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Deferred imitation in 9- and 14-month-old infants: A longitudinal study of a Swedish sample

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Abstract

This study investigated deferred imitation using a longitudinal design. A total of 62 Swedish children (32 girls) were tested at both 9 and 14 months of age. The memory delay interval was 10 minutes at 9 months and five minutes at 14 months of age. At both ages children in the imitation group displayed significantly more target actions after modelling than the children in the control group, thus replicating earlier reports of imitation from memory. It was found that individual children with a tendency to perform low deferred imitation at 9 months of age tended to remain low on the test at 14 months, thus raising the possibility of stable individual differences in imitation. This study provides a first investigation of deferred imitation longitudinally among young children, and supports recent theoretical claims that deferred imitation arises earlier in ontogeny than was hypothesized by classical theory. It was observed that there are cultural differences in the way that Swedish versus American adult–infant pairs act in the test situation and ideas are offered regarding the roots of such differences.

Deferred imitation is regarded as an important milestone in the early cognitive development of children. For Piaget (1962) deferred imitation represents one of the important end-points of the sensorimotor period; it indexed the emergence of the child's representational capacity and was not fully developed until late in the second year of life (around 18–24 months). According to Piaget, the capacity for deferred imitation was necessary in order for further symbolic and pre-operational development to occur, and it emerged in synchrony with symbolic play and high-level object permanence (`serial invisible displacements').

This view has taken hold not only among developmental psychologists and researchers but also among clinicians. For example, in a recent clinical theory, Stern (1985) argued that the child adds an important representational and symbolic capacity to his or her repertoire towards the middle of the second year as he or she moves from a subjective self to a verbal self at this period. For Stern, deferred imitation was one of the most important indicators and facilitators of such a change and it first arose in late infancy. Stern's ideas have been embraced by clinicians trying to integrate empirical research with their knowledge and experience of changes at the end of the second year of life.

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Although Piaget's and Stern's views have received some support (e.g. Abravanel & Gingold, 1985; McCall, Parke & Kavanaugh, 1977) recent findings have seriously questioned the validity of viewing deferred imitation as a capacity that first emerges in the second year. Meltzoff was the first to report deferred imitation before the standard age of 18 months (sensorimotor `stage 6'). He reported on deferred imitation in 14-month-old infants after both a one day (Meltzoff, 1985) and a one week delay (Meltzoff, 1988*a*), and more recently that 14-month-old babies will imitate the behaviour of other babies whom they observed on previous days both in the laboratory and in a day-care setting (Hanna & Meltzoff, 1993). A few studies have pushed deferred imitation back to even younger ages. Meltzoff (1988*b*) reported findings indicating that children as young as 9 months are capable of deferred imitation after a delay of 24 hours. It was also reported that there was no significant decrement in imitation as a function of whether the test was immediate or after a delay, an observation supported by Abravanel (1991) in 13–16-month-old infants after a 10-minute delay. Finally, Rast & Meltzoff (1995) studied deferred imitation in a population of children with Down's syndrome. They reported deferred imitation in children as young as 20 months (chronological age), and that this performance was not dependent on their ability to solve high-level object permanence tasks (deferred imitation was evident among subjects performing below the one-year level on object permanence tasks). Taken together, there seems to be some support for Meltzoff's (1990, 1995) view that our contemporary developmental theories have to be rewritten in order to take account of the young child's ability for deferred imitation. However, before such a revision can be undertaken, the findings on imitation in 9-month-olds have to be replicated. This paper presents a first attempt to carry out such a replication in a different laboratory and in a different culture (Sweden).

The study had two main goals. The first was to replicate the earlier observations on deferred imitation of object-related actions in 9- and 14-month-olds. The second goal was more exploratory in nature: to test whether there were stable individual differences among the children who were tested at both 9 and 14 months of age. A serendipitous observation concerned some interesting differences in the way that Swedish and American adult–infant pairs behaved in the test situation, which led to ideas about the origins and early development of cultural variations in modes of interpersonal interaction.

Method

Participants

The imitation group consisted of 31 children (15 girls) with a mean birth weight of 3748.4 g (SD = 450.1) and a mean Apgar score five minutes' post partum of 9.1 (SD = 1.4). The first observation was carried out when the children were approximately 9- to 10-months-old (M = 38.7 weeks, SD = 1.1) and the second observation when they were 14- to 15-months-old (M = 62.4 weeks, SD = 1.2). Twenty-seven children (11 girls) completed the second observation. Four children were lost due to fussiness, illness and procedural errors.

The control group consisted of 31 children (16 girls) with a mean birth weight of 3568.5 g (SD = 572.2) and a mean Apgar score five minutes' post partum of 9.0 (SD = 1.3). The first observation was carried out when the children were about 9–10-months-old (M = 40.4

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weeks, SD = 2.1) and the second observation at about 15 months (*M* = 64.9 weeks, SD = 2.0). Twenty-eight children (15 girls) completed the second observation. Three children were lost due to fussiness and procedural errors.

Procedure

Both the 9- and 14-month observations employed a procedure as similar as possible to that previously used by Meltzoff (1985, 1988*a*,b). Sufficient time and effort were devoted to training the Swedish research group and the toys used were exact replicas of the toys used in the earlier studies carried out at the lab in Seattle, USA.

The 9-month observation. Imitation group—A set of three specially constructed toys was used. The first object was an L-shaped wooden construction composed of a wooden rectangle connected by a hinge to a larger rectangular base. The action was to reach out and push the vertical extension over so that it lay flat on top of the base. The second object was a small black box with a black button mounted in a recess. The action demonstrated was pushing the button in order to produce a beeping sound. The third object consisted of a small plastic orange egg and the action demonstrated was to pick up the egg and shake it.

In the test, each action was demonstrated three times during approximately 20 s. The children were not allowed to handle the toys during the presentation. After the actions had been presented a memory delay of 10 minutes was imposed (*M* = 11.24, SD = 2.29). During this delay the mother used a different set of toys and played with her infant on the floor of the observation room. A 10-minute delay with intervening motor activity on non-target toys was used to ensure that a genuine memory problem was posed. Meltzoff (1988*b*) used a longer delay (24 hours), but found that there was little loss of responding over the 24-hour delay as compared to immediate imitation. Because these data were being collected as part of a larger longitudinal study, we decided not to burden the mothers with two visits on separate days. It seemed that a 10-minute delay with intervening play with distractor toys was sufficient to test the basic point about imitation from memory.

After the delay, the experimeter engaged in a short warm-up until the infants were judged to be comfortable. Next, the children were presented the toys one by one in the same order as they had been demonstrated and videotaped to see if they would produce the target acts they had been shown. A response time of both 20 and 30 s was used. The reason for using two different response intervals was based on results from preliminary observations at the Swedish lab. These pilot data indicated that the Swedish children sometimes appeared to take longer to produce the target than had the American infants (to be discussed later) and therefore that a 30 s response period might be more appropriate than the 20 s used in the American studies. The shorter period was also used in the analysis to facilitate intercultural comparisons. The actual mean length of the response time was 29.3 s (SD = 1.9) for the imitation group and 29.0 s (SD = 1.9) for the control group.

Control group—The procedure was identical for the control group, except that the children never saw the target actions demonstrated. The modelling period was simply omitted for the baseline condition (*N* = 15) while the children in the activity-control condition (*N* = 16) saw the experimenter demonstrating alternative actions with the objects.

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The alternate action for the black box was to produce the beeping sound through activation of a small switch in the back of the box that was invisible to the child. For the L-shaped wooden construction, the experimenter used wooden pieces identical to those used in the experimental condition but without the metal hinge screwed on. The action presented was to move the smaller wooden block towards the infant and back such that the distance approximated that traversed by the arc of the flap in the imitation condition. For the egg, the experimenter produced the rattling sound by putting the egg in between his hands and tapping it back and forth between his hands.

The 14-month observation—The procedure at 14 months was basically similar to the one used at 9 months, although a different set of toys and a response time of only 20 s were used.

Imitation group—The three toys used corresponded exactly to the toys used previously by Meltzoff (1988*a*) and Hanna & Meltzoff (1993). The first object was a pull toy that could be pulled apart and put back together again. It consisted of two 2.5 cm wooden cubes, each with a 7.5 cm length of plastic tubing extending from it. One length of tubing was slightly narrower and fitted inside the other. The action demonstrated was to pick up the object by the wooden cubes and pull outward with a very definite motion so that the toy came apart. The second object was a collapsible cup that could be folded up like a telescope by pressing downward on it. The action demonstrated was to show the cup in its unfolded position and then let the child see the experimenter place an open palm on the top surface and press it closed. The third action used two objects: one empty plastic cup and a string of beads. The action demonstrated was for the adult to pick up the beads and slowly lower them into the plastic cup.

The test procedure was similar to that described for the 9-month test except for the following changes. After the actions had been presented a delay of five minutes ($M = 6.89$, SD = 2.25) was introduced during which the mother and child were asked to leave the room. They waited in the hallway or played with a different set of toys in a neighbouring room.

Control group—The procedure was identical for the control group except that the children never saw the target actions demonstrated. The modelling period was simply omitted for the baseline condition ($N = 14$) while the children in the activity-control condition ($N = 14$) saw the experimenter demonstrating alternative actions with the objects that closely matched the experimental acts under test, but were not the same. The alternative action for the pull toy was to move the already separated object up and down, spanning a linear extent that matched the horizontal movement of pulling the object apart. For the cup the experimenter presented the child with the cup already in the folded position and then moved the cup up and down in a movement mimicking the path and extent of that shown in the imitation group. For the string of beads and the cup, the experimenter took the beads and slowly moved them down towards the surface of the table and then dropped the beads onto the table (at a distance of 10 cm from the cup).

Scoring

The videotaped records of the response periods for the experimental and control infants were identical in the sense that all infants had a series of three response periods that were at least 20 s long. Thus there were no artifactual clues on the videotape as to whether or not the infant had been exposed to the target action. The judges, who were all naïve to group assignments, viewed an edited version of the tape that only included the response periods. The task of the scorer was to produce a dichotomous `yes/no' code as to whether the infant produced the target action with each object. For the objects at 9 months, a `yes' for the L-shaped toy was recorded if the vertical flap was folded down with an arc greater then 45° towards the base-plate; a `yes' for the egg was coded if the infant shook the egg, where shake was defined as a quick bidirectional movement in which the trajectory retracted itself; a `yes' for the black box was recorded if the button was pushed so that a beeping sound could be heard. For the objects at 14 months, a `yes' was coded for the pull toy if the child succeeded in separating the two parts of the toy; a `yes' for the collapsible cup was recorded if the cup was completely collapsed; a `yes' for the beads and cup was coded whenever the string of beads ended up within the cup with no more than a third of the beads hanging over the edge of the cup.

The 9-month deferred imitation tasks were coded by two different observers, one in Sweden and one in the USA. The obtained agreement (Pearson product moment correlation) was .91 for the short (20 s) and .88 for the long response period (30 s). The 14-month data were coded by two Swedish research assistants ($r = .95$).

Statistical analysis

Only results based on parametric methods are included in the paper, although the same statistical effects were found using non-parametric methods (Mann–Whitney or Kruskal–Wallis) instead of the *t* tests and ANOVAs.

Results

The 9-month observation

The results for the short (20 s) response period provide support for the hypothesis of imitation (Table 1). Preliminary analyses showed that there was no significant differences in the number of target acts performed in the two different control groups (baseline: $M = 0.87$, SD = 0.99; activity-control: $M = 0.81$, SD = 0.91; $t(29) = -.16$, $p > .80$), and therefore the data were collapsed for subsequent analyses. The findings reveal that the children in the imitation group performed significantly more target actions ($M = 1.35$, SD = .91) than the children in the control group ($M = 0.84$, SD = .93; $t(60) = 2.20$, $p < .05$). This was further analysed using a 2 (condition: experimental/control) × 2 (sex) ANOVA which yielded a significant main effect for condition ($F(1,58) = 4.84$, $p < .05$), while neither the main effect of sex ($F(1,58) = 1.56$) nor the condition × sex interaction ($F(1,58) = 0.51$) approached significance.

The results for the long (30 s) response period were even stronger (Table 1). A *t* test comparing the imitation versus control groups revealed a highly significant overall effect

(t(60) = 2.86, $p < .006$). This was further supported by a 2 (condition) × 2 (sex) ANOVA that yielded a significant main effect for condition (F(1,58) = 7.94, $p < .007$). In addition, the main effect for sex (F(1,58) = 3.18, $p < .10$) reflected the fact that there was a slight tendency for boys to score higher in both the experimental (M = 1.76, SD = .97) and the control conditions (M = 1.12, SD = .81) than the girls (imitation group: M = 1.36, SD = .74; control group: M = 0.73, SD = .96). The sex × condition interaction did not approach significance ($F < 1.0$).

Other ways of collapsing the data into categories futher illustrate the strong effect of deferred imitation. For the 30 s response period, 52 per cent (N = 16) of the infants in the imitation condition displayed two or more of the target actions compared with only 22.5 per cent (N = 7) in the two control groups (Table 2). It is also of interest to consider the differences among the groups in the number of infants scoring 0 in the short response period. Fourteen of the children in the control group (45 per cent) failed to produce any target action, while such low responding is observed only for five of the children in the imitation group (16 per cent).

The 14-month observation

The results from the test at 14 months also revealed significant deferred imitation (see Table 3). Once again, preliminary analyses indicated that there was no significant difference in the number of target acts produced by the two different control procedures (baseline: M = 0.93, SD = .83; activity-control: M = 0.86, SD = .77; t(26) = −.34, $p > .90$), and therefore the controls were collapsed for subsequent analysis. Significantly more target actions were observed in the imitation group (M = 1.89, SD = .89) than in the controls (M = 0.89, SD = .79; t(53) = 4.40, $p < .0001$). This was further analysed using a 2 (condition: experimental/control) × 2 (sex) ANOVA which yielded a significant main effect for condition (F(1,49) = 8.71, $p < .0007$), while neither the main effect of sex, nor the condition × sex interaction reached significance ($F < 1.0$).

Table 4 displays the raw number of target actions performed by the children in the different groups. Inspection of the frequencies shows the strong differences in performance. As can be seen, 26 per cent (N = 7) of the infants in the imitation group produced all three target actions after the memory delay, while 0 per cent of the children in the control condition did so. Furthermore, fully 75 per cent (N = 21) of infants in the control condition produced none or only one target action, a response pattern that was observed only among 30 per cent (N = 8) in the imitation group.

Stability in individual patterns

An exploratory *post hoc* analysis of the stability of individual patterns over the longitudinal test revealed an interesting finding (Table 5). For this analysis the infants at the two ages were classified into dichotomous categories of either being `low' or `high' imitators (using the short response period for both ages). Low imitation at 9 months was defined as scoring 0, that is, producing no target actions, while a high imitative tendency was defined as a score of 1, 2 or 3. This isolated five participants who were at the bottom end of the scoring range. The division at 14 months was different because only two subjects in the imitation group failed to display any target actions. Thus, the 14-month-old infants scoring 0 or 1 were classified as low and those scoring 2 or 3 classified as high. This isolated eight infants with low scores. When the 2 × 2 data matrix is arranged accordingly (Table 5), one sees that 65.4 per cent of the children (17 out of 26) are classified as high imitators at both ages and 15.4 per cent (four out of 26) remained low at both ages. Thus, about 80 per cent of the infants were stable in their imitative tendency. This 2 × 2 matrix can be analysed by a Fisher's exact test (expected frequencies too small for χ^2), which shows that there is a statistically significant association between how an infant is classified at the two ages ($p < .05$, Fisher's exact test). A different treatment of the data yielded similar results. A logistic regression analysis was conducted using the performance at 9 months of age as a grouping variable and the infants' scores (low/high) at 14 months of age as the dependent measure. The results showed that the performance at 14 months varied significantly ($p < .05$) as a function of their 9-month-old classification, with the infants who scored low at 9 months performing more poorly at 14 months of age.

Discussion

The results from this study indicate that deferred imitation of simple actions is already evident among 9-month-old babies and strongly present at 14 months. At both ages, children in the imitation condition outperformed the children in the control group, and it did not matter whether the children in the control condition had seen the objects in an alternate presentation (activity-control) or in a pure baseline assessment. The extra exposure to the toys given to the children in the activity-control did not significantly increase the likelihood that a child would produce a target behaviour.

The design used here is noteworthy because it allows a strong case to be made about deferred imitation and memory. In the present design the children were not allowed to touch or handle the toys during the adult's demonstration. The first time the children could manipulate the objects was after the memory delay. This necessarily means that they had to act solely upon their memory for the adult's act; they could not simply be repeating a motor scheme that they had already performed on the toy (as might be possible if infants were allowed to perform immediate imitation before the deferred test). This is a strong form of deferred imitation, and, yet, as reported, there was imitation from memory in 9-month-olds. This indicates that deferred imitation should not be used as the indicator of a major shift in an infant's mental capacity during the second year of life as proposed by both Piaget (1962) and Stern (1985). Deferred imitation must be studied in itself and can no longer be seen as dependent upon parallel language development or the emergence of an 18-month-old semiotic function. As demonstrated by Rast & Meltzoff (1995), different developmental paths seem to exist for imitation and object permanence.

This was the first study to investigate longitudinal stability in deferred imitation. Although not definitive, the data are compatible with the idea of individual differences in imitation, at least concerning the extremes of performance. Children scoring low (0) on deferred imitation at 9 months also tended to stay low at 14 months. The data showed that 80 per cent (four of five children) who were low at 9 months of age scored low at 14 months. In contrast, only 19 per cent (four of 21 children) who were high at 9 months of age scored low at 14 months. Perhaps deferred imitation taps cognitive capacities (e.g. recall memory) that remain stable over infancy, such that infants who scored 0 at the 9-month-old visit have a slower cognitive development than the others. This interpretation is, however, pure speculation at this point, and the finding has to be further studied and replicated before any valid interpretations can be made. Moreover, differences in attention and social responsivity would need to be examined.

Finally, we were struck by an observation about differences between Swedish and American interactive styles that deserves mention. Although the Swedish infants performed deferred imitation at 9 months, there seemed to be a difference in interactive style as indicated by the videotapes of the Swedish and American tests. Empirically, this may be manifest by the fact that the strongest evidence of deferred imitation in the Swedish sample emerged after the 30 s response period, which is slightly longer than was found necessary in the American infants that have been reported. Of course, the Swedish sample showed significant effects at 20 s, and the strengthening of the effect for the 30 s period may be due to random factors. However, we would like to suggest another idea that builds on some interesting observations that we made during the study. We suspect that cultural differences between the USA and Sweden in how adults speak with young children might influence their speed or readiness to respond during the response period. Although `Motherese' is a phenomenon observed in almost all countries (Grieser & Kuhl, 1988), cultural differences have also been observed. Studies suggest that parents in the US exaggerate more when speaking to their infants than parents in other cultures (Fernald, Taeschner, Dunn, Papousek, de Boysson-Bardies & Fukui, 1989). In our experience, it seems true that the American experimenters speak and move in a more animated and exaggerated (`jazzier'?) style when interacting with the test participants than do their Swedish counterparts. This may induce the American infants to be responsive more quickly. Another related possibility is that a more general `cultural style' of American versus Swedish interactions has already begun to affect the pace and style of the infants, independent of the particular test session. It has been reported, for example, that Swedish adults place a value on being relatively cautious or reserved, and exhibit this behaviourally (Daun, 1996; Daun, Burroughs & McCroskey, 1988). Thus, the Swedish infants might already have begun to adopt this style and interact with the adults and toys in a more deliberate, reserved or cautious fashion than the American infants. There are precedents in other areas of infant development suggesting that cultural differences may influence infants in this age range. The effect of cultural–linguistic differences on infant behaviour was demonstrated as early as 6 months of age in a study of infant speech perception, in which the ambient language was found to have altered the way that Swedish versus American infants responded to different speech sounds (Kuhl, Williams, Lacerda, Stevens & Lindblom, 1992). The speculation offered here is that the ambient culture might have an influence on infants' motor-interactive styles. This makes a good deal of sense within the present context of reporting deferred imitation. Deferred imitation demonstrates that a short-term laboratory exposure is enough to change the behaviour of the infant. Deferred imitation shows that the infants' current actions can be controlled on the basis of a long-term memory of what they saw the adult do. It is therefore not unreasonable to wonder whether the everyday adult–adult and adult–infant interactive style that the child observes might also influence the child's behavioural pattern. This would entail deferred imitation at a more macro level. If so, it would underscore the power of learning by observation and imitation before verbal instructions are possible.

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Table 1

Deferred imitation at 9 months ($N = 62$): Mean target actions observed for the three different conditions

		Response time			
		20 s		30 s	
Condition	***N***	**Mean**	**SD**	**Mean**	**SD**
Imitation	31	1.35	.91	1.58	.89
Control	31	0.84	.93	0.94	.89
Baseline control	15	0.87	.99	0.93	.96
Activity control	16	0.81	.91	0.94	.85

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Table 2

Number of 9-month-old infants producing different numbers of target acts as a function of test condition when a short (20 s) or a long (30 s) response time (RT) is used

	***N* target acts**			
	0 or 1		**2 or 3**	
Condition	**RT 20 s**	**RT 30 s**	**RT 20 s**	**RT 30 s**
Imitation (*N* = 31)	17	15	14	16
Control (*N* = 31)	24	24	7	7
Baseline control	*11*	*11*	*4*	*4*
Activity control	*13*	*13*	*3*	*3*

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Table 3

Deferred imitation at 14 months (*N* = 55): Mean target actions observed for the three different conditions

		Score	
Condition	***N***	**Mean**	**SD**
Imitation	27	1.89	.89
Control	28	0.89	.79
Baseline control	14	0.93	.83
Activity control	14	0.86	.77

Table 4

Number of 14-month-old infants producing different numbers of target acts as a function of the test condition

	***N* targets acts**			
Condition	**0**	**1**	**2**	**3**
Imitation (*N* = 27)	2	6	12	7
Control (*N* = 28)	10	11	7	0
Baseline control	*5*	*5*	*4*	*0*
Activity control	*5*	*6*	*3*	*0*

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Table 5

Stability of individual differences: Number of infants in imitation group classified as low or high imitators on tests at 9 and 14 months

	Imitation at 14 months		
Imitation at 9 months	**Low (score 0–1)**	**High (score 2–3)**	***P* <**
Low (score 0)	4	1	
High (score 1–3)	4	17	.05[a]

[a]Fisher's exact test.