Available online at www.sciencedirect.com
SCIENCE DIRECT®
Cognitive Development 21 (2006) 199–213
COGNITIVE DEVELOPMENT

The development of representational play in chimpanzees and bonobos: Evolutionary implications, pretense, and the role of interspecies communication

Heidi Lyn [a,1], Patricia Greenfield [b,*], Sue Savage-Rumbaugh [c]

[a] *Sea Mammal Research Unit, Getty Marine Lab, School of Biology, University of St. Andrews, Fife KY16 8LB, UK*
[b] *Department of Psychology and FPR-UCLA Center for Culture, Brain, and Development, UCLA, 1285 Franz Hall, 405 Hilgard Avenue, Los Angeles, CA 90095-1563, United States*
[c] *Great Ape Trust, 4200 S.E. 44th Avenue, Des Moines, IA 50320, United States*

Abstract

This research investigates the development of symbolic or representational play in two species of the genus *Pan*, bonobos (*Pan paniscus*) and chimpanzees (*Pan troglodytes*). The participants varied not only by species, but also as to whether they had become proficient in communicating with humans via a set of arbitrary visual symbols, called lexigrams. Using a developmental sequence of representational play based on McCune, we found every level that children manifest to be constructed by *Pan*. The most robust and regular ontogenetic sequence for both bonobos and chimpanzee was not McCune's five-level progression, but a three-step ontogenetic sequence: Level 1 (no representation, no pretense) precedes Levels 2–4 (representation but no pretense), which in turn precedes Level 5 (includes pretense as well as representation). A linguistic system for interspecies communication was necessary for Level 5 representational play and "true" pretense. Human scaffolding produced developmental progress within sequences for all the apes, except the bonobo who lacked a system of interspecies communication. This evidence suggests that the potential for representational play and its social stimulation were present in the common ancestor of bonobos, chimpanzees and humans five million years ago.

Keywords: Representational play; Chimpanzees; Bonobos; Interspecies communication; Pretend play; Cognitive development

* Corresponding author.
E-mail address: greenfield@psych.ucla.edu (P. Greenfield).
[1] Present address: University of St. Andrews, Scotland.

0885-2014/$ – see front matter © 2006 Elsevier Inc. All rights reserved.
doi:10.1016/j.cogdev.2006.03.005

1. Investigating the evolution of symbolic capacities through comparative ontogeny

The evolutionary history of symbolic capacities is of great developmental interest. Two great developmental theorists, Piaget (1945/1978, 1962) and Werner (1948), emphasized the intertwining of phylogeny and ontogeny in symbolic development. The evolution of a species can be seen as a sequence of ontogenies that are modified over evolutionary time (Parker, Langer, & McKinney, 2000). The species comparative work of Antinucci and colleagues has utilized this perspective to compare primate species utilizing a Piagetian framework to describe ontogeny (Antinucci, 1989). We follow this tradition.

One approach to the evolutionary history of symbolic capacities is to investigate the ontogeny of these capacities in our closest living relatives, chimpanzees (*Pan troglodytes)* and bonobos (*Pan paniscus)*. By using both species in a comparison with humans, we have a clade, that is, a complete set of species with a common ancestor at a given point in evolutionary time, in this case, about five million years ago (Stauffer, Walter, Ryder, Lyons-Weiler, & Blair-Hedges, 2001). Insofar as we find a common ontogenetic sequence in a complete clade, which in this case consisted of bonobo, chimpanzee and human, it is likely that the capacity for this developmental sequence was present in the common ancestor. Herein lies the theoretical interest in comparing both bonobo and chimpanzee development to human development.

A symbolic capacity of particular phylogenetic interest is symbolic or representational play – acting as if – because this capacity develops so early in human children, starting in the second year of life, around the same time as early language. Representational play also shows a very regular sequence of ontogenetic stages in its behavioral development (McCune, 1995; McCune-Nicolich, 1977; Piaget, 1945/1978; Piaget, 1945/1978, 1962). While phylogeny does not recapitulate ontogeny, early stages of closely related species are more similar than later stages. Therefore, early ontogenetic sequences are more likely than later ones to manifest ancestral traits; these early sequences therefore shed light on evolutionary origins. This line of thought leads to our first research question:

Question 1: Is there a common ontogenetic sequence of symbolic play in the clade consisting of chimpanzees, bonobos, and humans? If so, do bonobos and chimpanzees progress as far as human children in it?

2. Ontogenetic sequence and cognitive processes

What is the developmental sequence of representational play and what is the nature of the cognitive changes that underlie this sequence? We turn first to the behavioral sequence. Five levels of representational development based on McCune and Agayoff (2002) are shown in Table 1, which also was the basic rubric for our coding. Note that Level 1 is not representational; it involves the use of the same objects and themes as appeared in events categorized as representational in Levels 2–5. McCune's data indicate that Levels 1–5 constitute an ontogenetic sequence, although some children skip Level 2 (McCune, 1995).

2.1. Pretense as one type of representational play

But not all symbolic or representational play is pretense. Leslie (1987) notes that much of the behavior classified in developmental sequences such as that shown in Table 1 can be based on an understanding of the conventional uses of objects and is therefore ambiguous as pretense. In Leslie's view, only three types of behavior constitute unambiguous examples of "true" pretense:

Table 1
Coding system for levels of pretend play

Level	Name/description	Child example	Nonhuman primate example
1	Presymbolic schemes – child or ape shows understanding of object use or meaning by action – no pretending	Child picks up a comb, touches it to his hair, drops it. The child gives a toy mop a swish on the floor	Ape touches or explores toy object[a]
2	Self-pretend/auto-symbolic games – Child or ape pretends at self-related activities while showing elaborations such as sound effects, affect and/or gesture and an awareness of the pretend aspects of the behavior	The child eats from an empty spoon. The child closes her eyes, pretending to be asleep	Ape eats from a picture of food with "lipsmacking" behavior[a]
3	Single representational play acts – Including other actors or receivers of action (doll, mother) – Pretending at activities of other living creatures and objects (dogs, trucks, trains, etc.)	The child feeds her mother or doll. Child pretends to mop floor.	Ape grooms or feeds a doll[b]
4	Combinatorial pretend—single scheme applied to multiple recipients or multiple schemes applied to a single recipient	Child combs own hair with a toy comb, then mother's hair (single scheme). Child stirs in pot, feeds doll, pours food into dish (multi-scheme)	Ape puts on mask and chases different apes and people (single scheme)[a]. Ape "puts on make-up," then primps at mirror (multiple schemes)[b]
5	Hierarchical pretend/hierarchical combinations – an internal plan or designation is the basis for the pretend act – child or ape engages in verbalization, search, or other preparation. One object is substituted for another with evidence that the child or ape is aware of multiple meanings being expressed. Child or ape constructs imaginary object. Child or ape treats inanimate object as if it were active or animate. Child or ape shows behaviorally that he or she actively expects an inanimate object to carry out an action with the aid of another	Child picks up toy screwdriver, says "toothbrush" and makes motions of brushing teeth (object substitution). Child picks up comb and doll, sets comb aside, removes dolls hat (preparation), then combs dolls hair. Child places spoon by doll's hand indicating expectation of doll taking spoon in hand	Ape moves and gestures as if pulling imaginary pull-toy around room[b] (construction of imaginary object). Ape holds bowl up to doll's mouth, then moves the doll as if it is eating[a] (animating inanimate object)

Adapted from McCune and Agayoff (2002).
[a] Example taken from current study.
[b] Example taken from coded ape examples in McCune and Agayoff (2002).

object substitution (e.g., using a banana as a telephone), attribution of pretend properties (e.g., pretending the doll's clean face is dirty), and imaginary objects (e.g., holding an imaginary toothbrush and pretending to brush one's teeth with it). Harris and Kavanaugh (1993), in turn, operationally define pretense comprehension as extending the pretend stipulation of another through behavior; e.g., Panbanisha's Example 6 where she extends Liz's stipulation to feed the monkey grapes by

introducing a bowl. Leslie also supplies a general definition: "Pretend is a special case of acting as if where the pretender correctly perceives the actual situation" (Leslie, 1987, p. 413). We will apply these criteria as well to our corpus of examples.

2.2. Separate domains or developmental dependencies?

While Leslie's distinction between functional play and true pretense is valuable, we posit more cognitive and developmental continuity than does Leslie. Instead of a rubicon between functional object play and true pretense, we see the levels in Table 1 as building developmentally on one another. Ontogenetic continuity is necessary for evolutionary continuity; each step in an evolutionary progression builds on what is already there, both genetically and ontogenetically. Whereas the literature of recent years emphasizes the ambiguity of behaviors in Levels 2–4 as pretense (e.g., Racoczy, Tomasello, & Striano, 2005), we see this "ambiguity" as evidence of intermediate steps in an ontogenetic sequence.

3. The relationship between language and pretend play

Question 2: Is representational play one expression of a general symbolic function or does linguistic communication play a causal role in the development of representational play in chimpanzees and bonobos?

On a theoretical level, Piaget claimed that both language and representational play depend on the ontogeny of a general symbolic or representational function; but he also saw language as having a socializing influence on pretend play as it develops (Piaget, 1945/1978). In line with Piaget's notion of a general symbolic function, McCune found a correlation between stages of pretend play and stages of language development (McCune, 1995; McCune-Nicolich, 1977). However, correlational studies cannot provide causal information. We have therefore made use of a natural experiment to study the possible causal relations between language and pretend play. In the present study, we compare the development of representational play in chimpanzees and bonobos skilled in a linguistic system for interspecies communication with members of the same two species who do not have this skill.

The notion of a general symbolic function has been supported by observations of various levels of representational play in wild populations of bonobos and chimpanzees, where the populations have of course no exposure to human language (Goodall, 1986; Greenfield, Maynard, Boehm, & Yut, 2000). For example, Wrangham and Peterson (1996) reported a young chimpanzee acting as if a log were a doll or baby; this would be Level 5 object substitution in the McCune scheme, "true" pretense according to Leslie. Similar behaviors have been reported in captive colonies where no human symbol training has occurred, although there is a certain degree of interaction with humans and their culture (de Waal, 1989).

Based on Piagetian theory and these data, one would expect that language would not be necessary for representational play. On the other hand, Tomasello, Savage-Rumbaugh, and Kruger (1993) found that only symbol-trained chimpanzees imitated novel actions on unfamiliar objects performed by a human demonstrator. Their results therefore suggest human language and or human enculturation as a causal force in at least one type of representational activity, imitation of novel human actions on humanly constructed objects.

Indeed, most examples of representational play in nonhumans are reported in apes that were humanly socialized in an English-speaking environment (e.g., Matevia et al., 2002; Miles, 1994; Mitchell, 2002; Patterson, 1978; Savage-Rumbaugh & McDonald, 1988). Among these is one

example of constructing an imaginary object, an instance of "true pretense" (Leslie, 1987). Hayes (1951) described an interaction with their home-reared chimpanzee, Vicki, where she played with an imaginary pull-toy, even making appropriate gestures to "free" it when it became stuck on a (real) object.

4. Pretense and social interaction

A whole body of work underlines the social nature of representational play (Leslie, 1987; Lillard & Witherington, 2004; Racoczy et al., 2005). Indeed, in humans, pretend play is in fact the outcome of a social scaffolding process (Bondioli, 2001; Farver, 1993; Zukow, 1986). Each stage of pretend play occurs first as a product of interaction with a caregiver, and only later as an independent, self-initiated act (Zukow, 1986). We are therefore led to the following question:

Question 3: What is the role of interspecies interaction with humans in the apes' development of representational play? (a) Will there be a developmental transition from human initiation to ape initiation across sessions (macrodevelopment)?(b) Will the process of scaffolding move an ape from one level of representational play to the next in the space of a single sequence of pretend play (microdevelopment)?

5. Summary: Unique contributions of this study

While apes have been observed to engage in representational play, no study up to now has assembled a corpus of examples. Most important, no one has investigated the symbolic play of apes in its social context. Our corpus, presented as interactive discourse, permits the first exploration of both developmental sequencing and social scaffolding in the symbolic play of apes. Because of the unique variability in our ape histories, we can also compare the symbolic play of apes who have acquired an interspecies symbol system with those who have not. Last but not least, this is the first investigation of symbolic play in both bonobos and chimpanzees, enabling us to complete the clade that includes *Homo sapiens*.

6. Methods

6.1. Participants

Our participants are as follows: Three bonobos (*P. paniscus*) – Panbanisha, Tamuli, her sister, and Nyota, Panbanisha's son; and two chimpanzees (*P. troglodytes*) – Panpanzee and Mercury. Panbanisha and Panpanzee were born six weeks apart and were raised together. All three bonobos and both chimpanzees were reared at the Language Research Center in Atlanta, GA where these data were collected.

Panbanisha, Panpanzee, and Nyota were reared in an environment where they learned to understand spoken English and to use a lexigram keyboard (Brakke & Savage-Rumbaugh, 1995, 1996). For the first two years of her life, Tamuli, the non-lexigram-using bonobo, was reared with her mother Matata, who does not use lexigrams either. Mercury, the non-lexigram-using chimpanzee, was also reared with his mother Lana for two years. Following this two-year period, Tamuli and Mercury were introduced into the human-enculturated environment, but failed to learn any of the symbolic skills acquired by Panbanisha, Panpanzee, and Nyota (Williams, Brakke, & Savage-Rumbaugh, 1997). Perhaps most important in the present context, all five apes were

Table 2
Design and subjects

Bonobos	Chimpanzees
Competent in interspecies communication	
Panbanisha Nyota	Panpanzee
Not competent in interspecies communication	
Tamuli	Mercury

cared for by humans who interacted with them and with objects that encouraged the use of pretense.

This sample constituted a systematic research design. Together, the apes filled out a two-by-two matrix (Table 2). We had two bonobos with interspecies communicative competence (Panbanisha and Nyota) and one without (Tamuli); we had one chimpanzee with interspecies communicative competence (Panpanzee) and one without (Mercury). Although our sample is small, it allows us to begin to assess the effects of species and language.

6.2. Corpus

Results are based on 99 h of videotape. For Nyota, Panpanzee, and Panbanisha, the focal subjects of the video, a minimum of 1 h of video was coded within each three-month period between the ages of one and three years for each ape. After this three-year mark, a minimum of 1 h for every 6 months was coded for each. Mercury and Tamuli appeared opportunistically in the videos and were coded for pretend play when they appeared.

6.3. Transcription and qualitative analysis

Qualitative analysis was selected in order to reveal basic information about the processes of pretend play in two species of nonhuman primate (Greenfield, 1997). Transcription included all caregiver speech, all lexigram productions, all gestures, actions, and interactions relevant to the instance of pretend. Wherever available on the video, transcription includes enough prior context to code the initiator of the pretend play incident.

Our method of presenting data is somewhat similar to that of Piaget's pioneering work on the development of pretend play in his three children (Piaget, 1945/1978, 1962), but with one important difference: Whereas Piaget conceptualized his children as interacting primarily with objects, we have included transcription of all social interaction as part and parcel of each pretend play sequence; unlike Piaget, we view social interaction as an important element in the development of representational play.

Section 7 presents every example from Nyota, Panpanzee, Tamuli, and Mercury. For Panbanisha, we present every example up to age 4. Preserving all critical information, we have shortened some of the examples; full-length versions can also be seen at www.greatapetrust.org. Because Panbanisha's seven adult examples all occurred at age 9 and most repeat levels already found in the developmental database, we present the only adult example that represents a new level of performance. The six other examples in our corpus produced by the nine-year-old Panbanisha can also be viewed at the same Web address.

6.4. Coding

6.4.1. Defining representational play and selecting the corpus

In order to identify all potential instances of representational play, we began with the following operational definition: play behavior (behavior that does not have a survival goal outside of the behavior itself) that has a possible imaginary component (e.g., change of personality, food that does not exist), either solitary or interactive. Instances distributed themselves among certain themes such as playing blind man's bluff or eating pictured food. These themes were familiar to the researcher who coded the videos. Therefore, she was able to include in the database instances of functional play using the same themes or objects. In this way, we could identify precursors to pretend play, which, following McCune and Agayoff (2002), were coded as Level 1 (see Table 1 for examples). The inclusion of nonrepresentational behaviors in the database meant that inter-rater reliability required discrimination between representational and nonrepresentational behaviors, as well as discrimination among levels of representation.

Each example of representational play was coded according to level based on the definition of each level in Table 1; the levels run from functional play (Level 1) to "true" pretense (contained in Level 5). Levels 2–4 were more ambiguous. Because DeLoache, Pierroutsakos, Uttal, Rosengren, and Gottlieb (1998) found that infants treat realistic pictures as real objects, exploring them manually, from about 8 to 18 months, we were particularly careful to require action specific to the pictured object before coding play with pictures as Level 2 pretense. Table 1 provides examples from both child and ape data. In addition, the discourse examples are presented in the Section 7 with their coding for representational level.

In addition to level of representational play, we coded two other variables: initiation and scaffolding. Initiation was scored as either Ape Initiated or Human Initiated; the variable specified which interactant ape or human, initiated one of the five levels of play. Scaffolding was scored when the human interactant gave any cue (including verbal or gestural cues) that guided the ape into the highest level of pretense within a given sequence. The purpose of these variables was to assess the social construction of symbolic play in bonobos and chimpanzees.

Imitation of a human model was not a separate behavioral category. If modeling occurred at the beginning of a sequence, it would be coded as human initiation of the sequence. Where modeling and imitation led to a higher level in the course of a behavioral sequence, it would be coded as an instance of scaffolding. Our view is that modeling and imitation are important learning mechanisms that push ontogeny forward (Greenfield et al., 2000). Indeed, there is evidence to support the idea that what is in the course of being learned is most readily imitated (e.g., Bloom, Hood, & Lightbown, 1974). Nonetheless, the symbolic status of pretend behavior is clearest in unscaffolded examples that unfold without modeling and imitation; and our coding scheme allows us to identify these.

All examples were coded by two independent coders; therefore initial reliability was based on 100% of the examples. Disagreements were resolved and errors corrected by consensus; when necessary, consensus was achieved by going back to the videotape. Agreement for level of representation was 20/27 (Cohen's kappa = .68), for scaffolding, 26/27 (kappa = .93), and for initiation 21/25 (kappa = .68). (Initiation could not be determined for two examples, due to the video beginning when the action had already begun.) All kappas are in the good to very good range. Based on a critique from one of the reviewers, the coding of a few examples was changed after reliability coding had taken place. Inspection of these changes for their reliability implications indicated that the only change was in the kappa for level of representation; there kappa went down from .68 to .63, still in the "good" range.

7. Results

Twenty-seven examples of play varying from no pretense (Level 1) through clear-cut pretense (Level 5) were coded throughout the developmental and adult data bases. This is the most extensive corpus of pretend behaviors in a nonhuman group recorded to date.

All examples ($N = 20$) through age seven are presented below. As explained above, one adult example from Panbanisha is also presented, while Panbanisha's six other adult examples, redundant with earlier levels of pretend play, can be seen on the Web. Of the 21 examples presented in this paper, Panbanisha contributed 7, Nyota 6, Panpanzee 5, Tamuli 2, and Mercury 1. The examples that follow are arranged as a longitudinal sequence for each ape, with a summary following each ape's data.

7.1. Nyota (P. paniscus)

Example 1: Nyota, age 18 months, 7 days: Sue (third author of this article) pretends to eat off of picture, when she stops briefly, Nyota reaches out and takes her hand that is holding the picture, bringing the picture to her mouth, then to his own. *Code: Human initiation; highest ape level—Level 1.*

Example 2: Nyota, 27 months, 1 day: A caregiver has been washing Nyota with a washcloth. She then asks, in English and at the keyboard, "Nyota, would you like to play hide—towel"? She tries repeatedly to put the washcloth on Nyota's head, with no success. The caregiver then pulls Nyota over and tells him multiple times that they are going to play hide—she also uses the sign language gesture for hide (placing the hand over the eyes). She places the washcloth on Nyota's head and he walks around, both bipedally and quadripedally, with the washcloth covering his eyes. When the washcloth falls off, it is replaced over and over by Nyota. *Code: Human initiation; highest ape level—Level 2, scaffolded from Level 1.*

Example 3: Nyota, age 30 months, 16 days: Nyota is kissing/biting a picture of an orangutan. (This behavior is simple, undifferentiated mouthing.) A caregiver encourages the behavior verbally, saying "orangutan". *Code: Ape initiation, highest ape level—Level 1.*

Example 4: Nyota, age 37 months, 5 days: Nyota pretends to eat M&Ms off picture with encouragement from an experimenter ("are those good M&Ms"? holding picture for him). Nyota while "eating" the M&Ms engages in "lip-smacking" behavior. This behavior (where the bonobo holds his lips together while sucking in and then releases his lips with a large "smacking" sound) has been described in bonobos and other primates in circumstances that include feeding with evident enjoyment (de Waal, 1989; Kano, 1998). *Code: Ape initiation, highest ape level—Level 2.*

Example 5: Nyota, age 39 months, 27 days: Nyota picks up a yellow plastic box and puts it over his head. He charges around the room. At one point he stands on the edge of the box, then tips the box over, picks it up and puts it on his head again. In this case, it is clear that his behavior is more controlled and less rambunctious when the box is not on his head. *Code: Ape initiation, highest level—Level 1.*

Example 6: Nyota, 45 months, 3 days: In this example Nyota "eats" grapes off a picture, Liz asks "are those good grapes?" The eating behavior is fully developed. *Code: Ape initiation, highest level—Level 2.*

7.1.1. Summary of Nyota's development of representational play

Nyota moves from human-initiated Level 1 play (pre-pretend) at 18 months of age to self-initiated Level 2 pretend play at 37 months. Earlier, scaffolding takes him to Level 2: at 27

months of age, a human caregiver provides the interactional support to move him from Level 1 to Level 2 in the course of a single episode. Thus, Nyota provides evidence relating to several of our questions: he observes the developmental sequence described by McCune for children's symbolic play, but he does not reach the highest levels. Nor does he attain pretense. He shows evidence of progressing from an inter-individual form of pretend play (other-initiated) to a more intra-individual form (self-initiated). Finally, one of Nyota's human caregivers provides a scaffold that moves him one step ahead (to Level 2) in the course of a pretend play sequence.

7.2. Panbanisha

Example 1. Panbanisha, age 22 months, 8 days: Kelly selects and gives Panbanisha a picture of a towel and Panbanisha proceeds to hug and kiss the picture. Her behavior is not clearly differentiated from simple mouthing behavior (which has been described in a variety of primate species). Code: *Ape initiation: highest ape level—Level 1.*

Example 2. Panbanisha, age 27 months, 27 days: Jeaninne shows Panbanisha a picture of a gorilla, saying that she has a monster TV (video). Panbanisha hits the picture of the gorilla, Jeaninne hits the picture as well saying "monster". The picture drops to the ground and Panbanisha hits it and stomps on it. Panbanisha then bites the picture, tearing it. A similar pattern continues while Jeaninne and Panbanisha are watching the monster video. *Code: Ape initiated, highest ape level—Level 4*

Example 3. Panbanisha, age 28 months, 6 days: Panbanisha puts on a hat, pulls it down over her eyes, and is playing around. Her caregiver mentions the hat and that Panbanisha is hiding. The caregiver then pretends to not know where Panbanisha is and conducts a search for her. The caregiver mentions that she spies a hat and is going to go get the hat, then Panbanisha runs away. *Code: Ape initiated, highest ape level—Level 4, scaffolded from Level 3.*

Example 4. Panbanisha, age 34 months, 17 days: Panbanisha gives Kelly a turtle picture, Kelly pretends to bite the turtle, then points out the turtle's head and pretends she's been bitten back. Panbanisha offers her the picture again, and Kelly smacks it away, saying "that's a bad turtle!" Panbanisha then smacks the turtle picture as well. Panbanisha continues to offer the turtle picture to Kelley although Kelley says she is scared. Panbanisha also kisses the picture and does not react when Sue asks, "Isn't the turtle biting your tongue"? *Code: Human initiated, highest ape level—Level 3, scaffolded from Level 1.*

Example 5. Panbanisha, age three and one-half: This example details a ritual that developed around a toy snake. Panbanisha says "snake" at the keyboard and when Liz asks her where the snake is, she points toward the T-room (toy storage area). They head to the T-room and Liz again asks Panbanisha where the snake is. Panbanisha points toward cabinets and Liz opens them. Panbanisha initially seems tense. She holds onto her caregivers' neck with both hands, hesitates before indicating a cabinet, and holds her hand up to the door of the cabinet as if to ward off what may come out. When the snake is discovered (a plastic snake normally kept in the T-room), Panbanisha holds more tightly to her caregiver's neck and does not look at the cabinet as her caregiver slams the door shut on the "snake", hits the door several times making human approximations of bonobo fear barks, and departs. *Code: Ape initiation, highest ape level—Level 5 (because of the symbolic planning, with the lexigram "snake". While this is coded as Level 5, it may not be pretense according to Leslie's definition: Pretense is a special case of acting as if where the pretender correctly perceives the actual situation. Here, the fear response seems real rather than "as if".)*

Example 6. Panbanisha, age four years, four months: Liz brings out monkey puppet with Panbanisha. She gives Panbanisha grapes and asks her to feed the grapes to the monkey, Panbanisha

puts a grape directly into the puppet's mouth and holds it there. When Liz makes the monkey move as if eating the grape, Panbanisha goes mouth-to-mouth with the hand puppet and eats the grapes (mouth-to-mouth food sharing is common in these apes). Later, Panbanisha passes a grape from her mouth to the mouth of the monkey doll. Liz asks Panbanisha to feed the monkey some grapes and Panbanisha holds a bowl up to the puppet's mouth, pauses, then with her other hand, moves the puppet's head into the bowl as if making it eat. Code: *Human initiation; highest ape level—Level 5, scaffolded from Level 4. (The action of moving the puppet's head to indicate pretend 'eating' may reveal an ability to extend the carer's initial pretend stipulation to feed the puppet. By Harris and Kavanaugh's (1993) account such extensions imply an understanding of the pretend nature of the game.)*

Example 7. Panbanisha, age 9: In this example, Panbanisha "eats" directly off a picture of blueberries. She places her mouth onto the photograph, closes her lips while touching them to the picture, raises her head and makes mouth movements as if chewing. After a few repetitions of this behavior, Panbanisha then picks "blueberries" off of the picture with her fingers and "eats" them off her fingers—extending her mental representation of the pretend blueberries into visible space (i.e., away from the picture and her mouth). *Code: Ape initiation of pretend play, highest level—Level 5 (construction of imaginary object, which also qualifies the example as pretense according to Leslie's criterion.)*

7.2.1. Summary of Panbanisha's development of pretend play

Like some children, Panbanisha shows no Level 2 pretend play, but does manifest all of the other levels up through the highest level, Level 5. As with Nyota, she starts with Level 1, progressing from there to Levels 3 and 4, which do not seem to be developmentally differentiated. That makes sense because those two levels are qualitatively the same; it is only the quantity of pretend schemes or acts that differentiates them. On the other hand, Level 5 appears last in the ontogenetic sequence. Two of Panbanisha's Level 5 examples are also clear examples of pretense. Unlike Nyota, Panbanisha initiates representational play from her earliest period and is not reliant on human initiation. In some sequences, scaffolding takes place, moving her representational play from a lower level to a higher level in a given sequence. However, in each case, the scaffolding induces her to reach a level of pretend that she had earlier reached without human scaffolding. Panbanisha also shows that not all behaviors categorized at Level 5 attain one or the other criteria for pretense. However, she does have two examples where her representational play is clearly pretend: In Example 6, she behaviorally extends a caregiver's pretend stipulation. In Example 7, she constructs an imaginary object.

7.2.2. Panpanzee

Example 1. Panpanzee, 27 months, 14 days: Panpanzee points to a chimpanzee picture, then moves her hand carefully toward different points on the chimpanzee's body such as the armpits, leg joints and feet—areas where the apes often engage in tickling or scratching. Kelly then asks, "are you scratching it*?" Code: Ape initiation, highest ape level—Level 3.*

Example 2. Panpanzee, age, 27 months, 14 days: Kelly opens a cupboard for Panzee who immediately jumps on the monster doll inside. She pulls it out, kicking and hitting it as Kelly says "that's your monster". Kelly then suggests "getting" Panbanisha and Sue with the monster. She tells Linda and Panbanisha that Panpanzee is coming to attack them. Panpanzee pushes the monster doll in front of her until she reaches her "victims". She then picks up the monster doll and pushes it into the face of the two that she is "getting". One of the humans then screams in mock horror. *Code: Ape initiation, highest ape level—Level 5, scaffolded from Level 3. (This example*

also meets a criterion for pretense. The action of moving the monster doll to indicate "pretend attack" may reveal an ability to extend the carer's initial pretend stipulation to "get Panbanisha and Sue". It seems reasonably clear that the attack is not a real one.)

Example 3. Panpanzee, age, 27 months, 14 days: Panpanzee is playing with a gorilla toy. Sue tells her to make the toy bite Kelly. She then brings the toy over to Kelly and puts it to Kelly's throat. Kelly pretends to be scared, screams and puts a blanket over her head, stating HIDE at the keyboard. Panpanzee tries to look at her face under the blanket, then heads back over to Sue and brings the gorilla doll up to Sue's face, Sue pretends to be scared. *Code: Ape initiated pretend play, highest level: Level 5, scaffolded from Level 1. (This level 5 behavior also fits a criterion for pretense; the analysis is the same as for the prior example.)*

Example 4. Panpanzee, age 3½: Panpanzee requests to see a toy snake, climbs into her caregiver's arms, preparing to be carried, and points toward the T-room (where the toy snakes are stored). Jeannine says "YES GO SNAKE" and turns—then asks Panpanzee where they are going. Panpanzee again points toward the T-room. As they enter the T-room, Jeannine mentions that she "hasn't done this in awhile", so Panpanzee will have to help her. Jeannine has a small stick and when Panpanzee points to a cabinet and tries to get her fingers under the door to open it, Jeannine hits the door with the stick, then climbs a chair to open the cabinet door. She at first tries to move the stick under the door to "pry" it open. Jeannine hits the door with the stick again and Panpanzee touches the door several times, then hits it. Jeannine pretends not to be able to open the cabinets when Panpanzee points to several other doors, then leaves the area with Panpanzee in her arms. In this case, the ape requests the snake search, but the human does not bring the game to its normal conclusion—finding the toy snake. *Code: Ape initiation, highest ape level—Level 1.*

Example 5. Panpanzee, age four years, four months: Liz asks Panpanzee to give the monkey puppet a bite of her pear, Panpanzee brings the bowl to the doll's mouth. This behavior continues for several minutes. Panpanzee gives the monkey some orange when Liz says (as the monkey) "mmm, good orange". Liz asks Panpanzee to groom the monkey and Panpanzee immediately starts poking at its mouth. She then begins to groom herself and give the monkey the "bugs" off of her body. When Liz talks about what Panpanzee is doing, she begins to give the "bugs" to Liz. Liz asks Panpanzee to slap the monkey's belly; she does and then investigates the opening where Liz's hand goes in. Liz asks if Panpanzee want to put the monkey on her hand and she reaches for the puppet. Panpanzee puts the monkey on her own hand and does some grooming with it. Liz pretends to take a bug off the monkey and give it to Panpanzee, Panpanzee pretends to eat it. Liz says that Panpanzee could make the monkey bite her (Liz). Panpanzee immediately brings the puppet up to Liz's neck and moves it like it's attacking Liz. *Code: Ape initiation, highest ape level—Level 5. (Here Panpanzee exhibits two criteria of pretense: she extends her caregivers pretend stipulation to feed the doll by bringing the bowl to the doll's mouth and she also extends her caregiver's imaginary bug stipulation by pretending to eat the imaginary object.)*

7.2.3. Summary of Panpanzee's development of representational play

Unlike the bonobos, we have no examples under age two of Level 1 from Panpanzee, a chimpanzee. However, she shows unscaffolded Level 3 in the same age period as her age mate and constant companion, Panbanisha. In terms of developmental sequencing, both unscaffolded Level 3 and Level 1 are observed at 27 months of age. However, self-initiated Level 5 does appear last. Her last example at four years four months is the most clearcut pretense, involving an extension of her caregiver's pretend stipulations to feed and groom the monkey doll. Unlike Panbanisha, Panpanzee utilizes scaffolding to initially attain the highest level.

7.3. Apes without lexigram competence

7.3.1. Tamuli

Example 1. Tamuli, a bonobo, age two years, 10 months: Tamuli is playing with the monkey puppet. She hugs it very tight (as if genital–genital rubbing—a common social behavior between bonobos (Kano, 1998)) she does not understand Liz's request to feed the monkey grapes. She looks into its mouth and touches the mouth when Liz moves it—but more as a direct mimic than as exploration. Liz requests that Tamuli groom the monkey puppet. Tamuli continues to hug the doll and bites at its face. Tamuli continues to play with the monkey, hugging and slapping it. At one point she raises the monkey up on her feet and slaps at it with her hands (a behavior her mother regularly engages in with the infants*). Code: Ape initiation; highest ape level—Level 4.*

Example 2. Tamuli, age 7: Tamuli is trying to put on a mask after Panbanisha has been playing with it. She is not successful in that the eyeholes are not lined up with her eyes and she keeps bumping into things. Sue attempts to verbally guide her, "you have to put the holes over your eyes like your sister did". Tamuli's behavior does not change. *Code: Ape initiation, highest ape level—Level 1.*

7.3.2. Mercury

Example 1. Mercury, a chimpanzee, age three years, 4½ months (PBZ 1394 9:17): Mercury is at first hesitant when Liz approaches with the monkey puppet and touches him with it. He then starts biting at its face and slapping it. Liz begins a biting/tickling game between the monkey doll and Mercury; Mercury has a play face and interacts, but keeps looking at Liz's arm as it moves the monkey. Mercury does not respond to requests to feed the monkey or groom with it. Liz puts food in Mercury's mouth for him to share with the monkey, but he lets it fall from his mouth and continues to bite and slap the doll. When Liz removes the puppet from her hand, Mercury picks at its nose as if grooming it, then slaps and throws it around, then tosses it out of the way. *Code: Human initiation; highest level—Level 4, scaffolded from Level 1.*

7.3.3. Summary of apes without lexigram competence

Tamuli, the bonobo, reached Level 4 in self-initiated representational play. Mercury, the chimpanzee reached Level 4 with scaffolding, demonstrating that lexigram competence was not necessary either for most levels of representational play or for successful human scaffolding. However, the play of the apes who did not have a sophisticated means for interspecies communication did not approach true pretense, but did reflect the ape way of life (e.g., Tamuli slapping the monkey puppet as her mother slapped her).

8. Discussion

Question 1: Is there a common ontogenetic sequence of representational play in the clade consisting of chimpanzees, bonobos, and humans? If so, do bonobos and chimpanzees progress as far as human children in it?

Our data show that both chimpanzees and bonobos with an interspecies communication system show basically the same levels as children, including level 5 and the "true" pretense of creating imaginary objects and extending the pretend stipulations of their human caregivers. However, not all steps are in order and their developmental pace is slower. Still there is an ontogenetic pattern. Under two years of age, we find only Level 1, functional play with no representation. Independent production of Levels 2–4 first appear between about two and three years of age. Independent

production of Level 5 (with no scaffolding) never occurs before 3½ years of age The entire sequence is visible in Panbanisha's data, the early part in Nyota's, and the later part in Panpanzee's.

In terms of developmental pacing, Piaget's (1945/1978) children provided examples of Level 5 as early as the second year of life. So even with stimulation of pretend to members of the whole clade, the apes' movement to the highest level is slower than that of children, albeit going through all the levels in the same general order.

In terms of the ontogenetic sequence, what seems quite robust and regular is not McCune's five-step sequence but a three-step ontogenetic sequence: Level 1 (no representation, no pretense) develops earlier than Levels 2–4 (representation but no pretense), which in turn precedes Level 5 (includes pretense as well as representation).

Because of the emphasis in recent years on connecting pretense to theory of mind and the controversy about exactly what this connection is (Lillard, 2001), it is important to note here that our study does not attempt to make claims about what or whether *theory of mind* is implied by the various forms of representational play. Instead, our study focuses on the developmental transformation of naturalistic pretend *behaviors* of two species of ape. This naturalistic baseline study of developmental change then paves the way for ape experimentation at a later point in time, much as the earlier studies of Piaget paved the way for the experiments of Harris and Kavanaugh (1993) and Lillard (1993). In short, we compare the ontogeny of ape *behavior* in the domain of pretend to the ontogeny of children's *behavior* in this same domain, using a common scale and common criteria as the basis for cross-species comparison.

8.1. Relationship between language and pretend

Question 2: Is representational play simply one expression of general symbolic function or does linguistic competence play a causal role in the development of representational play in chimpanzees and bonobos?

The answer to the latter question is a partial "yes." We have signs of Level 4 for apes lacking an interspecies communication system, the chimpanzee Mercury (at 40 months) with scaffolding, the bonobo Tamuli (at 34 months) without. Thus, the chimpanzee and bonobo who lack a linguistic system for interspecies communication, move through several levels of representational development, but they do so more slowly than the apes who have mastered such a system. Nor do they reach Level 5 or "true" pretense, even when given the same stimulus (the monkey hand puppet) as symbol-competent apes who do attain Level 5 and true"pretense under the same stimulus conditions. Given the lack of a sophisticated system for interspecies communication, we see that the symbolic play of these two apes represents the ape way of life more than it responds to the pretend stipulations of their human caregivers.

At the same time, we also have evidence that representational play is an expression of a general symbolic function. First, we find the beginnings of representational play even without a formal language system. Second, we find a correlated individual difference between two bonobos in the lanaguage and pretend play domains: Panbanisha excelled Nyota in both: level of pretend play and language level (unpublished data). In sum, language seems to provide a means for social construction of representational play, more than it creates its symbolic nature.

8.2. Acquisition of pretense: interaction between learning and development

Question 3: What is the role of interspecies interaction with humans in the apes' development of representational play?

(a) Will there be a developmental transition from human initiation to ape initiation across sessions (macrodevelopment)?

Whereas Panbanisha and Panpanzee initiated codable sequences of play from the very earliest point in their corpora, Nyota made a developmental transition from other initiation to self initiation at about 30 months of age.

(b) Will the process of scaffolding move an ape from one level of representational play to the next in the space of a single sequence of pretend play (microdevelopment)?

Human interaction seems to scaffold the representational play of apes to higher levels and more complexity; successful scaffolding occurred in about one-third of the examples presented here. Scaffolding was successful for all participants except Tamuli, who in any case had very little data. Looking at the scaffolding data from a developmental perspective, all of our examples of scaffolding occurred when the apes were between 2 and 4 years of age. This is not because there is no encouragement of symbolic play for the younger apes. Instead, guidance and help must occur in a creature's zone of proximal development to be effective (Vygotsky, 1978). The data imply a minimum age for movement from one representational level to the next. However, unlike Zukow's (1986) human data, scaffolding did not always precede independent enactment of a given level in the ape data, notably in the case of Panbanisha.

8.3. Evolutionary implications

Humans, chimpanzees, and bonobos constitute a complete clade, with a common ancestor. Therefore, any capacity present in all three is a good candidate to have been present in that ancestral species approximately five million years ago. The ontogeny of representational play and its sensitivity to social interaction is just such a candidate. As such, it can help us to understand the phylogeny of the symbolic function.

Acknowledgement

This work was supported in part by a grant from National Institute of Child Health and Human Development (2 PO HD06016-29).

References

Antinucci, F. (Ed.). (1989). *Cognitive structure and development in nonhuman primates*. Hillsdale, NJ: Erlbaum.

Bloom, L., Hood, L., & Lightbown, P. (1974). Imitation in language: If, when, and why. *Cognitive Psychology*, *6*, 380–420.

Bondioli, A. (2001). The adult as a tutor in fostering children's symbolic play. In A. Goncu & E. L. Klein (Eds.), *Children in play, story, and school* (pp. 107–131). New York, NY: Guilford Press.

Brakke, K. E., & Savage-Rumbaugh, E. S. (1995). The development of language skills in bonobo and chimpanzee—1. Comprehension. *Language and Communication*, *15*(2), 121–148.

Brakke, K. E., & Savage-Rumbaugh, E. S. (1996). The development of language skills in *Pan*—ii. Production. *Language and Communication*, *16*(4), 361–380.

DeLoache, J. S., Pierroutsakos, S. L., Uttal, D. H., Rosengren, K. S., & Gottlieb, A. (1998). Grasping the nature of pictures. *Psychological Science*, *9*, 205–210.

de Waal, F. M. B. (1989). *Peacemaking among primates*. Cambridge, MA: Harvard University Press.

Farver, J. A. M. (1993). Cultural differences in scaffolding pretend play: A comparison of American and Mexican mother–child and sibling–child pairs. In K. MacDonald (Ed.), *Parent–child play: Descriptions and implications* (pp. 349–366). Albany, NY: State University of New York Press.

Goodall, J. (1986). *The chimpanzees of gombe*. Cambridge, MA: Harvard University Press.

Greenfield, P. M. (1997). Culture as process: Empirical methods for cultural psychology. In J. W. Berry, Y. Poortinga, & J. Pandey (Eds.), *Handbook of cross-cultural Psychology: Vol. 1. Theory and method* (pp. 301–346). Boston: Allyn & Bacon.

Greenfield, P. M., Maynard, A. E., Boehm, C., & Yut Schmidtling, E. (2000). Cultural apprenticeship and cultural change: Tool learning and imitation in chimpanzees and humans. In S. T. Parker, J. Langer, & M. L. McKinney (Eds.), *Biology, brains, and behavior: The evolution of human development* (pp. 237–277). Santa Fe: SAR Press.

Harris, P. L., & Kavanaugh, R. D. (1993). Young children's understanding of pretense. *Monographs of the Society for Research in Child Development*, *58*, 231.

Hayes, C. (1951). *The ape in our house* (1st ed.). London: Gollancz.

Kano, T. (1998). A preliminary glossary of bonobo behaviors at Wamba. In T. Nishida (Ed.), *Comparative study of the behavior of the genus Pan by compiling video ethogram* (pp. 39–81). Kyoto: Nissho Printer.

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

Lillard, A. (1993). Young children's conceptualization of pretense: Action or mental representational state? *Child Development*, *64*, 72–86.

Lillard, A. (2001). Pretend play as twin earth: A social-cognitive analysis. *Developmental Review*, *21*, 495–531.

Lillard, A. S., & Witherington, D. C. (2004). Mothers' behavior modifications during pretense and their possible signal value for toddlers. *Developmental Psychology*, *40*, 95–113.

Matevia, M. L., Patterson, F., & Hillix, W. A. (2002). Pretend play in signing gorillas. In R. W. Mitchell (Ed.), *Pretending and imagination in animals and children* (pp. 285–306). Cambridge: Cambridge University Press.

McCune, L. (1995). A normative study of representational play at the transition to language. *Developmental Psychology*, *31*, 198–206.

McCune, L., & Agayoff, J. (2002). Pretending as representation: A developmental and comparative review. In R. W. Mitchell (Ed.), *Pretending and imagination in animals and children* (pp. 43–55). Cambridge: Cambridge University Press.

McCune-Nicolich, L. (1977). Beyond sensorimotor intelligence: Assessment of symbolic maturity through analysis of pretend play. *Merrill-Palmer Quarterly*, *23*, 89–101.

Miles, H. L. W. (1994). Me chantek: The development of self-awareness in a signing orangutan. In S. T. Parker, R. W. Mitchell, & M. L. Boccia (Eds.), *Self-awareness in animals and humans: Developmental perspectives* (pp. 254–272). Cambridge, UK: Cambridge University Press.

Mitchell, R. W. (2002). *Pretending and imagination in animals and children*. Cambridge: Cambridge University Press.

Parker, S. T., Langer, J., & McKinney, M. L. (Eds.). (2000). *Biology, brains, and behavior: The evolution of human development*. Santa Fe: SAR Press.

Patterson, F. (1978). Conversations with a gorilla. *National Geographic*, *154*, 438–465.

Piaget, J. (1962). *Play, dreams and imitation in childhood*. New York, NY: Norton.

Piaget, J. (1945/1978). *La formation du symbole chez l'enfant*. Lausanne, Switzerland: Delachaux & Niestle (This is the original French edition of *Play, Dreams, and Imitation*, reissued).

Racoczy, H., Tomasello, M., & Striano, T. (2005). On tools and toys: How children learn to act on and pretend with 'virgin objects'. *Developmental Science*, *8*, 57–73.

Savage-Rumbaugh, E. S., & McDonald, K. (1988). Deception and social manipulation in symbol-using apes. In A. W. Richard & W. Byrne (Eds.), *Machiavellian intelligence: Social expertise and the evolution of intellect in monkeys, apes, and humans* (pp. 224–237). Oxford, England: Clarendon Press/Oxford University Press.

Stauffer, R. L., Walter, A., Ryder, O. A., Lyons-Weiler, M., & Blair-Hedges, S. (2001). Human and ape moecular clocks and constraints on paleontological hypotheses. *Journal of Heredity*, *92*, 469–474.

Tomasello, M., Savage-Rumbaugh, E. S., & Kruger, A. (1993). Imitative learning of actions on objects by children, chimpanzees, and enculturated chimpanzees. *Child Development*, *64*, 1688–1705.

Vygotsky, L. S. (1978). Play and its role in the mental development of the child. In M. Cole, V. John-Steiner, S. Scribner, & E. Souberman (Eds.), *Mind in society*. Cambridge, MA: Harvard University Press.

Werner, H. (1948). *Comparative psychology of mental development* (revised edition). New York: International Universities Press.

Williams, S. L., Brakke, K. E., & Savage-Rumbaugh, E. S. (1997). Comprehension skills of language-competent and non-language-competent apes. *Language and Communication*, *17*(4), 301–317.

Wrangham, R. W., & Peterson, D. (1996). *Demonic males*. London: Bloomsbury.

Zukow, P. G. (1986). The relationship between interaction with the caregiver and the emergence of play activities during the one-word period. *British Journal of Developmental Psychology*, *4*, 223–234.