Siblings as Models in Early Infant Learning

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WISHART, JENNIFER G. Siblings as Models in Early Infant Learning. CHILD DEVELOPMENT, 1986, 57, 1232–1240. 4 groups of infants, 2 at 6 months and 2 at 12 months, were tested on the Stage IV–V and V–VI object concept tasks. All groups were then retested on the same tasks 1 week later. Retesting of the experimental groups was preceded by an all-correct demonstration of the 2 search tasks by the infant’s preschool sibling; control groups were not exposed to any model prior to reassessment. No effect of exposure to the sibling model was initially found in either age group. If, however, infants’ initial stage of development was taken into account, cognitive performance on the lower-level task did show a significant improvement after modeling. Overall, the results suggest that sibling modeling could possibly be an effective method of facilitating cognitive development in infancy, but that the success or failure of any modeling attempt may be stage- rather than age-dependent.

Learning by observing the behavior of others has long been recognized as an important factor in development, and a number of experimental studies have demonstrated that exposure to a model can have a powerful effect on the behavior of preschool and school-age children (Bandura, 1977; Bandura & Walters, 1963; for a review of modeling studies, see Maccoby & Jacklin, 1974). The current study was designed to investigate whether modeling could also facilitate learning in 6- and 12-month-old infants, or, more specifically, to investigate whether exposure to the successful search behavior of a sibling in two object-concept tasks would enhance infants’ subsequent performance on these tasks.

Imitation is widely acknowledged as a basic means by which the child acquires both social and intellectual competences (Rosenthal & Zimmerman, 1978). It is already known that the sibling plays an important role in the day-to-day life of the infant (Abramovitch, Corter, & Lando, 1979; Lamb, 1978; Pepler, Abramovitch, & Corter, 1981); there is also evidence that infants are more likely to be attracted to, to imitate, and to relate to “like-self” models—that is, siblings and peers—than to adults (Edwards & Lewis, 1979; Lewis & Brooks-Cunn, 1979; see also Rubinstein & Howes, 1976; Vandell, Wilson, & Buchanan, 1980). To date, however, little or no direct research on the role of modeling in the infant’s cognitive development or on the possible influence of the sibling as a model in early infant learning has been done.

Most studies on infant imitation—generally using an adult model—have concentrated on elementary motor, vocal, or social behaviors (see, e.g., Kay, 1982; Kessen, Levine, & Wendrich, 1979; Meltzoff, 1985; Meltzoff & Moore, 1977, 1983). A cognitive task was selected in this study in order to examine whether modeling could also facilitate performance on a task that would require more than straightforward reproduction of the model’s behavior, one that would require mapping onto or identifying with the higher-level cognitive rules that direct that behavior.

Object-concept development was selected as a paradigm case for several reasons. First, it is one of the most widely researched areas of cognitive development in infancy (see the reviews of Harris, in press; Schubert, 1982). A recent cross-sectional normative study (Wishart & Bower, 1984) provides a precise, up-to-date data base against which to assess performance, and previous longitudinal work (Bower, 1982; Bower & Paterson, 1972; Gratch & Landers, 1971; Luger, Wishart, & Bower, 1984) has established criteria for learning. Such highly detailed information on other areas of cognitive development in infancy is not yet available.

Second, object-concept development has been shown in numerous studies to be a universal process; infants in all cultures and of all levels of intelligence apparently pass through the same six stages in the same sequence. Rate of object-concept development has,

This research was supported by MRC project grants G970932/N and G8314998N. Thanks are also due to all the mothers, infants, and siblings who participated in this study and to Stuart Aitken, Tom Pitcairn, and T. G. R. Bower for encouragement and advice throughout. Reprint requests should be sent to the author at the Department of Psychology, University of Edinburgh, 7 George Square, Edinburgh EH8 9JZ, Scotland.

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however, been shown to be highly susceptible to environmental influences. For example, Hunt, Paraskevopoulos, Schickedanz, and Uzgiris (1975) showed that age of achievement of the highest stage of object-concept development can vary between 73 weeks (in a low-income, U.S. group taking part in a training program) and 182 weeks (in a Greek orphanage with a very low staff-to-infant ratio). Similarly, Wishart and Bower (1985) have shown that weekly exposure between 12 and 28 weeks of age to a highly structured, conceptually rich visual tracking task can apparently double the rate of subsequent object-concept development. This susceptibility of rate of object-concept development to environmental input suggests that it would be worth investigating whether exposure to modeling of the target search behaviors affects subsequent performance on these tasks.

Third, object-concept development is considered by many to be the prototype of all later processes of cognitive development, and a number of developmental psychologists view acquisition of the object concept as crucial to subsequent cognitive development (see Bower, 1982; Piaget, 1937/1955). Object-concept development is one of the few cognitively directed behaviors of infancy that has any predictive validity for later intellectual development (Birns & Golden, 1972; Wachs, 1975; Wishart, 1979), and there is evidence to suggest that it may also be related to subsequent rate of language acquisition (Siegel, 1981).

**Method**

**Subjects**

Subjects were 24 6-month-old infants and 24 12-month-old infants, 12 males and 12 females at each age. All infants were within 1 week of 6 or 12 months on the first of the two testing sessions. Both age groups were divided into experimental and control groups, six males and six females in each. All of the younger infants were able to reach and had been doing so for at least 4 weeks prior to the first testing session.

Subjects were selected from a volunteer pool of babies available to the psychology department. For a number of reasons, this pool has a bias toward first-time mothers. As a result both of this bias and the increasing trend toward single-child families, it proved impossible to obtain 24 subjects with siblings at each age level. Since all subjects in the experimental group had to have a sibling to act as model, selection of control subjects was restricted to infants without siblings rather than have a group composed of infants both with and without siblings.

Siblings ranged in age from 2.3 to 4.5 years. Mean age was 3.03 years in the 6-month group (SD: .63 years), 3.16 years in the 12-month group (SD: .89 years). There were nine matched-sex and three mixed-sex infant-sibling pairs in the 6-month experimental group; the 12-month group contained 10 matched-sex and two mixed-sex pairs.

**Design and Procedure**

All infants made two visits to the lab, the second visit within 1 week of the first. Infants were tested with the Stages IV–V and V–VI object-concept tasks in both sessions. For the control group, both testing sessions were identical. For the experimental group, testing on the second session took place after an all-correct demonstration of both tasks by his or her sibling. A detailed description of exact testing conditions can be found in Wishart and Bower (1984). Only those aspects of testing directly relevant to the study reported here are given below.

Infants sat on their mothers’ knee at a small testing table, facing the experimenter. Plain white cardboard cups, 10 cm high × 6 cm in diameter, were used as occluders. A variety of small objects—brightly colored wooden dolls, bells, squeaky rubber animals, and the like—were used for hiding. All infants were first presented with four warm-up trials in which a cup was slowly placed over an object (the standard Stage III–IV task; see Wishart & Bower, 1984). Few infants failed on any of the warm-up trials and no infant on more than one. The few “failures” seemed to reflect initial suspicion rather than conceptual problems, these particular infants being slow to take the object even when uncovered. All infants could therefore be assumed to be in at least Stage IV of object-concept development at the onset of the experiment.

**The Stage IV–V (or AAB) task**.—The two cups were placed 8 inches (20 cm) apart, at an equal distance from the infant. A toy was hidden under one (A) of the cups and the infant given 2 min in which to retrieve it. If successful, the same object was then again hidden in the same position (A). Any attempt to search first at the other occluder (B) was scored as an error, and the next set of trials commenced. If successful, however, the same object was then hidden in position B. On the B trial, a delay of 1 sec (during which the mother physically restrained the infant from reaching toward either cup) was introduced.
between hiding and onset of search (see Gratch, Appel, Evans, Le Compte, & Wright, 1974). Infants were given time (and encouragement) to correct any errors; if they failed to do so, the experimenter removed the cup and gave them the object.

Each infant was given four trials, two starting on his (or her) right, two on the left. Order of initial side at which the object was placed was randomized over trials for each infant and his matched control, all six possible orders of presentation being used twice each. Each AAB sequence was clearly separated by a short time interval, and a new object was used for each new set of trials.

**The Stage V–VI (or switching) task.**—The two cups were again placed 8 inches (20 cm) apart and at an equal distance from the infant. With the baby watching, an object was placed under one. The two cups were then transposed, resulting in the invisible displacement of the object from left to right or vice versa. The cup containing the object was always moved in front of the empty cup at the crossover point. A 2-min retrieval time was again allowed. All errors made by the infant were corrected by the experimenter if the infant did not attempt to do so himself.

Four trials were given, two starting on the right, two on the left. Each infant and his (or her) matched control were randomly assigned to one of the six possible orders of starting position over trials, with the proviso that the assigned order was different from that assigned in the first set of tasks. All six orders were used twice, as in the first task. Again, each switching trial was clearly separated by a short time interval, and a new object was introduced for each trial.

Testing Sessions 1 and 2 were identical for the two control groups. For the experimental groups, however, retesting was preceded by an all-correct modeling/demonstration (presented in the same order) by their older sibling. The sibling sat on the experimenter’s lap, facing the infant, who sat, as previously, on his or her mother’s knee. The same trial order used for each infant in each task in the first testing session was repeated in the second session, both for testing and modeling (with left and right defined from the infant’s point of view, that is, reversed for the sibling). Any unavoidable partial occlusions of the event were arranged so that the sibling rather than infant’s view was temporarily restricted. As far as possible, the same toys were used for hiding in both the modeling and testing parts of this second session.

Little encouragement to attend to the sibling and the tasks was required. Mothers frequently, in fact, had to restrain their infants from grabbing the cup before their sibling could get to it. With the exception of a very few of the youngest siblings, siblings needed no help (or encouragement) to choose the correct cup on each occasion, apparently enjoying their role as “teachers.” Discrete verbal prompting was used on the few occasions when the sibling looked about to remove the incorrect cup. Each time the sibling retrieved the hidden toy from under the correct cup, he or she gave it to the infant for a few seconds.1

**Success/failure criteria.**—In both tasks, direct recovery of the object on all four trials was taken as the criterion for success; failure on any trial was scored as failure on that task as a whole. This may seem a rather strict criterion for success. With a two-choice search task and four trials, however, anything less would be statistically unsound. Evidence from a recent normative study shows how easily adoption of a lesser criterion can lead to misassignment of stage of development (Wishart & Bower, 1984). There is also longitudinal evidence (Bower & Paterson, 1972) that success

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1 It could perhaps be suggested that a further control condition should have been included, one in which the siblings played with the toys and cups used in the hiding tasks but did not actually model the correct responses to the tasks. The aim would be to control for the possibility that any improvement in performance after modeling could simply be due to experimental infants being more motivated in the second testing session after seeing their siblings playing with the toys. Although such a control would make this study more analogous to the procedure used in traditional modeling studies, it was not run for two reasons. First, it seemed unlikely that infants in the experimental group were undermotivated in the first testing session. Many had to be restrained from reaching during the hiding sequence, and none took more than a couple of seconds to search at their first choice of cup. Second, such a control would seem to present both theoretical and practical problems. Outside of the hiding task, the toys used here, all selected for their previously demonstrated attractiveness to 6- and 12-month-olds, would hold little or no interest for the average 3-year-old. More important, much of what the sibling would be likely to do if given the experimental materials—two cups and the objects—and no directions would be likely to relate to the object concept as we presently understand it. Unless sibling activity in this period were strictly controlled (and how the cooperation of the sibling could then be ensured is highly problematic), it would seem that such a control might present more problems than it could solve.
on fewer than four trials, even on as many as three, is no guarantee that the infant has a high level of understanding of that particular task or is necessarily close to achieving that understanding.

Reliability

Video records of both testing sessions of four 6-month and four 12-month infants (two experimental, two control) were randomly selected and rescored by a second scorer familiar with object-concept testing procedures but blind to the aims of the experiment, to the order of presentation of the two testing sessions, and to the exact age of the subjects. (The modeling part of Testing Session 2 was deleted from the records of the experimental subjects.) Any discrepancy between the two scorers was reexamined and, if necessary, resolved in favor of the second scorer. Inter-rater reliability over all trials double-scored was .98.

Results

Session 1 and 2 scores for the 6- and 12-month experimental and control groups are compared in Table 1. In both age groups, performance improved on retesting in more experimental than control infants. The difference in number of subjects changing stage, however, was statistically significant in only the older age group on the easier task, and even this one positive finding was of dubious validity. From Table 1 it can be seen that 11/12 control infants were already in Stage V on the first of the two testing sessions. This artificial restriction on upward change therefore left only one control subject for whom it was even possible to show any improvement on retesting.

Are we then to conclude that exposure to a model has no effect on cognitive performance at either 6 or 12 months? Closer inspection of Table 1 would suggest that such a conclusion may not be warranted. In the case of the Stage IV–V task, for example, more than half of the 6-month-old experimental subjects did move up a stage after watching their successful sibling, and three infants, already in Stage V, had no opportunity to improve. Effectively, then, 7/9 infants improved after exposure to the sibling model.

Although these figures look promising, two problems arise in assessing their significance. First, the number of infants found to be in Stage V on the first testing session differed in experimental and control groups, and second, there is no obvious basis for determining the relative probabilities of change and no change on retesting (see above). Together, these rule out the use of any straightforward method of determining the significance of the revised results. In order to circumvent these problems, and to investigate the possibility that stage of development rather than chronological age may influence the effect of modeling on the infant’s subsequent performance, the three experimental and two control Stage V infants from the 6-month-old groups were replaced with five other 6-month-olds, dropping any replacement subjects who proved to be in Stage V on the first testing session (a total of seven infants needed to be tested to
TABLE 2

COMPARISON OF SCORES IN SESSIONS 1 AND 2 FOR STAGE-MATCHED 6- AND 12-MONTH GROUPS

<table>
<thead>
<tr>
<th>Task IV–V</th>
<th>Task V–VI</th>
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<tr>
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<td>EXPERIMENTAL GROUP</td>
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6-month Stage IV infants:
- No. passing ......................... 0 10 0 4 0 2 0 1
- No. showing improved performance on retesting ......................... 10** 4 2 1

12-month Stage IV–V infants:
- No. passing ......................... 5 11 10 11 0 4 0 0
- No. showing improved performance on retesting ......................... 6* 1 4 0

NOTE.—N = 12 for each group.

* That is, not yet in Stage VI.

** $\chi^2(1) = 3.23, p < .05$.

$\chi^2(1) = 4.29, p < .025$.

obtain five suitable same-sex subjects). The same procedure, for the same reasons, was considered for the 12-month groups. Replacing all infants already in Stage V with Stage IV infants would, however, have led to a very unrepresentative group of 12-month-olds, since erring on this task is very infrequent in infants of this age (Wishart & Bower, 1984). All experimental and control infants who were already in Stage VI (N = 2 and 3, respectively) were therefore replaced, since such subjects could not have been expected to better their performance on either of the two tasks on retesting. The results of this replacement procedure are shown in Table 2.

Using stage-matched groups, the Stage IV–V performance of subjects of both ages improved significantly after exposure to modeling. The same qualifications hold in interpreting the change in performance in the older infants as above, however. Since the older age groups were adjusted to include only infants who were not yet in Stage VI (rather than not yet in Stage V), the number of subjects already in Stage V was not directly controlled in experimental and control groups (N = 5 and 10, respectively). As a result, potential for upward change on the lower-level task was obviously much greater in the experimental group to start with, irrespective of any experimental manipulation.

This difference in potential for upward change, although invalidating the statistical difference found between the performance of the two older groups in the second testing session, is worth closer examination in its own right. In both the revised and original 12-month groups, initial performance on the Stage IV–V task was considerably better in the control groups, with nearly twice as many control as experimental infants passing, $\chi^2(1) = 2.84$ and 3.23, $p < .05$ in both cases. It is obvious that it is the experimental rather than the control group that deviates from the norm (Wishart & Bower, 1984), with the only difference between the experimental subjects used here and the Wishart and Bower subjects being that the latter were predominantly first-born (as were all the control infants used here); all experimental infants, by contrast, were second- or later-borns.

Neither age group of experimental infants managed to improve performance significantly on retesting on the higher-level task, although the 12-month group did better than the 6-month group, and of the seven instances of upward change, six were in experimental infants, with performance in the control groups remaining virtually unchanged on retesting. The difference in performance on initial testing between experimental and control subjects seen above in the Stage IV–V results did not emerge in the Stage V–VI results.

No sex differences were found in either session in any group of subjects. Effect of same- versus different-sex dyad on performance in the experimental groups could not
TABLE 3
COMPARISON OF SCORES IN SESSIONS 1 AND 2 FOR COMBINED 6- AND 12-MONTH STAGE-MATCHED GROUPS

|                      | COMBINED 6- AND 12-MONTH STAGE IV INFANTS | COMBINED 6- AND 12-MONTH STAGE IV-V INFANTS
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Experimental Group</td>
<td>Control Group</td>
</tr>
<tr>
<td>No. passing</td>
<td>0 16</td>
<td>0 5</td>
</tr>
<tr>
<td>No. showing improved</td>
<td>16*</td>
<td>5</td>
</tr>
<tr>
<td>performance on retesting</td>
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</tr>
</tbody>
</table>

*That is, not yet in Stage VI.

Sample size and the apparent importance of developmental status rather than chronological age on the effectiveness of modeling—unforeseen at the onset of this study—undoubtedly restricted the possibility of strong findings from the groups tested here. If, however, the Stage IV-V and V-VI results of all infants who had failed on the initial presentation of either (or both) tasks are analyzed, disregarding age, the modeling effect seen above is considerably strengthened. Combining the age groups and using only those infants for whom the possibility of improved performance on Session 2 had actually existed leads to a legitimate increase in stage-matched subject numbers and also removes the ceiling effect on results previously operating on the lower-level task results in the older age groups. Nineteen experimental infants and 14 control infants were in Stage IV on Session 1 and qualified therefore for the Stage IV-V analysis; 27 experimental and 26 control infants were not yet in Stage VI and could therefore be included in the Stage V-VI analysis. When first and second testing sessions were compared, the significance of the modeling effect previously found for the lower task rose from .025 to .01, \( \chi^2(1) = 6.23 \). The combined Stage V-VI results did not reach significance but were suggestive of a similar trend, \( \chi^2(1) = 2.46, p < .10 \) (see Table 3). This would suggest that with larger numbers and more carefully defined groups, stronger results might well be obtained.

**Discussion**

This study investigated the effect of exposure to sibling modeling of two object concept tasks on subsequent search behavior in 6- and 12-month infants. In the initial age-matched groups, no significant effect of modeling was found for either task. If, however, infants’ initial stage of development was also taken into account in matching, performance on the easier of the two tasks modeled was shown to have improved significantly in the 6-month-old group exposed to a sibling model. If, moreover, the results from both age groups were collapsed, with infants being matched for initial stage of development irrespective of age, the significance of this effect was considerably strengthened. Similar trends were evident in the results from the higher level task, but none reached significance.

The positive effect of modeling seemed then to be limited in two respects: first, to upward change of only one stage, from Stage IV to Stage V, and second, to infants at a particular stage in their development. Although 16 out of 19 Stage IV infants improved on their initial performance after exposure to modeling, only four out of these 16 moved up two stages, to Stage VI; of those 6-month-olds already in Stage V on the first testing session, none moved into Stage VI after modeling. Taken together, these limitations suggest that developmental stage of the infant subject may
be more important than his or her age in determining the success or failure of any modeling attempt, with proximity to the natural transition point in development increasing susceptibility to the accelerative effect. Very few 12-month-olds improved on their initial Stage V–VI performance, possibly because they were still well below the age when they might have been expected to succeed on this task (Wishart & Bower, 1984). Overall, the findings fit well with results from modeling studies in other areas (e.g., Shipley, Smith, & Gleitman, 1969; Turmel, 1966) and also with the few noncognitive infant modeling studies done to date (Fenson & Ramsay, 1981; Harnick, 1978). In all of these studies, the effectiveness of modeling has been restricted by the developmental level of the subject.

Although the trends found in this first exploratory study are limited, they are nonetheless promising, particularly given the strictness of the criteria used for assessing improvement in performance on retesting and the inherent advantage the results suggest that the firstborn control infants may have had over the experimental infants. Any future study should, however, match groups for sibling status in order to control for any direct or indirect influences, positive or negative, that this may have on performance. It is also possible that the failure to achieve any statistically significant effect of modeling on the higher-level task could have stemmed from the fixed order of presentation of the tasks, subjects responding better to the task that was both demonstrated and tested first. When the trend toward improved performance in older subjects on the higher-level task, not seen in control subjects, is also taken into account, a stage-determined, cognitive-developmental interpretation of the results seems more interesting than one based on subject memory limitations. Balancing the order of presentation or testing older groups, say, 15- or 18-month-olds, could easily, however, disambiguate the two hypotheses.

Why should sibling modeling have influenced subsequent cognitive performance? Although the sibling successfully retrieves the object on each occasion, whether it is visibly or invisibly moved to a new location, the rule that directs his or her choice of location is clearly not directly perceptible in any way by the infant. It is possible that establishment of a joint focus of attention (Bruner, 1977) with a highly significant partner increases the salience of the task-relevant information for the infant. The structured demonstration by the sibling may help the infant to organize his imitative abilities, and since he already knows that he can lift cups, the modeling by the sibling may emphasize that more is necessary for success in these tasks. From the video records, it is clear that the infant also rehearses his or her own choices during the modeling period, often struggling to reach for the A cup on the B trial, for instance, only to see his brother or sister choose the other, correct cup; this highlighted mismatch between responses must surely foster attention to the relevant features of the task situation, facilitating the process of cognitive matching between infant and sibling. Repeated exposure to a cognitively rich tracking task has been shown to accelerate development of the cognitive rules necessary for success in object-concept tasks (Luger et al., 1984; Wishart & Bower, 1985). This study confirms that visual activity on the part of the infant can be a powerful route to cognitive solutions.

The results suggest the possibility of a new, fruitful area of research, one that might provide a much-needed interface between research into the social and cognitive aspects of early development. Since infants in the age group tested here are more attentive to peers than adults (Rubinstein & Howes, 1976; Vandell et al., 1980) and are particularly attentive to same-age children (Edwards & Lewis, 1979; McCall & Kennedy, 1980), it might be that (filmed) peer modeling would be more effective than sibling modeling, with a same-sex peer being most effective (Lewis & Brooks, 1974; Stewart, 1983). A study both to examine this possibility and to test how long-lasting the beneficial effects of modeling are is presently under way.

Deliberate and frequent formal modeling would seem unnecessary for normal development. Should the trends seen here be confirmed in subsequent studies, however, cognitive modeling could possibly play a role in facilitating development in infants who are known or can be expected to be delayed in their development. Use of a sibling as model in such cases could serve a dual purpose over and above the hoped-for benefits for the infant: it would take some of the weight of the intervention program off the parents (Cunningham, 1982) and also involve the sibling more directly with the handicapped infant, a process which has already been shown to be beneficial for both parties (Schreibman, O'Neill, & Koegel, 1983).

One last point is worth discussing—the nonexperimental finding that object-concept
performance on the initial testing session was much poorer in both 12-month-old experimental groups than in their matched controls. This difference between first- and later-born did not show up in the 6-month groups. There seems to date to have been no direct investigation of the possible effects of birth order on object-concept development. This study suggests that later-born children are at a disadvantage in cognitive development from a very early age, with the gap between them and firstborns first becoming established somewhere between 6 and 12 months of age. To some extent, this finding is difficult to reconcile with the outcome of the experiment reported here. Since later-born children have almost unlimited access to a sibling model, it might be expected that any advantage in cognitive development should be in their favor, rather than vice versa. That it would appear not to be suggests that the effectiveness of modeling may be highly dependent on both presentation and content being carefully structured.

References


