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Intentional Behavior and Intentional Communication in Young Free-Ranging Orangutans

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The goal of this study was to describe the ontogeny of the manipulation of an animate object (i.e., the mother) by young free-ranging orangutans within the context of food sharing. The food-sharing context is an important one in the development of object manipulation skills and social communication. 5 orangutans, ranging in age from 1 month to 5 years, were videotaped with their biological mothers for 18 hours over the course of 9 months. Systematic coding of the videotapes revealed that even young orangutans, 1–6 months old, used intentional (i.e., goal-directed) behaviors. When young orangutans directed behavior toward the mother in addition to the goal object then maternal responses were positive, resulting in the infant obtaining the food. Intentional communication, evident in gestures and consisting of an abbreviated action directed toward the mother, was found in the 3 oldest orangutans (2 1/2, 3 1/2, and 5 years of age). Cognitive competence and behavioral performance are considered from the developmental perspectives of Piaget and prelinguistic communication. The ability to use a communicative gesture as an intermediate means in the coordination of actions on a social agent with actions on an object is evident in young orangutans.

Orangutans have been neglected among the great apes in the search for commonalities among hominoids (e.g., Schwartz, 1987), especially in such issues as the evolution of prelinguistic abilities and cognitive abilities (Lethmate, 1982). For example, there have been only three orangutan “language” projects, each conducted with a single subject (Furness, 1916; Laidler, 1978, 1980; Miles, 1983, 1990), compared with at least six different chimpanzee language projects, conducted with a total of more than 14 chimpanzees (Fouts, Hirsch, & Fouts, 1982; Gardner

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& Gardner, 1969; Hayes & Hayes, 1951; Kellogg & Kellogg, 1933; Premack, 1976; Rumbaugh & Gill, 1977; Savage-Rumbaugh, 1984; Savage-Rumbaugh, Rumbaugh, & Boysen, 1978; Terrace, 1979). Orangutans are considered equal in intelligence to chimpanzees, and both have been compared favorably to young children (Bard, in press; Boesch & Boesch, 1984; Chevalier-Skolnikoff, Galdikas, & Skolnikoff, 1982; Kohler, 1925; Mathieu, Dauselin, Dagenais, & Decarie, 1980; Miles, 1990; Vauclair & Bard, 1983; Woodruff & Premack, 1979; Yerkes, 1943).

This article is concerned only with those signals used in the food sharing context, and thus communicative signals used in this context alone are considered. Those primate species that develop communicative signals in the food sharing context in their natural habitat are chimpanzees, *Pan troglodytes* (Boesch & Boesch, 1989; Ghiglieri, 1988; McGrew, 1974; Plooij, 1978, 1984; Silk, 1978; van Lawick-Goodall, 1968) and *Pan paniscus* (Kano, 1980; Kuroda, 1980), and orangutans, *Pongo pygmaeus* (Borner, 1979; Galdikas & Teleki, 1981; MacKinnon, 1974; Rijksen, 1978; Rodman, 1979). No food sharing has been observed among feral gorillas, and thus no communicative signals are involved in this context (Fossey, 1979, 1983; Watts, 1985; but see also Gomez, 1990, for documentation of the development of intentional communication in hand-reared gorillas).

Missing from these studies is a specification of the development of a gesture, specifically, a full description of all the component parts (Goodall, 1986; Tomasello, 1990). For example, researchers have lumped together all the actions used to get food from another individual and labeled them all as gestures (e.g., Hiraiwa-Hasegawa, 1990). Specification of the type of action may be crucial in order to describe the ontogeny of communicative abilities.

In the literature on the development of prelinguistic communication in humans, distinction is made between communicative behavior and intentionally communicative behavior (e.g., Bates, Camaioni, & Volterra, 1975; Golinkoff, 1981). This distinction is made because mothers typically interpret early infant behaviors as "meaningful communications" prior to the time when infants purposefully send communicative messages. This distinction, therefore, highlights the contributions of each partner to communicative interchanges. With the Piagetian perspective used in this study, in contrast, the distinction is made between intentional behavior and intentional communication (e.g., Bretherton, McNew, & Beeghly-Smith, 1981). This distinction focuses attention on the infants' abilities and the transition from bifocal behavior (i.e., goal-directed sequences involving either objects or social agents) to behavioral sequences that involve coordination between social agents and objects.

When discussing intentional communication it is important, first, to define some terms (Volterra, 1987; for a more detailed discussion see Bard, 1990). *Intentional Behavior* consists of a series of actions with at least one serving as a "means" and another action serving as "end" that is used to attain the goal (Piaget, 1952, 1954). In other words, intentional behavior is a *goal-directed sequence* of behaviors. Here the word intentional does not mean that the actor necessarily can account for or be conscious of her intentions (Bruner, 1982). Moreover, early intentional behavior is bifocal, that is, infants at this developmental stage are able to coordinate actions upon an object or to coordinate actions upon a social agent but not both (Case, 1985).

*Intentional communication*, in contrast, can be defined as the ability to coordinate sequences of behavior involving objects with sequences of behavior involving social agents. The distinguishing characteristic of intentional communication is that the infant acts socially with the adult as opposed to manipulating body parts of the adult. Thus the infant attempts to use the adult as an agent (Golinkoff, 1981; Sugarman, 1984). Intentional communication is a complex type of goal-directed sequence that involves the ability to coordinate actions on objects with actions on social agents (Sugarman, 1983, 1984). This ability is alternately labeled a coordinated person-object sequence (Sugarman, 1983, 1984), social tool use (Bard, 1990, in press), secondary intersubjectivity (Trevarthen & Hubley, 1978), a mutually intentional relationship (Bruner, 1973; Damon, 1981), elaborated coordinations (Case, 1985), conventional signaling (Zinober & Martlew, 1985), proto-imperatives (Bates et al., 1975), and symbolic gesturing (Acredolo & Goodwyn, 1988).

Documentation of both intentional behavior and intentional communication in free-ranging orangutans may lead to the fur-
other investigation of correlated cognitive abilities. The study of the development of communicative abilities in a species where communication does not naturally lead to language might help to elucidate differences and similarities in the developmental processes.

This study was part of a larger study designed to investigate the development of manipulative behaviors in free-ranging orangutans (Bard, 1987). In this study, the types of actions used in the manipulation of an animate object were documented. The effectiveness of these actions was evaluated by specifying both the response of the mother to the different types of infant actions and the successfulness of infants’ actions (i.e., whether or not the infant obtained the goal). In other words, the intentional manipulation of another individual with or without the use of a communicative gesture was investigated.

Method

Subjects.—Five free-ranging orangutan mothers with their biological offspring were studied. Data were collected for five young orangutans at the following six ages: Tom, 1–5 months; Riga, 1–6 months and 7–10 months; Arnold, 2 years; Mooch, 3½ years; and Siswi, 5 years. Riga’s data were divided into two periods because a dramatic change in the relative percentage of action types occurred in her seventh month. This change was consistent within the period from 7 months through 10 months. The division also allowed for a comparison of a similar time period with the other young subject, Tom.

The mother of the 3½-year-old was feral; all other mothers were ex-captive and had made full rehabilitation to their free-ranging state prior to mating and subsequently rearing their offspring. All subjects were free-ranging, that is, they had constant and unrestricted access to the forest and to camp. The offspring traveled with their mothers and shared the same nest with their mothers at night.

Setting.—The setting chosen for the study of intentional communication was the provisioning site of the Orangutan Research and Conservation Project (ORCP). This site was located at the end of a 250-m wooden bridge that ran from the base camp to the Sekoyner Kanan River and was bordered by river-edge swamp. Food sharing was not dependent on provisioning: it was observed frequently in the 35-km² study area of Tanjung Puting Reserve (Bard, 1987). (For a full description of the field setting, Tanjung Puting Reserve of Central Indonesian Borneo, see Galdikas, 1979.) Gestures and other subtle or short-duration behaviors, however, were not clearly visible in the rainforest canopy where mother and infant orangutans are typically located. The provisioning site, on the other hand, provided relatively unobstructed observations that were accessible to videotaped recording.

The subjects were videotaped during feeding time, which consisted of a wagon full of fresh fruit, rice, and milk carried to the end of the bridge twice a day at 7:00 and 17:00 hours. All free-ranging orangutans were called by name, but not all were present on any one day. Food was placed on the bridge and also handed to individuals; typically, it was not given to infants but rather to their mothers. Subjects to be videotaped were selected on a rotating basis from those attending the feeding session. Videotaping began with their arrival on the bridge and ended with either their departure or the depletion of food. A total of 18 hours of videotape were collected over a 9-month period. The total number of sessions for each individual is listed in Table 1.

Procedure.—Two types of bouts were considered in preliminary reports (Bard, 1990): those that occurred when the mother held the food and those that occurred when the infant obtained food independently. The type of bout was defined by the direction of the infant’s behavior. Only those bouts in which the infant solicits food from the mother are considered in the present study. The category “Has no food” (in Table 2)/“Has none” (in Table 6) is for bouts in which the mother either had food and ate it just before the infant solicited food or did not have food but the infant solicited food nonetheless.

Preliminary data consisted of single events, with each food-directed action considered separately (Bard, 1990). The present report is concerned with a series of connected events at the level of the bout. A bout began with any infant-initiated action that brought the infant into closer proximity or contact with food. The bout ended when either the infant obtained the food or redirected attention to other activities. A bout consisted of between one and 13 single events (see mean and range columns of Table 1).
TABLE 1
DESCRIPTIVE CHARACTERISTICS OF INFANT ORANGUTANS' SOLICITATION BOUTS DIRECTED TO
FOOD IN THEIR MOTHERS' POSSESSION

<table>
<thead>
<tr>
<th>Subject</th>
<th>Age</th>
<th>No. of Videotaped Sessions</th>
<th>% of Total Bouts</th>
<th>No. of Bouts of Events (No. of Events)</th>
<th>Range</th>
<th>Modal Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tom</td>
<td>1–5 months</td>
<td>12</td>
<td>74.2</td>
<td>91</td>
<td>2.42</td>
<td>1–13</td>
</tr>
<tr>
<td>Riga A</td>
<td>1–6 months</td>
<td>10</td>
<td>65.7</td>
<td>46</td>
<td>1.76</td>
<td>1–7</td>
</tr>
<tr>
<td>Riga B</td>
<td>7–10 months</td>
<td>9</td>
<td>75.9</td>
<td>60</td>
<td>1.70</td>
<td>1–8</td>
</tr>
<tr>
<td>Arnold</td>
<td>2 years</td>
<td>23</td>
<td>31.0</td>
<td>113</td>
<td>1.88</td>
<td>1–7</td>
</tr>
<tr>
<td>Mooch</td>
<td>3½ years</td>
<td>19</td>
<td>57.4</td>
<td>163</td>
<td>1.92</td>
<td>1–8</td>
</tr>
<tr>
<td>Siswi</td>
<td>5 years</td>
<td>14</td>
<td>6.3</td>
<td>14</td>
<td>1.21</td>
<td>1–3</td>
</tr>
</tbody>
</table>

NOTE.—The total number of bouts in this table includes some bouts in which components could not be classified. Thus the totals may be slightly higher than totals in subsequent tables. Total bouts refers to bouts in which the mother was in possession of the food (presented in this paper) and bouts independent of the mother (presented in Bard, 1990).

The data were collected from the videotape systematically using the detailed coding system summarized in Table 2. The different ways in which the infant engaged in food-directed behavior when the food was in the mother's possession are defined below. The order of presentation from first to last is indicative of a hierarchy, with only the highest-order action being coded. Look was defined as visual attention directed toward food and was coded only when an additional action did not occur. Reach was defined as the infant's hand or foot directed toward but not touching the mother or the food. Thus, reach was coded only when contact was not made. Mouth was coded when movement of the lips or face was the primary action that brought the infant into contact or proximity with the food. Grasp was coded when the infant's hand or foot was in contact with the mother or with food. Pull was defined as an action, additional to grasp, that consisted of drawing the mother's body part closer to the infant. Gesture was defined in accordance with the requirements presented in the introduction. The observable behavior took the form of an action, directed toward the mother, that did not involve the physical manipulation of her body. Usually this was an open, cupped hand, palm up, held underneath, but not necessarily touching, the mother's chin.

TABLE 2
OVERVIEW OF CODING SYSTEM USED WHEN INFANT SOLICITED FOOD IN MOTHER'S POSSESSION

<table>
<thead>
<tr>
<th>I. Solicitation bout</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Infant action type</td>
</tr>
<tr>
<td>1. No goal: look or reach (without contact)</td>
</tr>
<tr>
<td>2. Intentional behavior: (a) to food, (b) to mother</td>
</tr>
<tr>
<td>3. Gesture</td>
</tr>
<tr>
<td>B. Maternal response</td>
</tr>
<tr>
<td>1. Positive: (a) allow, (b) give</td>
</tr>
<tr>
<td>2. Negative/neutral: (a) reject, (b) ignore</td>
</tr>
<tr>
<td>C. Additional infant behavior</td>
</tr>
<tr>
<td>1. Successful: obtain food</td>
</tr>
<tr>
<td>2. Unsuccessful</td>
</tr>
<tr>
<td>II. Context</td>
</tr>
<tr>
<td>A. Type of food available</td>
</tr>
<tr>
<td>1. Easy to process (milk, rice)</td>
</tr>
<tr>
<td>2. Moderately difficult (banana, cooked cassava, pineapple)</td>
</tr>
<tr>
<td>3. Difficult (uncooked cassava, purple vegetable, sugar cane)</td>
</tr>
<tr>
<td>B. Maternal food activity</td>
</tr>
<tr>
<td>1. Has no food</td>
</tr>
<tr>
<td>2. Holding food</td>
</tr>
<tr>
<td>3. Processing food</td>
</tr>
<tr>
<td>4. Eating food</td>
</tr>
<tr>
<td>5. Not visible</td>
</tr>
<tr>
<td>6. Obtaining food</td>
</tr>
</tbody>
</table>
Subsequently, these infant actions were categorized according to complexity. In addition, the reclassification differentiated between actions directed toward the food and those directed toward the mother. No-goal was defined as single sensorimotor actions that did not result in contact with food or mother (i.e., look, reach). Thus, the goal was not obtained. Intentional behavior was defined as a goal-directed sequence of actions with at least two behaviors used in coordination toward achieving a particular goal. In this case, the goal is eating the food that is in the mother’s possession. The action can be directed to the food, for instance, with a grasp coordinated with eating (a two-action sequence involving both the hands and the mouth), or the action can be directed to the mother, for instance, with a pull on the mother’s body (involving grasping and pulling actions, and subsequently eating). Intentional communication is the highest complexity type and involved the construction of a functional relationship as indicated in the use of a gesture. In this case, a gesture involved the coordinated sequence of actions directed toward a social agent and of actions directed toward an object. For ease of presentation this category is referred to as gesture.

The maternal response to the infant’s actions was classified as positive, including the behaviors of allow and give, or negative/neutral, including the behaviors of reject and ignore. Allow was defined as a relatively passive reaction, in which the mother lets her body be moved, or lets the food be moved, or lets the food be taken out of her possession by the infant. Give was defined as the active transfer of food from the mother’s possession to that of the infant. Reject was defined as the mother actively repulsing the infant’s attempt to gain access or proximity to the food. The mother may reject the action by acting on the food, such as moving it out of the infant’s reach, or she may reject by acting on the infant by repositioning, restraining, or acting aggressively toward the infant. Ignore was defined as no discernible maternal response.

The final part of the infant action-maternal response sequence was success, that is, whether or not the bout resulted in the infant getting food. Success, therefore, was determined by whether the infant obtained the food, not whether the food was ingested.

Reliability.—The author served as primary coder for the videotapes. Two types of reliability estimates were obtained. The agreement between two different observers (interobserver) was assessed on three sessions (3% of the total number of sessions). The agreement by the same observer coding a session at two different times (intraobserver) was assessed on 10 sessions (11% of the total number of sessions: 17% of total number of minutes of observation).

An independent observer was trained by the primary observer with the use of a procedures manual for 10 hours per week for 8 weeks. The selection of sessions for training and, subsequently, for assessment of interobserver agreement was not random. Sessions that showed the maximum diversity and complexity of each subject’s behavior were chosen.

Intraobserver agreement was assessed from 10 sessions that were selected to include data collected from observations of each subject during two different chronological periods. This selection of sessions was random, with the following two restrictions: (a) selected sessions were not the same ones as those chosen for interobserver training or reliability purposes, as many behavioral sequences had become familiar to the observer through the training, and (b) selected sessions equally represented those from the beginning and those from the end of the coding period (which lasted 1 year).

The results are presented in Table 3. The agreement on classification (measured by Cohen’s kappa and percent agreement) was quite high both between observers and between two times for the same observer. The primary observer, however, was more sensitive to the occurrence of events than was the secondary observer, and the sensitivity of the primary observer increased slightly over time. The relatively large number of missed bouts probably reflects how difficult it was for the secondary observer (who was initially naive with respect to subjects, observing behavior, and coding) to catch all events from sessions that were specially selected for their complexity.

All kappas were above 0.8, except for the category of maternal food-directed behavior. Scores above .8 are considered good to excellent (Bakeman & Gottman, 1986). The category of maternal food-directed behavior was not clearly defined during training and assessment of interobserver agreement, as the low interobserver reliability score indicates. Subsequently, the definition
TABLE 3
RELIABILITY ESTIMATES: COHEN'S KAPPA

<table>
<thead>
<tr>
<th>Behavioral Codes</th>
<th>Interobserver:</th>
<th>Intraobserver:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Kappa ..................</td>
<td>Kappa ..................</td>
</tr>
<tr>
<td></td>
<td>Percent agreement .....</td>
<td>Percent agreement .....</td>
</tr>
<tr>
<td></td>
<td>Percent missed ........</td>
<td>Percent missed ........</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Food Type</th>
<th>Infant Action</th>
<th>Maternal Food Activity</th>
<th>Maternal Response</th>
<th>Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kappa</td>
<td>1.00</td>
<td>.79</td>
<td>.51</td>
<td>.84</td>
<td>1.00</td>
</tr>
<tr>
<td>Percent agreement</td>
<td>100.0</td>
<td>84.2</td>
<td>63.1</td>
<td>89.5</td>
<td>100.0</td>
</tr>
<tr>
<td>Percent missed</td>
<td>52.5</td>
<td>97.2</td>
<td>95.3</td>
<td>96.6</td>
<td>100.0</td>
</tr>
</tbody>
</table>

was simplified and the primary coder was consistent in coding maternal food-directed behavior, as the high intraobserver reliability score indicates.

Results

The types of actions used by infants, the responses of the mothers, and their relative success are presented for those solicitations in which the infant solicited food from the mother. Bouts in which the infants obtain food independently of the mother are presented elsewhere (Bard, 1990). This means that Siswi, the 5-year-old, has been dropped from most of the following analyses since the actual number of solicitations she directed to her mother was quite small (see Table 1; 93.7% of Siswi's bouts are independent of the mother).

Infant actions.—The relative proportion of different action types for each orangutan subject is presented in Table 4. Single sensorimotor actions attaining no goal were displayed by all subjects. One-fifth of the actions of the youngest orangutans consisted of this simple type of action, whereas the orangutans older than 6 months rarely acted without attaining a goal. The majority of actions for all subjects consisted of intentional behaviors (i.e., goal-directed and obtained). Gestures, indicative of intentional communication, occurred only in the two older subjects and were the highest level action in almost 30% of the bouts only for the 3½-year-old orangutan.

Maternal responses.—The percentages of positive maternal responses (indicating potential transfer of food) for the two youngest orangutans were almost identical (at 25%), whereas the percentage was higher for the older infants (45% for Riga at 7–10 months, 59% for Arnold, and 66% for Mooch). This suggests a positive relation of maternal response with infant age.

Success.—Successful bouts predominated for both Riga B (7–10 months) and Arnold: they obtained food in more than 80% of their solicitations. The two youngest subjects were least often successful at obtaining food items from their mother (approximately 33%). Successful bouts were frequent for the 3½-year-old (70%). Mother-dependent bouts for the 5-year-old were few in number; however, the percentage that was successful was twice that of the younger subjects (64%).

Relations.—The analyses that follow specify the relations between the sequential parts of bouts. It is important to demonstrate that, although it may appear obvious and intuitively logical, significant relations exist between infant action, maternal response, and success. The following analyses provide evidence that coordination and cooperation do exist between infant and mother orangutans, as is the case with preverbal communication in human infants. Contingency tables were formed and chi-square values obtained. Categories were dropped when more than one expected cell frequency was less than 5.

The relation between the complexity level of infant action types and maternal response within a bout was considered for each subject (Table 5). The specific question addressed was whether intentional behaviors directed to the mother are responded to differently than intentional behaviors directed to the food. Infant actions were sig-
significantly related to maternal responses ($p < .05$ for all subjects, excluding Arnold). In other words, maternal response was most often positive when infant's actions involved contact with her and were intentional behaviors, that is, goal-directed. Adult orangutans do differentiate behavior directed to a social partner from behavior directed to an inanimate object.

Maternal response largely determined the success of bouts for all individuals: Tom, $\chi^2(1) = 37.98, p \leq .01$; Riga A, $\chi^2(1) = 17.62, p < .01$; Riga B, $\chi^2(1) = 3.98, p \leq .05$; Arnold, $\chi^2(1) = 30.91, p < .01$; Mooch, $\chi^2(1) = 78.80, p < .01$. Positive maternal responses and success occurred more often than expected by chance, whereas maternal rejection and success occurred less often than expected by chance.

**Context.**—The processing ease of different foods did not influence either the infants' solicitation behavior, maternal response, or success of the bout. Additionally, infants were equally able to obtain all food types. Recall, however, that success refers to attainment, not necessarily ingestion. Typi-
TABLE 6

RELATION BETWEEN MATERNAL FOOD-DIRECTED BEHAVIOR AND INFANT SUCCESS

<table>
<thead>
<tr>
<th>SUBJECT</th>
<th>Has None</th>
<th>Obtain</th>
<th>Process</th>
<th>Eat</th>
<th>Hold</th>
<th>( \chi^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tom:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Success</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>9</td>
<td>11</td>
<td>6.99*</td>
</tr>
<tr>
<td>No success</td>
<td>14</td>
<td>1</td>
<td>2</td>
<td>23</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Riga A:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Success</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>12</td>
<td>2.76</td>
</tr>
<tr>
<td>No success</td>
<td>6</td>
<td>0</td>
<td>1</td>
<td>9</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Riga B:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Success</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>39</td>
<td>2.86</td>
</tr>
<tr>
<td>No success</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Arnold:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Success</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>23</td>
<td>51</td>
<td>11.65**</td>
</tr>
<tr>
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<td>0</td>
<td>0</td>
<td>4</td>
<td>10</td>
<td>4</td>
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<tr>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Success</td>
<td>0</td>
<td>1</td>
<td>18</td>
<td>25</td>
<td>63</td>
<td>44.0**</td>
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<td>No success</td>
<td>8</td>
<td>4</td>
<td>5</td>
<td>22</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

*p < .05.  
**p < .01.

cally, the youngest infants were unable to ingest the foods that were difficult to process.

The mother's activity at the time of the infant's solicitation (i.e., obtaining the food item, processing it, eating from it, or holding it) appeared to be a key contextual factor in the success of the bout. Contingency tables reveal that, for all subjects except Riga, this was true (Table 6). In general, the orangutan infant was most often successful if the solicitation was timed to occur when the mother was holding the food item (i.e., after processing and eating from it). Moreover, the older subjects were able to direct their solicitation toward the mother at the time when she was most likely to respond positively, that is, when she was finished processing, had taken a bite, and was holding the food item. It was important to have the mother respond positively because the type of maternal response largely determined the success of bouts. Note that the youngest subjects often solicit food from the mother when, in fact, she does not have any food. This error, reminiscent of a lack of object permanence, occurs infrequently in older orangutans.

These analyses suggest that the mother does encourage intentional behavior, and that infant actions and maternal responses are indeed coordinated and cooperative. When the infant learns to time solicitations in coordination with the mother's food activity and use intentional behavior directed to the mother, the infant is more successful at obtaining the goal.

Discussion

Orangutans engage in intentional behavior and intentional communication. Intentional behavior occurs in orangutans during the first months of life. Intentional behavior, defined simply as goal-directed sequences when Piagetian criteria are applied, takes two forms: direct manipulations of food items, and direct manipulations of the mother. The latter manipulation is of an instrumental nature, moving the mother's body as an intermediate means toward the goal of obtaining food. Human infants also demonstrate bifocal behavior during the first months of life (Case, 1985). They attempt to "set mother's hand in motion" or direct behaviors to objects held by the mother but without referring to the animate nature of the mother (e.g., Harding, 1983, 1984; Piaget, 1952, 1954). The data from this study appear to demonstrate that orangutans show a similar type of bifocal behavior.

A coordination in behaviors that involve both a social agent and an object is evident in the behavior of Arnold, the 2-year-old orangutan. Moreover, the 2-year-old infant directed behavior at the mother per se and not just at her appendages. The 2-year-old observed the actions of the mother, waited, and acted in a manner that coordinated his
activity with the ongoing activity of the mother (Table 6). Thus, the 2-year-old orangutan appeared to act in accordance with the independent actions of the mother (Wolf, 1982). In human children, the ability to understand the independent agency of another occurs around 20 months of age. It appears that the 2-year-old orangutan has developed some aspects of coordinated person-object sequences as suggested for slightly younger human infants (Sugarman, 1983). The oldest subject, the 5-year-old, was not observed using communicative gestures with her mother. This was because, in fact, she rarely solicited from her mother. Instead, she obtained food independently. She did, however, use intentional communication when humans held food. These gestures included the behavioral characteristics of an abbreviated signal (a hand-held-out behavior; Rijksen, 1978) sometimes accompanied by vocalizations, and alternate behavior when the desired goal was not obtained. This behavior was successful in getting food from human providers. When food was laid out for the orangutans to obtain on their own, as was the case during the videotaped observation sessions, the 5-year-old most often chose to obtain food independently from the pile and rarely attempted to obtain food from her mother. When orangutans become capable of independent feeding, by 5 or 6 years of age, food sharing becomes a rare event (Bard, 1987). The observation of intentional communication in the 5-year-old acquiring food from human providers documents this orangutan’s ability to use gestures, even though she did not exhibit gestures with the mother.

Intentional communication was observed in the behavior pattern of the gesture: it occurred twice in a rudimentary form in a 2½-year-old orangutan; it was observed to occur frequently in an orangutan of 3½ years of age; it occurred in the 5-year-old orangutan in interaction with people. Moreover, intentional communication was observed to occur in 9 out of 14 young orangutans in the field setting (Bard, 1987), although their gestures were not as visible as their temper tantrums, which are an exaggerated form of intentional communication (Bates et al., 1979). All instances of intentional communication observed in the field setting occurred in subjects between 2½ and 5½ years of age.

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Gestures, as defined here, are an important development in children, one that signals the attainment of communicative intent. The earliest gestures are request gestures, used to regulate another’s behavior. Request gestures appear on the average at 14 months of age (Acredolo & Goodwyn, 1988). It has been demonstrated that there are cognitive abilities that develop at the same time as these early communicative skills: (a) the understanding of others as causal agents (Bates & Snyder, 1987; Golinkoff, 1981; Harding, 1984; Piaget, 1954; Sexton, 1983; Wolf, 1982); (b) understanding of means-end relations, such as a

The documentation of communicative gestures in orangutans in the provisioning site and in the field setting of the ORCP contributes new evidence to the discussion of tool use in feral orangutans. Young feral orangutans, unlike adults, are unable to obtain independently some hard-to-process, embedded food items (Bard, 1989; Galdikas, 1979), which is believed to be an impetus for tool use (i.e., Parker & Gibson, 1977). Contrary to the evidence on the lack of tool use in feral orangutans (Galdikas, 1982), the current study suggests that feral orangutans can obtain some embedded foods with the use of a tool. The tool that is used by young orangutans is a communicative gesture. This argument is the basis for asserting that social tool use can be used as an alternative term for social agent-object relations (Sugarman, 1984). The cognitive complexity of these two phenomena is equivalent (see Bard, 1990, in press, for details). The gesture is the mechanism by which the infant constructs a functional relation between object and social agent. A lack of food-processing ability combined with the cognitive capacity to discover and use objects as tools may be the basis for the development of communicative gestures in young free-ranging orangutans.

The main limitation of this study was the small number of subjects. This study was
part of a larger study (Bard, 1987) designed to investigate the manipulative behavior of infant free-ranging orangutans. It is the first and only field study, to date, that has focused on infant orangutans. The conclusions related to age, however, must be considered preliminary. Further studies with the use of additional subjects should provide corroborative information. Future studies focusing on development up to 5 years of age could provide further information on the development of complex manipulative skills, such as the ability to discover and invent solutions to problems, through trial and error experimentation and insightful solution, respectively. The development of communicative gestures, in particular, should be studied in orangutans between the ages of 2 and 3½ years of age.

The documentation of intentional communication in free-ranging orangutans is important for at least three reasons. First, it suggests that orangutans might be more profitably utilized in research on communicative competence. Second, it documents the ubiquity of intentional communication by showing that intentional communication is a behavior present in the natural habitat. The influence of human behavior on orangutan behavior remains difficult to measure in rehabilitant, zoo, and laboratory settings. In fact, the occurrence of conventional tool use in rehabilitant orangutans appears to be directly related to the extent of human intervention (Galdikas, 1982). Therefore, documentation of gestures in the feral orangutan is crucial to showing that intentional communication is naturally occurring and not taught or learned through association with humans. Finally, because intentional communication does exist in apes, this study suggests that there is an evolutionary foundation for communicative competence.

References


cognition on two fronts. In J. Flavell & L. Ross (Eds.), *Social cognitive development*. New York: Cambridge University Press.


