Preschoolers' and Chimpanzees' Use of Source Reliability on Action-Based Tasks

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Abstract

One way to optimize social learning is to be selective when choosing from what sources to accept information. Preschoolers prefer to learn from previously accurate or competent sources, rather than from unreliable ones (e.g., Koenig, Clément, & Harris, 2004). The current study extends this work by comparing the ability to monitor an actor's success in two species: children and chimpanzees. Members of both species saw two actors try to open containers, with different outcomes. Then, a forced-choice response was used to determine whether participants would pair the container with the previously successful actor. While preschoolers correctly elicited help from a previously successful actor, chimpanzees did not reliably select the type of object the actor could open. The current findings suggest a difference between humans and chimpanzees' use of past source reliability, which may reflect or result from differences in their use of social learning.

Keywords: source reliability; social learning; preschoolers; chimpanzees

Introduction

Much of what humans learn comes from other people (Bandura, 1977) including their own birthdates and the fact that Mt. Everest is the highest mountain on the Earth. Whenever an individual relies on others for information, he or she becomes vulnerable to misinformation. Such misinformation could be accidental, with the informant being simply mistaken or not well informed. However, misinformation could also be intentional, with the informant intending to mislead in order to gain advantage. One way to optimize social learning is to seek information selectively from reliable sources (Laland, 2004).

There is evidence that even young children can track and make use of source reliability. In a typical experimental demonstration of this phenomenon, children are presented with two sources of information: one reliable and one unreliable. They are then asked to choose between these sources for help. From age 3, children are shown to selectively choose informants who have given accurate versus inaccurate labels (e.g., Corriveau & Harris, 2009; Koenig, Clément, & Harris, 2004). Indeed there is some evidence that even 16-month-olds recognize when sources provide inaccurate versus accurate information (Koenig & Echols, 2003).

By age 4, children are also able to use more subtle cues than mislabeling when making accuracy judgments. Specifically, when there are differing degrees of inaccuracy, 4-year-olds trust information from the *most* accurate source (e.g., trusting an accurate source over a neutral source, but a neutral source over an inaccurate source), though 3-year-olds are less sensitive to these degrees of inaccuracy, and only differentiate when an actor is entirely correct or incorrect (Corriveau et al., 2008; Pasquini et al., 2007). Children can also take behavioral subtleties into account; trusting confident, rather than uncertain, sources (Birch, Akmal, & Frampton, 2010; Sabbagh & Baldwin, 2001) or sources of information that have been approved by bystanders (Fusaro & Harris, 2008).

This monitoring of source reliability seems to have meaningful effects on children's acceptance of new information. For one, children generalize a source's accuracy to a new, but similar task, but not to a different type of task (e.g., labeling an object vs. knowing what is inside of a closed box; Brosseau-Liard & Birch, 2011). Also, children expect source accuracy to apply in the future; after identifying actors as accurate or inaccurate labelers, 3- and 4-year-olds reported that only the accurate actor would be correct in the future (Koenig et al., 2004). Further, Corriveau and Harris (2009) found that 3- and 4-year-olds were significantly more likely to trust an accurate actor's information not only immediately, but also up to a week later, even when they had not been explicitly asked at any point to state which actor was accurate.

Although there is now a substantial literature investigating human children's reliability monitoring, little research has investigated whether other species track and use information about others' accuracy. Tracking who provides good information could also be useful for non-human animals. For example, chimpanzees, our closest living relatives, demonstrate several kinds of social learning, from low-level stimulus enhancement to relatively sophisticated emulation and imitation (see Whiten, Horner, Litchfield, & Marshall-Pescini, 2004, for a review). Recent advances in social network analysis have indicated that tool-use behaviors are also sometimes socially transmitted in chimpanzees (Hobaiter, Poisot, Zuberbühler, Hoppitt, & Gruber, 2014) and regional differences in chimpanzee behavior suggest social learning on a large scale (Whiten, 2000).

Because chimpanzees use social learning to gain information from those around them, it is likely that misinformation—intentional or not—may be a challenge that is not unique to human communication. Like people, chimpanzees could provide misinformation mistakenly; for example, they may forget the location of hidden food and search in the wrong place. There is also evidence that non-human primates mislead or withhold information from conspecifics (Byrne & Whiten, 1985; Hare, Call, & Tomasello, 2006; Hirata, 2006; Mitchell & Anderson, 1997) to obtain or maintain control of resources in both the wild and in the laboratory. Considering the risk of both intentionally- and unintentionally-provided misinformation, differentiating between accurate and inaccurate sources of information could have practical benefits for chimpanzees as well as children.

However, it is likely that chimpanzees may be less familiar with bad information. Although there is evidence that chimpanzees are able to use deception (e.g., Byrne & Whiten, 1985; Hare et al., 2006), they do so at rates much lower than those seen in humans. Additionally, their forms of deception differ from humans, primarily focusing on food acquisition, rather than skillfulness. It is therefore possible that chimpanzees will not show the same monitoring of same reliability that has been evident in human children.

The present studies investigate the ability to monitor sources of information in both 3-year-old human children and chimpanzees. To do this, all participants were tested on a similar action-based task. A task involving actions on objects was chosen for three reasons. First, language was not required, thereby making it a fairer task for comparing the species. Second, little work has been done to explicitly examine source reliability on an action-based task, and the present method addressed this limit. One study that had given cues to children about an actor's competence on an action-based task measured children's rates of imitation of a competent or incompetent actor's (e.g., one putting shoes on his feet versus hands) demonstration (Zmyj et al., 2010). The authors found that infants' action imitation, but not their item preferences, were influenced by a model's previous competence. In the current study, we take a slightly different approach by using success versus failure on an action-based task to distinguish the sources. Past research also shows that children consider such efficacy when imitating (Want & Harris, 2001; Williamson & Meltzoff, 2011). Both species were presented with a successful actor (someone who could successfully open a box) and an unsuccessful actor (someone who could not successfully open the same box).

A third reason for choosing an action based task is that an (in)ability to open containers may be ecologically relevant for chimpanzees; that is, chimpanzees may be familiar with trying to open different fruits in the wild. There has also been evidence for their competence at opening boxes in the laboratory (e.g., Whiten, Custance, Gomez, Teixidor, & Bard, 1996).

After witnessing each source's success or failure, participants were given a chance to match the container to a person who could successfully open it. This forced-choice response measure is similar to that of many past studies of monitoring source reliability that use language. Choices were recorded in order to determine whether members of either species preferentially chose the previously successful actor.

This procedure extends the existing literature in two ways. First, we tested children on a novel action-based task. In a procedure very similar to past source-monitoring tasks using labeling, the children were given the opportunity to endorse either a reliable or an unreliable actor when presented with the same task. We also included a comparison condition to determine whether children would generalize past success to a different, but similar task. A second study extended source reliability research to nonhuman primates by using a variation of this new procedure with chimpanzees that involved matching the type of container with the actor who had previously opened it. We predicted that participants of both species would consider the actors' past success and use this to guide their future choices when seeking out help (i.e., showing above chance-level performance on forced-choice trials).

Study 1: Children

Methods

Participants Thirty-six typically developing 3-year-old children (35-42 months, M = 37.6 months, SD = 1.7; 16 males) were recruited through Georgia State University's Infant and Child Subject Database. According to parental report, 44% self-identified as Black/African American, 39% as Caucasian, and 8% as Asian (3 families did not specify). Additionally, 81% self-identified as non-Hispanic/Latino and 3% identified as Hispanic/Latino (6 families did not specify). The highest level of education completed by the children's parents was reported to be an advanced degree (e.g., M.A., PhD., MD) for 32%, a 4-year college degree (e.g., B.A., B.S.) for 19%, some college education for 21%, a high school diploma for 3% (education for 19 parents was not specified).

Materials Four types of boxes were used. Each of the boxes contained a small plastic toy inside (e.g., a sandwich). Unknown to the children, a hidden locking mechanism was inside the boxes, which made them impossible to open without the use of a key. Thus, although the boxes looked like they could be easily opened by lifting a hinged lid, specific knowledge was needed to successfully open the box.

Five small puppet animals were used as the actors. Two of these (a horse and a rabbit) were always presented in trial 1, and two others (a mouse and an owl) were always presented in trial 2. The final puppet (a bear) was used in both test trials. All puppets were controlled by one experimenter.

Finally, a curtained enclosure was used to conceal each puppet while it attempted to open a box. This allowed the experimenter to surreptitiously use the magnetic key to open the box.

Procedure All children were tested individually in a small, dedicated lab space with their parent and an experimenter present. Children were randomly assigned to one of two between-subjects conditions: *same box* (n = 16) or *generalization* (n = 20).

Familiarization Children first saw a small, open box with a toy inside. They were given the opportunity to play with the toy, and then it was inserted into the box. The box was then closed, and the experimenter demonstrated that the box could not be reopened. Each puppet actor was then given the opportunity to try to open the box. Each puppet was individually put into the curtained enclosure with the locked box, and described as trying to open the box. One actor was successful, emerging from the curtained enclosure with the box open. The experimenter briefly handed the child the small toy from the box for the child to play with. The other puppet was unsuccessful. It emerged from the curtained enclosure with the box still closed, having failed to open the box or produce the toy from inside. After the first puppet's turn, the toy was returned to the box (if necessary) and the second actor then had the opportunity to attempt to open the box.

Test A third actor appeared, and the experimenter stated that the third actor wanted to get the box open. The experimenter then asked the test question, "Who should he ask for help?" Children's responses were scored for which of the two earlier actors (either the previously successful or unsuccessful actor) was chosen. Children could either label one of the actors or point to make their responses.

The procedure in the generalization condition was identical to that used in the same box condition, except that a new box was introduced with the third actor. That is, children were asked which actor to ask for help with opening a box that the successful and unsuccessful actors had no prior experience with. This condition was used to assess whether children would generalize an actor's past success with opening boxes beyond the specific box that had previously been acted upon.

In both conditions, a second trial was then conducted with 2 different familiarization actors and a new box. For each trial, which of the puppets was successful and the order in which the puppets attempted to open the box was counterbalanced between children.

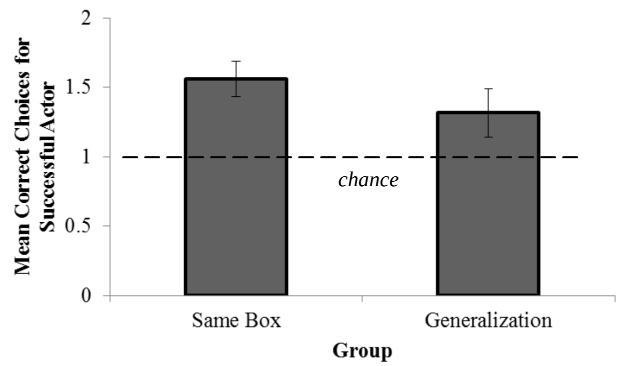
Results

Preliminary analyses indicated that there was no effect of gender or parental level of education on the children's performance, so all subsequent analyses were collapsed across these variables.

The mean number of choices for the successful actor in each pair was first calculated for each child (out of 2). A Kolmogorov-Smirnov goodness-of-fit test first revealed that the data were non-normally distributed. Thus, a Mann-Whitney test was conducted to test for differences in successful actor choice across the two groups; no significant difference was found, U = 139.5, p = .46.

Children's number of choices of the successful actor was then compared to chance levels (1.0). Wilcoxon signed rank tests were used to test for differences in performance compared to chance levels. These tests revealed that 3-year-olds were able to choose the successful actor on levels significantly above chance when the third party actor needed help opening the same box, p = .002, one-tailed. Additionally, they also chose the correct actor on the generalization trials, p = .03, one-tailed; see Figure 1.

Figure 1: Mean number of previously reliable actor choices (+/- *SE*) for children as a function of test group.



Discussion Taken together, these results indicate that on a novel action-based task, 3-year-old children are capable of tracking a source's past performance and using this information to make a decision regarding from whom to seek help on both the same task, and a related, but slightly different task (opening a new box). To assess the phylogeny of this ability, a similar paradigm was used with chimpanzees.

Study 2a: Chimpanzees—Two Actors Manipulating Two Containers

Methods

Participants Two chimpanzees housed at the Language Research Center at Georgia State University participated in this study (Panzee—26 years, Sherman—38 years). These chimpanzees were housed together, along with two other chimpanzees that were not tested in this study, and spent time together socially throughout the day. The subjects were tested individually on all test sessions. Chimpanzees participated for preferred food treats, but were not deprived of food or water at any time.

Materials Four hinged boxes and four drawstring bags (all of different colors and sizes) were used. Chimpanzees received approximately 5 crackers on each training trial when they correctly solved a test trial.

Procedure Both chimpanzees were tested in their home cages. Although they were tested in individual cages, they had visual and auditory access to other group members throughout each session. Data was recorded by the first and second authors using a paper and pen during the test trials (a typical practice in chimpanzee testing). Each chimpanzee was tested on three non-consecutive days.

Each session began with 8 to 12 training trials in which the first two authors alternately approached the chimpanzees and attempted to open two types of containers immediately after one another (1 hinged box and 1 drawstring bag). One model was always successful at opening the hinged box and unsuccessful at opening the drawstring bag, while the second model was always successful at opening the drawstring bag and unsuccessful at opening the hinged box. Chimpanzees were always promptly rewarded with crackers after the model successfully opened a container.

Previous research with these animals revealed that the chimpanzees would not reliably point to human actors. Thus, a different response measure was chosen. Instead of pointing to one of the actors, chimpanzees were instead prompted to point at a container.

During test period, each model alternately approached the chimpanzee's cage. The third author, seated in front of the cage with his back to the actors would ask the chimpanzee, "Which one should I give to her?" while pushing a tray holding both a hinged box and a bag toward the chimpanzee. When the chimpanzee pointed to a container, the experimenter would hand it to the actor. If it was the type of container that she had previous success in opening, she would open it and give the chimpanzee the cracker reward inside. However, if it was the type of container that she had not successfully opened, she struggled with the container for approximately 5 seconds, handed it back to the experimenter unopened, and the chimpanzee received no reward. The order of the models and side of the hinged versus drawstring containers were counterbalanced between trials. Each chimpanzee was tested over 3 days. Panzee received a total of 27 test trials, and Sherman received a total of 28 test trials.

Results

When the chimpanzees saw two actors alternately act on two different types of containers, binomial tests revealed that neither Sherman (p = .35) nor Panzee (p = .42) chose the correct container to give to a specific actor at above-chance levels. See Table 1 for frequency counts of performance.

Discussion

After watching multiple trials of two actors each successfully opening one type of container, chimpanzees showed no evidence of using this past information to guide their choices. That is, their performance was at chance levels for choosing which type of box to give to a specific actor for her to open.

Table 1: The number of choices of each box made by the chimpanzee participants.

Study 2a: 2 models, 2 containers		
	Incorrect	Correct
Panzee	15	10
Sherman	17	11
Study 2b: 2 models, 1 container		
	Incorrect	**Correct**
Panzee	14	8
Sherman	10	12

Study 2b: Chimpanzees—Two Actors Manipulating One Container

Given the chimpanzees' difficulties with the previous task, an attempt was made to simplify the demands placed on the chimpanzees. In a second phase, the use of a new paradigm attempted to highlight for the chimpanzees each actor's success or failure at opening a given type of container. This was also more consistent with the paradigm used with the children, in which each child saw two actors attempt to open the same box.

Methods

Participants The same two chimpanzees participated in this task, under the same housing protocol.

Materials The same eight containers (i.e., four hinged boxes and four drawstring bags) were used during testing. Chimpanzees were again given approximately 5 crackers on each correct trial as a reward.

Procedure Each session began with 12-15 training trials that now consisted of both actors approaching the chimpanzees simultaneously, and the actors taking turns to manipulate only one container per trial, *either* a hinged box or a drawstring bag. As before, the same actor was only capable of opening hinged boxes, and could never open the drawstring bags, while the other could only ever open drawstring bags, and could never open the hinged boxes. During this training period, chimpanzees were rewarded with crackers when either actor successfully opened a container.

Test trials were identical to those described in Study 2a, where each model alternately approached the cage and the experimenter asked the chimpanzees "Which one should I give her?" while pushing forward one box and one bag. Each chimpanzee participated in 22 trials over 2 non-consecutive days.

Results

The number of choices of the correct container again did not differ from chance levels when presented with two models manipulating one type of container during training trials for either Sherman (p = .83) or Panzee, (p = .29, binomial tests); see Table 1 for frequency counts of performance.

Finally, we were interested in investigating any effects of learning over the trials, as chimpanzees at this point had seen over 50 trials in which the same actor could only open one type of container. After these trials, chimpanzees were no better at matching the actor and the container that she was able to successfully manipulate (Sherman day 5: 7/12 correct, p = .77; Panzee day 5: 5/12 correct, p = .77).

Discussion

These findings suggest that, even when the relationship between a given actor and a type of container was made more salient, chimpanzees were still unable to successfully pair together an actor with the container that she had previously opened.

General Discussion

Overall, the current findings show a cross-species difference in the use of information about an actors' past performance on an action-based task. After only a brief experience (i.e., 1 familiarization trial) with an actor's success or failure, 3-year-old children tracked which of two actors successfully opened a box, and chose to receive help from the previously successful actor versus the unsuccessful one on opening a new box. Notably, children were able to make these distinctions not only when the box was the same as the one that they had previously seen opened, but they also generalized this success to a new box of the same type.

In contrast, we found no evidence that chimpanzees associated an actor with the container type she was able to successfully open. When presented in training with two actors manipulating two different types of objects (study 2a), *or* two actors manipulating a single type of object in turn (study 2b), chimpanzees did not use this information to choose to give an actor a type of container that they had previously opened. This lack of association is especially striking, because even after 50 experiences with a model opening the same type of container, the chimpanzees still showed no better performance on matching the actor and an object that she was successfully able to manipulate.

There are several possibilities accounting for the observed difference between the species for tracking past source success with different objects. The first of these possibilities is methodological in nature. Although the procedures used with the chimpanzees were matched as closely as possible with those used with the children, there were some necessary variations that may have influenced the chimpanzees' performance. Specifically, chimpanzees were found unwilling to point to the human actors, so a manipulation was used that allowed them to instead point to the containers. Thus, the task used with the chimpanzees may have been more challenging, as it required them to keep in mind both the different actors and to generalize across two types of containers. Conversely, the children only needed to keep in mind which actor was successful (or not) at manipulating one type of container.

Further, neither the procedures used with the children nor those used with the chimpanzees have high levels of ecological validity; scenarios in which either children ask a puppet for help or chimpanzees choose which container an actor should open may be rare. However, the children may have been better at understanding such a pretense context, as they likely have experience with make-believe play involving toys and animals. If this is the case, chimpanzees may fare better if the procedure better reflected their everyday experiences. The chimpanzees may also be accustomed to people around them acting successfully (e.g., opening doors, producing food), and may not have believed that either given actor could not successfully open a particular type of container. Thus, future studies should vary the nature of the sources (e.g., a person, a puppet, a chimpanzee conspecific) providing information to chimpanzees to provide a more complete understanding of their ability to monitor source successfulness.

Despite these limitations, it is worth considering the alternative possibility that chimpanzees may not be as effective at monitoring and utilizing others' past performance as are human children. Chimpanzees may not monitor others' accuracy because they rely less on social learning. They may not have the experience required with learning from others in order to successfully complete a source reliability task. Although there is some research (Byrne & Whiten, 1988; Hare, Call, & Tomasello, 2006; Hirata, 2006) that suggests that chimpanzees can deceive others, they deceive at rates much lower than that of human beings. Furthermore, the incidents of deception seen in chimpanzees most often involve food acquisition, rather than skills or tool-use; that is, a chimpanzee may deceive a conspecific in order to avoid sharing food resources, but not to misinform them about a particular behavior. Consequently, if they are unfamiliar with the notion that a conspecific may be intentionally giving them bad information, then it is likely not as relevant for them to track sources of information.

In addition to providing a comparative perspective to the question of source reliability, the current results also add to the developmental literature on this issue. That is, 3-year-old children were able to monitor source reliability on an action-based task, gaining information about sources through their ability to successfully manipulate an object. Importantly, they were able to draw these conclusions when the box that a third puppet needed to be opened was the same as one that the successful puppet had opened before, but also when a new box was presented, underlying children's ability to generalize this past source reliability. These findings are consistent with past literature (e.g., Brosseau-Liard & Birch, 2011) that has found that children expect accuracy to generalize across objects, suggesting a parallel in the developmental trajectory in which children encode information about an actor's reliability on a label- versus action-based task.

In conclusion, the findings of the present study suggest that after only a single familiarization trial, 3-year-olds draw conclusions about an actor's success, and use this to inform their future decisions. Specifically, they were more likely to suggest to a third actor that help should be sought from a previously successful actor, rather than a previously unsuccessful actor. Chimpanzees, however, did not reliably choose a previously successful actor. Their performance may be due to methodological limitations or a difference in social understanding. Taken together, these results suggest that 3-year-olds are selective in their learning on action-based tasks, considering past performance when seeking out help, while chimpanzees may not monitor others' accuracy.

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