. J. M. D. Yoon, M. H. Johnson, G. Csibra, *Proc. Natl. Acad. Sci. U.S.A.* **105**, 13690 (2008).
7. G. Csibra, G. Gergely, *Trends Cogn. Sci.* **13**, 148 (2009).
8. J. Topál, G. Gergely, Á. Erdőhegyi, G. Csibra, Á. Miklósi, *Science* **325**, 1269 (2009).
9. This work was funded by the Országos Tudományos Kutatási Alap (grant K76043) and the Bolyai Foundation of the Hungarian Academy of Sciences. We thank J. Spencer and E. Dineva for providing us with their code.

24 March 2009; accepted 1 September 2009
10.1126/science.1173024