Developmental Psychology
1993, Vol. 29, No. 1, 88-95

0012-1649/93/$3.00

Self-Awareness and Other-Awareness: Mirror Self-Recognition and Synchronic Imitation Among Unfamiliar Peers

Jens B. Asendorpf and Pierre-Marie Baudonnière

A theoretical analysis of the cognitive capacities underlying self-awareness and other-awareness suggested that (a) self- and other-awareness are closely linked because both require a cognitive capacity for secondary representation, and (b) other-awareness facilitates the synchronic imitation of object use with an unfamiliar peer. The relation between mirror self-recognition and synchronic imitation was investigated in 56 dyads of unfamiliar 19-month-old children who were systematically paired according to their mirror self-recognition status and who were observed during free play with sets of duplicate toys. Long phases of synchronic imitation occurred in nearly all dyads consisting of recognizers but in only one dyad composed of nonrecognizers; in mixed dyads these phases were shorter than in recognizer dyads. Discussion focuses on the synchrony of the development of self- and other-awareness.

During the second year of life, children's social–cognitive competence shows a dramatic increase. Kagan (1981) has described many of these changes, for example, becoming concerned with parental standards for behavior, developing a sense of one's effectiveness in solving a task, and beginning to appreciate the difference between pretense and reality. According to Kagan (1981), these changes indicate the onset of *self-awareness:* Children become able to evaluate their appearance and actions in terms of their own and others' standards. From another perspective, the social–cognitive changes during the second year also reflect the onset of *other-awareness:* Children become aware of others' intentions, motivations, and emotions, and they become increasingly able to use this information in social interaction.

Self-awareness is a cognitive capacity that marks a specific step in self-development. In recent years, different sequences have been proposed for the development of the self during the first 2 years of life (e.g., Emde, 1983; Lewis, 1986, 1990; Stern, 1985). Despite some differences in their definitions of the developmental levels, these authors agree that a critical step is reached when children become able to represent themselves as an object of knowledge and imagination (the representational self, Emde, 1983; the categorical self, Lewis, 1986; and the verbal self, Stern, 1985). This capacity for self-awareness sets the stage for self-conscious social emotions such as embarrassment, pride, and shame that are triggered by self-evaluation in the presence of others (H. Heckhausen, 1984; J. Heckhausen, 1988; Lewis, Sullivan, Stanger, & Weiss, 1989), and self-awareness is a prerequisite for self-presentation in social interaction (e.g., deception; Lewis, Stanger, & Sullivan, 1989).

Research on self-development in the second year has found that many children show indications of self-awareness before using verbal labels for themselves (Bertenthal & Fischer, 1978; Lewis & Brooks-Gunn, 1979). According to this research, the best empirical indicator of self-awareness is the mirror self-recognition test originally proposed by Amsterdam (1972). Children are marked with a spot of rouge on their face: Mark-directed behavior (instead of mirror-directed behavior or no reaction) is interpreted as evidence that children infer from the mirror image that they themselves have a mark.

We understand other-awareness as a cognitive capacity that marks a specific stage in the development of empathy, just as self-awareness marks a specific stage in self-development. Empathy in a broad sense refers to sharing the cognitions and emotions of others (see Eisenberg & Strayer, 1987). Hoffman (1976, 1987) proposed a three-step developmental sequence for empathy. Infants are capable of emotional contagion, that is, they react to the emotional expression of others with the same emotion. In the next stage of "egocentric empathy," children can experience another's emotional state as distinct from their own state because they possess a separate "image of self" and "image of other." This capacity makes empathic behavior much more flexible, because now children can react to another's emotional state with a different emotion or with behavior that reflects the emotional meaning of the situation for the other person rather than for themselves (e.g., helping a victim of distress). The cognitive capacity to represent another's internal state as distinct from one's own state is what we call other-awareness.

Other-awareness does not require role- or perspective-taking skills. These skills emerge later; according to Hoffman (1987),

Jens B. Asendorpf, Max-Planck-Institut für psychologische Forschung, München, Germany; Pierre-Marie Baudonnière, Laboratoire de psychobiologie de l'enfant, Conseil National de Recherche Scientifique, Paris, France.

The study reported here was conducted as part of the project, "Development of Early Social Cognition," funded by Max-Planck Society, Germany, and Conseil National de Recherche Scientifique, France. We thank the children and parents involved in this study for their cooperation; Angelika Caputo and Monique Bruston for coding the tapes; Doris Bischof-Köhler, Jaqueline Nadel, and three anonymous reviewers for their helpful comments on our work; and Merry Bullock for assisting with our English.

Correspondence concerning this article should be addressed to Jens B. Asendorpf, Max-Planck-Institut für psychologische Forschung, Leopoldstrasse 24, D-8000 München 40, Germany.

they mark the third stage of empathy development. Perspective taking means that a child can deliberately take the perspective of another person; it is studied in situations when children are verbally instructed to take the view of others (e.g., Flavell, Botkin, Fry, Wright, & Jarvis, 1968; Selman, 1980; Wimmer & Perner, 1983). In contrast, we assume, similarly to Bischof-Köhler (1989, 1991), that other-aware children "find themselves in the perspective of others" by a spontaneous act of empathic identification.

The notion of other-awareness becomes perhaps most clear when it is viewed within recent theories on the origins of children's theory of mind (Leslie, 1987; Perner, 1991). Infants can form *primary representations* that are more or less accurate reflections of the perceived reality (Leslie, 1987; Perner, 1991). More advanced is the cognitive ability to coordinate primary representations with *secondary representations* (Perner, 1991) that are detached from immediate reality to represent past, future, pretended, or purely hypothetical situations (in his analysis of pretense play, Leslie, 1987, has called them *metarepresentations*). Other-awareness rests on the ability to coordinate one's perception of others' behavior (primary representation) with representations about others' cognitions or emotions (secondary representations); thus, other-awareness requires the capacity for secondary representation.

The notion of secondary representation is also helpful for understanding self-awareness and its relationship with other-awareness. Self-objectification requires forming a mental model of oneself that can be manipulated in fantasy—a secondary representation. Mirror self-recognition requires coordinating a mirror image (primary representation) with one's objectified self (secondary representation). Thus, both self- and other-awareness appear to rest on the same cognitive capacity for secondary representation and, therefore, they may emerge in rather close synchrony. Discrepancies may still arise because of additional capacities that are necessary for either self- or other-awareness but not for both. The central aim of the present study was to explore the synchrony between self- and other-awareness.

A few empirical studies on the relationship between self- and other-awareness exist, and their results do not disconfirm the synchrony hypothesis. Zahn-Waxler, Radke-Yarrow, and King (1979) found that children began to react with empathic behavior to victims of distress around the age of 18 months—behavior that could not be explained by emotional contagion. In a later study (Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992), self-recognition as assessed by the visual self-recognition test of Bertenthal and Fischer (1978) showed modest relations with prosocial and empathic behaviors directed to victims of distress at 24 months but not at 18 months. Because mirror self-recognition is only one of five tasks in this test, these results are only tangential to the synchrony hypothesis. Direct support comes from two studies with 16- to 24-month-old children by Bischof-Köhler (1988, 1991), who found a strong correlation between mirror self-recognition and empathic responses to a victim of distress, even after partialling out chronological age.

In the present study, we related mirror self-recognition to another possible indicator of other-awareness: synchronic imitation of object use among unfamiliar peers. Ritualized forms of social coordination such as peek-a-boo can be observed early in life, but these infant games require only the acquisition of simple stimulus–response rules, such as turn alternation (see Bruner, 1983; Ross & Kay, 1980). What appears to emerge during the second year is the more advanced ability of coordinating one's behavior with the *nonritualized* behavior of an adult (Eckerman & Didow, 1989; Eckerman & Stein, 1990; Ross & Lollis, 1987) or a peer (Eckerman, Davis & Didow, 1989; Mueller & Brenner, 1977; Ross, 1982). Most clear to interpret are situations in which a child in an unfamiliar environment is confronted with an unfamiliar partner, because the child cannot communicate with the partner by means of preestablished behavioral rituals.

Because verbal contact initiation is rarely possible around the age of 18 months, children at this age approach each other most often by parallel play, that is, by playing with similar toys near to the partner, with some visual regard of the partner but without clear indications of interaction (Parten, 1932). If they move on to interaction, it is most frequently a particular form of preverbal communication: the *synchronic imitation* of each other's object usage (Baudonnière, 1988a, 1988b; Eckerman et al., 1989; Eckerman & Stein, 1990; Nadel & Fontaine, 1989; Nadel-Brulfert & Baudonnière, 1982).

In synchronic imitation, two children play at the same time with the same type of object in a similar, though not always identical way. They appear to be well informed about each other's activity, as indicated by regular looks to the partner; seem to realize and to enjoy the reciprocity inherent in their play, as indicated by a positive mood; and often begin using the objects at about the same time. This type of behavior is different from mere attraction to the same type of objects (which is indicated by delayed imitation or parallel use of the same type of objects without visual regard), and it is different from parallel play because it is a form of communication that involves a common code (using common objects in a similar way) as well as reciprocity of behavior.

This theoretical perspective suggests that the capability for other-awareness makes it easier for children to coordinate their behavior with the behavior of an unfamiliar partner—particularly to start synchronic imitation and to continue it for a longer period of time—because they can become aware of the partner's intentions of using objects that increase the predictability of the partner's behavior. Increased predictability, in turn, increases attention to the partner and provides some emotional satisfaction. The extent to which children are able to engage in synchronic imitation with an unfamiliar peer thus appears to be a good empirical indicator of their other-awareness, and the association between mirror self-recognition and synchronic imitation with an unfamiliar peer can be interpreted in terms of a synchrony between self- and other-awareness.

Therefore, in this study, we systematically paired unfamiliar 19-month-old children in terms of their mirror self-recognition status and studied the extent to which they engaged in synchronic imitation. We adopted the observational setting from Nadel and Baudonnière (Baudonnière, 1988a, 1988b; Nadel & Fontaine, 1989; Nadel-Brulfert & Baudonnière, 1982), who studied imitation in dyads of 2- to 4-year-olds in a room equipped with pairs of objects, initially placed side by side. This

arrangement elicits synchronic imitation among familiar children and facilitates the coding of imitation.

On the basis of the synchrony hypothesis for self- and other-awareness, we expected that sustained synchronic imitation occurs when both peers are self-recognizers. We further hypothesized that in mixed dyads, in which only one of the peers is a recognizer, the recognizer will try to initiate synchronic imitation more often than the partner but, because the partner will have difficulties in joining communication, we expected only short sequences of synchronic imitation. Finally, we expected that two nonrecognizers would not engage in sustained synchronic imitation. If they did use objects in similar ways, they would do this only because their attention had been drawn by the partner to these objects in a noncommunicative context.

Method

Subjects

The parents of all 548 children born in the inner city of Munich, Germany, during a 4-month period in 1988 were asked by letter to participate in a study on "ego development." Parents of 167 children (30.5%) agreed to participate in the study. From this sample, 41 children were excluded because parents reported some risk factor (e.g., the child was a preterm baby, there were complications during pregnancy or birth, or the child suffered from a major illness after birth). In addition, 12 children did not participate on 1 of the 2 days of observation because of illness or scheduling problems. Thus, 114 children participated in the study. Their age varied between 18.6 months and 19.6 months ($M = 19.1$, $SD = 0.2$).

Because of the self-selection of the parents, the sample was biased toward better educated parents and nonworking mothers. Two children attended a full-day nursery school, and 31 had a sibling of age 4 or younger. Of the remaining 81 children, 66 children attended small play groups with children up to age 4 (average time attended varied between 2 and 12 hr per week), and 15 children had no regular contact with peers. This rather restricted peer experience in the sample is fairly representative of children in Munich.

Mirror Tests

On the first day of observation, a female experimenter involved the children in warm-up play with some small toys in front of a mirror while the accompanying parent was reading a magazine in a corner of the room (6 m × 4 m) about 3 m away from the child. The mirror (1.2 m × 0.6 m) stood 0.5 m away from the wall. A video camera was arranged at a slight angle to the mirror so that the mirror images of children's faces were visible just above their head in the video recording. The experimenter ensured that children visually fixated the mirror image of their face for at least three times (and at least one time for at least 2 s) during the warm-up play.

When the child had met this condition and felt comfortable with the experimenter, the parent cleaned the child's nose with a paper tissue and, with the other hand, unobtrusively applied a mark (a large dot of dark blue hypoallergenic cosmetic) about 3 cm below the child's right eye. Then the experimenter again played with the child in front of the mirror, making sure that the child fixated the mirror image of his or her face at least three times (and at least one time for at least 2 s). If the child did not look at the mirror within 1 min, the experimenter tried to attract his or her attention to the mirror by moving a toy between the child's head and the mirror. When the child looked at the mark for the first time, the experimenter asked, "Who is that?" and if the child hesitated, the experimenter again asked, "Who is that?"

One child refused to play in front of the mirror. All other children met the looking criteria both for the baseline and for the mark phase. Two observers independently coded the video recording of the mark phase for any mark-directed behavior of the child—for example, trying to touch the mark, including touching the corresponding part on the left side of the face—and verbally referring to both the mark and self (the child's name or "I") or only to self when looking at the mark. Children who showed at least one mark-directed behavior were classified as recognizers; all others were classified as nonrecognizers. The two observers disagreed in three cases (3%); these cases were resolved by consensus.

There were 59 recognizers and 54 nonrecognizers on the first day of observation. To increase the validity of the test for nonrecognizers, we retested these children 1 or 2 days after the first mirror test exactly as in the previous experiment, but with a shorter baseline period. One child refused to play in front of the mirror. Of the remaining children, 50 were again classified as nonrecognizers, and 3 children were classified as recognizers contrary to the preceding test (94% agreement for the two tests). Thus, there were 62 recognizers and 50 nonrecognizers altogether. The recognizers were slightly older than the nonrecognizers (mean difference = 3.5 days). This slight difference was significant because of the restricted age variance in the sample, $t(110) = 2.59$, $p < .02$. A chi-square test indicated that girls recognized themselves more often than did boys, $\chi^2(1, N = 112) = 12.70$, $p < .001$ (74% recognizers among girls, 40% among boys).

Peer Play Session

The 112 successfully tested children were assigned to three types of dyads: 18 recognizer dyads (2 recognizers playing together), 12 nonrecognizer dyads, and 26 mixed dyads (a recognizer playing with a nonrecognizer). The two partners of each dyad were unfamiliar with each other when they entered the observation room. The two accompanying parents were seated in a corner of the room, separated from the "play field" by two low tables through which children could pass to reach their parent. A screen covered the other corner of this side of the room, and a video camera with a wide-angle lens was placed between these two corners. In this way, the whole remaining play field (approximately 18 m^2) was visible in the video recording.

Ten pairs of objects were arranged along the sides of the play field. The two exemplars of each object were placed side by side, and the distance between one pair and the next was the same for all pairs of objects. The objects in the pairs included a doll, a ninepin, a rattle, a bear, a hat, a wash basin, a frog, a chair for toddlers, a sand mill, and a balloon. In addition, a box made of cardboard (0.8 m × 0.5 m × 0.3 m) was placed in the middle of the play field.

Children were invited by their parents to play with the toys; no other person was in the room during the play session. The parents were instructed to read magazines during the play session and not to interfere with the play of the 2 children unless physical danger for a child was present. Parents were also asked to bring their child back to play as quickly as possible if the child approached them.

Observation time began when the two parents sat down on their chairs. Play time was defined as any time when both children were on the play field for at least 20 s. If a child crawled onto one of the tables in front of the parents, this time was included as play time only if the child was visually oriented toward the play field. Observation ended when play time exceeded 15 min, observation time exceeded 30 min, or (in two cases) one of the children was so distressed by the situation that it seemed unethical to continue.

Observational Measures

Two coders who were unaware of the mirror status of the children watched their videotaped behavior and coded their synchronic imita-

tion, their object-holding activity, and their proximity to the parents. Coding was done second by second on a microcomputer in terms of onset and offset times and codes for objects or behaviors. Intercoder agreement was assessed by independent codings of 12 dyads (4 nonrecognizer, 4 recognizer, and 4 mixed dyads—21% of all dyads).

Synchronic imitation. The beginning and end of a synchronic imitation sequence was determined as follows: A sequence began when (a) Child 1 held an object and Child 2 took at least a second exemplar of this object *and* (b) Child 2 was oriented to Child 1 in the time interval of ±3 s *and* (c) both children were oriented to the partner at least once within 10 s after the beginning of the sequence. In this case, Child 2 was coded as starting synchronic imitation. Orientation to partner included looking, verbalizing, showing an object, and pointing to an object. Also, a sequence could begin when both children had at least one object in common and were oriented to each other at the same time; in this case, no starting child was identified. A sequence continued if both children had at least one object in common and each child was oriented to the partner at least once every 10 s. A sequence ended when (a) a child turned away and the child or the partner dropped the object or objects within 10 s so that there was no longer a common object; (b) a child turned away and held a common object for 10 s but was not oriented to the partner within this 10 s; and (c) a child dropped an object so that there was no longer a common object and did not take a common object within 10 s. Intercoder agreement for synchronic imitation was acceptable (89% agreement, $\kappa = .74$). Agreement for identification of the starting child was also acceptable (number of agreements/mean number of disagreements = 81%).

In addition, for each child, instances were coded when the child requested that the partner use a common object: offering, showing, pointing to, or verbally referring to the second exemplar of an object while holding the first one; or offering one exemplar of an object when the second exemplar was not used by the partner. The intercoder agreement of 82% was acceptable.

Object-holding activity. For each child in a dyad, an activity was coded when the child either (a) took or (b) dropped an object of the 10 pairs of objects or of the box. *Taking* was defined by touching for the first time, and *dropping* by letting go of the object (i.e., putting a hat from one's head to the floor, stopping to play with the balloon, or leaving a chair or the box). Intercoder agreement was high (99% agreement, $\kappa = .94$).

Proximity to parents. For each child the onset and offset was coded of (a) being *close* to the parents (leaving the play field, as described previously), (b) being *near* to the parents (feet on the play field within 0.5 m of the tables in front of the parents), and (c) being *far* from the parents (neither close nor near). Intercoder agreement was acceptable (87% agreement, $\kappa = .85$).

Results

Selection and Correction for Play Time

The 56 dyads varied strongly in terms of play time (defined by the time when both children were on the play field for at least 20 s): $M = 633$ s, $SD = 276$ s, min = 23 s, and max = 900 s (by definition). The play time of some of the dyads was so short that it would be impossible to evaluate the results. Therefore, the 15 dyads with play time of under 450 s (27% of all dyads) were dropped from further analysis. This procedure resulted in 41 dyads (12 recognizer dyads, 9 nonrecognizer dyads, and 20 mixed dyads). Nonrecognizer and mixed dyads tended to consist more of boys than girls, whereas the opposite was true for recognizer dyads, but this Gender × Type of Dyad interaction was not significant, $\chi^2(2, N = 41) = 2.93$, $p > .20$.

To avoid biased results associated with differences in play time, most of the following analyses were restricted to the first 450 s of play time for all 41 dyads. To avoid biases in the results for children's object use because of a tendency to orient to a parent, we computed all percentage-of-time measures in terms of percentage of play time. Furthermore, analyses of events (object holds, imitation sequences, and requests for imitation) included only those events that began within play time.

Control for Background Variables

For analyses at the individual level, four types of children were distinguished: recognizers playing with recognizers; recognizers playing with nonrecognizers; nonrecognizers playing with recognizers; and nonrecognizers playing with nonrecognizers. Possible differences between these four types of children in the selected 41 dyads were evaluated by analyses of variance (ANOVAs) for various background variables that were assessed in an interview with the parent on the first day of observation. The four types of children did not differ significantly in terms of mean age, $F(3, 78) = 1.89$, $p > .10$, or whether the child had a peer sibling (i.e., a sibling not more than 2 years older), $\chi^2(3, N = 112) = 5.99$, $p > .10$. For the children without a peer sibling, the amount of regular contact with peers (estimated hours per week) did not vary significantly across the four types of children, $F(3, 59) < 1$. Thus, between-dyad differences could be interpreted with some confidence in terms of children's mirror status. Because of the importance of controlling for differences in chronological age, in all cases, an additional analysis of covariance was done with age as the covariate.

Analyses at the Dyadic Level

The main analyses of synchronic imitation refer to variables that are identical for both partners of the dyad; hence they were analyzed at the dyadic level. Three different types of dyads were distinguished: recognizer dyads consisting only of recognizers, mixed dyads composed of a recognizer and a nonrecognizer, and nonrecognizer dyads consisting only of nonrecognizers.

Rate of synchronic object holds. Table 1 presents the means and standard deviations for the three types of dyads for the rate of synchronic object holds (the percentage of play time when both children held an exemplar of the same object during the first 450 s of play time).

A linear contrast within an ANOVA confirmed the hypothesis that recognizer dyads had a higher synchronic object-holding rate than mixed dyads, and mixed dyads a higher rate than nonrecognizer dyads, $F(1, 38) = 4.87$, $p < .04$ (see Table 1). When the mean chronological age of the two partners in a dyad was partialled out by analysis of covariance, the linear contrast was still significant, $F(1, 37) = 4.29$, $p < .05$; the size of this effect in terms of $d = 2\sqrt{(F/df)} = .68$ was considerable (see Cohen, 1977). The rate of synchronic object holds did not differ significantly between boys and girls or children with and without a peer sibling (a sibling not more than 2 years older), and this rate was not significantly correlated with the amount of regular contact with peers among the children without a peer sibling.

Synchronic imitation. Synchronic object holds include pe-

Table 1
Means and Standard Deviations of Dyadic Measures of Synchronic Imitation

		% synchronic object holds		% synchronic imitation		*M* length of synchronic imitation (s)	
Type of dyad	*N*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Nonrecognizers	9	7.8	7.5	3.8	3.1	8.4	7.9
Mixed	20	19.0	19.5	8.4	11.1	11.5	13.6
Recognizers	12	24.1	16.5	13.6	10.9	19.4	7.9
All	41	18.0	17.3	8.9	10.3	13.1	11.7

Note. The percentage refers to percentage of the first 450 s of play time, mean length (in seconds) to duration (in seconds) divided by frequency (defined as zero for zero frequency).

riods of synchronic imitation but also periods of chance overlap of object use or phases when the two partners use the same object in a noncommunicative context simply because they are attracted to the same type of object. Synchronic imitation sequences were defined as being accompanied by visual regard of the partner at least once every 10 s. Therefore they provide a more specific measure of synchronic imitation. Table 1 presents the data for the percentage of play time spent in synchronic imitation as well as the mean length of the synchronic imitation sequences for the three types of dyads.

A linear contrast within an ANOVA confirmed the hypothesis that recognizer dyads spent more time with synchronic imitation than mixed dyads, and mixed dyads more time than nonrecognizer dyads, $F(1, 38) = 5.76$, $p < .03$ (see Table 1). When the mean chronological age of the two partners in a dyad was partialled out by analysis of covariance, the linear contrast was still significant and had a considerable effect size, $F(1, 37) = 4.48$, $p < .05$, $d = .70$. Similar results were found for the mean length of the synchronic imitation sequences, $F(1, 37) = 5.01$, $p < .04$; after correcting for age, $F(1, 37) = 4.46$, $p < .05$, $d = .69$. These results were very similar to the findings for the rate of synchronic object holds, although about 50% of the synchronic object-holding time was excluded by the additional communicative criteria (see Table 1). Thus, ignoring synchronic object holds that were due to chance overlap or noncommunicative activity reduced errors of commission, but this advantage was balanced by errors of omission associated with the lower reliability of the coding of communicative aspects of synchronic imitation.

We tested the more specific hypothesis that nonrecognizer dyads do not produce long imitation sequences whereas recognizer dyads do show such instances of sustained imitation by excluding from the aforementioned analysis all imitation sequences that were shorter than 20 s. Nonrecognizer dyads showed very few such sequences ($M = 0.2$), whereas dyads consisting of recognizers produced on average more than one such sequence during the first 450 s of play time ($M = 1.3$), and mixed dyads were in between ($M = 0.75$, for the linear trend), $F(1, 38) = 6.35$, $p < .02$; after correcting for age, $F(1, 37) = 5.06$, $p < .04$, $d = .74$.

An even stronger effect was found for the dyads' mean length of sustained imitation (setting the length of all sequences with a length below 20 s to zero), $F(1, 38) = 9.41$, $p < .004$; after correcting for age, $F(1, 37) = 7.61$, $p < .01$, $d = .91$. Thus, when the analysis was restricted to long imitation sequences by assuming a threshold effect for communicative imitation, the differences among the three types of dyads were particularly strong.

An analysis of the incidence of long imitation sequences by dyadic type indicated that 1 of the 9 nonrecognizer dyads but 10 of the 12 recognizer dyads showed at least one such sequence. This pattern deviates significantly from chance, $\chi^2(1, N = 21) = 10.73$, $p < .002$, and indicates an association between type of dyad and incidence of sustained synchronic imitation (Cohen's $\kappa = .71$).

The rate and the mean length of synchronic imitation did not differ significantly between boys and girls or children with and without a peer sibling, and these variables were not significantly correlated with the amount of regular contact with peers among the children without a peer sibling (in both cases, $|r| < .15$, *ns*).

Analyses at the Individual Level

The behavior of an individual child in the dyadic play situation was affected not only by his or her own characteristics but also by characteristics of the partner. Consequently, the effect of mirror status on the child's behavior was evaluated by 2×2 ANOVAs, with the mirror status of the focal child and the mirror status of the partner treated as two factors. This approach allowed us to analyze child effects, partner effects, and their interaction.

As Kraemer and Jacklin (1979) have pointed out, individual differences in dyadic behavior should not be analyzed within a regular ANOVA approach that treats child and partner effects as uncorrelated factors. In fact, child and partner effects may strongly covary. As a solution to this problem, Kraemer and Jacklin (1979) proposed a modification of the regular ANOVA model that takes intercorrelated factors into account. Compared with the normal ANOVA procedure, means remain unchanged, but variances depend on the within-group correlations of the dependent variable. This leads to more adequate tests of the child, partner, and child by partner effects in terms of *t* tests, with degrees of freedom estimated from the within-group variances (see Satterthwaite, 1946). Age effects were ad-

ditionally controlled by conducting these t tests for residual scores in a regression on age.

Initiations of imitation. Children's attempts to initiate an imitation sequence were reflected by two different behaviors: requests for imitation (when the partner did not hold an object) and starting imitation (when the child joined the partner's object use). Therefore these two types of initiations were summed over each child. Because of the small frequencies of these events, all events during play time were analyzed. As expected, recognizers tended to show more initiations (M = 2.8 per 450-s play time) than nonrecognizers (M = 1.9); for the difference, $t(34) = 1.76$, $p < .10$; after correction for age differences, $t(34) = 1.84$, $p < .10$. The partner and child by partner effects were not even marginally significant (in each case, $t < 1$, *ns*).

Object-holding activity. To exclude the possibility that differences in synchronic imitation across dyadic types were due to different interest in the objects themselves by recognizers and nonrecognizers, we analyzed, by dyadic ANOVAS, the frequency and mean length of object use as well as the percentage of play time spent with objects. For the 3 × 3 tests, only the partner effect for mean length of object use was significant, $t(33) = 2.76$, $p < .01$; after correction for age, $t(33) = 2.60$, $p < .02$. An inspection of the means indicated that children continued to hold the same object or objects for a longer time when their partner was a recognizer (M = 28.9 s) than when their partner was a nonrecognizer (M = 19.3 s). Thus, recognizers apparently stimulated their partner to use the same object longer; in contrast, children's own mirror status was unrelated to their object use.

Proximity to parents. The percentage of play time spent near to (as opposed to far from) the parents as well as the number of interruptions of play time (by children's moving close to the parents) was analyzed. In both cases, a significant partner effect was found: for proximity, $t(22) = 2.21$, $p < .05$, after correction for age differences, $t(23) = 2.27$, $p < .05$; for interruptions of play time, $t(29) = 2.97$, $p < .01$, after correction for age differences, $t(35) = 2.56$, $p < .02$. An inspection of the means indicated that children who played with a nonrecognizer (a) were more often near to the parents (M = 45.3%) than children whose partner was a recognizer (M = 35.7%), and (b) approached the parents more often (M = 2.7) than children whose partner was a recognizer (M = 1.8). No significant child or child by partner effects were found (in each case, $t < 1$, *ns*).

Together these differences indicate that in addition to the normal attachment behaviors of children of this age, the children approached the parents in response to difficulties with a nonrecognizer by leaving the play field or by staying near to the parents. In contrast, the children's own mirror status was unrelated to their attachment behavior. Gender and sibling status were not significantly related to any of these variables at the individual level.

Discussion

This study has shown that mirror self-recognition is associated with sustained synchronic imitation as a form of preverbal communication with an unfamiliar peer. Unfamiliar 19-month-old children who passed the mirror self-recognition test became engaged in long phases of synchronic imitation if their partner was also a recognizer. In mixed dyads in which a recognizer and a nonrecognizer were paired, fewer long imitation sequences resulted, and the average length of these sequences was shorter than in dyads in which both partners were recognizers. Dyads consisting only of nonrecognizers showed only very few and short phases of synchronic imitation. Recognizers tended to initiate synchronic imitation more often than nonrecognizers by inviting them to join play or by joining the play of the partner. These differences remained intact even after controlling for differences in chronological age. (It should be noted that such a control is to some extent an overcorrection, because it also partials out the intrinsic correlation between chronological age and mirror self-recognition.)

We interpret these findings as support for the hypothesis that the capacities for mirror self-recognition and for synchronic imitation of the object usage of an unfamiliar peer emerge synchronically. Together with Bischof-Köhler's (1989, 1991) findings of a strong association between mirror self-recognition and empathic reactions to a victim of distress, the present study supports the more general hypothesis of a synchrony between self- and other-awareness. However, it should be noted that both the present study and the two studies of Bischof-Köhler were cross-sectional. Longitudinal studies could provide stronger tests for the synchrony hypothesis and could test for possible developmental lags between self- and other-awareness.

Three additional effects of children's mirror status on their partner's behavior indicated that a self-recognizing child reinforces the partner's play behavior: Partners of recognizers held toys longer than partners of nonrecognizers, approached their parent less often, and spent less time near their parent. We interpret these effects again as reflecting the empathic ability of recognizers. Because they have a capacity for other-awareness, they can better coordinate their behavior with the behavior of the partner, even if the partner does not have this ability, and by doing this, they attract the partner to play.

The results of the present study underscore once more the frequent finding that the mirror self-recognition test marks an important developmental milestone during the second year of life. The retest reliability of this test was high but not perfect; we could identify 6% false negatives by a repetition of the test. Because the actual rate of misses is likely to be somewhat higher, at least 10% of the children who do not pass the mirror test are probably capable of self-awareness. The nonperfect reliability of the mirror test may explain why 1 of the 9 nonrecognizer dyads engaged in sustained synchronic imitation. That 2 of the 12 recognizer dyads did not show any long imitation sequences does not necessarily suggest an asynchrony between the emergence of self- and other-awareness; one of the partners in these 2 dyads may have preferred to play alone despite a capacity for other-awareness.

We did not find significant relations between peer experience and synchronic imitation or other measures of social–interactional behavior. Many theorists have linked the development of interindividual differences in the self-concept or in empathic responding to prior experiences in interactions with parents or peers (e.g., Cooley, 1902; Hoffmann, 1987; Lewis, 1986; Mead, 1934; Stern, 1985). It is important, however, to clearly distinguish between interindividual differences in the

onset and in the later developmental course of a capacity. Whereas there is clear evidence for an impact of social experience on the later developmental course of the self-concept (Harter, 1983) and empathy (Radke-Yarrow, Zahn-Waxler, & Chapman, 1983), to our knowledge there is no clear evidence that the onset of the capacity for self- or other-awareness is mediated by social–experiential factors. The present study supports this view.

Future studies could try to replicate the findings of the present study by relating mirror self-recognition to the extent to which children engage in synchronic imitation with an unfamiliar adult who scaffolds their imitation (see Eckerman & Didow, 1989, for a paradigm that could be adopted here). It would also be interesting to relate children's mirror self-recognition to their coordination of play behavior with a familiar person (well-known playmates, siblings, or parents). From the theoretical perspective developed here, we would expect that nonrecognizers may be able to show some coordinated play behavior if it is based on acquired play rituals, but because of their other-awareness, recognizers should be better able to coordinate their behavior with novel behavior of a familiar partner or to follow partners when they switch from one type of play to another.

References

Amsterdam, B. K. (1972). Mirror self-image reactions before age two. *Developmental Psychobiology, 5,* 297–305.

Baudonnière, P.-M. (1988a). Evolution in mode of social exchange in 2, 3, and 4 year old peers. *European Bulletin of Cognitive Psychology, 8,* 241–263.

Baudonnière, P.-M. (1988b). *L'évolution des compétences à communiquer chez l'enfant de 2 à 4 ans* [Development of communicative competences between 2 and 4 years of age]. Paris, France: Presses Universitaires de France.

Bertenthal, B. I., & Fischer, K. W. (1978). Development of self-recognition in the infant. *Developmental Psychology, 14,* 44–50.

Bischof-Köhler, D. (1988). Über den Zusammenhang von Empathie und der Fähigkeit, sich im Spiegel zu erkennen [The relationship between empathy and mirror self-recognition]. *Schweizerische Zeitschrift für Psychologie, 47,* 147–159.

Bischof-Köhler, D. (1989). *Spiegelbild und Empathie: Die Anfänge der sozialen Kognition* [Mirror image and empathy: The emergence of social cognition]. Bern, Switzerland: Huber.

Bischof-Köhler, D. (1991). The development of empathy in infants. In M. E. Lamb & H. Keller (Eds.), *Infant development: Perspectives from German-speaking countries* (pp. 1–33). Hillsdale, NJ: Erlbaum.

Bruner, J. (1983). *Child's talk.* New York: Norton.

Cohen, J. (1977). *Statistical power analysis for the behavioral sciences.* San Diego, CA: Academic Press.

Cooley, C. H. (1902). *Human nature and the social order.* New York: Scribner.

Eckerman, C. O., Davis, C. C., & Didow, S. M. (1989). Toddlers' emerging ways of achieving social coordinations with a peer. *Child Development, 60,* 440–453.

Eckerman, C. O., & Didow, S. M. (1989). Toddlers' social coordinations: Changing responses to another's invitation to play. *Developmental Psychology, 25,* 794–804.

Eckerman, C. O., & Stein, M. R. (1990). How imitation begets imitation and toddlers' generation of games. *Developmental Psychology, 26,* 370–378.

Eisenberg, N., & Strayer, J. (Eds.). (1987). *Empathy and its development.* Cambridge, England: Cambridge University Press.

Emde, R. N. (1983). The prerepresentational self and its affective core. *The Psychoanalytic Study of the Child, 38,* 165–192.

Flavell, J. H., Botkin, P. T., Fry, C. L., Wright, J. W., & Jarvis, P. E. (1968). *The development of role-taking and communication skills in children.* New York: Wiley.

Harter, S. (1983). Developmental perspectives on the self-system. In P. H. Mussen & E. M. Hetherington (Eds.), *Handbook of child psychology: Socialization, personality and social development* (Vol. 4, pp. 275–385). New York: Wiley.

Heckhausen, H. (1984). Emergent achievement behavior: Some early developments. In J. G. Nicholls (Ed.), *Advances in motivation and achievement. Vol. 3: The development of achievement motivation* (pp. 1–32). Greenwich, CT: JAI Press.

Heckhausen, J. (1988). Becoming aware of one's competence in the second year: Developmental progression within the mother–child dyad. *International Journal of Behavioral Development, 11,* 305–326.

Hoffman, M. L. (1976). Empathy, role taking, guilt and development of altruistic motives. In T. Lickona (Ed.), *Moral development and behavior* (pp. 124–143). New York: Holt, Rinehart & Winston.

Hoffman, M. L. (1987). The contribution of empathy to justice and moral development. In N. Eisenberg & J. Strayer (Eds.), *Empathy and its development* (pp. 47–80). Cambridge, England: Cambridge University Press.

Kagan, J. (1981). *The second year. The emergence of self-awareness.* Cambridge, England: Cambridge University Press.

Kraemer, H. C., & Jacklin, C. N. (1979). Statistical analysis of dyadic social behavior. *Psychological Bulletin, 86,* 217–224.

Leslie, A. M. (1987). Pretense and representation: The origins of "Theory of mind." *Psychological Review, 94,* 412–426.

Lewis, M. (1986). Origins of self-knowledge and individual differences in early self-recognition. In A. G. Greenwald & J. Suls (Eds.), *Psychological perspectives on the self* (Vol. 3, pp. 55–78). Hillsdale, NJ: Erlbaum.

Lewis, M. (1990). Social knowledge and social development. *Merrill-Palmer Quarterly, 36,* 93–116.

Lewis, M., & Brooks-Gunn, J. (1979). *Social cognition and the acquisition of self.* New York: Plenum Press.

Lewis, M., Stanger, C., & Sullivan, M. W. (1989). Deception in 3-year-olds. *Developmental Psychology, 25,* 439–443.

Lewis, M., Sullivan, M. W., Stanger, C., & Weiss, M. (1989). Self-development and self-conscious emotions. *Child Development, 60,* 146–156.

Mead, G. H. (1934). *Mind, self, and society.* Chicago: University of Chicago Press.

Mueller, E., & Brenner, J. (1977). The origins of social skills and interaction among playgroup toddlers. *Child Development, 48,* 854–861.

Nadel, J., & Fontaine, A.-M. (1989). Communicating by imitation: A developmental and comparative approach to transitory social competence. In B. H. Schneider, G. Attili, J. Nadel, & R. P. Weissberg (Eds.), *Social competence in developmental perspective* (pp. 131–144). Dordrecht, Netherlands: Kluwer.

Nadel-Brulfert, J., & Baudonnière, P. M. (1982). The social function of reciprocal imitation in 2-year-old peers. *International Journal of Behavioral Development, 5,* 95–109.

Parten, M. B. (1932). Social participation among preschool children. *Journal of Abnormal and Social Psychology, 27,* 243–269.

Perner, J. (1991). *Understanding the representational mind.* Cambridge, MA: MIT Press.

Radke-Yarrow, M., Zahn-Waxler, C., & Chapman, M. (1983). Children's prosocial dispositions and behavior. In P. H. Mussen & E. M. Hetherington (Eds.), *Handbook of child psychology: Socialization, personality and social development* (Vol. 4, pp. 469–545). New York: Wiley.

Ross, H. S. (1982). Establishment of social games among toddlers. *Developmental Psychology, 18,* 509–518.

Ross, H. S., & Kay, D. A. (1980). The origins of social games. In K. H. Rubin (Ed.), *Children's play* (pp. 17–31). San Francisco: Jossey-Bass.

Ross, H. S., & Lollis, S. P. (1987). Communication within infant social games. *Developmental Psychology, 23,* 241–248.

Satterthwaite, F. E. (1946). An approximate distribution of estimates of variance components. *Biometrics Bulletin, 2,* 110–114.

Selman, R. L. (1980). *The growth of interpersonal understanding: Developmental and clinical analyses.* San Diego, CA: Academic Press.

Stern, D. N. (1985). *The interpersonal world of the infant.* New York: Basic Books.

Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition, 13,* 103–128.

Zahn-Waxler, C., Radke-Yarrow, M., & King, R. A. (1979). Child-rearing and children's prosocial initiations toward victims of distress. *Child Development, 50,* 319–330.

Zahn-Waxler, C., Radke-Yarrow, M., Wagner, E., & Chapman, M. (1992). Development of concern for others. *Developmental Psychology, 28,* 126–136.

Received August 28, 1991
Revision received January 29, 1992
Accepted May 2, 1992 ■