Imitation of Intentional Manipulatory Actions in Chimpanzees (*Pan troglodytes*)

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In this study, the authors investigated the understanding of other’s actions in 5 adult chimpanzees (*Pan troglodytes*). A human demonstrated an attempt to open different containers. Each container required a different motor pattern to open it. Along with the container, a 2nd object was made available. After a free play period in which the chimpanzees’ natural behaviors toward the objects were recorded, the authors tested the following 2 phases: The demonstrator (a) tried but failed to open and (b) opened the container successfully, with 1 of 2 alternative strategies, either using an “irrelevant tool” or by hand. The chimpanzees did not reproduce the demonstrator’s motor patterns precisely but did reproduce the demonstrated strategies in both phases. These results suggest that chimpanzees anticipate the intentions of others by perceiving the directionality and causality of object(s) as available cues.

Recently, there has been much controversy over whether nonhuman animals imitate. Comparative psychologists have argued that imitation has important implications for the biological and phylogenetic foundations of cognitive complexity. Much of this debate centers on how the act of imitation is defined (e.g., Byrne & Russon, 1998; Byrne & Tomasello, 1995; Galef, 1988; Heyes, 1993, 1995; Heyes & Galef, 1996; Tomasello, Kruger, & Ratner, 1993; Visalberghi & Fragaszy, 1990; White, 1998; White & Ham, 1992). However, it has proved difficult for researchers to agree on a definition of imitation and to decide which nonhuman animals can imitate.

In attempting to determine whether the capacity for imitation exists in animals, comparative psychologists should consider it from another point of view. The question that must be asked is, how do imitators understand what the demonstrator did? In other words, how does the imitator represent the actions of others? If we see another’s actions as a series of precise physical movements (e.g., right arm moves up 20 cm, knees bend 30°, etc.), we might be very puzzled and unable to predict what the other is doing. It is clear that humans extract some component elements from the actions of others within a psychological framework (e.g., intention, desire; Baron-Cohen, 1995; Fodor, 1983; Tomasello, 1996). From this cognitive perspective, researchers must determine what components of the actions the imitators process.

In humans, nonverbal tests provide suggestive evidence that infants as young as 14 to 18 months old understand something about the intentions of others (Carpenter, Akhtar, & Tomasello, 1998; Meltzoff, 1995). Meltzoff investigated the understanding of others’ intentions in 18-month-old infants. He took advantage of the natural human tendency to reproduce the actions of others called the behavioral re-enactment procedure. This procedure capitalizes on an infant’s natural tendency to imitate adults’ actions. In this experiment, infants watched the demonstrator try but fail to reach the end state of an action (e.g., he tried to pull the ends of a dumbbell outward, but his hands slipped off). After the demonstration, when given an opportunity to manipulate the object themselves, the infants could achieve the end state of the actions spontaneously. They actually achieved success as often as infants who saw a successful demonstration (i.e., the end state of the action) and more often than infants in other control conditions. Meltzoff concluded that 18-month-old infants are able to represent the actions of others in a psychological framework through the body movement used to achieve an underlying goal or intention.

Little is known about how nonhuman animals understand the actions of others. Some researchers have attempted to demonstrate that apes understand something of the intention of others. Premack and Woodruff (1978) published the first study on a chimpanzee’s understanding of others’ intentions. A language-trained chimpanzee named Sarah observed several problem-solving situations featuring a human actor on videotape. For example, Sarah watched a video of an actor looking up at an out-of-reach banana hanging from the ceiling. After that, she was shown a pair of photographs, one of which pictured the solution (e.g., the actor climbed on a box under the banana). Sarah successfully chose the correct alternatives well above the level of chance. Premack and Woodruff argued that Sarah could attribute intention to the human actor.

Recent experimental research on apes’ understanding of others’ actions has focused on discrimination between intentional and
accidental actions (Call & Tomasello, 1998; Povinelli, 1991; Povinelli, Perilloux, Reaux, & Bierschewale, 1998; Premack, 1986). However, the results have been both positive (e.g., Povinelli, 1991; Call & Tomasello, 1998) and negative (e.g., Povinelli et al., 1998; Premack, 1986). It is not evident whether or how apes distinguish intentional from accidental actions performed by others. These researchers focused on determining whether nonhuman apes can distinguish intentional actions from accidental actions in a dichotomous fashion. Moreover, the results may be interpreted in several ways: (a) Chimpanzees have developmentally limited cognitive skills; (b) the result depends on their history of interacting with humans, including language training; or (c) there exist salient setting cues for each defined action in apes that differ from the humans’ perspective.

Myowa-Yamakoshi and Matsuzawa (1999) investigated the factors that determine the degree of difficulty in chimpanzees’ (Pan troglodytes) imitation. We found that there are some constraints in the basic cognitive processes required to transform visual information into matching motor acts when chimpanzees imitate human actions. For example, chimpanzees are less sensitive to body movement than to the manipulated objects involved in the demonstrated actions. On the other hand, it has been suggested that 18-month-old human infants understand the mental states of others through body movement (Butterworth, 1994; Meltzoff, 1995). If chimpanzees have a limited capacity for processing visual–motor information as it relates to body movement, their capacity to understand intentions of others may be different from that of humans.

Our aim in the present study was to investigate how chimpanzees represent the action of a human demonstrator. This is the first study to explore the understanding of others’ actions with the use of a nonverbal completion procedure (such as the one Meltzoff, 1995, used) to formulate action plans based on chimpanzees’ interpretation of the performance. We focused on the structure of the demonstrated actions to find what kinds of cues are available for chimpanzees to understand the intentions of others. The action was designed to involve various motor patterns and strategies for manipulating objects as independent variables. We expected that the chimpanzees would pick up some information from the demonstrator’s actions in ways that differed from those of humans.

To begin with, chimpanzees observed a demonstrator who tried but failed to perform the intended actions. Then, the chimpanzees saw the demonstrator achieve the intended actions successfully (Experiment 1). The hypothesis was that chimpanzees would understand something about the intention of the demonstrator depending mainly on the information about how the objects can be used (strategies for manipulating objects), even though the demonstrator’s action failed. In this respect, the results would be different from those of humans who read the intention of others through their body movements.

**Experiment 1**

**Method**

**Subjects**

The subjects were 5 female chimpanzees from 12 to 20 years old housed at the Kyoto University Primate Research Institute (KUPRI). Ai (20 years old at the time of this study) was born in the wild. Pendesa (18 years) and Chloë (15 years) were born in captivity and have been reared by humans since they were less than 1 year old. Popo (13 years) and Pan (12 years) are full siblings that were born through artificial insemination and raised in a nursery by humans at KUPRI starting within 24 hours of birth because their biological mother did not exhibit sufficient maternal care. All of the chimpanzees live together in a community of 11 chimpanzees in a semi-natural environment enriched with trees and a stream. They were not deprived of food for testing. Before this experiment, the chimpanzees had participated in different perception and cognitive capacity experiments involving a variety of objects (Fujita & Matsuzawa, 1990; Kojima, 1990; Matsuzawa, 1985; Matsuzawa, Kojima, & Shinohara, 1997; Tanaka, 1995; Tomonaga, 1993) and in a task that involved reproducing several kinds of actions (Kojima, 1991; Myowa-Yamakoshi & Matsuzawa, 1999). Throughout this study, all the chimpanzees paid attention to the actions demonstrated by the human. Then, when they were handed the objects, they remained in one place and manipulated the objects with great interest.

**Test Materials**

Eight pairs of objects were used as test stimuli (see Appendix, Table A1). In each pair, one object was a container that required one of a variety of different motor patterns to open (pushing, pulling, or twisting), and the other was an irrelevant tool that was not required to open the container. With each of these eight pairs of objects, opening the container was considered a successful action. No food was needed to sustain the interest of the chimpanzees.

**Experimental Design**

Each chimpanzee participated in a total of eight experimental sessions: one session was conducted with each pair of objects. Each session consisted of two phases of demonstration: (a) The demonstrator tried but failed to open the container because one of his hands “slipped” off the part of the container to be opened (failure phase), and (b) the demonstrator successfully opened the container (success phase). In both phases following each demonstration, the chimpanzees were given a chance to interact with the objects. Each of them experienced the two phases in the above-stated order (we did not counterbalance the order of the two phases in this study because we primarily focused on chimpanzees’ understanding of the intention of the demonstrator).

In each success and failure phase, the demonstrator manipulated the container with one of two alternative strategies: trying to open the container (a) with the irrelevant tool or (b) by hand. We counterbalanced the subjects to examine the alternatives within each phase and session (see Figure 1).

**Procedure**

Each chimpanzee was tested individually in a familiar playroom (5.0 x 7.2 m with a ceiling at 3.0 m) at KUPRI. There were two experimenters. One demonstrated the actions by sitting face to face with the chimpanzee in the playroom. The other experimenter recorded the trials on videotape from outside the room through an acrylic panel. All the chimpanzees had previously learned to sit quietly on a wooden seat whenever they participated in a cognitive test. Each session started with free play followed by the two test phases.

**Free play.** A pair of objects was presented to the chimpanzee for approximately 3 min of free play. During this time, the subject interacted in some way with each of the two objects. The demonstrator then retrieved the objects and proceeded with the following two phases (see Figure 2).

**Failure phase.** The demonstrator showed an action in which he tried but failed to open a container using one of two alternate strategies, either with the irrelevant tool or by hand. Each action was demonstrated two or three times to each chimpanzee to ensure that she paid attention to the
IMITATION OF INTENTIONAL ACTIONS IN CHIMPANZEES

(a)

Figure 1. A chimpanzee (Pendesa), sitting face to face with a human demonstrator who is performing the demonstrated actions (Session 7) in Experiment 1. (a) The demonstrator is trying to open a box with an irrelevant tool; (b) the chimpanzee’s performance using the demonstrated strategy.

(action. After the demonstration, the chimpanzee was then given the pair of objects and allowed 3 min to manipulate them. After 3 min elapsed, the objects were retrieved, and the chimpanzee received a piece of food in exchange for the objects. No further verbal description or encouragement was provided.

Success phase. After the failure phase, we proceeded with the success phase: The demonstrator showed the chimpanzee how to open the container successfully with one of the two alternate strategies. Following this demonstration, the chimpanzee was given the pair of objects and allowed another 3 min to manipulate them. The procedure in the success phase was identical to that followed in the failure phase, except that the demonstrator succeeded in opening the container.

One session consisted of free play and the two phases of the imitation test. There were four sets of conditions (failure with the irrelevant tool, failure by hand, success with the irrelevant tool, success by hand) in a total of eight sessions. Each session incorporated two of the four conditions. The order of conditions in each phase was counterbalanced across the subjects.

Each chimpanzee participated in two sessions each day, 3 or 4 days a week. Even if the chimpanzees successfully opened the containers in the free play period, we conducted both subsequent testing phases. All the testing sessions were recorded on videotape (Sony, CCD-TR3000) in their entirety for later analysis.

Data Analysis

During free play before the two testing phases, the chimpanzees often spontaneously opened the containers. In all cases, they opened the containers by hand, not by using the irrelevant tool. We excluded the cases of these successes in free play from further analysis. We analyzed only the sessions in which the chimpanzees failed to open the container in the free play period and observed the experimenter’s demonstration in the following two test phases.

As for the period of chimpanzees’ manipulation observed in the free play period and the two phases, we defined a performance as starting when the
chimpanzee touched the object(s) and ending when contact with the object(s) ceased, whether or not the container was opened. In addition, we defined the categories of motor patterns for chimpanzees’ performances. Each performance was coded according to mutually exclusive categories. A vocabulary for motor patterns was coined and is listed in Table 1. Using these definitions, we identified 18 motor pattern categories in total.

Chimpanzees’ spontaneous performances in free play were excluded from further analysis. As a result, we identified 29 performances in the failure phase and 33 performances in the success phase. Each of the chimpanzee’s performances were analyzed with regard to the strategies used to manipulate the container—specifically, whether the chimpanzee manipulated it alone or with the irrelevant tool.

**Scoring**

Two independent observers were initially given the definition of a performance and received a list of 18 identified motor pattern categories (see Table 1). Then, the performances for each session (25% of the cases for eight sessions) were presented to the observers in random order. They noted whether the container was manipulated alone or with the irrelevant tool in each session. At the same time, they determined on the basis of the list which motor patterns they thought the chimpanzees were performing. The observers were unaware of the hypotheses being tested and free to choose any of the strategies for each performance regardless of any previous nominations. Interobserver agreement on the performances calculated using the kappa statistic (designed to correct for chance agreement) was high, $k = .83, p < .01$.

**Results**

**Successful Performances**

Table 2 lists the performances of each chimpanzee for all sessions in each phase and the mean latency from first touch to opening the container in free play. In 4 out of 19 cases, the chimpanzee successfully opened the container after observing the demonstrator.

In the failure phase, the chimpanzees successfully opened the containers in 2 cases (11% of a total of 19 cases). Pan opened the container using a different strategy from that previously shown by the demonstrator. Ai opened the container using the demonstrated strategy. Both chimpanzees opened the containers by hand. The latencies to their first opening the containers were 9.8 s (Pan, Session 3) and 8.7 s (Ai, Session 6).

In the success phase, excluding the 2 cases in which chimpanzees had already opened the container in the preceding failure phase, they succeeded in opening the container in 2 of 17 cases (12%). Both chimpanzees reproduced the demonstrated strategy. The latencies to open the container were 26.2 s (Ai, Session 2) and 9.4 s (Chloé, Session 4).

There were no clear differences between the chimpanzees’ successes in the failure and success phases. When they succeeded in opening the container in either of those phases, the latency was much shorter than the mean latency for the cases in which the same container was opened in free play (Sessions 2, 3, 4, and 6. $M = 109, 77, 107,$ and 63 s, respectively). The chimpanzees did not engage in extensive trial and error; rather, they opened the container directly.

There were no performances in which the container was directed toward the tool in the two phases; the chimpanzees always manipulated the tool alone or directed it toward the container.

**Reproducing the Strategy for Manipulating Objects**

We analyzed the performances in each phase from two perspectives. First, did the chimpanzees manipulate the container with the irrelevant tool or by hand? Second, did they use the demonstrated strategies? In other words, when the demonstrator manipulated the container with his hands, did they also manipulate the container with their hands without using the irrelevant tool? When the demonstrator manipulated the container using the irrelevant tool, did they also manipulate the container using the irrelevant tool?

Table 3 shows the frequencies of performances by subjects for each type of demonstration in both phases. We found that chimpanzees used the demonstrated strategy significantly more often than an alternative strategy: Wilcoxon signed rank test, $T(N = 5) = 0, p < .05, 72\%$ in the failure phase; $T(N = 5) = 0, p < .05, 88\%$ in the success phase (see Figure 3). However, the difference in the alternative strategies in the failure phase versus the success phase was not significant: $T(N = 4) = 5, ns$.  

![Figure 2. Experimental procedure in Experiment 1.](image-url)
In the success phase, the demonstrator used either the identical or a different strategy to open the container as he used in the failure phase. As an example of the latter, the demonstrator manipulated the container with his hands in the preceding failure phase and used the irrelevant tool in the success phase (also see Figure 2). No difference was found in the choice of strategy used between both cases: $T(N = 5) = 5, ns$. The chimpanzees significantly tended to use the demonstrated strategy, irrespective of whether the demonstrator used the same strategy in both phases.

**Reproduction of Motor Patterns**

Table 4 presents the proportion of the performances reproduced by the chimpanzees in each demonstrated motor pattern in each phase. Wilcoxon’s signed rank test showed that there was no significant difference in the proportion of reproduction of the motor patterns between the two phases: $T(N = 4) = 3, ns; M = 17\%$ in the failure phase; $M = 15\%$ in the success phase. As for the proportion of reproduction of each type of motor patterns, the Friedman test showed that there was no significant difference among the three types, $\chi^2(2, N = 5) = 6.23, ns$; pulling, $M = 9\%$ in Sessions 1, 4, and 7; pushing, $M = 27\%$ in Sessions 2, 3, 6, and 8; twisting, $M = 0\%$ in Session 5. The chimpanzees did not accurately reproduce the motor patterns involved in the demonstrator’s actions in both phases.

**Discussion**

The results show that the chimpanzees reproduced some aspects of the demonstrated actions in the failure and success phases. They manipulated the objects using the demonstrated strategy significantly more often than other strategies. Even though they saw the demonstrator fail to open the container, they tried to use the strategies demonstrated in the failure phase. On the other hand, they did not appear to reproduce precisely the demonstrator’s body movements involved in the demonstrations in both phases.

**Experiment 2**

In Experiment 2, we presented the sets of objects during free play and then tested the chimpanzees using the order of success phases followed by failure phases. The hypothesis was that once chimpanzees had seen the demonstrator succeed in the success phase, they would understand how to open the container. As a result, even though the demonstrator showed the alternative strategy in the later failure phase, chimpanzees would not try the strategies demonstrated in the failure condition, which would differ from the results of Experiment 1.
Table 2
Cases by Chimpanzees for Each Session in the Failure and Success Phase in Experiment 1

<table>
<thead>
<tr>
<th>Subject</th>
<th>Mean latency*</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td>Failure Phase</td>
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</tbody>
</table>

Note. ● = chimpanzee opened the container; x = chimpanzee failed to open the container; - = chimpanzee already opened the container in free play period prior to the success phase and failure phase.

Method

Subjects

The subjects in Experiment 2 were the same 5 chimpanzees who were tested in Experiment 1.

Test Materials

Four other pairs of objects were used as test stimuli (see Appendix, Table A2). In each pair, one object was a container, and the other was an irrelevant tool that was not required to open the container.

Procedure, Data Analysis, and Scoring

The procedure was similar to that in Experiment 1 but differed in the order of presentation of the failure and success phases. Each chimpanzee participated in a total of four sessions. One session was conducted with each pair of objects. After the free play period, the experimenter first demonstrated the success phase and then the failure phase. Furthermore, in the success phase followed by the failure phase, the demonstrator showed alternative strategies. That is, two demonstrated conditions existed: trying to open the container (a) with the irrelevant tool in the success phase and by hand in the failure phase, or (b) by hand in the success phase and with the irrelevant tool in the failure phase. The order of the conditions in each session was counterbalanced. All sessions were videotaped.

The tapes were analyzed by the same method in Experiment 1. Excluding performances that the chimpanzees spontaneously did in free play, we identified 37 performances in the success phase and 38 performances in the failure phase in total.

Interobserver agreement by two independent observers of the performances calculated using the kappa statistic was high, $k = .89, p < .01$.

Results

Successful Performances

There was only one case in which the chimpanzees could open the containers in the success and failure phases. In the success
Table 4
Proportion of Performances Reproduced by Chimpanzees in Each Demonstrated Motor Pattern in Each Phase

<table>
<thead>
<tr>
<th>Motor patterns</th>
<th>Phase</th>
<th>Pulling (Sessions 1, 4, 7)</th>
<th>Pushing (Sessions 2, 3, 6, 8)</th>
<th>Twisting (Session 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Failure</td>
<td>7.0 (1/14)</td>
<td>28.6 (4/14)</td>
<td>0.0 (0/1)</td>
</tr>
<tr>
<td></td>
<td>Success</td>
<td>10.5 (2/19)</td>
<td>23.1 (3/13)</td>
<td>0.0 (0/1)</td>
</tr>
</tbody>
</table>

Note. The first number in parentheses represents the number of the performances that subjects reproduced from the observed motor patterns. The second number represents the total numbers of subjects' performances in three types of sessions.

phase, 1 chimpanzee, Pan, successfully opened the containers by hand (7% of a total of 15 cases). Pan opened it using the strategy that had previously been shown by the demonstrator. The latency to open the container was 42 s (Session 1).

Reproduction of the Strategy or Manipulating Objects

Table 5 illustrates the frequencies of chimpanzees' performances for each type of demonstration in the success and failure phases as a function of the strategies shown by the demonstrator. We found that the chimpanzees used the demonstrated strategy significantly more often than an alternative strategy in the success phase: Wilcoxon's signed rank test, $T(N = 6) = 0, p < .05, 97\%$ in the success phase.

On the other hand, in the failure phase, the chimpanzees significantly used the strategy that had previously been shown in the success phase in both conditions: $T(N = 5) = 0, p < .05, 92\%$ in the failure phase. No difference was found in the choice of strategy between two conditions in the two phases: $T(N = 4) = 6, ns$, in the success phase; $T(N = 3) = 4, ns$, in the failure phase. The chimpanzees significantly tended to use the demonstrated strategy in the success phase, even though they saw the alternative strategies in the failure phase. Figure 4 presents the percentage of performances in which the chimpanzees performed using identical strategies shown by the demonstrator in both phases. There were no performances in which the container was directed to the tool; the chimpanzees always manipulated the tool alone or directed it toward the container.

Discussion

There were few successes in which the chimpanzees could open the containers after observing the demonstration in the two test phases. However, the chimpanzees reproduced some aspects of the demonstrated actions only in the success phases. When the chimpanzees saw the demonstrator succeed in opening the containers, they used the identical strategy in the success phase. On the other hand, once they had seen the demonstrator succeed, chimpanzees did not use the alternative strategy demonstrated in the failure phase.

Experiment 3

In previous experiments, the chimpanzees produced a few more actions in the failure and success phases compared with the free play condition. The findings suggest that the chimpanzees benefited from the demonstrator's action in the two phases. However, the longer the chimpanzees manipulated the containers, the more likely they would be to discover how to open them. In Experiment 3, we explored the effect of extended practice on the chimpanzees by presenting some sets of objects in a free play situation that lasted as long as the combined free play, failure, and success phases.

Method

Subjects

The subjects in Experiment 3 were the same 5 chimpanzees who were tested in Experiments 1 and 2.

Test Materials

Four additional pairs of objects were used as test stimuli (see Appendix, Table A3). In each pair, one object was a container, and the other was an irrelevant tool that was not required to open the container.

Table 5
Frequency of Types of Performances Used by Chimpanzees After the Demonstrator Attempted to Open the Container in Each Phase

<table>
<thead>
<tr>
<th>Subjects' manipulation</th>
<th>Success phase</th>
<th>Failure phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstrator's manipulation</td>
<td>By hand</td>
<td>With irrelevant tool</td>
</tr>
<tr>
<td>By hand</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>With irrelevant tool</td>
<td>17</td>
<td>1</td>
</tr>
</tbody>
</table>
In this study, we used a completion procedure to investigate whether chimpanzees understand the intentions of other individuals. Experiment 1 showed that the chimpanzees were rarely able to open the containers in the failure phase (less than 11% of total cases). Overall, there was no clear difference in the success of actually opening the container between the failure and success phases. The chimpanzees did not appear to be more successful, even after being shown how to open the container.

How might we interpret the results of Experiment 1? Did the chimpanzees understand any of what the demonstrator tried to impart? There are two possible hypotheses. One is that the chimpanzees already understood something about the intention of the demonstrator in the failure phase. The other is that the chimpanzees could not understand the demonstrator’s intention, even after observing the outcomes of the demonstrated actions.

Although the chimpanzees did not open the container very often after observing the demonstration, when they did open it, they reproduced the demonstrated strategy in both phases in Experiment 1. Myowa-Yamakoshi and Matsuzawa (1999) found that chimpanzees were less sensitive to imitating a demonstrator’s body movements compared with imitating the manipulations of the objects involved in the demonstrated action. Therefore, although the chimpanzees might have understood the demonstrator’s intention in the failure phase, it might be difficult for them to actually reproduce opening the container from the view of an all-or-none issue.

These results could be easily explained in terms of simple stimulus enhancement, in which seeing some act done on a particular object would increase the observer’s probability of interacting with that object (Spence, 1937). However, when we compare the results of Experiments 1 and 2, we can rule out stimulus enhancement as an explanation. Chimpanzees tried to complete the demonstrator’s alternative strategies in success phases when they could not have understood how to open the containers in failure phases (Experiment 1). On the other hand, once they had seen the demonstrator succeed in success phases, they did not try to follow the demonstrator’s alternative strategies in failure phases (Experiment 2). Chimpanzees seemed to understand that there was no need to try alternative strategies because they already knew how to open the container from the success phases. They learned from the demonstrator some causal relationships between the tools used to open the containers or the containers to be opened in the action. (Tomasello, 1990). Namely, these findings would seem to go beyond stimulus enhancement.

Moreover, the fact that the chimpanzees produced a few more actions in the failure and success phases compared with the free play could be explained as an effect of extended exposure to the containers. However, this explanation seems unlikely in light of the findings of Experiment 3. In Experiment 3, we presented chimpanzees sets of objects in a free play situation that lasted as long as the combined free play, failure, and success phases in the first two experiments. Even so, the mean latencies from the first contact with the containers to opening them in Experiment 3 were not different from those of free play in Experiments 1 and 2.

We concluded that the chimpanzees understood something about the intention of the demonstrator in the failure phase. However, they mainly observed the directionality of objects as cues rather than the demonstrator’s body movements (i.e., pulling, pushing, and twisting). In that sense, chimpanzees may interpret other’s actions in different ways from humans. For that reason, our results differ from the results for human infants (Carpenter et al., 1998; Meltzoff, 1995).
Role of Body Movement in Understanding the Actions of Others

It is fruitful to compare our results with previous studies in which researchers investigated chimpanzees’ understanding of the intentions of others. These studies have produced both positive and negative results. We will review the tasks used in each study to determine what kind of cues lead chimpanzees to understand others’ intentions.

As mentioned above, Myowa-Yamakoshi and Matsuzawa (1999) suggested that chimpanzees might not be sensitive to the details of the body movements of others. Chimpanzees may have more difficulty than humans in understanding gestures consisting of only body movements (see also Call & Tomasello, 1995, for examples involving orangutans). This view is congruent with the negative results of experiments in which the subject was required to discriminate between another’s intentional and accidental actions.

Povinelli et al. (1998) reported that 5- to 7-year-old chimpanzees did not understand the distinction between accidental and intentional actions. In our view, this seems reasonable. The accidental and intentional actions Povinelli et al. studied had physically equivalent outcomes (e.g., the actor’s hand touched the cup, and the juice in the cup spilled on the floor). The only difference between the two actions was the actor’s body movements defined from a human perspective (e.g., the actor intended to pour a cup of juice slowly, or the actor accidentally spilled it). We suggest that it was difficult for chimpanzees to distinguish these actions because they paid more attention to the information in the physically equivalent outcomes than to the actor’s body movements.

The same interpretation may be applied to the study by Tomasello, Call, and Gluckman (1997). Young children (2.5 and 3.0 years old), chimpanzees, and orangutans observed a human experimenter hide a reward in one of three opaque containers on a wooden plank. Another experimenter played the role of communicator and helped the subject find the reward using one of three signs: pointing, marker, and replica. Pointing involved placing a hand directly above the correct container with the index finger oriented down. Marking was when a wooden block was placed on top of the correct container. Replica involved holding up a duplicate of the correct container. The results showed that young children understood all three communicative signs above the chance level. On the other hand, apes were not previously trained to use the marker and pointing strategies did not score above chance for any of the intentional communicative signs. Tomasello et al. (1997) argued that the naive apes did not understand the communicated intentions of others. However, although the naive apes all performed at the chance level, their best performance was with the marker, followed by the replica and pointing. This result is also consistent with ours, because the apes may have responded to the containers and objects (marker and replica) held by the communicator rather than to the communicator’s body movement (pointing).

We investigated whether chimpanzees could understand a demonstrator’s intention without seeing the outcome of the actions. The results suggest that chimpanzees do not understand others’ intentions in the same way that humans do. Human infants understand the intentions of others in a psychological framework through body movements. On the other hand, chimpanzees anticipate the forthcoming action of others by perceiving the directionality and physical causality of objects as a more available cue compared with the details of the body movements of the demonstrator performing the manipulation. In our task, we can only speculate whether it is more difficult for chimpanzees to distinguish between actions that have the same outcome or body movements to understand another’s intentions.

In the present study, we used a completion procedure to show that chimpanzees can understand another’s intentions. In the published studies on whether chimpanzees understand the intention of others, there may have been different levels of task difficulty. The constraint on visual–motor information processing may have produced mixed results regarding the ability of chimpanzees to understand intention. Whereas humans interpret another’s intentions by perceiving both body movements and the directionality of manipulated objects, chimpanzees depend mainly on the information about the manipulated objects to anticipate the intentions of others.

References


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**Appendix**

**Table A1**

The Eight Pairs of Objects Used and the Motor Patterns Needed to Open Each Container in Experiment 1

<table>
<thead>
<tr>
<th>Session</th>
<th>Container</th>
<th>Irrelevant tool</th>
<th>Motor pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Transparent box</td>
<td>Spatula</td>
<td>Pulling</td>
</tr>
<tr>
<td>2</td>
<td>Airtight jar</td>
<td>Wooden handle</td>
<td>Pushing</td>
</tr>
<tr>
<td>3</td>
<td>Fishing box</td>
<td>Brush</td>
<td>Pushing</td>
</tr>
<tr>
<td>4</td>
<td>Chopstick case</td>
<td>Screwdriver</td>
<td>Pulling</td>
</tr>
<tr>
<td>5</td>
<td>Sprayer</td>
<td>Tongs</td>
<td>Twisting</td>
</tr>
<tr>
<td>6</td>
<td>Plastic basket</td>
<td>Wooden spoon</td>
<td>Pushing</td>
</tr>
<tr>
<td>7</td>
<td>Key box</td>
<td>Pin</td>
<td>Pulling</td>
</tr>
<tr>
<td>8</td>
<td>Case for spectacles</td>
<td>Cap opener</td>
<td>Pushing</td>
</tr>
</tbody>
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### Table A2

<table>
<thead>
<tr>
<th>Session</th>
<th>Container</th>
<th>Irrelevant tool</th>
<th>Motor pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Floppy disk case</td>
<td>Spurtle</td>
<td>Pulling</td>
</tr>
<tr>
<td>2</td>
<td>CD box</td>
<td>Spanner</td>
<td>Pulling</td>
</tr>
<tr>
<td>3</td>
<td>Camera</td>
<td>Corkscrew</td>
<td>Pushing</td>
</tr>
<tr>
<td>4</td>
<td>Radio</td>
<td>Straw</td>
<td>Pushing</td>
</tr>
</tbody>
</table>

### Table A3

<table>
<thead>
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<th>Container</th>
<th>Irrelevant tool</th>
<th>Motor pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Remote control</td>
<td>Hanger</td>
<td>Pushing</td>
</tr>
<tr>
<td>2</td>
<td>Ashtray</td>
<td>Beetle</td>
<td>Pulling</td>
</tr>
<tr>
<td>3</td>
<td>Clock</td>
<td>Swizzle-stick</td>
<td>Pushing</td>
</tr>
<tr>
<td>4</td>
<td>Pot</td>
<td>Rake</td>
<td>Pushing</td>
</tr>
</tbody>
</table>

Received August 10, 1999
Revision received April 10, 2000
Accepted April 11, 2000