JOURNAL OF EXPERIMENTAL CHILD PSYCHOLOGY **51**, 423–433 (1991)

The Role of Person and Object in Eliciting Early Imitation

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The role of person and object in eliciting early imitation was examined in this study. Twenty-seven infants, between 5 and 8 weeks old were assigned randomly to two conditions. In the person condition ($N = 12$) they were presented with tongue protrusions and mouth openings modeled by an adult, whereas in the object condition ($N = 15$) they were presented with these gestures simulated by two objects. Two infant behaviors were coded; mouth openings and tongue protrusions. Infants in the person condition selectively reproduced the mouth open and tongue protrusion gestures at significant levels, infants in the object condition did not. Instead of reproducing the congruent gestures (mouth openings and tongue protrusions when they were modeled) infants in the object condition reproduced the incongruent gestures at significant levels. Together, the findings indicate that imitation is a social response, which has implications for the development of nonverbal communication and speech. © 1991 Academic Press, Inc.

The ability to imitate the actions of others has been accorded great significance in the development of thinking and behavior (Bandura, 1969; Piaget, 1962). In the developmental study of imitation, it was believed for many years that babies were unable to imitate gestures that they could not observe themselves perform until relatively late in infancy, (e.g., 10–12 months of age, Piaget, 1962). Before this age, one could observe phenomena such as contagious crying and cooing, but selective imitation of facial behaviors, involving watching a model perform some action and then later replication, was not possible without a considerable amount of previous developmental experience (Piaget, 1962; Uzgiris & Hunt, 1975).

Piaget's account of the origins of imitation was challenged by the findings of Meltzoff and Moore (1977). As the result of data collected using a new technique (cross-target design), the authors provided evidence that

This research was funded by a grant from the Social Sciences and Humanities Research Council of Canada (410-89-1119). I would like to thank Johanna Robertshaw, Elisabeth Walsh, and Isabel Fearon for assisting with data collection and coding, and Doug Williams for statistical advice. Special thanks further to the parents and infants for donating their time and energy and to the staff of the Grace Maternity Hospital for recruiting the participants. Requests for reprints should be sent to Maria Legerstee, Department of Psychology, York University, 4700 Keele Street, Toronto, Ontario, M3J1P3, Canada.

0022-0965/91 $3.00

babies during the first month of life will imitate tongue protrusions and mouth openings. In that study the infants reproduced more tongue protrusions when it was modeled than when mouth opening was modeled and conversely they produced more mouth openings when it was modeled than to the experimenter's tongue protrusion. Later, a series of studies by Meltzoff and Moore (1977, 1983a) and others using cross-target paradigms (Abravanel & Sigafoos, 1984; Field, Goldstein, Vega-Lahr, & Porter, 1986; Field, Woodson, Greenberg, & Cohen, 1982; Fontaine, 1984; Jacobson, 1979; Reissland, 1988; Vinter, 1986) confirmed the evidence that babies as young as a few hours old can imitate proprioceptive behaviors. But, other researchers using similar procedures failed to replicate some of the findings (Hayes & Watson, 1981; Koepke, Hamm, Legerstee, Russell, 1983a, 1983b; McKenzie & Over, 1983). However, when dealing with perceptual phenomena in early infancy, differences in the results generated by studies addressing similar issues should be seen as informative rather than problematic (Tees, 1989). Rather than focusing on the absence or presence of the imitative capacity, research is needed that directs attention to the mechanisms underlying this capacity and to understand the broader implications of this emerging ability.

For instance, it is unclear whether the baby will imitate social models and not nonsocial models. Such information would have important implications for theories of social development and communication. Although 2-month-old infants respond differentially to people and objects with a variety of behaviors (Field, 1979; Klein & Jennings, 1979; Legerstee, in press; Legerstee, 1986; Legerstee, Pomerleau, Malcuit & Feider, 1987; Legerstee, Corter, & Kienapple, 1990), their imitative differentiation of animate and inanimate stimuli remains to be demonstrated.

One study (Jacobson, 1979) has addressed this issue. In that longitudinal study infants from 6 to 14 weeks old were presented with five gestures, two of them being produced by animate models. The results showed that 6-week-old infants produced as many tongue protrusions to a person modeling that gesture as to a white ball and pen moving toward and away from the infant's mouth, but less than toward opening and closing of a hand and a white ring that simulated these hand movements. Jacobson (1979) interpreted her results as indicating that the infant's matching behaviors were released responses since they were elicited by animate as well as inanimate stimuli.

Jacobson's (1979) study contains limitations that make her interpretation of the results somewhat difficult to support. Robertshaw-Legerstee (1979) repeated the Jacobson study in part with 2- to 3-week-old infants. The author presented mouth openings and tongue protrusions of a human model to the babies (see Koepke et al. 1983a) and also a forward moving black felt pen. She found that the infants produced significantly more mouth openings toward the pen than toward the mouth openings and tongue protrusions produced by the human model. Had Jacobson (1979) measured other facial responses toward the stimuli, such as mouth openings, she might have found that her babies responded to the approaching pen (and possibly to the other stimuli) with increased mouth openings as well and so would have had to revise her hypothesis that tongue protrusion was the specific response released by these stimuli.

Thus it remains uncertain whether the tendency to imitate may reflect a consistent differentiation of animate and inanimate events. The purpose of the present research was to study imitation in 5- to 8-week-old infants. In particular, this study aimed to identify whether infants will imitate facial gestures produced by people and objects simulating these gestures.

METHOD

Subjects. Of the 39 infants recruited, 32 infants achieved a quiet and alert state (Stage 4, Wolff, 1966) and 27 infants completed the study (14 girls). All babies were healthy and born at term (40 ± 2 weeks). Their postpartum ages ranged from 5 to 8 weeks (mean age 6.6 weeks) and their birthweight ranged between 2550 and 4350 grams (mean 3230 grams). All babies were from middle income families, and were first or second born. The subjects were observed 15–20 min after feeding to avoid tongue protrusions that could be attributed to hunger.

Procedure. All infants were observed in an Infancy laboratory at the University. Each baby was seated in an infant seat facing the experimenter (E) who wore headphones and had a videomonitor in her visual field. The E would use this monitor to see whether she was positioned in such a way that none of the gestures she modeled would be recorded on the videotape. This would aid in the subsequent nonbiased coding of the infants' responses. The infants were randomly assigned to two conditions: (1) a person condition (N = 12; 5 boys; 7 girls) and (2) an object condition (N = 15, 8 boys, 7 girls). Infants in the person condition were presented with tongue protrusions and mouth openings of an adult. Infants in the object condition were presented with two objects. The object that was to simulate tongue protrusions consisted of a white tube (10 × 5 cm in length) that was held at one end by the experimenter. It had a blue disk (15 cm in diameter) mounted on the other end, which faced the infant and which prevented the infant from seeing the hands. The E would move a red elongated object (2 cm in diameter and 15 cm in length) through the white tube toward the infant's face until 5 cm of the elongated object protruded through the blue disk. Thus the baby saw a flat, blue disk with an opening in the center, through which a red object (the size of a tongue) moved back and forth. The object simulating mouth openings consisted of a blue box that had hinges on one side and therefore opened on the other side only. It measured 15 cm × 15 cm on the outside and showed a red inside (10 cm × 10 cm), when opened. When presenting this object, the experimenter would place one hand partially on top of the box and the other under the box, in such a way that her fingers were hidden from the infant's view, while at the same time this position enabled her to open and close the side of the box that faced the infant. All gestures were presented at a 20 cm distance of the infant's face. Order of presentation of gesture, tongue protrusion (T), or mouth opening (M), was either TM or MT, but assignment of each particular sequence was randomized.

Each condition began with a short observation phase to allow the infant to become familiar with the experimental setting. During this phase the E sat in front of the infant with a pleasant expression on her face and without moving at a 50 cm distance. She was surrounded by white walls and a white curtain that blocked the entrance. During the object condition the E would move to the side, and out of the visual field of the infant, so that only the objects were visible. The objects, and the person's face were illuminated by a 40 watt spotlight 20 cm above and 50 cm behind the baby. During testing the other lights were turned down. A video camera (Hitachi, HV 730, B/W) with a zoom lens (V 12.5-75 M.P.S = 3) was used to film the infants. This white colored camera was mounted on the wall, behind and above the left shoulder of the experimenter and out of the visual field of the infant. It was controlled with a remote control by a research assistant who viewed the infant's responses on a 36 cm color video monitor (Mitsubishi, AM1301) from the adjacent operating room. This allowed for continuous filming of the infants when changes in head position occurred. The assistant also timed the modeling and response phases and signaled their onset and offset to the E through the headset.

As soon as the baby seemed content and alert and fixated E's face, the E would begin presenting the first gesture of either the animate or inanimate condition, 10 times during a 25 s modeling phase. Each modeling phase was followed by a 25 s response phase. This 50 s modeling and response sequence was repeated four times. Thus total modeling and response time for each gesture was 200 s. If the infant stopped gazing for longer than 2 s at the stimulus during the modeling phase the camera operator would stop filming and the data for that particular baby was discarded. Thus the decision to not continue with particular infants was based on whether or not the infant fixated either the social or nonsocial stimulus. To ensure that this was a bias-free procedure, the camera operator was kept naive to the purpose of the study. Instead, she was told that we were interested in the way the infant "scanned" the moving stimuli, and that therefore babies had to continuously look at the stimulus during its presentation. A total of five infants were lost from the 32 babies that were initially able to achieve an alert and quiet state. Two of these infants were discontinued during filming of the object condition and three during filming of the person condition.

Dependent Variables

Tongue protrusions and mouth openings were coded for the animate and inanimate conditions. For tongue protrusions, all partial (tongue between lips) and complete tongue protrusions (tongue beyond lips) were coded. For mouth openings, all mouth openings from a closed, or semi-open lip position were scored. The mouth had to close after opening in order to be coded. No limit was imposed on the length of time the mouth was allowed to remain open since for most infants, a mouth opening did not last more than between 1 to 2 s before it returned to its closed or partially closed position. Since the behaviors were coded continuously with an event recorder it was necessary to form exhaustive categories (see Legerstee et al., 1990). Therefore, mouthing behaviors not falling under the mouth open and tongue protrusion definitions were coded under the category "other mouth movements" (e.g., movements associated with yawning, tongue in cheek, tongue against lips, tongue sucking, spitting, etc., as well as "no movements"). These movements were not included in the analyses.

Transcription of Videotapes

The videotapes were coded in real time from a 54 cm T.V. monitor by students naive to the nature of the experimental hypothesis. Before beginning the coding process, the 8 subphases were assigned a segment number and then copied to a new tape in a random order. Thus, the coders were rendered blind to the modeling and response phases of the gestures. One coder would code the gestures and another coder coded the same behaviors in 20% of the infants. Cohen's Kappa measures were .89 for mouth opening; .90 for tongue protrusion; and .89 for "other".

During videotaping of the conditions the camera operator began filming each new infant immediately following the preceding infant. Since our videorecorder would rewind somewhat before beginning to move forward to film a new condition, 1 to 3 s were lost from each eighth response phase. In order to account for these variations between the phases the amount of frequencies produced during each phase was divided by the length of the phase to give a proportion which was multiplied by 60 to obtain rates per minute. Table 1 presents the mean rates per minute of the two infant behaviors in the modeling and response phases with mouth open and tongue protrusion gestures in the person and object conditions.

RESULTS

The rates per minute were submitted to a five-way univariate analysis of variance (ANOVA). The between-subjects variables were Model (2: person or object) and Order (2: TM or MT) and the within-subject vari-

TABLE 1

MEAN RATES PER MINUTE OF TWO INFANT BEHAVIORS IN MODELING AND RESPONSE PHASES WITH MOUTH OPEN AND TONGUE PROTRUSION GESTURES IN PERSON AND OBJECT CONDITIONS

Model's gesture	Mouth opening	Tongue protrusion	Both gestures
	Infant behaviours in modeling phase		
Person condition			
Mouth opening	5.41	2.06	3.73
Tongue protrusion	1.68	6.64	4.16
Both gestures	3.56	4.35	
The means in the interaction are 6.03 vs 1.87			
	Infant behaviours in response phase		
Person condition			
Mouth opening	7.22	3.06	5.14
Tongue protrusion	2.52	7.06	5.21
Both gestures	4.87	5.48	
The means in the interaction are 7.56 vs 2.79			
	Infant behaviours in modeling phase		
Object condition			
Mouth opening	1.62	4.43	3.03
Tongue protrusion	2.85	3.45	3.15
Both gestures	2.24	3.94	
The means in the interaction are 2.54 vs 3.64			
	Infant behaviours in response phase		
Object condition			
Mouth opening	2.05	4.86	3.46
Tongue protrusion	4.10	3.49	3.80
Both gestures	3.08	4.18	3.62
The means in the interaction are 3.80 vs 4.48			

ables were Gesture (behavior modeled, 2: mouth opening vs tongue protrusion) by Phase (2: modeling vs response), and Congruence (2: infant's response consistent with model's gesture vs infant's response inconsistent with model's gesture). This analysis provides a direct statistical comparison between the two types of responses and a direct statistical comparison of the effectiveness of the two gestures.

The analysis showed a significant main effect for Congruence of response $F(1, 23) = 7.61$, $p < .011$, with more infant tongue protrusions and mouth openings produced when they were modeled than when they were not. More importantly, there was a significant Model × Congruence interaction, $F(1, 23) = 37.95$, $p < .000$. As Table 1 shows, there were significantly more congruent than incongruent responses in the person conditions and significantly more incongruent than congruent responses in the object conditions. Thus, infants in the person conditions imitated

TABLE 2
INFANT RESPONSE RATES WHEN MODEL'S FIRST GESTURE WAS MOUTH OPENING OR TONGUE PROTRUSION

	Modeling phase		Response phase	
Model's gesture	First	Second	First	Second
Mouth opening	3.84	2.92	4.92	3.29
Tongue protrusion	3.62	3.69	4.00	5.38

tongue protrusion and mouth opening gestures. The opposite was true in the object condition.

There was also a significant main effect for Phase, $F(1, 23) = 13.88$, $p < .001$. Overall the infants produced more tongue protrusions and mouth openings during the response phases than during the modeling phases. Finally, there was a significant Phase × Order interaction, $F(1, 23) = 4.56$, $p < .043$. As can be seen from Table 2, the infants' overall rate of responding was greater when the model's first gesture was mouth opening than when it was tongue protrusion.

DISCUSSION

The results of the present study indicate that 5- to 8-week-old infants imitate tongue protrusions and mouth openings of a human model. That babies less than 2 months old are capable of imitating facial gestures has been reported by previous authors (Abravanel & Sigafoos, 1984; Field et al., 1982; Fontaine, 1984; Jacobson, 1979; Maratos, 1973; Meltzoff & Moore, 1977, 1983a; Reissland, 1988; and Vinter, 1986). It is important to note, however, that the subjects in this research were 5- to 8-week-old infants rather than neonates. This age difference is important in that the present findings do not clearly support an innate mechanism to allow for imitation as proposed by Meltzoff and Moore (1977); and Field et al. (1982). That is, parents taking part in face-to-face interactions often imitate the babies' behavior and thus might shape the imitative responses of their children. Whether trained or not, the fact remains that babies as young as 5 weeks of age imitate facial gestures and they do so unequivocally.

The infants also produced more mouth openings and tongue protrusions during the response phases than during the modeling phases. Meltzoff & Moore (1983b, p. 290) suggested that the modeling and response paradigm used in imitation studies during which the "infant perceives a human adult acting, then stopping, acting, then stopping, may motivate the infant to action, rather than to mere visual fixation". Research on early communicative development shows that mothers when speaking to their very young infants often pause as if they were "expecting" a reply of their infant (Stern, Jaffe, Beebe, & Bennet, 1975; Legerstee, Kienapple, & Walsh, 1989). The social significance of the caretakers' actions would be to incite the infants to continue to reciprocate in their communicative exchanges (Bruner, 1975). The fact that the infants increased their overall responsiveness when the order of the gestures was MT rather than TM, seems to suggest that certain characteristics associated with the social and nonsocial mouth opening stimuli, such as perhaps opening and closing movement of the stimulus, aroused the infant more than the tongue protrusion gesture.

The results of this study further highlight the role of the person in eliciting imitation. Infants facing people produced higher rates of a gesture when it was modeled than when it was not. In contrast, infants presented with the objects simulating the same gestures failed to show evidence of differential matching. This finding does not support the results of Jacobson (1979), who found that the infants produced more tongue protrusions when a person protruded a tongue than when a person moved her hand, but also more tongue protrusions when an object simulated tongue protrusion than when the object simulated a hand gesture. Rather than modeling one facial gesture, in the present study, we modeled two. As our study indicated, oral behaviors do indeed increase when inanimate objects move in front of babies' faces. However, rather than responding with imitative or congruent behaviors the infants responded with the incongruent behaviors. Thus the infants responded differently depending on the social nature of the object. That very young infants distinguish in their responses between people and objects has been shown in other studies (Field, 1979; Klein & Jennings, 1979; Legerstee, in press; Legerstee, 1986; Legerstee & Bowman, 1989; Legerstee et al., 1990; Legerstee et al., 1987). The present study sheds light on the imitative differentiation of the two classes. As the results show, when infants face people they may reproduce their facial gestures, but when infants are presented with objects that move toward their faces they will increase their oral behaviors as if to explore them.

The finding that 5- to 8-week-old babies imitate behaviors of animate models but not of inanimate models strongly suggests that imitation is a social response. "Imitative play offers a unique channel for early communication, one in which both the timing and the form of the exchange give both partners the opportunity to share reciprocally in the exchange (Meltzoff, 1985, p. 28)".

Overall, the results of the present study indicate that imitation is best seen in terms of a prelinguistic communication code between an infant and an adult. However, this does not mean that by imitating the adult the infants show they understand the point of behavior that they imitate. Rather, these behaviors may be tools, used by infants to learn about people. The infant's behavior is an objectively communicative action whose meaning is implicit in the action, though not objectively cognized by the infant. Thus, through imitating the behavior of the adult and through noting the adult imitating certain behaviors of the child, the social significance of the act internalized in the adult comes to be internalized in the infant (Barresi, 1984; Lock, 1982; Vygotsky, 1962).

In particular, there is evidence to suggest that imitation of the oral gestures of an adult has particular implications for the acquisition of speech (Kuhl & Meltzoff, 1982; Legerstee, 1990; Massaro, 1987; Trevarthen, 1977). For instance, Trevarthen (1977) describes how the visual information about articulation is available in 2- to 3-week-old infants. Apparently, these young infants produce early "prespeech" movements through mimicking the mouth movements of the adult during a communicative exchange. More recently, Kuhl & Meltzoff (1982) showed that somewhat older infants had learned to associate the sight of the person producing speech to the auditory concomitant. The infants' ability to relate the shape of the person's mouth and the sound produced is an important factor in the production of speech. Legerstee (1990) found that if the auditory signal matched the visual identifier (e.g., /a/ sound and /a/ mouth), the infants would imitate the speech sounds of the model. If the visual and auditory components of the vocal act were incongruent (e.g., /a/ sound, /u/ mouth) they would not. These demonstrations of the infants' imitative competencies not only indicate that the infants are able to differentiate articulatory gestures and to modify their behavior, but that their early reproduction of the behavior of people lays the foundation for further cognitive and social development (cf. Massaro, 1987; Meltzoff, 1985).

In summary, this work indicates that imitation is a social response since 2-month-old infants imitate actions of people but not of objects. In particular, it appears that imitation of the oral gestures of adults in very young infants is an important factor for the acquisition of speech (Massaro, 1987). Future research should be aimed at replicating and extending these findings by examining whether infants imitate gestures using a paradigm that couples a cross-modal design to actual social interactions.

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RECEIVED: February 22, 1990; REVISED: August 14, 1990.