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Pretend play, mirror self-recognition and imitation: a longitudinal investigation through the second year

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Abstract

The aim in the current study was to investigate the emergence of pretend play, mirror self-recognition, synchronic imitation and deferred imitation in normally developing human infants. A longitudinal study was conducted with 98 infants seen at three-monthly intervals from 12 through to 24 months of age. At each session the infants were tested on a range of tasks assessing the four target skills. Deferred imitation was found to emerge prior to synchronic imitation, pretend play and mirror self-recognition. In contrast, the latter three skills emerged between 18 and 21 months and followed similar developmental trajectories. Deferred imitation was found to hold a prerequisite relation with these three skills. Synchronic imitation, pretend play and mirror self-recognition were not closely associated and no prerequisite relations were found between these skills. These findings are discussed in the context of current theories regarding the development of pretend play, mirror self-recognition, synchronic imitation and deferred imitation in the second year.

Keywords: Pretend play; Self-recognition; Imitation; Secondary representation; Infancy

Concern with the importance of imitation, pretend play and mirror self-recognition in the social and cognitive development of human children can be traced back to the pioneers of modern developmental psychology (Baldwin, 1894, 1897a, 1897b; Dixon, 1957; Gesell & Thompson, 1934; Guillaume, 1926/1971; Lacan, 1949; Merleau-Ponty, 1964; Piaget, 1962; Preyer, 1983). Recently there has been a renewed interest in these skills as a result of speculation that each provides the developmental founda-

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tion upon which a mature 'theory of mind' is built (Asendorpf, Warkentin, & Baudonnière, 1996; Bard, 1998; Gallup, 1998; Gopnik & Meltzoff, 1994; Leslie, 1987; Meltzoff & Gopnik, 1993; Meltzoff & Moore, 1995; Nielsen & Dissanayake, 2000; Perner, 1991; Rogers & Pennington, 1991; Suddendorf & Whiten, 2003; Whiten, 1996). Rogers and Pennington (1991) propose that in order to engage in imitation, infants must form and coordinate social representations of self and other through "representational processes that extract patterns of similarity between self and other" (p. 137). They further argue that this same process is implicated, albeit with a more complex level of representation, in the generation of a 'theory of mind'. Therefore, when the ability to imitate is impaired, a 'cascade effect' will result leading to a deficit in the development of a 'theory of mind' (see also Meltzoff, 2002; Meltzoff & Gopnik, 1993).

Leslie (1987), on the other hand, claims that the cognitive functions enabling children to engage in pretend play are the same ones that the child subsequently exploits when constructing a theory of mind. For Leslie, pretend play is an early manifestation of the meta-representational abilities necessary for the development of a theory of mind.

The ability to recognise oneself in a mirror has also been posited as a developmental precursor to a 'theory of mind'. Gallup (1982, 1983, 1985, 1991, 1998) argues that in order to recognise themselves in mirrors, individuals must be capable of becoming the object of their own attention. Accordingly, self-recognisors are endowed with a capacity for engaging in introspection and can thereby develop knowledge of their own mental and emotional states. For Gallup, self-recognisors are thus provided with an intuitive basis for imputing mental states to others.

Alternatively, imitation, pretend play and mirror self-recognition may be precursors to a theory of mind through their reliance on the maturation of a common underlying mechanism. In Perner's (1991) influential theory of children's growing representational skills, 'secondary representation' refers to the ability children have for mentally representing things in the world not how they are but how they could be. Perner argues that secondary representations are purposely 'decoupled' from reality, and underscore an ability to think of the past, entertain possible futures, speculate about the nonexistent and reason hypothetically. According to Perner, a capacity for secondary representation provides the foundation for the latter development of 'metarepresentation'—an ability to understand that one thing can stand in a representational relation to something else. It is the capacity for metarepresentation that underlies the ability of children to pass false belief tasks (representing that someone else is representing the world in a particular, incorrect, way). In this context Perner has argued that skills which rely on a capacity for secondary representation may be associated with the later emergence of a 'theory of mind'. A capacity for secondary representation has thus been speculated by Perner (1991) to underpin the development of pretend play and mirror self-recognition and by others (Asendorpf, 2002; Suddendorf & Whiten, 2001) to underpin the development of synchronic imitation.

1. Pretend play

Emerging towards the middle of the second year, pretend play involves the non-literal transformation of the here-and-now whereby the infant or child, in the context of a play sequence, treats the world contrary to reality (Garvey, 1990; Leslie, 1987; Lillard, 2002). Typically, in pretend play infants begin to apply their knowledge base to symbolically manipulate objects and their properties, and to allow their imagination, rather than the stimulus itself, to dominate their behaviour. A characteristic of pretend play is that the very objects and actions whose functions the infant is becoming aware of are treated in a fashion which may

be in direct contrast to their logical purpose. In this sense the non-literal nature of pretence has presented a challenge to developmentalists. That is, how are infants able to engage in pretence while ensuring that features of their make-believe world do not fuse with features of their real world? How do infants maintain a growing 'real world' knowledge that is not corrupted by the illogical and counterfactual nature typical of pretend play? According to Perner (1991) real and pretend worlds are quarantined through the use of secondary representations.[1] That is, children have a secondary representation of the pretend scenario (e.g., a 'telephone') that is decoupled from the primary representation of its real world referent (e.g., a banana).

2. Mirror self-recognition

Perner (1991) argues that the ability of infants to recognize themselves is also underpinned by secondary representations. Since the early seventies, the principal tool for assessing mirror self-recognition in pre-verbal individuals is what is often referred to as the 'mark test' (Amsterdam, 1972; Gallup, 1970). Here, the individual is surreptitiously marked on a region of his or her face that cannot be seen without the aid of a mirror and is then exposed to a mirror. The premise of this task is that if the individual appreciates that the reflected image corresponds to the self, he or she will react by touching and exploring the marked region on his or her own face. The ability to demonstrate appropriate mark directed behaviour emerges in the second year and is present in most infants by 24 months of age (Amsterdam, 1972; Bertenthal & Fischer, 1978; Lewis & Brooks-Gunn, 1979; Schulman & Kaplowitz, 1977). In mirror self-recognition, as the face cannot be directly perceived, infants must match a mental model of what they think they 'ought' look like to the image in the mirror. According to Perner, infants must therefore quarantine the image in the mirror from their perceptions of themselves in reality in order to pass the mark test.

3. Synchronic imitation

There is only limited speculation regarding imitation in Perner's (1991) theory. However, using his theoretical framework, various authors have maintained that secondary representation is necessary for the emergence of a particular type of imitation, 'synchronic imitation' (Asendorpf, 2002; Asendorpf & Baudonnière, 1993; Asendorpf et al., 1996; Suddendorf & Whiten, 2001). Synchronic imitation is a typical characteristic of play which emerges from the middle of the second year, whereby infants show a preference for engaging with objects that are similar to ones chosen by their play partner, and use the common object in a similar postural, motoric, and symbolic way (Nadel & Baudonnière, 1980, 1982; Nadel & Fontaine, 1989). Such play is emphasised by its inherent reciprocity whereby partners do not solely adopt one role but consistently alternate between model and imitator (Nadel, Baudonnière, & Fontaine, 1983). According to proponents of the secondary representation view, in order to engage in synchronic imitation infants must understand the intentions of their play partner regarding the on-going use of objects and his or her willingness to maintain the alternating roles of model and imitator. To understand the intentions of their play partner, infants must coordinate a primary representation (the

[1] In this context Perner's (1991) theory of the representational underpinnings of pretend play and theory of mind differ from Leslie's (1987) theory noted previously.

direct perception infants have of the behaviour of their partner) with a secondary representation (the representation infants have of their partner's thoughts or emotions).

4. Deferred imitation

Deferred imitation, the capacity of the individual to note a model's behaviour at the time of demonstration and recall that demonstration following a retention interval, has also been identified as a possible precursor to theory of mind (Meltzoff & Gopnik, 1993). However, in contrast to each of the skills noted above (pretend play, mirror self-recognition and synchronic imitation) which emerge in the second year, 'deferred imitation' has been documented in infants aged 6–9 months (Barr, Dowden, & Hayne, 1996; Heimann & Meltzoff, 1996; Meltzoff, 1988b)—well before secondary representations are theorised to emerge.

5. Aim and rationale

There is little direct empirical evidence to support the claims that imitation, pretend play or mirror self-recognition are developmental precursors to a theory of mind. Youngblade and Dunn (1995) reported an association between role-oriented pretend play in 33-month-old children and their success in passing a series of false-belief tasks seven months later. However, two subsequent studies failed to reveal a similar longitudinal association between pretence and theory of mind development (Charman et al., 2000; Jenkins & Astington, 2000). Charman et al. (2000) also failed to reveal an association between the exhibition of imitation at 20 months and theory of mind at 44 months. No study has yet evaluated the association between mirror self-recognition and theory of mind. The lack of direct empirical evidence in support of the proposed theoretical links between theory of mind development and the earlier onset of imitation, pretend play and mirror self-recognition is compounded by the absence of any longitudinal study in which each of these earlier abilities has been assessed.

Considerable importance has been afforded to Perner's (1991) theory of representational development (see Suddendorf & Whiten, 2001). If the view that the onset of pretend play, self-recognition and synchronic imitation all rely on the maturation of the same psychological mechanism (i.e., secondary representation) is adopted, the exhibition of these three abilities should be strongly associated in development. Partial support for this hypothesis is provided by reports of a positive correlation between the exhibition of pretend play and success on the mark test of mirror self-recognition (Baudonnière et al., 2002; Chapman, 1987; Lewis & Ramsay, 1999). Similarly, Asendorpf et al. (1996) report that 18-month-old mirror self-recognisors engage in synchronic imitation for more than double the time than do non-recognisers. However, no study has been conducted in which these three social-cognitive skills have been assessed longitudinally in the same infants. Similarly, the development of deferred imitation has not been explored in relation to these skills. Investigation into the associations between the co-development of pretend play, mirror self-recognition, synchronic imitation and deferred imitation provides a means by which Perner's theory can be evaluated. Therefore, the primary aim in this study was to chart the co-development of pretend play, mirror self-recognition, synchronic imitation and deferred imitation through the second year of life in order to establish the ways in which these abilities are associated. In so doing, it was hoped that the results would provide a basis for

understanding the means by which these abilities might be linked with the later onset of a theory of mind.

6. Method

6.1. Participants

Ninety-eight infants (48 male, 50 female) were seen five times at intervals of three months from 12 to 24 months of age. The infants were recruited from Maternal and Child Health Centres in suburbs surrounding La Trobe University, Melbourne, Australia. The infants were predominantly Caucasian, of middle socio-economic status, and participated in this study as part of a larger longitudinal investigation (Nielsen, 2002; Nielsen, Dissanayake, & Kashima, 2003).

All testing was conducted within one month of the relevant target age. Eight infants were used to pilot test the actions used in the deferred imitation and synchronic imitation tasks used throughout the study and to test the actions used in the pretend play task at 12 and 15 months. These infants were excluded from the analyses reported here. In addition, nine infants were unable to attend one of the five sessions due to extraneous circumstances, and eight infants were withdrawn by their carers altogether at different stages of the study. As a result of these exclusions, coupled with situations where infants chose not to engage in particular tasks, age-of-emergence data (see Section 6.3) was only available for 77 infants across each of the four skills measured here.

6.2. General procedure

The sessions were conducted in two playrooms at the Child Development Unit at La Trobe University. Playroom 1 was 5.35 m × 4.60 m and contained a video camera (that could be operated remotely) positioned above a 1.54 m × 1.60 m play mat placed on the floor. Playroom 2 measured 2.60 m × 2.45 m and contained a table (120 cm × 60 cm) that was placed between two cameras. These cameras were used to videotape the infant and experimenter during administration of the tasks. All infants were tested individually with their primary carer present.

Upon arrival at the Child Development Unit, the infant and carer were escorted into Playroom 1. The carer and the experimenter sat on the play mat together with the infant who was allowed to explore the room. This warm-up stage was terminated once the infant appeared comfortable with both the playroom environment and the experimenter (usually less than 5 min). Due to constraints of the larger longitudinal study it was not possible to counterbalance the order of presentation of the four tasks. Thus, synchronic imitation was assessed first in all sessions followed, respectively, by the deferred imitation, mirror self-recognition, and pretend play tasks.

6.3. Measures

Following Carpenter, Nagell, and Tomasello (1998), the main dependent variable for the four tasks was the age at which an infant was first able to successfully perform a particular task or skill (i.e., 12, 15, 18, 21, or 24 months). Given the 3-month interval between testing sessions, the age of emergence measures referred to throughout this study indicate the approximate age at which the infants first engaged

in the relevant behaviours. It is acknowledged that a capacity to exhibit any of these behaviours may have emerged in the 3 months preceding the age of emergence session.

6.4. Pretend play

Consistent with past research (e.g., Rubin, Fein, & Vandenberg, 1983), none of the eight children pilot tested on the pretend play task at 12 months of age produced the requisite behaviours (see below). Thus, the pretend play task was not introduced until the 15-month session.[2] This task comprised two stages.

6.4.1. Self stage

The experimenter presented the infant with a toy jug and cup and said, "Can you have a drink?" Once the infant had either produced an act of pretence or 30 s had expired the Doll stage was conducted.

6.4.2. Doll stage

The experimenter introduced a baby doll to the infant and said, "This is Dolly. She's thirsty. Can you give her a drink?" Once the infant had either produced an act of pretence or 30 s had expired the task was terminated, and the session concluded.

6.4.3. Scoring

Each infant was given a score of one for 'drinking' from the cup during the Self stage. To be scored as pretence, 'drinking' had to be accompanied by sound effects or exaggerated gestures (e.g., throwing the head back) that suggested an awareness of the differentiation of the literal and pretend behaviours (McCune, 1995). During the Doll stage, the infant was given a score of one for giving the doll a 'drink' from the cup. During both stages, the infant was also given a score of one for 'pouring' from the jug to the cup. Therefore, infants could receive a pretend play score ranging from 0 to 4 at each session. The age-of-emergence of pretend play was determined to be the age of the infant at the session during which he or she obtained a score of one or better.

6.5. Mirror self-recognition

Traditionally, marking for the mirror self-recognition test has been achieved by surreptitiously applying rouge to the infant's face. However, in the current investigation, a brightly coloured sticker was used, instead of rouge (cf. Povinelli, Landau, & Perilloux, 1996; Suddendorf, 1999). The mirror self-recognition procedure consisted of three stages, administered in the following order.

6.5.1. Mirror-no sticker stage

The experimenter presented a medium sized mirror (46 cm × 89 cm) to the infant, allowing interaction with his or her reflection for 20 s. This established a baseline of the infant's natural inclination to touch the target area. No infant spontaneously brushed his or her hair (at all) during this stage.

[2] In order to implement each task administered as part of the larger longitudinal study (including those not discussed here), the infants and their carers were required to attend the Child Development Unit for between 60 and 90 min at each session. Given the lack of any signs of pretence in the eight infants pilot tested at 12 months, the decision not to introduce the pretend play task until the 15-month session was driven by the desire to keep testing time to a minimum.

6.5.2. Mirror-sticker stage

The experimenter placed the mirror out of sight and, while the infant was occupied with a toy, rubbed the forehead, surreptitiously fixing a sticker around the fringe area. To ensure that the infant was unaware of the sticker, the infant and experimenter continued to play with the toy for a further 60 s. If the infant reached for the sticker within this 60 s play period the task was not administered. If the infant did not respond to the sticker within the 60 s play period, the mirror was re-introduced and the infant was again given 20 s of mirror exposure. If the infant responded by bringing the hand within 2 cm of the sticker, while visually observing him or herself in the mirror, he or she was classified as a 'self-recogniser' and the test was terminated. If the infant failed to respond, he or she was classified as a 'non-recogniser' and the Sticker-saliency stage was implemented.

6.5.3. Sticker-saliency stage

In contrast to a number of non-human primate studies (Anderson, 1984; Gallup, Wallnau, & Suarez, 1980; Shillito, Gallup, & Beck, 1999; Suarez & Gallup, 1981), child development researchers, to date, have not investigated how children respond to marks on their own bodies that are clearly visible without a mirror. Therefore, if the infant was classified as a 'non-recogniser', the experimenter placed the mirror out of sight and surreptitiously placed a second sticker on the back of the infant's hand (note that this provided tactile cues). The aim in administering this stage was to ensure that the failure of an infant to reach for the sticker placed on his or her fringe was not due to a lack of motivation to retrieve the sticker (i.e., a false negative).

6.5.4. Scoring

Mirror self-recognition was coded from the videotapes of each session. The observer was first required to judge if the infant attempted to reach for the sticker prior to the mirror being introduced in the Mirror-sticker stage, and if not, whether he or she responded after the mirror was introduced by bringing either hand within 2 cm of the sticker while observing him or herself in the mirror. If the infant was judged as failing to respond to the sticker in the Mirror-sticker stage the observer was further required to judge if the infant removed the sticker from his or her hand in the Sticker-saliency stage. The age-of-emergence of mirror self-recognition was determined to be the age at which the infant first reached for the sticker in the Mirror-sticker stage.

6.6. Synchronic imitation

The procedure for synchronic imitation was adapted from Asendorpf et al. (1996). The experimenter sat on the play mat opposite the infant. The infant's carer sat behind the infant and was instructed to avoid engaging with him or her. The experimenter placed a small tray of four duplicate toys/objects behind him. The episode commenced when the experimenter took the first object, offered the duplicate object to the infant, and began the first activity with that object. The experimenter continuously modelled an action for 15 s and then performed a second action with the same object for a further 15 s. Following completion of the second modelling period, the experimenter placed the object and its duplicate in the tray behind him and repeated the procedure until the infant had been exposed to all four objects and their accompanying actions. The order of administration was counterbalanced across subjects. If the infant stopped paying attention to the experimenter, the sequence was paused and recommenced when the infant reoriented to the experimenter. A complete list of the objects and modelled actions is included in Appendix A.

6.6.1. Scoring

The combined amount of time each infant spent engaged in synchronic imitation during the four trials of each session was coded from the videotapes. Following Asendorpf et al. (1996) a synchronic imitation sequence was determined to have commenced when the infant took the duplicate object, looked at the experimenter within 3 s, and imitated the action of the experimenter for at least 3 s. The duration of the sequence was coded for as long as the infant maintained imitation of the modelled action and continued to look at the experimenter at least once every ten seconds. A synchronic imitation sequence was considered to have terminated when either the experimenter stopped the activity or when the infant stopped the activity for more than 3 s.

For each session the infant could receive a synchronic imitation score ranging from 0 to 120 s. The age-of-emergence of synchronic imitation was determined to be the age of the infant at the session during which at least one synchronic imitation sequence was first exhibited.

6.7. Deferred imitation

The deferred imitation task was adapted from (Meltzoff, 1985, 1988a, 1988b). All testing took place with the experimenter sitting across from the infant at the table. The procedure was the same for each session although the objects and actions used were changed (a complete list of the objects and modelled actions is included in Appendix B). The procedure consisted of four distinct stages.

6.7.1. Baseline stage

A baseline stage was introduced to ensure that no infant spontaneously produced the target actions. The experimenter placed the first object on the table in front of the infant. If necessary the experimenter attracted the infant's attention to the object by making neutral comments that did not relate to the task. The infant was given 30 s to explore the object. This procedure was repeated until the infant had been exposed to three objects. The order in which the objects were presented was counterbalanced across infants. None of the target actions were spontaneously produced during this phase.

6.7.2. Modelling stage

Immediately following the baseline stage, the experimenter modelled the target actions associated with each object in the same order that the objects had been presented. Each action was modelled four times within a 30 s period. The experimenter then removed the object from the table thus ensuring that the infant was given no opportunity to engage with it until the response stage.

6.7.3. Intervention stage

The last object was placed away and the infant was engaged in other unrelated tasks for 8 min.

6.7.4. Response stage

The infant was presented with the objects under the same conditions as the baseline stage. He or she was given 30 s with each object to produce the target behaviour.

6.7.5. Scoring

All coding was conducted from videotape. The coder was required to judge whether the target behaviour was produced in the response stage and, if so, the infant was awarded one point for each action. Therefore,

for each session the infant could receive a deferred imitation score ranging from zero to three. The age-of-emergence of deferred imitation was determined to be the age of the infant at the session during which at least one target action was first exhibited.

6.8. Reliability

The first author was the primary coder of all measures. A second trained coder, who was blind to the specific hypotheses of the study, independently observed and coded the videotapes of 12 (17%) randomly selected infants (two from each session). Intraclass Correlation Coefficients (Shrout & Fleiss, 1979) were calculated between the scores of the two coders for each measure. The inter-rater reliability on all measures was high. The individual coefficients were as follows: deferred imitation 0.96; synchronic imitation 0.98; pretend play 0.99; and mirror self-recognition 1.00 (i.e., there was 100% agreement).

7. Results

As the first objective was to chart the developmental progressions of pretend play, mirror self-recognition, synchronic imitation and deferred imitation, the results for the individual measures are presented first. The second objective was to appraise the developmental relations between these variables.

8. Individual measures

8.1. Pretend play

The mean age of emergence for pretend play was 17.23 (S.D. = 2.49) months, indicating that it was not until around 18 months of age that the majority of infants (85%) began to exhibit pretend play. The means scores and 95% confidence intervals for performance on the pretend play task are presented in Fig. 1. The infants scored progressively higher from the 15 through to the 21-month session with only a slight increase up to the 24-month session. The cross-lag correlations for the infants' performance on the pretend play task are presented in Table 1. Stable individual differences in the exhibition of pretend play are evident in the significant correlations between the score achieved on the pretence task in one session and the score achieved in the subsequent session.

Table 1
Pearson's product–moment correlation coefficients between the measures of pretend play across sessions

	PP18	PP21	PP24
PP15	0.37**	0.14	0.13
PP18		0.29*	0.32**
PP21			0.42**

* $P < 0.05$ (two tailed).
** $P < 0.01$ (two tailed).

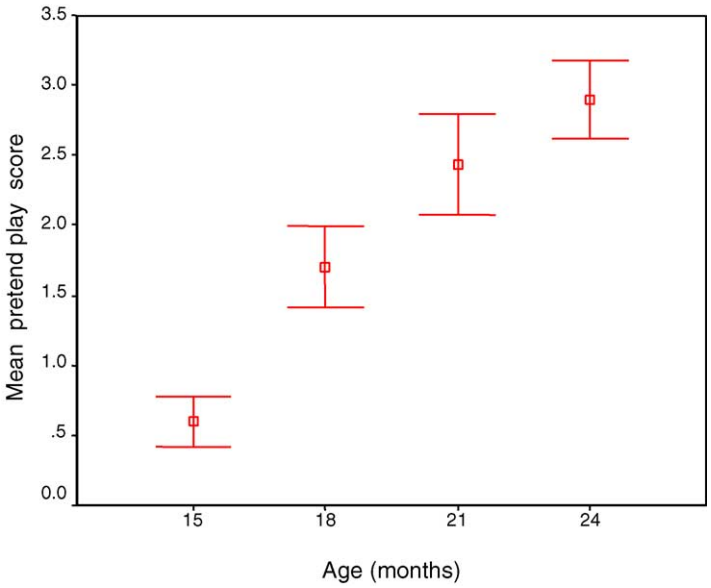

Fig. 1. Mean score (and 95% confidence intervals) for pretend play achieved by the infants from 15 to 24 months of age.

8.2. Mirror self-recognition

With the exception of one infant, all infants who failed to respond to the sticker in the Mirror-Sticker stage of the mirror task removed the sticker from their hand in the Sticker-Saliency stage. As the infant who failed to respond to the sticker being placed on his hand had not previously exhibited mark-directed behaviour, his failure to show interest in the sticker meant that his age of emergence of mirror self-recognition could not be reliably determined. Therefore, this infant was excluded in subsequent analyses involving the age of emergence of mirror self-recognition. Three infants reached for the sticker prior to the mirror being introduced in the Mirror-Sticker stage. However, as each of these infants had exhibited mirror self-recognition in a previous session their age of emergence was not affected. Similarly, one infant failed to show mirror self-recognition in one session (24 months) having previously exhibited it in previous sessions (18 and 21 months). The age of emergence data for these four infants were retained. In addition, seven infants failed to show mark-directed behaviour in any session. These seven infants were coded as having passed mirror self-recognition at +24 months. Consistent with past research, the mean age of emergence for mirror self-recognition was 18 months. Sixty-four percent of infants first recognized themselves at this session. Fig. 4 presents the cumulative percentage of infants showing mirror self-recognition from 12 to 24 months of age.

8.3. Synchronic imitation

The mean age of emergence of synchronic imitation was 16.88 (S.D. = 3.14) months, reflecting the finding that the majority of infants exhibited synchronic imitation for the first time in either the 15-month (43%) or 18-month (84%) sessions. The mean duration and 95% confidence intervals of synchronic

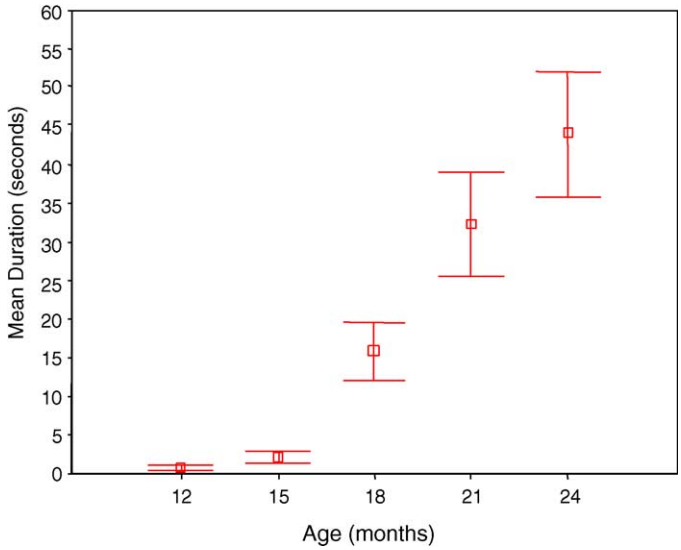

Fig. 2. Mean duration (seconds) (and 95% confidence intervals) of synchronic imitation exhibited by the infants from 12 to 24 months of age.

imitation exhibited by the infants at each session are presented graphically in Fig. 2. The infants exhibited little synchronic imitation prior to the 18-month session but showed a marked increase in the duration of this behaviour from the 18-month session onwards. By the 24-month session, infants were spending approximately one third of the 120-s episode engaging in sustained imitative sequences.

While the cross-lag correlations (see Table 2) between the synchronic imitation scores prior to 18 months were not significant, there was consistency in the exhibition of synchronic imitation from the 18-month session onwards, with each of the correlations between the scores at the 18-, 21-, and 24-month sessions being significant. These results suggest that stable individual differences in the exhibition of synchronic imitation do not emerge until the middle of the second year.

8.4. Deferred imitation

The majority of infants (78%) exhibited at least one imitative act in the 12-month session. Thus the mean age of emergence of deferred imitation was 12.66 (S.D. = 1.33) months. The means and 95% confidence

Table 2
Pearson's product–moment correlation coefficients between the measures of synchronic imitation across sessions

	SI15	SI18	SI21	SI24
SI12	0.11	0.11	−0.00	−0.19
SI15		0.07	0.02	0.12
SI18			0.34**	0.30*
S21				0.68**

* $P < 0.05$ (two tailed).
** $P < 0.01$ (two tailed).

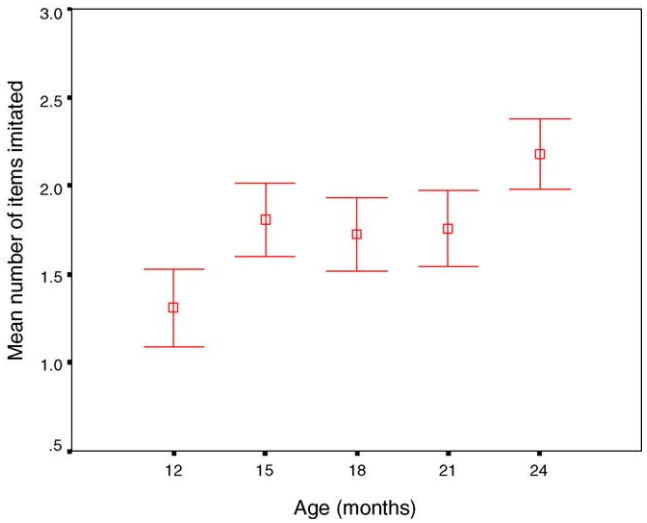

Fig. 3. Mean number (and 95% confidence intervals) of deferred imitation items exhibited by infants from 12 to 24 months of age.

intervals for deferred imitation are presented in Fig. 3. The number of items imitated increased from the 12- to 15-month session, after which performance reached a plateau before increasing again at the 24-month session. The cross-lag correlations (see Table 3) indicate that the individual performance of infants on the deferred imitation task remained relatively stable over time. That is, those infants who scored comparatively high in one session were likely to do so in subsequent sessions.

9. Developmental interrelations

The cumulative percentage of infants demonstrating at least one example of each measure was calculated for each session (see Fig. 4). Of the four skills measured here, deferred imitation emerged first. Synchronic imitation and pretend play emerged later followed by mirror self-recognition. Moreover, synchronic imitation, pretend play and mirror self-recognition all showed a common developmental trajectory with few infants exhibiting these skills at 12 months, the majority doing so at 18 months and almost all by 24 months.

Table 3
Pearson's product–moment correlation coefficients between the measures of deferred imitation across sessions

	DI15	DI18	DI21	DI24
DI12	0.28*	0.21	0.13	0.21
DI15		0.36**	0.32**	0.36**
DI18			0.38**	0.34**
DI21				0.54**

* $P < 0.05$ (two tailed).
** $P < 0.01$ (two tailed).

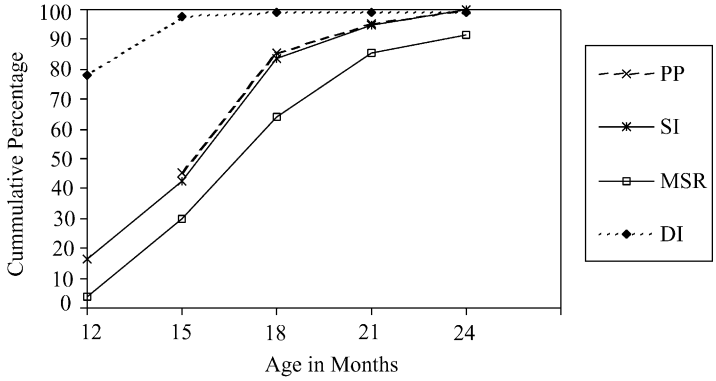

Fig. 4. The cumulative percentage of infants showing evidence of pretend play (PP), synchronic imitation (SI), mirror self-recognition (MSR) and deferred imitation (DI) at each session.

Individual infants' patterns of emergence of deferred imitation, synchronic imitation, pretend play and mirror self-recognition were determined. As it was common for two of the skills to emerge in the same testing session, analysis was based on skills that emerged *before or in the same session* as other skills.

The most common pattern of emergence for the four skills (see Fig. 5a) was deferred imitation ⇒ synchronic imitation ⇒ pretend play ⇒ mirror self-recognition. Of the 77 infants who provided age of emergence data for all four skills, 46 (60%) showed this pattern. This percentage is significantly different from what could be expected by chance (4%; binomial test, $P < 0.0001$).[3] The numbers of infants who displayed each pair and triplet within the main pattern is also shown in Fig. 5b along with a breakdown of the number of infants displaying the relevant pairs of skill in the same session or in a previous session (Fig. 5c).

A Guttman (1950) scalogram analysis was conducted in order to test the scalability of the main pattern noted above. This analysis evaluates the degree to which skills that are proposed to emerge later only appear in individuals who have already acquired skills that are proposed to emerge earlier. As this analysis is conducted at one time point only it avoids any problems that may be inherent in using a criteria based on "skills that emerged before or in the same session as other skills". Analysis was conducted on the pass/fail scores on each of the four measures at 15 months. A pass on each measure was given when the infant had exhibited at least one target behaviour. Data from 15 months was chosen for analysis as it was in this session that the infants first began to show evidence of synchronic imitation, pretend play and mirror self-recognition.[4] The coefficient of reproducibility for the above sequence was 0.93, indicating that a linear hierarchy model did not accurately fit the task data. This result demonstrates that the items were not highly scalable, indicating the independence of the four abilities considered.

Additional analysis using Bart and Airasian's (1974) ordering-theoretic method was thus conducted on infants pass/fail scores at 15 months. The ordering-theoretic method identifies prerequisite relations

[3] Following Carpenter et al. (1998), this number was calculated by dividing the number of different ways an infant could display this pattern given the "before or in the same month as" rule (8) by the total number of different patterns possible given that rule (192).

[4] The analyses reported here were also conducted on the pass/fail scores on each of the four measures at 18 months. As these alternative analyses did not effect the substantive interpretations made, for the sake of parsimony only the data derived from the 15-month session are reported here.

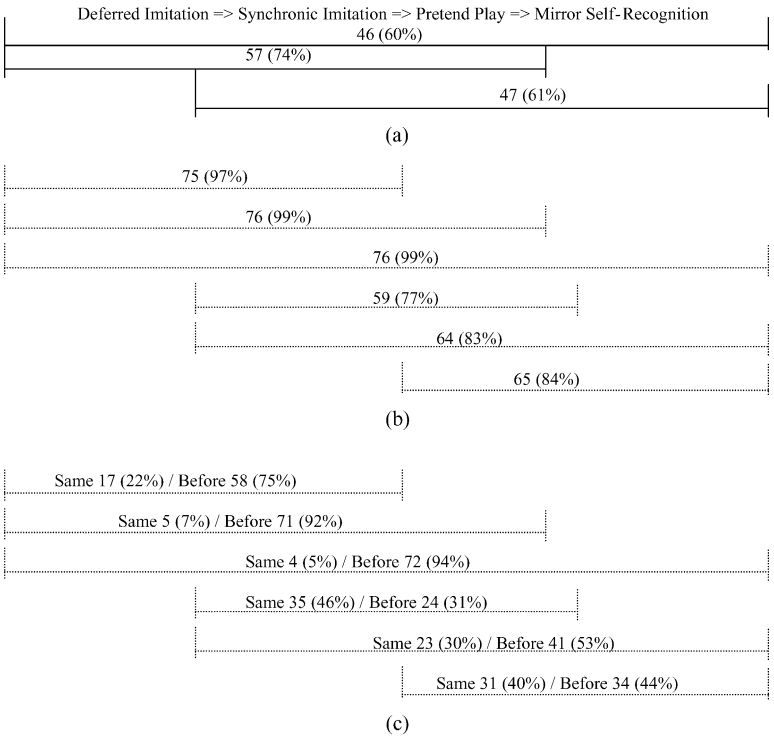

Fig. 5. The most common pattern of emergence (based on skills that emerged before or in the same session as other skills) of deferred imitation, synchronic imitation, pretend play and mirror self-recognition, with the number (and percentage) of infants displaying this pattern and its component patterns. (a) Lines represent the number of infants fitting the entire sequence and the number fitting the two possible ordered triplets within the entire sequence. (b) The lines here represent pairs of abilities (i.e., where a skill emerged before or in the same session as its paired skill). (c) The lines here represent pairs of abilities with the number (and percentage) of infants displaying the relevant skills in the same session and in a previous session.

(i.e., where one skill is exhibited only if another skill is also exhibited) between pairs of skills rather than testing an entire sequence of skills. Using a 1% tolerance level a prerequisite relation was found between deferred imitation and each of the remaining three skills. That is, for all but one infant, deferred imitation was displayed before synchronic imitation, pretend play and mirror self-recognition were displayed. No prerequisite relations were found between synchronic imitation, pretend play and mirror self-recognition.

The next series of analyses was aimed at evaluating the specific timing of the emergence of synchronic imitation, pretend play and mirror self-recognition. Deferred imitation was excluded from these analyses as this skill had emerged in the majority of infants by 12 months (see Fig. 4). The time it took the infants to exhibit the remaining three skills was examined by counting the number of months it took each infant to show all three skills in any order for the first time. Of the 70 infants who had exhibited synchronic imitation, pretend play and mirror self-recognition by 24 months of age (i.e., excluding the seven infants who failed to pass the mark test by the final session), 11 infants (16%) showed all three skills for the first time in the same session. The three skills emerged in two sessions or less for 45 (64%) infants, in three sessions or less for 66 (94%) infants, and in four sessions or less for all 70 infants. As testing took place at intervals of 3 months these figures indicate that synchronic imitation,

pretend play and mirror self-recognition emerged within 3 months of one another for less than one fifth of the infants tested. For a majority of the infants it took 6 months or less for all three skills to emerge.

The actual age, as opposed to the time period, by which synchronic imitation, pretend play and mirror self-recognition first emerged was also assessed. All three skills emerged by 15 months for 10 infants (14%), by 18 months for 35 infants (50%), by 21 months for 61 infants (87%), and by 24 months for all 70 infants. Pearson correlations were calculated to assess whether the age of emergence of one skill was associated with the age of emergence of another skill (see Table 4). The only significant associations were between the age of emergence of mirror self-recognition and the ages of emergence of synchronic imitation and pretend play.

The aim in the following series of analyses was to assess whether passing one task in one session was associated with passing another task in the same or in a later session. Pearson correlations were calculated between the scores for each variable derived from each session. Due to the large number of correlations, a significance level of 0.005 was used. Significant correlations were revealed between several pairs of skills. The only consistent pattern of association was found between deferred imitation and pretend play (see Table 5). Infants' exhibition of deferred imitation at 15 months was significantly correlated with their exhibition of pretend play at 18 months and 21 months. Similarly, deferred imitation and pretend play were significantly correlated at 21 and 24 months of age. The only other significant associations were revealed between mirror self-recognition at 15 months and pretend play at 18 months ($r = 0.36$, $P = 0.004$), mirror self-recognition at 18 months and deferred imitation at 21 months ($r = 0.35$, $P = 0.002$) and synchronic imitation and pretend play at 24 months ($r = 0.43$, $P < 0.001$).

Table 4
Pearson's product–moment correlation coefficients between the ages-of-emergence of mirror self-recognition (MSR), deferred imitation (DI), synchronic imitation (SI) and elicited pretend play (EPP)

	DI	SI	EPP
MSR	−0.15	0.30**	0.28*
DI		0.10	−0.04
SI			0.10

* $P < 0.05$ (two tailed).
** $P < 0.01$ (two tailed).

Table 5
Pearson's product–moment correlation coefficients between the measures of deferred imitation (DI) and pretend play (PP) across sessions

	DI12	DI15	DI18	DI21	DI24
PP15	0.11	0.18	0.09	−0.08	0.11
PP18	0.15	0.37*	0.32	0.16	0.25
PP21	0.16	0.35*	0.09	0.35*	0.35*
PP24	0.16	0.22	0.21	0.42*	0.40*

* $P < 0.005$ (two tailed).

10. Discussion

The aim in this study was to chart the development of pretend play, mirror self-recognition, synchronic imitation and deferred imitation in a cohort of infants through the second year. Deferred imitation has long been regarded as important in the social and cognitive development of children. However, this is the first study to investigate the developmental changes in deferred imitation longitudinally from 12 months of age through to the end of the second year, when children are developing the kinds of representational skills that Piaget (1952) argued are necessary for the exhibition of deferred imitation. Consistent with past research, the majority of infants exhibited deferred imitation at 12 months (Barr et al., 1996; Heimann & Meltzoff, 1996; Meltzoff, 1988b). The number of actions imitated increased in the 15-month session, and then remained relatively constant thereafter, save for a small increase again in the 24-month session. In addition, infants showed relatively stable individual differences in the exhibition of deferred imitation, and the association between the number of actions imitated from one session to the next became stronger with increasing age (i.e., the strongest correlation was between deferred imitation at 21 and 24 months).

In contrast to deferred imitation, synchronic imitation, pretend play and mirror self-recognition were all characterised by a low level of exhibition up to and including the 15-month session, after which a marked increase in performance was observed. In addition, stable individual differences were evident in the exhibition of pretend play and synchronic imitation. Deferred imitation thus emerged earlier and followed a distinct developmental trajectory from that followed by synchronic imitation, pretend play and mirror self-recognition. In the 15-month session, synchronic imitation, pretend play and mirror self-recognition were each exhibited by fewer than half of the infants studied here. In contrast, at the same age almost all of the infants engaged in deferred imitation. Moreover, no discernable change was detected in the exhibition of deferred imitation at 18 or 21 months. Thus, in line with Heimann and Meltzoff (1996), there is little evidence here to suggest that deferred imitation should be included with other indicators of developing mental capacity in the second year of life.

Nonetheless, developing a capacity for deferred imitation may be important to the later development of pretend play. That is, deferred imitation at 15 months was associated with the onset of pretend play at 18 and 21 months. Moreover, the number of deferred imitation items replicated was significantly correlated with the number of pretend play items produced at 21 and 24 months of age. A growing number of contemporary researchers argue for the presence of a developmental link between imitation and pretend play (e.g., Mitchell, 2002b; Parker, 1998; Rakoczy, Tomasello, & Striano, submitted for publication; Rogers & Pennington, 1991; Striano, Tomasello, & Rochat, 2001). The present study is the first to provide longitudinal data in support of this theoretical assertion. In this context it is noteworthy that the pretend play task administered here required the infants to produce a simple action that, more likely than not, would have been modelled to them by their carers, that is drinking ‘tea’ from a cup. It may thus be speculated that in order to perform in the pretend play task the infants had to retrieve from memory the actions on objects they had previously seen being performed by others. That is, they had to rely on their capacity for deferred imitation. This speculation is in line with the view that pretend play is acquired through cultural learning and that infants generate their own pretence only if exposed to the pretence of others (Rakoczy et al., submitted for publication; Tomasello, 1999a, 1999b; Tomasello & Rakoczy, 2003).

10.1. Synchronic imitation, pretend play, mirror self-recognition and secondary representation

Based on the theory of mental representation developed by Perner (1991) and expanded by others (Asendorpf, 2002; Suddendorf & Whiten, 2001), it was hypothesised that synchronic imitation, pretend play and mirror self-recognition would emerge in close parallel around the middle of the second year. The data presented here provide only mixed support for this hypothesis.

In line with the contention that synchronic imitation, pretend play and mirror self-recognition commonly depend on infants' capacity to entertain secondary representations each of these skills emerged in the second year and showed a similar developmental trajectory. Few infants exhibited these skills at 12 months, the majority doing so at 18 months and almost all by 24 months. In addition, the age of emergence of mirror self-recognition was associated with the ages of emergence of both synchronic imitation and pretend play. Significant associations were also revealed between mirror self-recognition at 15 months and pretend play at 18 months and between synchronic imitation and pretend play at 24 months.

However, no associations aside from those reported above were revealed between synchronic imitation, pretend play and mirror self-recognition. Moreover, having shown one skill a majority of infants took from 3 to 6 months to show all three skills. Additionally, while synchronic imitation generally emerged first, followed respectively by pretend play and mirror self-recognition, this order was not highly scalable and no prerequisite relations between the skills were revealed. Thus none these three skills should be treated as a developmental precursor to the emergence of the other skills, and the exhibition of one of these skills does not necessarily entail the exhibition of one of the others. Therefore, the association between the development of synchronic imitation, pretend play and mirror self-recognition was not as close as was predicted.

Though failing to support our hypothesis, the lack of a strong developmental association between the exhibition of synchronic imitation, pretend play and mirror self-recognition provides some insight into the way in which infants' thinking may change from a single mental model (primary representation) to multiple models (secondary representation). According to Perner (1991), changes in the second year that are attributable to secondary representations may arise due to distinct developmental processes. Perner notes that such changes might emerge due to the maturation of a new cognitive architecture. However, Perner alternatively argues that secondary representations are present early in development but infants have to learn how to use them meaningfully. Our data conforms to this latter explanation. Infants learn how to apply secondary representations in one developmental realm (e.g., synchronic imitation) but must then learn how to apply this knowledge in another (e.g., pretence). Thus, all secondary representational skills are not expressed at the precise same stage in development and learning how to apply secondary representations in one realm does not automatically mean that secondary representations can be applied in another. In this context the findings reported here also have implications for theorists who propose a domain-general change in infants capacity for representation around the middle of the second year (e.g., Karmiloff-Smith, 1992; Meltzoff, 1990; Piaget, 1952, 1954). If such proposals are valid, representational skills should emerge in greater synchrony than is apparent in the current study (see Courage & Howe, 2002).

10.2. Comparisons with past research

As noted in the introduction, past research has reported positive correlations between success on the mark test of mirror self-recognition and the exhibition of pretend play (Baudonnière et al., 2002; Chapman,

1987; Lewis & Ramsay, 1999). The findings in the present study of significant correlations between the ages of emergence of these two skills and between mirror self-recognition at 15 months and pretend play at 18 months are consistent with this research. Cross-sectional and longitudinal data suggesting a link between the exhibition of mirror self-recognition and the onset pretence in the second year are now available across three cultures. Future research can now focus on determining more precisely what behavioural and cognitive skills are responsible for this association (e.g., Mitchell, 2002a; Suddendorf & Whiten, 2001).

Past research has also reported a positive association between mirror self-recognition and the exhibition of synchronic imitation at 18 months (Asendorpf et al., 1996). It is argued that this association is due to both skills relying on a capacity for secondary representation (Asendorpf, 2002; Suddendorf & Whiten, 2001). In line with this assertion, the current study found an association between the ages of emergence of synchronic imitation and mirror self-recognition. However, despite using similar tasks, the current study did not replicate the finding reported by Asendorpf et al. (1996) in 18 month olds. Notably, the mean duration of synchronic imitation exhibited by 18-month-old mirror self-recognisers was almost identical across studies (14.69 s in Asendorpf et al., 16.05 s in the current study). However, whereas Asendorpf et al. report non-recognisers as engaging in synchronic imitation for less than half the time of recognisers (6.11 s), the non-recognisers in the present study exhibited synchronic imitation at a similar level to the recognisers (15.73 s). The difference between the two studies in the level of synchronic imitation exhibited by non-recognisers may be an outcome of infants in the present study having been administered the synchronic imitation task at 12 and 15 months. Thus, infants in the present study had been given prior opportunity to learn the demands of the task and may not have had to rely on their capacity for secondary representation to appreciate the intention of the experimenter for them to continue to copy his behaviour for a sustained period.

Some infants may therefore have engaged in synchronic imitation by learning, through prior experience, what the demands of the task are. As alluded to previously, some infants may also have exhibited pretend play by imitating the behaviours of others and in some cases may have done do so without appreciating the non-literal nature of what they were doing. Other infants may have engaged in synchronic imitation and pretend play by employing their capacity for secondary representation. It thus remains possible that infants exhibit skills, such as those investigated in the current study, using different behavioural and cognitive strategies. That infants could have exhibited the skills investigated here by using different strategies possibly militated against revealing the expected associations between skills. This emphasises the need for further refinement of the measures included in the present study.

11. Precursors to a theory-of-mind

As noted in the introduction, pretend play, mirror self-recognition, synchronic imitation and deferred imitation have each been identified as potential developmental precursors to the emergence of a theory of mind (Asendorpf et al., 1996; Bard, 1998; Gallup, 1991; Gopnik & Meltzoff, 1994; Leslie, 1987; Meltzoff & Gopnik, 1993; Meltzoff & Moore, 1995; Nielsen & Dissanayake, 2000; Perner, 1991; Rogers & Pennington, 1991; Suddendorf & Whiten, 2003; Whiten, 1996). According to Perner (1991), a theory of mind depends on a capacity for entertaining metarepresentations, something that develops only once a capacity for entertaining secondary representations has been established. In this context, synchronic imitation, pretend play and mirror self-recognition may each be associated with the later emergence of a

'theory of mind' through their common reliance on a capacity for secondary representation. The failure to reveal a close developmental association between these abilities means that this hypothesis remains to be fully supported. Future research is needed to investigate more closely the relation between the skills investigated here and other skills proposed to rely on secondary representation (e.g., means-ends reasoning and hidden displacement tasks). Moreover, long-term longitudinal research is now necessary to fully evaluate the degree to which these skills are associated with the later onset of a theory of mind.

Rogers and Pennington (1991) speculate that children with autism have a biological impairment which effects their ability to coordinate representations of self and other. These children are thus prevented from developing the notion that 'other' is a template of 'self'. Hence, their capacity for motor imitation is directly effected which in turn leads to impairments in other domains of social development that rely on an ability to coordinate representations of self and other. Impairment in the ability to engage in imitation thus results in subsequent deficits in pretend play, which in turn has knock-on effects for the development of a 'theory of mind'. The association between deferred imitation and the exhibition of pretend play revealed in the current study is consistent with this theory. That is, the imitative ability of young children towards the middle of the second year has, at least, a short-term association with their emerging pretence capabilities. Where the exhibition of imitation is diminished the later exhibition of pretend play is similarly diminished. Nevertheless, it is over the course of the third year that pretence becomes consolidated into children's play repertoire. Future research is therefore necessary to determine whether or not the ability of young children to imitate has a long-term association (compared to the comparatively short-term association demonstrated here) with their later development of pretence. Given the developmental sequence proposed by Rogers and Pennington there remains a need for research into the long-term developmental associations between imitation, pretend play and a theory of mind.

12. Conclusion

The current paper presents the first longitudinal investigation of the developing abilities of infants to exhibit pretend play, mirror self-recognition, synchronic imitation and deferred imitation through the second year of life. The results of this study provide valuable data regarding the ways in which these crucial abilities develop, both individually and in relation to each other. The pattern of results reported here demonstrates that synchronic imitation, pretend play and mirror self-recognition emerge following a similar developmental trajectory and are developmentally distinct from deferred imitation. However, the lack of a strong association between the three former abilities indicates that their emergence may be relatively independent of one another. There remains a need for continued investigation into the association between the skills investigated here and the development of a theory-of-mind, thereby directly addressing the status of these abilities as precursors to a representational understanding of mind. Such investigation will provide us with a greater understanding of the ontogenetic distribution of these important aspects of social and cognitive development.

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Appendix A. Synchronic imitation objects and actions

At each session, from the 15-month session onwards, one toy/object used in the previous session was deleted from presentation and a new toy/object introduced in its place. The following is a list of the objects and accompanying activities presented at each session.

12 months. The first object was a baby rattle (Rattle 1, 10 cm long). For the first action, the rattle was held in both hands and moved back and forth in front of the chest. Attached to the rattle was an arm that moved on a hinge through a 90° arc. For the second action, the rattle was held in one hand and the hinged arm was moved vertically through its arc using the other hand.

The second object was a small plastic bear (9 cm high). For the first action, the bear was placed on the mat and a 'squeaking' sound was produced by pushing on the bear. For the second action, the bear was held in both hands and then brought to the lips while making 'kissing' sounds.

The third object was a novel baby rattle (Rattle 2, 12 cm long). For the first action, the rattle was held in one hand and banged on the mat. For the second action, the rattle was placed on the mat and rolled back and forth.

The fourth object was a soft toy frog (14 cm long). For the first action, the frog was bounced up and down on the mat. For the second action, the frog was held in one hand and 'clapped' with the other hand.

15 months. The objects and actions were identical to the 12-month session except that Rattle 2 was replaced with a Plastic Hammer (18 cm long). For the first action, the experimenter placed the hammer on the mat and moved it through a 90° arc, using its head as a fulcrum. The experimenter then held the hammer in one hand and used it to gently hit the fist of the other hand.

18 months. The objects and actions were identical to the 15-month session except that Rattle 1 was replaced by a Plastic Spanner (16 cm long). The experimenter 'marched' the spanner along the mat for the first action. He then held the handle of the spanner in one hand, placed the open end on the middle fingers of the other hand, and moved it around the fingers as if tightening a bolt.

21 months. The objects and actions were identical to the 18-month session except that a Small Baby Doll (14 cm high) replaced the Frog. For the first action, the experimenter 'marched' the doll by holding its legs and moving it forward. For the second action, the doll was 'jumped' up and down.

24 months. The objects and actions were identical to the 21-month session except that a Rattle (Rattle 3, 12 cm long) replaced the Bear. For the first action, the experimenter placed the rattle on the mat and rolled it back and forward in front of him. For the second action, the rattle was moved continuously through a 90° vertical arc.

Appendix B. Deferred imitation objects and actions

12 months. Each of the three actions presented at the 12-month session utilised two objects. The first object pair was a plastic coil (10 cm in length when fully coiled and 8 cm in diameter) that expanded with moderate force, and a small sponge ball (6 cm in diameter). The action was to place the ball inside the

coil and push over the top of the coil such that it touched the tabletop, thus forming an arch with the ball remaining in one end.

The second object pair comprised a wooden dowel (12 cm long) with two wooden cubes (3^3 cm) attached to each end of the dowel, and a toy hippopotamus (11 cm long, 7 cm high) that produced a sound when squeezed. The action involved placing the hippopotamus on the table, holding the dowel by one cube, placing the other cube against the hippopotamus, and pushing down until it produced a 'squeaking' sound.

The third set of objects was a red plastic ring (10 cm diameter) and a small baby doll (18 cm high). The action was to take the ring and place it over the doll's head.

15 months. The first set of objects were a toy beaded necklace and a small wooden box (10^3 cm). The action was to place the necklace over the box.

The second object pair was a toy screwdriver (12 cm long) and a box (5.4 cm × 15 cm × 16.5 cm). The box was covered with black cloth, which served to hide a black button (2.2 cm × 3.0 cm) mounted 0.6 cm below the top surface of the box. The button was used to activate a switch inside the box, producing a beep of medium volume. The action was to take the screwdriver and use it to produce the beeping sound from the box by placing it against the covered button and pushing downwards.

The third object pair comprised a yellow spool (3 cm long) that had two plastic yellow pegs (6 cm long) protruding from each end (one fixed, one loose) and the wooden dowel apparatus described for the 12-month session. Each of the cubes of the dowel apparatus had a small hole drilled in one face. The action was to pull the loose peg out of the spool and place it in the hole of one of the cubes.

18 months. The first object pair was a green spool and an L-shaped wooden object, which consisted of a rectangular base (15.3 cm × 23.5 cm) with a smaller rectangle (9.2 cm × 10.0 cm) hinged to it. The action was to raise the hinged board, place the spool within its arc and close it so that it touched the spool.

The second object pair was a green wooden pear (10 cm high) that had a hole bored in its base and the wooden dowel apparatus described for the 12-month session. Protruding from the dowel, equidistant between the cubes, was a smaller dowel (2.5 cm long). In both the Pre-modelling and Response phases the dowel was presented to the child with the smaller dowel placed horizontal to the table. The action was to tip the smaller dowel up (so that it was at 90° to the table) and to fit the hole of the pear over the dowel.

The third object pair comprised a plastic yellow egg (6.4 cm high and 4.5 cm in diameter at its widest point) and a toy salt shaker (7 cm high). The action was to remove the top of the shaker and place the egg on the base of the shaker it as if it were an eggcup.

21 months. The first object/action pair used the toy hippopotamus described in the 12-month session. The experimenter held the hippopotamus in both hands and produced a squeaking sound by placing it against his forehead.

A second set of objects comprised two yellow cups (8 cm diameter, 7 cm high) and a small red ball. The action was to place the ball in one cup and then tip it into the second.

A third set of objects was a red tower (10 cm high) with a hollow base and a toy mascara brush small enough to fit inside the base of the tower. The action was, in one movement, to place the tower over the brush and then lift it off, placing it beside the brush.

24 months. The first object pair was an apparatus that comprised three plastic hands (8 cm long), which were attached to a common handle. By shaking the handle rapidly a 'clapping' sound was produced. The action was to produce the sound by gently 'banging' the apparatus against one's chest.

The second set comprised three separate objects: (1) a rectangular piece of yellow plastic (5 cm × 8 cm), (2) a red wooden block (8 cm long), and (3) a green plastic spool (3 cm long). The action was to place the plastic on the block to form a slide for the spool.

The third object pair was the wooden dowel apparatus described for the 12-month session and a small plastic puppy that produced a sound when squeezed. The action was to push the puppy from its upright position so that it laid on its back and then to produce the sound by gently tapping the puppy's stomach with the wooden dowel.

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