Toward a general model of perseveration in infancy

Renée Baillargeon and Andréa Aguiar

University of Illinois

One major strength of Dr. Munakata's account of infants' perseverative search errors lies in its approach. The field of infant cognition has progressed to the point where detailed descriptions of how infants form and use representations have become essential to fully explain the complex patterns of successes and failures that are observed across tasks and across ages. The days are rapidly disappearing in which researchers simply asked yes/no questions about infants' abilities ('Can infants succeed at x?'). More and more, investigators are attempting to specify in their accounts of infants' responses exactly what information is being represented and how this information is being manipulated (e.g., Needham, in press; Wilcox & Baillargeon, in press; Wynn, 1992; Xu & Carey, 1996). Dr. Munakata's research stands at the forefront of this important development in our field: her model seeks to provide a rigorous description of the information infants represent in repeated search trials, of the processes responsible for changes within these representations over trials, and of the ultimate consequences of these changes for infants' responses.

Despite the timeliness and rigor of its approach, Dr. Munakata's model does give rise to a few concerns. One particular concern has to do with the general applicability of the model. Dr. Munakata begins her article with two broad questions: 'Why do infants perseverate, and what do their perseverative errors reveal about their representations of the world?' (p. 3). Unfortunately, it is not entirely clear at the close of the article whether a 'unifying framework for understanding perseveration' (p. 33) has indeed been achieved. Dr. Munakata's model focuses primarily on the effects of delay on infants' perseverative search errors. Like adults, however, infants perseverate in a wide variety of tasks, many of which do not require infants to remember information about objects (e.g., Aguiar & Baillargeon, in press; Lockman & Pick, 1984; Matthews, 1993; McKenzie & Bigelow, 1986; Rieser *et al.*, 1982).

To illustrate, we have recently obtained evidence of perseveration in two series of tasks (Aguiar & Baillargeon, in press). In one, infants saw two adjacent cloths; one cloth had a toy on its far end, and the other cloth was folded in half and had an identical toy positioned behind it. Following a set of identical trials, infants received a novel trial in which the two cloths' locations were reversed. Results revealed that 11-month-olds tended to pull the correct cloth on the novel trial, but that 9-month-olds did not: they tended to perseverate, pulling the cloth they had pulled on the identical trials. These errors declined, however, when infants were shown at the start of each trial that the toy on the cloth was attached to it. Infants presumably found it easier to reason about the toy and cloth when they formed one as opposed to two objects. Further results indicated that, unlike 9-month-olds, 6.5-month-olds perseverated even when tested with the toy attached to the cloth.

The other series of tasks made use of a visual-attention rather than an object-manipulation paradigm and involved containment events. Infants first saw a familiarization event in which a large ball attached to the lower end of a rod was held above a shallow, very large container. Next, the container was hidden by a screen, and the ball was lowered behind the screen into the container. The screen was then removed to reveal the ball resting inside the container. Following the familiarization trials, infants saw a possible and an impossible test event. In these events, the shallow, very large container was replaced with a tall container that was about as wide (possible event) or only half as wide (impossible event) as the ball. At the end of both test events, the screen was removed to reveal the ball's rod protruding above the container. Results indicated that 8.5-month-olds looked reliably longer at the impossible than at the possible event, whereas 6.5-month-olds tended to look equally at the events. These younger infants did show a reliable preference for the impossible event, however, when (a) the shallow container was absent in the familiarization trials or (b) the back and bottom portions of the shallow container were removed so that only its front remained, forming a rounded occluder. These results suggested that the 6.5-month-olds in the initial task were perseverating in their reasoning: they brought forth the same containment

Address for correspondence: Renée Baillargeon, Department of Psychology, University of Illinois, 603 E. Daniel Street, Champaign, IL 61820, USA. email: rbailler@s.psych.uiuc.edu

expectation from familiarization to test ('the ball will go in the container'), and hence failed to detect the violation in the impossible event. Infants succeeded only when no such expectation was available, either because no container was used during familiarization or because infants were initially shown an occlusion rather than a containment event. In additional experiments, a similar developmental pattern was observed with 9.5- and 8.5-month-olds when the ball was replaced with a more complex object, an upside-down 'T'.

We believe that these findings, together with the evidence reported by Dr. Munakata, are best explained by the following problem solving model of perseveration. Our model makes two assumptions. The *first* is that how infants respond when given a novel problem following a series of identical problems crucially depends on how infants categorize the novel problem. If infants view the problem as a different type of problem than was shown before, they analyze it further and compute its solution (recall, for example, that infants respond correctly in Dr. Munakata's research when toy occlusion is first introduced in the *B* trial,[1] or in our own research when containment first occurs in the test trials). If infants judge the problem to be the same type of problem as before, they simply retrieve the familiar solution (recall, for example, that infants perseverate in our support task even though the two cloths and toys are visible). Finally, if infants judge that the novel problem is of the same type as before but presents a changed feature that calls for a new solution, they attempt to modify the familiar solution in line with the changed feature. If infants have difficulty retaining the information about the problem's changed feature, however, they are likely to perseverate (recall, for example, that infants respond correctly with shorter but not longer delays in the standard A$\overline{\text{B}}$ task). Dr. Munakata's hypothesis about competition between latent and active memory traces provides an elegant and precise mechanism for the perseveration that can occur when infants encounter distinct versions of a similar problem.

The *second* assumption of our model is that, as infants become skilled at reasoning about a type of problem, they become less likely to perseverate, for two reasons. One is that infants' encoding of the problem becomes deeper and more complete, with the result that they are more likely to notice changes (recall, for example, that 8.5-month-olds compare the width of the ball to that of the test containers even after receiving familiarization trials involving the shallow container). The other reason is that, as suggested by Dr. Munakata, infants become better at keeping active information about changed features among distinct versions of a same type of problem (recall that infants tolerate longer delays in the standard AB task with age).

The problem solving model just outlined attempts to account for a wide range of perseverative errors observed at different ages in different tasks. It should perhaps be emphasized, in light of some of Dr. Munakata's comments, that this model (a) assumes that perseveration can occur in both visual-attention and object-manipulation tasks; (b) attempts to explain both infants' successes and failures; (c) focuses on what information is represented across trials; and finally (d) attributes changes in infants' responses over time, not to the acquisition of all-or-none knowledge principles, but rather to subtle, incremental changes with learning and experience in the completeness and sophistication of infants' problem representations.

[1] Infants presumably perseverate in the toy-cover task used by Dr. Munakata because they fail to notice that no toy has been hidden on the *B* trial. It seems plausible that infants would be more likely to notice the introduction of a novel object (cover-toy-task), as opposed to the absence of a familiar object (toy-cover task).

References

Aguiar, A., & Baillargeon, R. (in press). Problem solving and perseveration in infancy. To appear in H. Reese (Ed.), *Advances in Child Development and Behavior*, Vol. **28**. New York: Academic Press.

Lockman, J. J., & Pick, H. L. (1984). Problems of scale in spatial development. In C. Sophian (Ed.), *Origins of cognitive skills* (pp. 3–26). Hillsdale, NJ: Erlbaum.

Matthews, A. (1993, March). *Infants' performance on* A$\overline{\text{B}}$*: Memory, means-end, or prefrontal cortex?* Paper presented at the biennial meeting of the Society for Research in Child Development, New Orleans, LA.

McKenzie, B. E., & Bigelow, E. (1986). Detour behavior in young human infants. *British Journal of Developmental Psychology*, **4**, 139–148.

Needham, A. (in press). Infants' use of prior experiences in object segregation. To appear in H. Reese (Ed.), *Advances in Child Development and Behavior*, Vol. **28**. New York: Academic Press.

Rieser, J. J., Doxsey, P. A., McCarrell, N. S., & Brooks, P. H. (1982). Wayfinding and toddlers use of information from an aerial view of a maze. *Developmental Psychology*, **18**, 714–720.

Wilcox, T., & Baillargeon, R. (1997). Object individuation in infancy: The use of featural information in reasoning about occlusion events. *Cognitive Psychology*, in press.

Wynn, K. (1992). Evidence against empiricist accounts of the origins of numerical knowledge. *Mind & Language*, **7**, 315–322.

Xu, F., & Carey, S. (1996). Infants' metaphysics: The case of numerical identity. *Cognitive Psychology*, **30**, 111–153.