Table 1. Distribution of responses across the four gestures shown to the infants. The figures in the first four rows are from figure 2 of (*1*). The remaining figures were obtained from A. N. Meltzoff. The italicized entries indicate matching responses. Abbreviations: LP, lip protrusion; MO, mouth opening; TP, tongue protrusion; and SFM, sequential finger movement.

Scored responses	Gestures shown to infants			
	LP	MO	TP	SFM
Lip protrusion	*27*	17	15	19
Mouth opening	11	*24*	17	19
Tongue protrusion	21	20	*30*	26
Sequential finger movements	14	13	16	*27*
Hand opening	22	24	28	24
Finger protrusion	18	19	10	8
Passive hand	18	16	18	13

shown in Table 1. It can be seen in the table that responses by the infants matching the model were more likely than some responses but not more likely than other responses. For instance, when sequential finger movement was modeled, the incidence of sequential finger movement responses (27) was clearly higher than the incidence of finger protrusion responses (8), but it was virtually the same as the incidence of tongue protrusions (26) and hand opening (24) responses. Whether one concludes that the infants did or did not imitate would then depend on an arbitrary selection of a comparison base. It can thus be concluded that when the data are properly analyzed, little evidence remains that neonates can imitate specific movements.

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References and Notes

1. A. N. Meltzoff and M. K. Moore, *Science* **198**, 75 (1977).
2. I am grateful to Dr. A. N. Meltzoff for providing part of the information in Table 1. The helpful comments of E. Anisfeld and A. C. Goldstein are gratefully acknowledged.

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In their report on the imitation of facial and manual gestures by human neonates, Meltzoff and Moore (*1*) hypothesized an active cognitive process involving cognitive representation and motor matching. Methodological problems, including the selection of target neonatal behaviors, the scoring and definition of "imitative" behavior plus a current absence of convergent evidence for the cognitive sophistication of newborns, allow the questioning of this conclusion.

In experiment 1, four discrete but not unrelated behaviors were modeled: lip protrusion, mouth opening, tongue protusion, and sequential finger movement. These behaviors all participate in early feeding and clinging reflex systems. Six judges (for whom no rater reliability was presented) scored videotapes of neonatal reactions to each modeled behavior, ranking the four possible behaviors according to the likelihood that they had occurred. For analysis, the top two ranked behaviors were each scored "yes" and the bottom two "no." This is problematic for a number of reasons. First, a "yes" judgment for imitation could occur when the actual imitative act was not the one a judge thought had occurred but rather the one thought to be second most likely. No information was given regarding the degree of "error" in judgments of imitation (judgments that the behavior matching the model was second most likely to have occurred). Moreover, collapsing these ranks set the chance or guessing probability that a given behavior would be scored as imitative equal to .50. Even though statistical analyses revealed significant differences between the frequency of "yes" judgments for the behavior matching the modeled one and that for the other behaviors, there is no indication that the frequency of "yes" judgments for the matching behavior significantly exceeded the guessing probability. A final problem of this scoring system is that it blurred the distinction between the behavior categories: If different oral behaviors (for example, lip pursing and tongue protrusion) were often confused so that raters ranked them 1 or 2 with equal frequency (both of which would produce a "yes' categorization), arguments that a broad spectrum of distinct behaviors had been imitated would not be tenable. Such reasoning is important to support any conclusion that neonatal matching behavior was guided by a general cognitive process.

Further problems relate to the single nonoral behavior included in experiment 1, sequential finger movements. This specific label implies that manual actions commonly labeled differently, such as grasping, were not appropriately descriptive of the act. It is important for this to be the case, since one ground for rejection of a releasing-mechanism interpretation would be that the behavior in question is not one that has already been shown to occur in reflex fashion or to participate in fixed-action patterns. Lacking is a discriminant analysis of the degree to which typical infant grasping behavior was identified by the raters as an example of "imitation" or whether the unique serial ordering of finger movements was present. This sort of discriminant validity seems unlikely to be achieved when rater variability was such that the two top and bottom probability rankings for possible responses had to be combined.

Experiment 2 is less methodologically flawed than experiment 1, but it adds little to the conclusion that complex representation processes are involved in early matching behavior. Only two behaviors were studied (tongue protrusion and mouth opening), both were oral, and thus were drawn from a repertoire of socially elicited neonatal feeding responses.

Although the several theoretical explanations proposed by Meltzoff and Moore for the apparent matching behavior of infants are still viable, their conclusion that complex cognitive processes guided imitative responding was premature in the face of methodological limitations and a general absence, at the moment, of evidence indicating that neonates are capable of the requisite representational processes. At least as sensible is a conclusion that the neonatal behaviors studied were relatively fixed-action patterns that are isomorphic in form to the visual stimuli eliciting or releasing them.

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References

1. A. N. Meltzoff and M. K. Moore, *Science* **198**, 75 (1977).

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Meltzoff and Moore (*1*) have recently reported that infants between 12 and 21 days of age imitate tongue protrusion, lip protrusion, mouth opening, and sequential finger movements in response to an adult's performance of similar acts. Our research was stimulated by the prior work of Maratos (*2, 3*), who found that 1-month-old infants produced matching behavior in response to seeing an adult exhibit tongue protrusion. However, both Maratos and Meltzoff and Moore failed to include controls that would test an alternative interpretation—namely, that these responses could also be released by inanimate stimuli and did not represent selective imitation of the model. Our study explored this alternative hypothesis.

Twenty-four white full-term infants (14 boys and 10 girls) were seen at 6 weeks of age. A series of five stimulus events were presented in a counterbalanced order. The first, tongue protru-

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