Imitative Reactions Among 14-21 Day Old Infants

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ABSTRACT: Imitative reactions in 11 infants, 14-21 days old, were observed. Stimuli were presented by the infant's mother, who protruded her tongue, opened her mouth, or interacted spontaneously. No conclusive overall group effects of the modeled action were found. However, when the responses of the infants were matched with the mothers' judgments concerning whether imitation had occurred, 6 infants showed imitative responses. It is concluded that observations on early imitation are influenced by individual differences between infants and that there may exist two different subgroups: High and low imitators.

Contradictory findings have been reported with regard to the presence of neonatal imitation. The earliest evidence was based on case studies of single infants during their first weeks of life (Gardner & Gardner, 1970; Zazzo, 1957), and it was not until the 1970s that the phenomenon was given deeper consideration and positive results from more or less controlled group observations were reported (Dunkeld, 1978; Field, Woodson, Greenberg, & Cohen, 1982; Maratos, 1973; Meltzoff, 1981; Meltzoff & Moore, 1977, 1983a). These reports claim that very young infants can imitate behaviors, such as tongue protrusion, during their first month of life. Furthermore, Field et al. (1982) present evidence that the human neonate even has the capacity to recognize and imitate happy, sad, and surprised expressions. These results contradict the conclusion of Piaget (1962), who claimed that before 8-12 months of age infants are not capable of true imitation of movements they cannot see themselves perform.

Despite the above-cited findings, the issue of whether infants are able to imitate specific behaviors during the opening weeks of life remains controversial. A number of

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reports have criticized or failed to replicate some of the findings (Ainsfeld, 1979; Hayes & Watson, 1981; Jacobson, 1979; Jacobson & Kagan, 1979; Koepke, Hamm, Legerstee, & Russell, 1983; Masters, 1979; McKenzie & Over, 1983). One example of an alternative interpretation is that the behavior performed by the infant is controlled by an innate releasing mechanism. Jacobson (1979) concludes that a moving pen or ball is as effective as the tongue model in eliciting imitative tongue protrusion for 6-week-old infants.

Most of the above reports have differed in both method and sample characteristics. Sample sizes varied from 1 subject in the early case studies (Gardner & Gardner, 1970; Zazzo, 1957), to between 5 and 14 (Dunkeld, 1978; Hayes & Watson, 1981; Koepke et al., 1983; Masters, 1979; McKenzie & Over, 1983; Meltzoff & Moore, 1977), to 24 in Jacobson's (1979) report, to a total of 40 infants in Meltzoff and Moore's (1983a) most recent study and 74 in Field et al.'s (1982) report. Differences are also evident in scoring techniques, in observational settings, in the usage of the experimenter or the mother as stimulus object, and in the locus of the observations (the laboratory or in the child's home). Taking the differences among reports into consideration, one can foresee the possibility that sample and procedural variations explain the contradictory findings, at least to some extent.

The divergent results also can be discussed from another viewpoint, that of individual differences between infants. This topic to date has been ignored almost completely; the only exception is one report by Field (1982). Instead, investigators tend to focus on group effects in search for normative trends. However, it is well known that human neonates show strong individual variability in responses as measured, for example, by the Brazelton Behavioral Assessment Scale. To us, an approach that fails to recognize individual variability overlooks the possibility of different subgroups among infants. Neonatal imitation is perhaps not an all or none phenomenon. It seems plausible that, if subgroups exist, combined group data may underestimate the imitative abilities of some infants.

In the present study we explored the capacity of very young infants, not older than 3 weeks, to imitate specific movements performed by the mother. Our purpose was twofold: First, to see whether we could detect significant overall abilities in imitating and, second, to determine the extent of individual differences in imitative responsiveness.

METHOD

Subjects

Five male and 8 female full-term infants between 14-21 days of age (mean age: 17.9 days), of normal birthweight and uncomplicated delivery completed a three-part session. All infants were judged to be neither pre- nor post-mature by pediatricians. The following criteria were met by all infants: (1) spontaneous or low forceps delivery; (2) exposed to only regional anesthesia or nitrous oxide; (3) the mother was given no barbiturates; (4) a 1-minute Apgar score of 7 or more; (5) no obstetric complications, and (6) good clinical condition. Two subjects were excluded from the analysis due to disturbances from siblings during observation. Another 15 infants were excluded earlier because of sleepiness and did not complete the session. It seems reasonable to assume that this loss of subjects due to procedural reasons (scheduling) did not affect the outcome of the experiment.

Procedure

All infants were tested in their homes. The mother held her child by the torso in a free-field way or supported the child on her lap in order to interact face-to-face with her infant. The mother functioned as stimulus-object. Sessions were begun when the infant was judged by the mother to be awake and alert. During the session, the mother's face was approximately 25 to 35 cm directly in front of the infant. The room was kept as free from auditory distraction as possible, and the infant was videotaped throughout the session (90 degree angle). The mothers had been told that we studied infants' reactions to moving objects and faces. They were fully debriefed after completion of the experiment.

The sessions were divided into three segments. All observations started by videotaping the mother and the infant together in spontaneous interaction (baseline) while in en-face position (segment I); the baseline period lasted for a minimum of 60 seconds. In the analysis, only the first 60 seconds of the baseline were used in order to equalize trial length. In the remaining segments the mother was told to protrude her tongue (TP-segment) four consecutive times or to open her mouth (MO-segment) four consecutive times. These two segments were counterbalanced for order of presentation; 50 percent of the dyads received the order MO - TP and 50 percent received TP - MO. The experimenter told the mother to present the stimulus (mouth opening or tongue protrusion) when she judged her child to be in an alert state and when eye contact had been established between mother and child. After stimuli were presented (tongue protrusion or mouth opening), the mother was told to remain passive for the last 60 seconds of the segment to provide a response period. Between each segment, there was a period of at least 30 seconds; the exact length depended on when the mother judged her child to be alert and in eye contact with her. During this part, the mother was allowed to interact with the infant in order to gain her child's attention. After the complete experiment, the experimenter (who also was operating the video camera) asked the mother how she interpreted her infant's reaction.

Infants' responses were scored independently by two graduate students, who were blind to the mother's behavior and the purpose of the experiment. They scored how often during the 60-second response period after stimulus presentation and how often during the baseline the infant protruded her or his tongue clearly beyond the lips or opened the mouth clearly. They also estimated the state of the infant, using the following

FIG. 1. Total number of tongue protrusions summarized over subjects in each segment ($N = 11$; BL = baseline; MO = mouth opening modeled by the mother; and TP = tongue protrusion modeled by the mother).

criteria (Theorell, Prechtl, Blair, & Lind, 1973): State 1: Quiet and/or active sleep or drowsiness; State 2: Quiet awake, eyes open, no movements; State 3: Active awake, eyes open, gross movements; State 4: Crying.

Each observer was given two 30-minute training sessions and scored each tape twice. The different intercorrelations (between the observers) ranged from .86 to .99. In the statistical analysis presented in this paper the scores produced by the coder with the highest intercorrelation (between first and second scoring) are used.

FIG. 2. Total number of mouth openings summarized over subjects in each segment ($N = 11$; see Figure 1 for further definitions).

RESULTS

Group Analysis

The frequencies of responding were compared across segments using the Wilcoxon signed-ranks test for matched pairs. The following comparisons were made between: (a) the frequency of tongue protrusions after tongue protrusions had been modeled, as compared with the frequency when mouth opening was modeled or the frequency dur-

ing baseline; and (b) the frequency of mouth opening when mouth opening was modeled as compared with the frequency when tongue protrusion was modeled or the frequency during baseline.

The numbers of tongue protrusions vs. mouth openings are shown in Figures 1 and 2. The total number of tongue protrusions or mouth openings (summarized over all 11 infants) was highest when these behaviors were modeled. For most comparisons, this increase in frequency failed to reach statistical significance. However, there was a clear increase in the frequency of tongue protrusions after modeling, as compared with baseline measures ($p < .035$). This was the only group effect found.

All children included in the final analysis were judged to be in either state 2 (quiet awake) or 3 (active awake). A number of children changed back and forth between these states during the observation. For two children the times between presentations were extended because they fell asleep. One child started to cry at the end of one of the response periods.

Individual Analysis

It is also of interest to investigate the reactions of individual children within the material. We noted, as did many of the participating mothers, that several children seemed to imitate, while others did not. The mothers were asked to make their judgment (whether the infant had imitated mouth opening, tongue protrusion, or both) when the experimental session was completed.

Table 1
Frequency Data: Number of Tongue Protrusions for Group A 1 (judged to imitate) and Group B 1 (judged not to imitate) in the Three Conditions (TP = tongue protrusion; BL = baseline; and MO = mouth opening)

Group A 1 ^a		Model ^b		
Subject #	TP	BL	MO	
1	5	0	0	
4	10	0	3	
5	2	0	0	
6	3	0	0	
10	2	0	1	
Group B 1				
Subject #				
2	1	1	3	
3	5	1	8	
7	0	1	5	
8	2	2	4	
9	0	0	0	
11	1	2	2	

^aGroup A 1: $p < .03$ for TP/BL and TP/MO.

^bGroup A 1 and B 1: $p < .035$ for TP/BL.

A different picture is obtained when children imitating tongue protrusion, as observed by their mothers, are taken into consideration (Group A1, subjects 1, 4, 5, 6, and 10; Table 1). Here there is a clear difference between the conditions, with more than five times as many tongue protrusions in the TP-situation as compared with the frequency after presentation of mouth opening or during baseline ($p < .03$).

Table 2

Frequency Data: Number of Mouth Openings for Group A 2 (judged to imitate) and Group B 2 (judged not to imitate) in the Three Conditions (TP = Tongue Protrusion; MO = Mouth Opening; and BL = Baseline)

Group A 2*		Model		
Subject #	MO	BL	TP	
1	20	12	18	
2	17	7	4	
4	9	2	3	
6	9	5	4	
10	3	3	3	
Group B 2				
Subject #				
3	5	4	8	
5	4	8	6	
7	13	15	5	
8	14	10	15	
9	3	3	2	
11	8	13	15	

^aGroup A 2: $p < .05$ for MO/BL and MO/TP.

Table 2 shows the results for mouth openings (Group A2, subjects 1, 2, 4, 6 and 10). The children in this subgroup displayed a clear increase in number of mouth openings when their mother opened her mouth in front of them ($p < .05$; Wilcoxon signed-ranks test, one-sided). Of the children who were judged to imitate, 4 out of 6 were judged to imitate both mouth opening and tongue protrusions (subjects 1, 4, 6 and 10).

The results for the infants who were not judged to imitate are quite different (Tables 1 and 2: Groups B1 and B2; no significant selectivity of responses). It seems, therefore, that we might have two types of reactions among the children. One more responsive subgroup imitates, and the other subgroup shows no selective reactions. This difference within the total sample could be the reason why the group analysis did not reveal any significant overall effect.

Furthermore, even among the children who imitated, there were wide differences according to the number of responses shown. The number of tongue protrusions, for example, varied from 2 to 10.

As stated earlier, all children were judged to be neither pre- nor post-mature. This was confirmed by an exploratory analysis of the children's gestational age: The gestational age varied from 39 to 42 weeks (median = 40 weeks). Thus, the age from

conception ranged from 41 to 45 weeks at the time of the experiment (median for imitating children: 42.5 weeks; median for non-imitating children as well as for the whole group: 42 weeks).

DISCUSSION

When the overall group of 2- to 3-week-olds were considered, no conclusive imitative response was found. The only significant result, a higher rate of tongue protrusions after modeling of tongue protrusions as compared with baseline, fails to support a conclusion of specific imitation success because the children responded as strongly when mouth opening was modeled. These findings appear to support the view that the very young infant lacks the capacity for specific imitations (Hayes & Watson, 1981; Koepke et al., 1983; McKenzie & Over, 1983; Piaget, 1951/1962).

Jacobson (1979), in a study that employed children 6-14 weeks of age, found that matching behavior did occur in response to seeing an adult display tongue protrusion, but that other inanimate stimuli were equally capable of eliciting the same response. In explaining her results, Jacobson suggested the existence of a released response mechanism: The pen and the tongue then sharing essential stimulus properties. Meltzoff and Moore (1979) criticized this conclusion and claimed that Jacobson's data support the existence of specific neonatal imitation if analyzed in a different way. Furthermore, Meltzoff (1981) suggests that the basic disagreement between Jacobson and Meltzoff and Moore concerns the interpretation of the data. Jacobson interprets her data as being in favor of a released response mechanism, while Meltzoff and Moore propose that the very young infant has the capacity of active intermodal matching (Meltzoff & Moore, 1977, 1983a, 1983b).

On the other hand, several reports have failed to find support for specific imitative reactions among neonates. Hayes and Watson (1981) concluded that "the data from which neonatal imitation has been inferred are simply artifactual" (p. 659). Negative results also have been reported recently by Koepke et al. (1983) and McKenzie and Over (1983). These contradictory and confusing interpretations are examples of the state of the field, and the question is still open as to whether to accept the existence of neonatal imitation.

Our data suggest, however, the possibility of an alternative interpretation. As expected, we found strong variability in the infants' responses. Taking the mothers' judgments as indication of whether or not imitation had occurred, nearly half of the infants showed imitative reactions following the blind scoring procedure. This finding is consistent with results reported by others that imitation can be seen in human neonates (Dunkeld, 1978; Field et al., 1982; Meltzoff & Moore, 1977, 1983a).

Individual data rarely are reported, except for the early single cases found in the literature (Gardner & Gardner, 1970; Zazzo, 1957). The only record of individual responses is given by Dunkeld (1978). She carried out two experiments that concerned tongue protrusion; each infant was tested on two occasions (age of infants ranged from 3 to 13 days). Her first experiment did not yield clear evidence of imitation, but in the second experiment 5 out of 6 infants imitated. When one examines each infant's responses over trials, it is apparent that there are great individual differences in performance. This variation in her sample is the reason Dunkeld gives for not accepting fixed-action pattern as a possible explanation of early imitative behavior.

Dunkeld's data, the positive findings reported by others, and the data from our own study collectively suggest that the issue of individual differences has not been examined thoroughly. Also, Hayes and Watson (1981), although arguing against neonatal imitation, occasionally observed strong tongue protrusion. They explained their observation as evidence that "some individuals were particularly prone to exaggerated responses of one type or another" (p. 657). Furthermore, McKenzie and Over (1983) reported that they observed similarities between modeled behavior and that performed by the infant. However, they concluded that their mode of analysis was not sensitive to the question of individual differences. More broadly speaking, the overall diversity of results may result in part from chance probabilities, i.e., that more highly imitative infants appear in some samples, but not in others.

Support for the hypothesis that children differ in their proneness to display imitative behaviors also can be found in studies that have investigated children's verbal imitation in relation to language acquisition. It has been suggested that there exist at least two groups of children: High vs. low imitators (Bloom, Hood, & Lightbown, 1974; Nelson, Baker, Denninger, Bonvillian, & Kaplan, 1981). It is our view that a similar dichotomy may be found for imitation within the neonatal period when the dichotomy is explicitly pursued, as in this study. Consequently, we suggest that one cannot assume all neonates to be capable of imitation. Psychologists do not conclude that a 9-month-old infant does not have the capability of walking on the basis of our knowledge that most infants do not walk at this age. Similarly, research on early imitation should ask different questions and should view imitation in its environmental and social context. Instead of asking whether neonatal imitation exists, we must try to investigate why some infants show imitation and others do not. What are the factors that increase the probability of imitative behavior? Do mother-infant dyads differ in their responsiveness in ways that can explain neonatal imitation? To what extent does neonatal imitation facilitate early contact and, in turn, to what extent is it a product of parental contact and responsiveness? With such questions in mind, one promising future project could be to follow infants regularly from birth on, in order to discover whether the individual differences in neonatal imitation are stable over time and how they relate to the quality of parent-infant relationship.

REFERENCES

- Ainsfeld, M. (1979). Interpreting "imitative" responses in early infancy. *Science*, 205, 214-215.
- Bloom, L., Hood, L., & Lightbown, P. (1974). Imitation in language development. *Cognitive Psychology*, 6, 380-420.
- Dunkeld, J. (1978). *The function of imitation in infancy*. Unpublished doctoral dissertation, University of Edinburgh.
- Field, T. M. (1982). Individual differences in the expressivity of neonates and young infants. In R. S. Feldman (Ed.) *Development of nonverbal behavior in children*. New York: Springer-Verlag.
- Field, T. M., Woodson, R., Greenberg, R., & Cohen, D. (1982). Discrimination and imitation of facial expressions by neonates. *Science*, 218, 179-181.
- Gardner, J., & Gardner, H. (1970). A note on selective imitation by a six week old infant. *Child Development*, 41, 1209-1213.
- Hayes, L. A., & Watson, J. G. (1981). Neonatal imitation: Fact or artifact? *Developmental Psychology*, 17, 660-665.
- Jacobson, S. W. (1979). Matching behavior in the young infant. *Child Development*, 50, 425-430.

- Jacobson, S. W., & Kagan, J. (1979). Interpreting "imitative" responses in early infancy. *Science*, 205, 215-217.
- Keopke, J. E., Hamm, M., Legerstee, M., & Russell, M. (1983). Neonatal imitation: Two failures to replicate. *Infant Behavior and Development*, 6, 1983, 97-102.
- Maratos, O. (1973). The origin and development of imitation in the first six months of life. Paper presented at the annual meeting of the British Psychological Society, Liverpool.
- Masters, J. C. (1979). Interpreting "imitative" responses in early infancy. *Science*, 205, 215.
- Meltzoff, A. N. (1981). Imitation, intermodal matching, and representation in infancy. In G. Butterworth (Ed.), *Infancy and epistemology*. Brighton, England: Harvester Press.
- Meltzoff, A. N., & Moore, M. K. (1977). Imitation of facial and manual gestures by human neonates. *Science*, 198, 75-78.
- Meltzoff, A. N., & Moore, M. K. (1979). Interpreting "imitative" responses in early infancy. *Science*, 205, 217-219.
- Meltzoff, A. N., & Moore, M. K. (1983a). Newborn infants imitate adult facial gestures. *Child Development*, 54, 702-709.
- Meltzoff, A. N., & Moore, M. K. (1983b). The origin of imitation in infancy: Paradigm, phenomena, and theories. In L. Lipsitt & C. Rovee-Collier (Eds.), *Advances in infancy research* (Vol. 2). Norwood, NJ: Ablex.
- Nelson, K. E., Baker, N., Denninger, N., Bonvillian, J., & Kaplan, B. (1981). Language-learning styles that combine semantic, syntactic, and imitative discourse components. Paper presented at the Second International Congress for the Study of Child Language, Vancouver, August.
- Piaget, J. (1962) (Originally published 1951). In C. Gattegno & F. M. Hodgson (Trans.), *Play, dreams and imitation in childhood*. New York: Norton.
- Theorell, K., Prechtl, H. F. R., Blair, A. W., & Lind, J. (1973). Behavioral state cycles of normal newborn infants. *Developmental Medicine and Child Neurology*, 15, 597-605.
- Zazzo, R. (1957). Le problème de l'imitation chez nouveau-né. *Enfance*, 2, 135-142.

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