Anim Cogn (2014) 17:1269–1279
DOI 10.1007/s10071-014-0760-1

ORIGINAL PAPER

Does own experience affect perception of others' actions in capuchin monkeys (*Cebus apella*)?

Hika Kuroshima · Ingrid Kaiser · Dorothy M. Fragaszy

Received: 25 February 2014 / Revised: 12 May 2014 / Accepted: 13 May 2014 / Published online: 21 May 2014

Abstract Anticipating another's actions is an important ability in social animals. Recent research suggests that in human adults and infants one's own action experience facilitates understanding and anticipation of others' actions. We investigated the link between first-person experience and perception of another's action in adult tufted capuchin monkeys (*Sapajus apella* spp., formerly *Cebus apella* spp.). In Experiment 1, the monkeys observed a familiar human (actor) trying to open a container using either a familiar or an unfamiliar action. They looked for longer when the actor tried to open the container using a familiar action. In Experiment 2, the actor performed two novel actions on a new container. The monkeys looked equally at the two actions. In Experiment 3, the monkeys were trained to open the container using one of the novel actions in Experiment 2. After training, we repeated the same procedure as in Experiment 2. The monkeys looked for longer when the actor manipulated the container using the action they had practiced than when she used the unfamiliar action. These results show that knowledge derived from one's own experience impacts perception of another's action in these New World monkeys.

H. Kuroshima (✉)
Department of Psychology, Graduate School of Letters, Kyoto University, Yoshida-honmachi, Sakyo, Kyoto 606-8501, Japan
e-mail: h.kuroshima@gmail.com;
kuroshima.hika.4z@kyoto-u.ac.jp

H. Kuroshima · I. Kaiser · D. M. Fragaszy
Neuroscience and Behavior Program, Psychology Department, University of Georgia, Athens, GA 30602-3013, USA

I. Kaiser
Psychologisches Institut, Universität Heidelberg, Hauptstrasse 47-51, 69117 Heidelberg, Germany

Keywords Action understanding · Social cognition · Tufted capuchin monkeys

Introduction

Predicting others' actions is an important ability for social animals, as it supports coordinated activity and social learning. Human infants can detect others' goals or intentions from their actions and predict future actions by around the first birthday. For instance, by 6–9 month of age, infants perceive certain actions as goal-directed, such as reaching or grasping (Hamlin et al. 2008; Király et al. 2003; Woodward 1998, 1999, 2005; Woodward and Sommerville 2000), and by the end of the first year infants flexibly interpret the same observed motion as goal-directed according to the context (Csibra et al. 2003; Csibra and Gergely 2007; Gergely and Csibra 2003; Gergely et al. 1995; Phillips and Wellman 2005).

Recent studies indicate that human infants' perceptions of other's actions as goal-directed is affected by their own action experience (Kanakogi and Itakura 2011; Rakison and Woodward 2008; Woodward 2009). To illustrate, Sommerville et al. (2005) investigated whether active experience affects infants' visual interest in an actor's goal-directed action. They arranged for 3-month-old infants to contact and pick up a pair of toys with a sticky mitten. A second group of infants did not receive this experience. Infants from both groups were then habituated to an adult actor's mitten-covered hand reaching to one of two toys. On test trials, the position of the toys was switched, so that infants observed the actor reaching for a new toy along the same path or the same toy along a new path. Infants with experience of using the sticky mitten looked longer at the actor grasping the new toy, showing awareness of the actor's goal, but those without training did not do so. The authors concluded that infants rapidly learned something from their own action and transferred this knowledge to an observed event. Similarly, Meltzoff and Brooks (2008) argued, on the basis of infants' gaze-following behavior, that self-experience influenced understanding of another's mental state, such as seeing. They demonstrated that 12-month olds who had experience of wearing an opaque blindfold followed the directional movement of the head (i.e., "followed the gaze") of a blindfolded adult significantly less than did control infants who experienced the blindfold but whose view had not been obstructed by it. Myowa-Yamakoshi et al. (2011) reported similar findings in 12-month-old infants using a preferential looking paradigm: infants who experienced occluded vision from wearing a blindfold looked longer at a blindfolded adult experimenter's successful action than at an unsuccessful action. However, the infants looked longer at the experimenter's failed action than her successful action when she was not wearing the blindfold. These results suggest that human infants use knowledge gained their own experience to infer the meaning of others' actions. Furthermore, in a study of imitation, Wood et al. (2013) investigated whether different knowledge acquisition methods (social or nonsocial) affected 5-year olds' imitation of causally irrelevant actions. In social group, children learned how to open and get a reward from a container by observing an actor's successful action. By contrast, children in the nonsocial group were simply given access the container and spontaneously learned how to get the reward from it. After these phases, the actor showed all children an alternative way of opening the container including causally irrelevant actions. Children who had learned through personal experience copied irrelevant actions less than children who had learned by observation. This result might indicate that knowledge acquired through active experience enhances attention to causally relevant actions.

As described above, studies of infants and children have assessed the effect of one's own experience on understanding of others' actions. Among non-human primates, however, chimpanzees (*Pan troglodytes*) showed no evidence that their personal experience influenced perception of a human actor's action (Buttlemann et al. 2013): One group of chimpanzees learned one of two opening actions (lifting or sliding a handle) to get a reward by individual effort. A second group observed a human actor opening the container using one of two techniques. Following this information phase, two human actors took up position in front of the subject and each tried to open a container using different actions. Chimpanzees who had learned through observation looked for longer at the actor who tried to open the container using the chimpanzees' familiar action rather than at the actor who demonstrated an unfamiliar action, whereas chimpanzees who had learned through their own action experience did not visually discriminate between the two actors. The question therefore arises: Is the influence of one's own active experience on understanding or perception of others' actions unique to humans?

In the present study, we focused on the impact of experienced action on perception of others' action in a New World primate, tufted capuchin monkeys (*Sapajus* spp.).[1] Numerous studies have shown that imitating novel actions demonstrated by others is difficult for ape (Buttlemann et al. 2013; Tennie et al. 2012; Hopper 2010; Whiten et al. 2009). Tufted capuchin monkeys do not appear to acquire novel actions from observing others' actions per se (Custance et al. 1999; Fragaszy et al. 2011; Fragaszy and Visalberghi 2004; Fredman and Whiten 2008), but captive capuchins diffuse alternative foraging methods within their group (Dindo et al. 2008, 2009; Perry 2009), suggesting that they attend not only to the outcome of others' actions, but may also attend to what they are actually doing. Moreover, Kuroshima et al. (2008) showed that tufted capuchin monkeys learned to solve a task by observing a conspecific's failed action. The authors prepared two food containers of identical appearance, but one could be opened only by lifting the lid and the other could be opened only by sliding a side wall. The monkeys were trained to correct their own mistakes and learned that when they could not open the container one way they should switch to the other way. In the test phase, subjects observed a conspecific fail to open the container using one method and were then given the opportunity to open the container themselves. Two of four monkeys reliably used the appropriate action, suggesting that capuchins can refer to another's action if that action is already in their own repertoire. Investigating the link between one's own active experience and perception of another's action may clarify ways of understanding others in human and non-human primates.

In the present study, we conducted three experiments. In Experiment 1, a human actor manipulated a container to extract food from it, in one way that the monkeys knew was usually successful, and in another way that the monkeys had never seen lead to an outcome. We asked whether the monkeys paid more attention to the action when they could expect to get a reward from the actor. In Experiment 2, the monkeys were given a new container that could be opened in two ways. The actor attempted to open the container using two novel actions, but failed each time. After determining that the monkeys looked equally at these two actions, we trained them to open the container using

[1] Tufted capuchins, until 2001 recognized as *Cebus apella*, are now recognized as belonging to several species and in a newly-recognized genus (*Sapajus*) (Lynch Alfaro et al. 2012).

one of the actions. Following training, in Experiment 3, we repeated the same procedure as in Experiment 2. If first-person experience affected their perception of another's action, we predicted that the monkeys would look differentially at the experienced and non-experienced actions; specifically, we predicted longer looking at the human performing the action that they had previously used themselves to open the container.

Experiment 1

The main purpose of Experiment 1 was to determine whether the capuchin monkeys' looking at an actor manipulating a container reflected the monkeys' anticipation of receiving food from the actor.

Method

Subjects

Eight male captive-born tufted capuchins (*Sapajus* spp.): Chris, Jobe, Leo, Mickey, Nick, Solo, Xenon, Xavier (14- to 20-years old) participated in all experiments. The monkeys were housed in pairs at the Life Sciences Building, University of Georgia for more than 10 years prior to the start of the study. Seven were mother-reared in mixed-sex breeding groups; the eighth was nursery-reared to 1 year of age and then housed with a conspecific companion. They were familiar with humans through daily routine research and caretaking activities. During the study, the monkeys were fed Lab Diet monkey chow twice daily and various fruits once a day, in normal quantities and on their normal schedule. Water was always available.

Apparatus

The monkeys were tested individually in a test cage (83.3 9 58.4 9 86.4 cm) constructed of clear Plexiglas walls and metal mesh floor. The front wall of the test cage had an aperture (8.5 9 6.0 cm) that allowed the monkey to extend his arm beyond the front of the cage. A clear glass jar (8.5 cm diameter 9 10 cm high) was placed on a metal table located immediately in front of the test cage. The table top was the same height as the floor of the test cage. A human actor was seated across the table from the monkey. A camcorder (Panasonic SDR-S100) positioned behind the actor recorded the monkey's behavior.

Procedure

Each monkey completed two test sessions. Each session consisted of 12 regular and four test trials. The first trial of each session was always a regular trial. In order to maintain motivation for food, we inserted four test trials among the remaining 11 regular trials in a quasi-random order; food was only given in regular trials. Each test trial was preceded and followed by at least one regular trial.

In regular trials, Experimenter (hereafter, *E*) entered the test room holding a cranberry, a preferred food of the monkeys. *E* sat on a chair across the table from the monkey and showed the cranberry to the monkey. After *E* was sure that the monkey had looked at the cranberry, *E* inserted it into the clear glass jar and closed the lid, and then left the room. Then actor (hereafter, *A*) entered and sat on the chair. When *A* determined that the monkey was visually oriented toward *A*, *A* looked at the jar, unscrewed the lid for about 3 s, opened the jar and gave the monkey the cranberry through the opening of the front panel in the test cage. The monkey always ate the cranberry. E and A were equally familiar to all monkeys.

In test trials, *E* put a cranberry into the jar and left the test room, following which *A* entered the test room and sat down as in regular trials. *A* waited for the monkey to look at her, then turned her gaze to the jar and performed one of two actions ("Familiar action" or "Unfamiliar action") ten times over a 30-s period, after which *A* left the test room without having opened the jar. In all trials, the same person had the same role. The two actions performed by *A* were as follows (see Fig. 1):

Familiar action *A* held the jar by the left hand and pretended to unscrew the lid with the right hand, re-grasping the lid about ten times. This action was the same as in the regular trials, but in test trials *A* did not open the jar.

Unfamiliar action A repeatedly touched the two sides of the jar with the extended index fingers of left and right hands (a pinching action) about ten times. The monkey had not seen this action prior to the experiment.

Coding and analysis

Videotapes of test trials were digitized at 30 frames/s using Adobe Premiere CS3. We coded the monkeys' looking toward *A*'s face and her hand(s) on the jar for 30 s, beginning when *A* initially touched the jar with her right hand (defined as the start of the test trial). The video camera was in the same location in all sessions and allowed a clear view of monkeys' looks toward *A*'s face and the container. A second observer coded 20 % of test trials to measure inter-observer reliability. The two coders achieved a Pearson's correlation of ? 0.957 for duration of looking. A Wilcoxon exact signed-ranks test was used to compare looking duration in Familiar vs. Unfamiliar conditions.

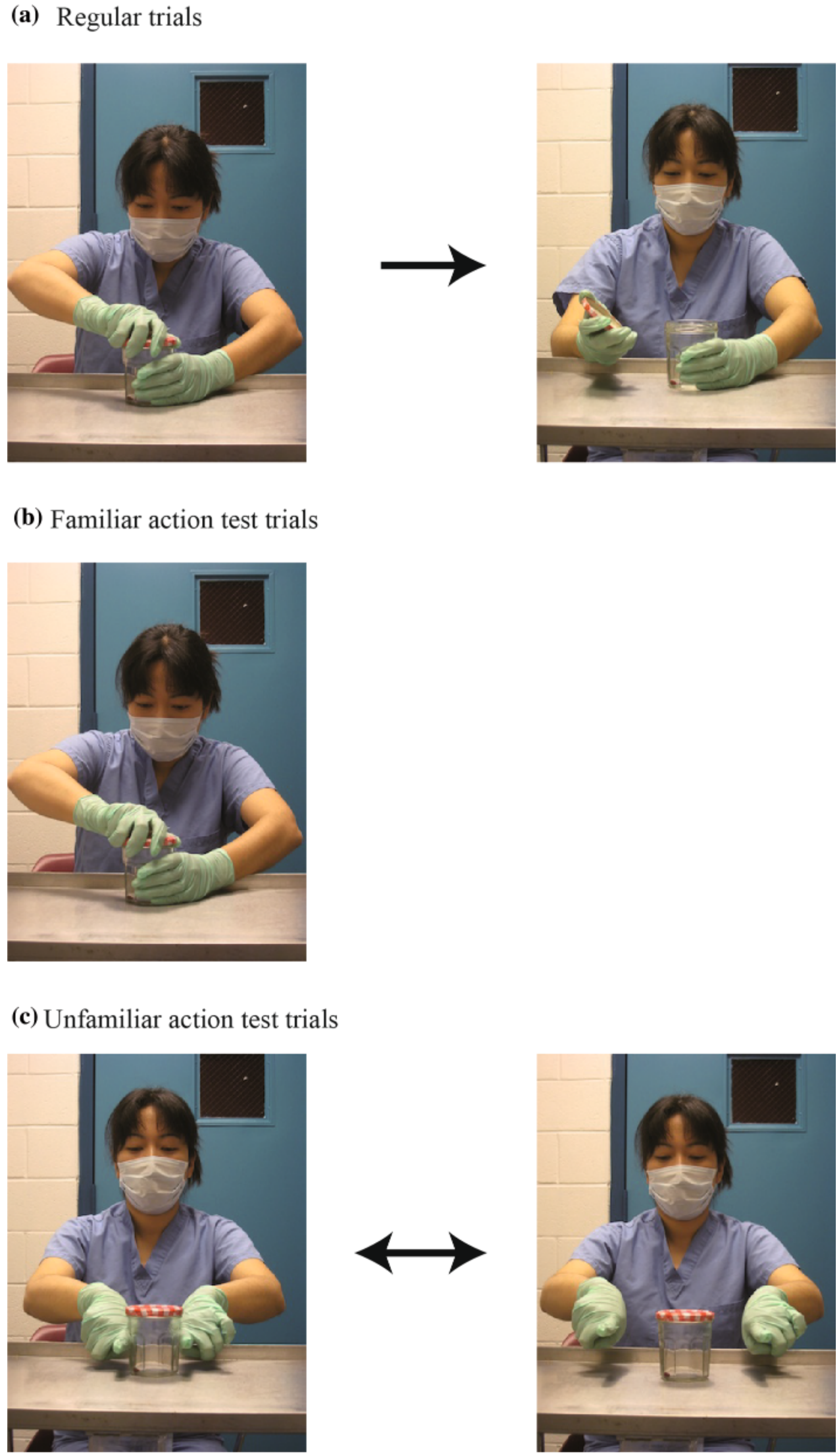

Fig. 1 Actor's action in regular trials (**a**), familiar action test trials (**b**), and unfamiliar action (**c1** and **c2**) test trials in Experiment 1

Results and discussion

The duration of looking at *A*'s face or jar and hands showed a significant difference between Familiar and Unfamiliar conditions (*Z* = - 2.52, *n* = 8, *p*\ .01) (Fig. 2a). All eight monkeys looked for longer when *A* performed the Familiar action compared to the Unfamiliar action. The monkeys learned that the outcome of the familiar action was delivery of food during the 12 regular trials of each test session, and they paid more attention to the situation when they could expect to receive food. Thus, in Experiment 1, we demonstrated the duration of looking at *A* while she manipulated the jar was a reliable behavioral index of the monkeys' expectation about the outcome of *A*'s action.

Experiment 2

Experiment 1 showed that during regular trials the monkeys learned to associate *A*'s action of twisting the lid of the jar and the delivery of food. They looked longer when they expected food to be delivered than when they did not expect food. In Experiment 2, *A* performed two novel actions with a new container, neither of which resulted in food. The purpose of Experiment 2 was to confirm that the monkeys did not expect a food reward outcome when merely observing novel actions by *A*.

Method

Apparatus

We used the same test room, video camera, test cage, and metal table as in Experiment 1, but a new transparent food container (Fig. 3, base: 25.0 9 35.0 cm, container: 11.0 9 12.0 9 11.5 cm) with a drawer (9.0 9 10.0 9 10.8 cm). The lid (11.0 9 12.0 cm) was covered with white adhesive tape to help the monkeys recognize the structure of the container. The container could be opened by lifting the lid or by pulling a handle (2.8 9 2.0 9 0.6 cm) at the front of the drawer, producing an opening (9.0 9 8.5 9 9 cm deep). A stopper (8.7 9 1.6 9 1.5 cm) in the bottom of the drawer prevented the monkey from removing the drawer.

Procedure

We used the same procedure as in Experiment 1: The monkeys received 12 regular trials and 4 test trials (Novel Action 1 and 2, twice each) per session, with the test trials distributed in a quasi-random order after the first trial. The first trial was always a regular trial: *E* entered the test

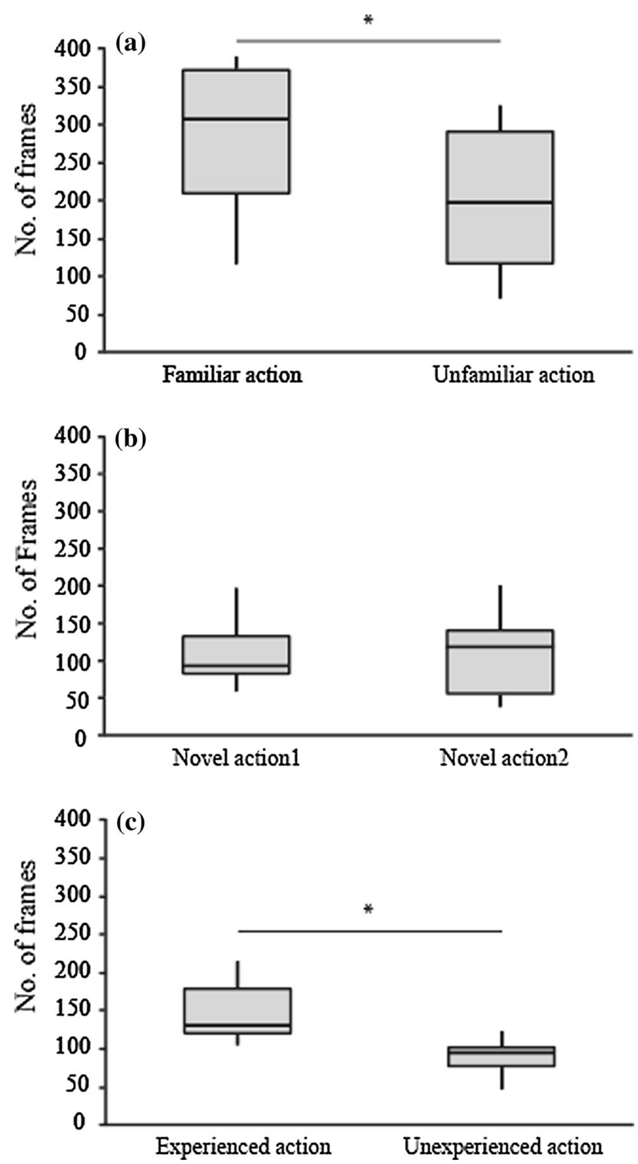

Fig. 2 Median number of frames spent looking at actor or the actor's manipulation of the apparatus in Experiment 1(**a**), 2(**b**), and 3(**c**). The *boxes* show the median, the interquartile range, and full range of scores. ***p*\ 0.05

room with a cranberry, sat on the chair, showed the cranberry to the monkey, lifted the lid of the container, put the cranberry into the container, and closed the lid. Immediately after *E* left, *A* entered the room, sat on the chair, waited for the monkey to look at her, looked at the container, put her left hand on the base, touched the lid with right hand for about 3 s, and opened the lid of the container. The action used to open the container was identical to *E*'s action for putting the cranberry into the container. *A* removed the cranberry and gave it to the monkey. There were two types of test conditions; Novel Action 1 and Novel Action 2. The procedures of two test trials were as follows (see Fig. 4):

Fig. 3 The food container used in Experiments 2 and 3. The container can be opened via the drawer or the lid

Novel Action 1 *A* put her left hand on the base and grasped the handle of the drawer with the fingers of her right hand. *A* re-grasped the handle about ten times, but never opened the drawer.

Novel Action 2 *A* put her left hand on the base and pushed the lid with her extended right index finger about ten times.

As in Experiment 1, in test trials, *A* looked at and manipulated the container for 30 s, after which she left the test room. In all trials, the same person played the same role. All monkeys received two sessions, each on a different day.

Coding and analysis

We coded the duration of looking at *A*'s face or hands as in Experiment 1. Two independent coders obtained a Pearson's correlation of $r =$? 0.906 for 20 % of the trials. A Wilcoxon exact signed-ranks test was used to compare looking at Novel Action 1 versus Novel Action 2.

Results and discussion

The monkeys did not discriminate between the two novel actions performed by *A*; the Wilcoxon test revealed no significant difference in duration of looking between Novel Action 1 and 2 ($Z = -\ .42$, $n = 8$, $p = .74$) (Fig. 2b). Thus, in Experiment 2, we confirmed that the two novel actions on the container were equally interpreted as being non-predictive of food for the monkeys. The question remained: Does active experience change perception of another's action? In the final Experiment, we examined whether actively performing one of the actions affected the monkeys' perception when the action was performed by another individual. For this purpose, we trained each monkey to open the container using Novel Action 1 of Experiment 2 (opening the drawer). We then re-tested them as in Experiment 2.

Experiment 3

Method

Apparatus

We used the same test room, video camera, and test cage as in Experiment 1 and 2 and the same transparent container as in Experiment 2.

Procedure

Training phase We trained the monkeys individually in the same setting as Experiments 1 and 2. *E* entered the test room, sat on the chair, put a cranberry into the container from the lid, fixed the lid with a transparent seal, and then moved the container closer to the monkey. On the first trial, the monkey could easily remove the cranberry because the drawer was fully opened. *E* closed the drawer slightly more fully after each trial. Finally, the monkey pulled the handle of the closed drawer and got the cranberry. In this phase, *E* held only the base of the container and never touched the handle of the drawer. Thus, the monkeys did not learn to associate pulling on the handle and access to food by observation, but by individual learning each monkey received ten trials per session, and they completed two sessions on different days. All monkeys completed training within 20 trials: They reliably got the cranberry by pulling the handle of the drawer immediately after *E* closed the drawer. During training, only *E* was in the testing room along with the monkey.

Test phase We used the same procedure as in Experiment 2. The monkeys received 12 regular trials and 4 test trials (Experienced Action and Unexperienced Action conditions twice each) per session, with the test trials distributed in a quasi-random order after the first trial. Before each session, the subjects completed five training trials to confirm that

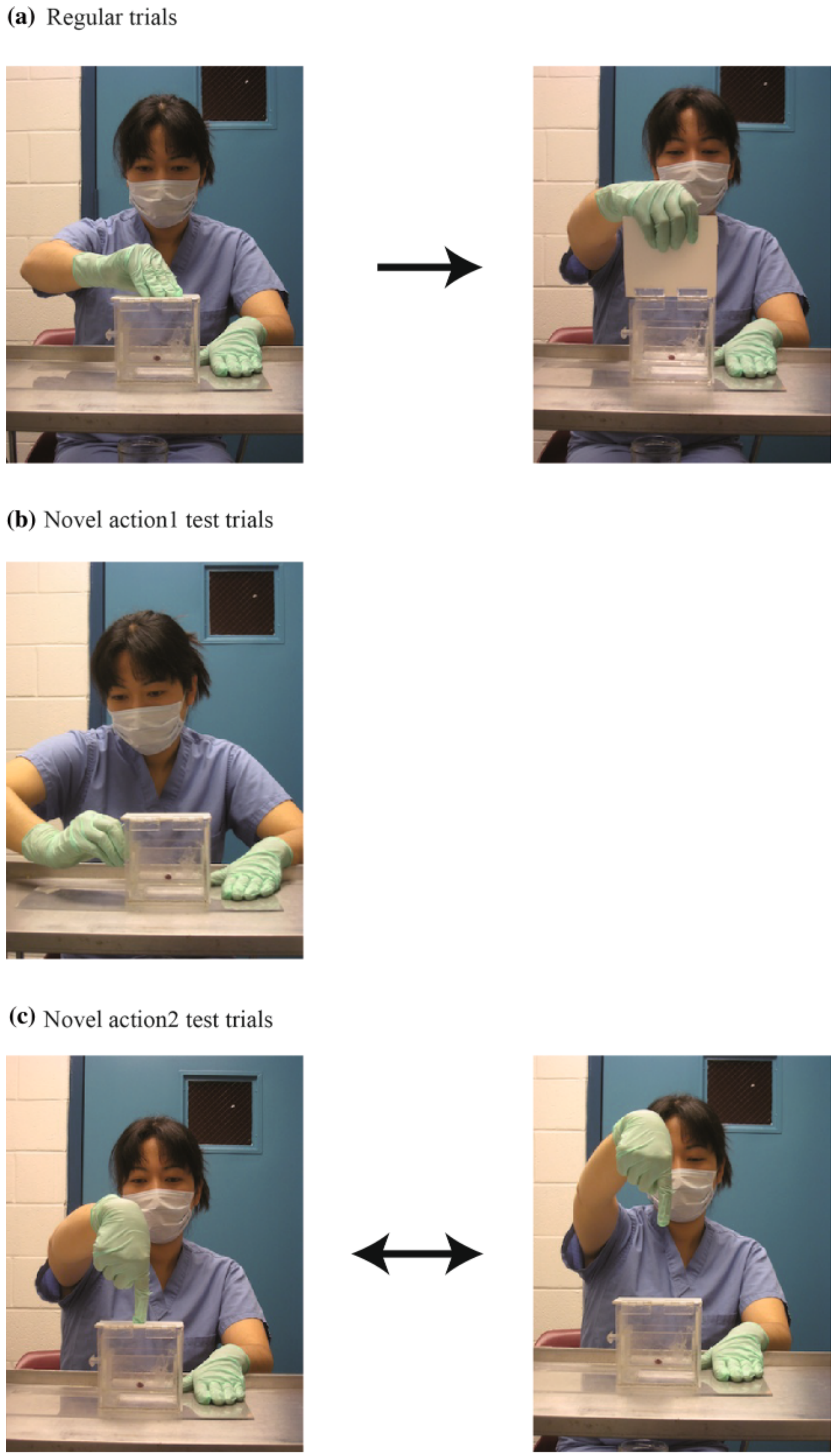

Fig. 4 Actor's action in regular trials (**a**), novel action 1 test trials (**b**), and novel action 2 test trials (**c**) in Experiment 2. Before Experiment 3, the monkeys were trained to open the container by novel action 1. In Experiment 3, the novel action 1 became the experienced action (**b**) and the novel action 2 became the unexperienced action (**c**)

they could open the container. *E*'s and *A*'s actions in regular and test trials were the same as Experiment 2. In all trials, the same person played the same role. All monkeys received two sessions, each on a different day.

Coding and analysis

We coded the duration of looking at *A*'s face or the container and *A*'s hands as in Experiments 1 and 2. A second observer coded 20 % of the test trials to measure inter-observer reliability. The two coders achieved a Pearson's correlation of ? 0.919 for duration of looking. A Wilcoxon exact signed-ranks test was used to compare looking behavior between test conditions (Experienced Action/Unexperienced Action).

Results and discussion

The duration of looking at *A*'s manipulation of the container differed significantly between the Experienced and Unexperienced action conditions ($Z = -2.52$, $n = 8$, $p \backslash .01$) (Fig. 2c). All 8 monkeys looked longer at *A*'s performance when she used their experienced action compared to the unexperienced action. This result is in contrast to that of Experiment 2, in which the monkeys looked equally at both actions. Additionally, we compared looking durations when *A* performed the same actions in Experiments 2 and 3. There was a significant difference between the Novel action 1 in Experiment 2 and the Experienced action in Experiment 3 ($Z = -2.24$, $n = 8$, $p \backslash .05$). However, there was no significant difference between the Novel action 2 in Experiment 2 and the unexperienced action in Experiment 3 ($Z = -.98$, $n = 8$, $p = .38$). This additional analysis showed that the monkeys began to pay closer attention to *A*'s manipulation of the container following their own experience of that action during training. Moreover, we compared looking durations when *A* performed the Familiar action in Experiment 1 and the experienced action in Experiment 3. For this analysis, we used only the 1st test trial of each experiment, because in Experiment 1 the monkeys could observe the outcome of the Familiar action performed by *A* during regular trials, whereas in Experiment 3 they had no opportunity to observe the outcome. The comparison showed no significant difference in looking between the 1st test trial of the Familiar action in Experiment 1 and the Experienced action in Experiment 3 ($Z = -.98$, $n = 8$, $p = .38$). This suggests that monkeys paid attention to *A*'s action as a result of learning the outcome from observing and also as a result of first-person experience of the action.

These results suggest that the monkeys' own active experience affected their perception of others' actions, in accord with findings in human infants. The monkeys developed an expectation about the outcome when *A* performed the experienced action, namely that food would be delivered.

General discussion

The current experiments investigated whether capuchin monkeys' own active experience affects their perception of others' actions. In Experiment 1, the monkeys paid more attention when a human actor (*A*) manipulated a jar using the same action that (usually) resulted in the jar opening and the monkey receiving food from the jar, compared to when she manipulated the jar using an unfamiliar action that the monkeys had never seen before. This finding indicated that the monkeys looked at *A* when they expected food from *A*. Experiment 1 also demonstrated that the monkeys easily associated an action with an outcome following repeated pairings of the sequence. In Experiment 2, *A* showed the monkeys two kinds of novel actions toward a new container, with neither resulting in the monkey receiving food. The monkeys' looking behavior did not differentiate between these two actions; they expected food to result from neither action. However, after the monkeys learned to open the container themselves using one of the two novel actions, in Experiment 3, they looked longer when *A* manipulated the container using the action that the monkeys had mastered, compared to the other, unpracticed action. These results suggest that monkeys refer to their first-person experience to anticipate the result of another's action.

Our results are consistent with those of a few earlier studies using capuchin monkeys. Paukner et al. (2009) demonstrated that capuchins looked longer at a human who imitated their behavior than at one who performed familiar actions non-contingently (i.e., randomly with respect to the monkeys' behavior). They also preferred to remain in proximity to the person who imitated them. This result implies that the monkeys detected that an action performed by another was similar to one they had performed themselves moments previously. Using a selection paradigm rather than looking time, Kuroshima et al. (2008) showed that capuchin monkeys made better decisions about which action to use when they observed a conspecific fail to open a container when they had previously practiced both the action performed by the conspecific and an alternative action. In that case, they more often used the alternative action than the (ineffective) one used by the conspecific. Both of these experiments suggest, along with the present study, that the monkeys recognized that the actions of another were similar to actions in their own repertoire. Our findings are also consistent with reports that human infants' first-person experience influences their perception of others' actions (Falck-Ytter et al. 2006; Meltzoff and Brooks 2008; Sommerville et al. 2005, 2008; Woodward 2009; Needham et al. 2002; Kochukhova and Gredebäck 2010; Myowa-Yamakoshi et al. 2011), indicating that this important cognitive ability is shared by humans and capuchin monkeys.

Contrary to the present results, in a study by Buttlemann et al. (2013), chimpanzees who learned to solve a task through personal experience showed no special sensitivity to an experimenter performing the same action. In Buttlemann et al.'s (2013) study, the difference between the two human actors' actions concerned simple motor acts (attempting to lift or slide a handle). The chimpanzees who acquired the correct solution through individual trial and error might focus on the relevant part of apparatus, rather than the actor's motor acts. In contrast, in the present study, there were multiple potentially important differences between two actions that the monkeys required had to discriminate: manipulated parts of the container, finger or hand shape, and arm movements. Future work should clarify what kind information is important for changing perception of another's actions. Another important difference between Buttlemann et al. (2013) and the present study is in the testing design. Buttlemann et al. (2013) ran a single test trial after each chimpanzee after learned a successful solution; it is conceivable that the apes might have expected to access the apparatus by themselves rather than getting a reward from the actor. In the present study, the inclusion of four test trials among regular trials might have facilitated the monkeys' understanding of the test situation.

What did the monkeys learn from their own active experience? Although studies of human infants' (Sommerville et al. 2005; Kanakogi and Itakura 2011; Rakison and Woodward 2008; Woodward 2009) suggest that infants' first-person experience affected interpretation or understanding of others' actions, conceivably the monkeys learned to understand the apparatus. They saw the same number of uncompleted actions by *A* in test trials of Experiments 2 and 3. However, they directly observed the end-state of the food container following their own "Experienced" actions in the training sessions before Experiment 3. Through this training the monkeys might have learned about the mechanism or affordance of the food container, rather than an association between their own action and the outcomes of the action. It has been reported that non-human primates are more sensitive to the movements of objects and their final spatial locations than to a demonstrator's object-directed action per se (Fragaszy and Visalberghi 2004; Fragaszy et al. 2011; Myowa-Yamakoshi and Matsuzawa 1999, 2000). During the test trials in the present study, the monkeys could have attended to the part of the container manipulated, as well as *A*'s action. From the videos, we could not accurately differentiate between attention to the action (bodily movements) and the part of the container being manipulated. Thus, it is not yet clear precisely what the monkeys learned from their own active experience. In future work, we aim to manipulate their active and visual experience of two target actions by using a ghost condition (Fawcett et al. 2002; Hopper et al. 2007, 2008; Hopper 2010) in which an apparatus automatically opens without any effortful action by an actor.

If capuchins can detect the correspondence between their actions and another's actions, we are left with the question why copying others' actions is so rare in these monkeys. We propose two possible explanations. First, recognition of another's action may be easier than production of the action. In order to produce an observed action, that action has to form part of the monkey's own action repertoire. Second, when monkeys observe another's actions they may pay more attention to the directional movement or altered position of an object in relation to the substrate than to the action itself. Fragaszy et al. (2011) reported that a young capuchin was more likely to match a familiar action performed by a human that moved an object in relation to the substrate or another object; Myowa-Yamakoshi and Matsuzawa (1999, 2000) reported similar findings for chimpanzees. Adams-Curtis and Fragaszy (1994) reported that capuchin monkeys most often matched the last action of a 3-action sequence to open a latch puzzle, indicating attention to the part of the sequence most closely associated with retrieval of the food reward. This pattern is also evident in the series of studies of multiple species opening a box by removing pins and opening latches (e.g., Custance et al. 1999). Attention to directional movements possibly supported diffusion of alternative foraging methods in groups of tufted capuchin monkeys (Dindo et al. 2008, 2009). Dindo et al. used leftward or rightward door-sliding as the target actions; the subjects learned to slide the door in the direction demonstrated by another monkey. Sliding an object is a natural action for capuchin monkeys. The salient movement of the door to a new position conceivably facilitated directional matching by the monkeys.

In conclusion, this study is the first demonstration that monkeys' own active experience of manipulating an object influences their perception of another's action on that object. They can utilize information acquired through their own experience to predict an outcome of another's action. The findings parallel those from studies with humans, suggesting that, like humans and macaque monkeys, capuchin monkeys can directly map observed action onto their own action representation. We cannot conclude from the present data that capuchins interpret another's action as goal-directed or intentional, nor can we state precisely what is learned through direct experience; however, the results suggest that in New World monkeys there are cognitive links between one's own experience and perception of another's action.

Acknowledgments We greatly thank Dr. Kazuo Fujita and Dr. James R. Anderson, along with anonymous reviewers and the editor for helpful comments. Also we thank Dr. Sumie Iwasaki for analyzing data for inter-observer reliability. This study was supported by Research Fellowships of the Japan Society for the Promotion of Science (JSPS) for Young Scientists to the first author. The experiments complied with the laws regulating animal care and use in the United States and were approved by the University of Georgia.

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