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DETECTING AGENCY AMONG COTTON-TOP TAMARINS (*SANGUINUS
OEDIPUS*) THROUGH THE SOCIAL TRANSMISSION OF FOOD PREFERENCE

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ABSTRACT

The theory of social learning has been well studied in animals. This paper attempts to connect this theory to that of intentionality via studying the social influence of food preferences between individuals. The experiment was divided into a volitional and non-volitional condition. Observers watched as a Demonstrator was given a choice between two foods and then were allowed to select between the foods themselves. The independent variable was whether the Demonstrator had access to both of the foods or just one (from the Observer's standpoint, this could not be distinguished). Analyses were based on the Observer's resultant food choice. Only one Observer produced data of potentially significant value, suggesting an ability to perceive the intentions of another conspecific.

TABLE OF CONTENTS

List of Figures	iii
List of Tables	iv
Acknowledgements.....	v
Chapter 1 Introduction	1
Intentionality	4
Learning About Social Preferences	7
Experimental Questions, Procedure, and the Theory Behind our Predictions	9
Chapter 2 Methods.....	12
Subjects	12
Stimulus and Materials	13
Apparatus	14
Procedure	16
Chapter 3 Results	21
Experiment 1 – Condition 1	22
Experiment 2 – Condition 1	23
Experiment 3 – Condition 2	25
Chapter 4 Discussion	28
REFERENCES	35

LIST OF FIGURES

Figure 1. Demonstrator’s Tray in Experiment1	15
Figure 2. Demonstrator’s Tray in Experiments 2 & 3	15
Figure 3. Observer’s Tray in Experiment 1	16
Figure 4. Set-up of Experiment 1	17
Figure 5. Two-holed Plexiglass Barriers of Observer and Demonstrator	18
Figure 6. Set-up of Experiments 2 & 3	19
Figure 7. Experiment 3 – Observer’s Plexiglass Barrier.....	21
Figure 8. Observer’s Food Selection Compared to Demonstrator’s (Exp 1).....	23
Figure 9. Observer’s Food Selection Compared to Demonstrator’s (Exp 2).....	24
Figure 10. Observer Food Choice Across Five Sessions (Exp 2).....	25
Figure 11. Observer’s Food Selection Compared to Demonstrator’s (Exp 3).....	26
Figure 12. Volitional Choices by Observers Compared to Demonstrator (Condition 1).....	26
Figure 13. Non-volitional Choices by Observers.....	27
Figure 14. Volitional versus Non-volitional Choices by Observer Mulva	28

LIST OF TABLES

Table 1. Experimental Food Form and Appearance	13
Table 2. Demonstrator and Observer Food Choice, Experiment 1	22
Table 3. Demonstrator and Observer Food Choice, Experiment 2	23
Table 4. Demonstrator and Observer Food Choice, Experiment 3	25
Table 5. Averages and Standard Deviations of all Observers Between Conditions	27

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Chapter 1

Introduction

It has been well documented that humans begin to perceive the intentions of others at an early age (Barnes et al., 2009; Behne et al., 2005; Biro et al., 1995, Dasser et al., 1989). This occurs early enough that by one year of age, children can ascribe intentions to others; they can identify an intended goal and rationalize the actions leading up to that goal (Biro et al., 1995). In order to understand the evolutionary history of this trait, research on human development may be extended to non-human primates. Evolutionarily, primates are our closest relatives, where we share similar homologous traits, likely inherited from our last common ancestor. Thus, we have speculated to what extent primates share these traits with humans, with particular concern on cognition (Fleagle & Lockwood, 1999). Consequently, several studies have been conducted investigating non-human primates' abilities to perceive the intentions of other agents (Anderson et al., 1995; Basile et al., 2002; Call & Tomasello, 1998; Hare, B. et al., 2004). While there is currently no definitive answer to the existence of non-human primates perceiving another's intentions, there is agreement that if such perceptions are in fact shared, they may be context-specific for nonhumans. For example, chimpanzees (Hare & Tomasello, 2004) and rhesus macaques (Flombaum & Santos, 2005) perform better in competitive settings over uncompetitive settings. In the study by Hare & Tomasello (2004), chimpanzees were better able to locate hidden food in a competitive context (Plexiglass barrier between the competitor and food) through social cues from a human competitor (rocking and staring at the chimpanzee; eating the food following an incorrect choice). Similarly, rhesus macaques took more grapes from a competitor who could not see them versus one who could (Flombaum & Santos, 2005). The mode of transmission for discerning intentional actions is equally as important (i.e. visual gaze,

body orientation, or gestures) and, likewise, may exhibit species specificity. If the mode of transmission cannot be perceived by a tested species, then no real conclusions can be made with concern to the ability to understand intentionality (Anderson et al., 1995; Basile et al., 2002; Call & Tomasello, 1998; Hare, B. et al., 2004).

Nonhuman intentionality has been of great interest because of its assumed relation to theory of mind, or the awareness of existing mind states of others. It has been posited that only humans are believed to have a full working theory of mind, with several unique abilities (Call & Tomasello, 2008; Premack & Woodruff, 1978; Rakoczy & Tomasello, 2003). Thus, it is questioned to what extent nonhuman primates possess theory of mind, in terms of its many components (understanding attention, perspective-taking, intention, beliefs, etc.; see Call et al., 2003; Call & Tomasello, 2008). This can help determine which aspects of the cognitive abilities in humans are truly unique and which may share an evolutionary lineage with other species.

Intentionality is presumed to be a component of theory of mind. In human social cognition, the first step toward a fully functional theory of mind is to understand a person as an intentional agent, by recognizing their intentions and perceptions. Without this first step, children cannot advance toward understanding people as mental agents, who have thoughts and beliefs of their own. This second step requires awareness of intentionality and experience through interaction. Therefore, theory of mind cannot develop without a sense of intentionality. (Rakoczy & Tomasello, 2003)

Experiments conducted on intentionality involve discriminatory behaviors, where subjects must be able to distinguish between actions that are intentional versus those unintentional. To do this, subjects must understand a conspecific's goal and the relevance of

their actions to that goal (Behne et al., 2005). Thus, the main question across these studies has asked whether or not animals perceive intentionality (Call & Tomasello, 1998; Lyons et al., 2006). Specifically, the research focuses on how test subjects behave in different conditions, where a model agent makes a choice between two options either with intention or due to environmental constraints. In this experiment, we are interested in researching intentionality in cotton-top tamarins by developing a method that capitalizes on the social transmission of food choice (Galef & Giraldeau, 2001; Galef & Whiskin, 2000).

For species living in groups, social transmission of behavior is a form of social learning. When an individual learns, they acquire information about a novel object or event, with the possibility of incorporating it into their repertoire. Social learning works just the same, except the newly acquired information comes from watching another individual engage in behaviors new to the observer, in pursuit of a goal (Galef & Whiskin, 2000). This acquisition of new information means that an individual can discern between behaviors that are relevant versus irrelevant to the goal (Bard et al., 1987). In social contexts, studies have shown that fish, birds, and rats can learn which mate is better fit to breed with or which food is better to eat. The purpose of these studies was to determine if social interactions with a demonstrator influenced the decision making of observing conspecifics. (Dugatkin, 1992; Freeberg, 2000; Galef & White, 1998; Galef & Whiskin, 2000; Galef & Giraldeau, 2001).

In this paper, I will first explain intentionality by reviewing the literature pertaining to the perception of intentions by nonhumans. Subsequently, I will draw on the fact that reacting to the intentions of other individuals necessitates that an individual has the ability to perceive and discriminate between relevant and irrelevant behaviors. I will then turn to the topic of food preferences through social learning, as this pertains to the methods employed in my experiments.

Intentionality

Interests in human intentionality have been extended to nonhumans, often emphasizing non-human primates, as they are more likely to share homologous traits with humans. An intention can be defined as “a plan of action that the organism chooses and commits itself to, in the pursuit of a goal” (Behne et al., 2005). In other words, in order to act with intention, or agency (Teo, 2001), an individual must produce an action to meet a projected goal. An understanding of intentions means that an organism must be able to discriminate between intentional and unintentional actions (Behne et al., 2005).

An intentional (or volitional) action is one that is consciously performed, where a behavior is performed under an individual’s control. Conversely, an unintentional (or non-volitional) action involves a behavior that is not under an individual’s control (Behne et al., 2005). While intentional and unintentional actions are performed every day, observing conspecifics cannot necessarily discriminate between them. Whether or not the ability to discriminate intentionality occurs in nonhuman primates has been a common topic of research.

Several studies in the literature concern the basic understanding of nonhuman primates’ intentions and perceptions; humans are known to possess the most complex system of understanding intentionality (Behne et al., 2005; Call & Tomasello, 2008; Rakoczy & Tomasello, 2003). Though, the literature has rather variable conclusions; it has not been decided upon whether or not nonhuman primates possess the ability to understand intentionality. Nevertheless, several experiments have looked at factors contributing to perceiving the intentions of conspecifics: social cues and gestures, experimental context, etc (Anderson et al., 1995; Hare & Tomasello, 2004).

Although primates cannot follow pointing cues, they can react to reaching and touching (Hare & Tomasello, 2004; Basile et al., 2002). Of the monkey species tested, unless excessively trained, most (if not all) cannot use pointing or gaze cues alone to locate food (Anderson et al., 1995; Basile et al., 2002). However, there have been claims that monkeys will frequently follow eye gaze, but do not use it as a social cue to find food. Despite converging notions, primates respond better (i.e. by correctly locating hidden food) through gestural cues, often in conjunction with eye gaze (Anderson et al., 1995).

In a study by Basile et al. (2002), cotton-top tamarins used a conspecific's spatial relationship and body orientation to determine which of two objects was baited with food. When the distance between subjects was minimized and the demonstrator tamarin was oriented toward the location of the baited food, observer tamarins were more apt at selecting the food-baited object (Basile et al., 2002). Based on an experiment by Hauser & Santos (1999), in order to identify the attentional state of others, cotton-top tamarins require eye cues joined with body orientation. This is important because if observers cannot identify an agent's point of focus, then they will not be able to understand the agent's behavior. This has particular application to our experiment: the distance between subjects and perceived gestures or social cues should influence observer behavior.

Being able to follow an agent's gestural cues requires that an observer at least understands the actions they have seen. Mechanistically, it is surmised that when an observer watches an agent perform an action, the action is first mapped onto the observer's pre-motor system (Fogassi et al., 2001). This belief is evidenced by studies showing that parts of the premotor and posterior parietal cortex are activated upon performing an action or upon observing a conspecific perform similar actions (Fogassi et al., 2001; Chitty et al., 1990). According to the

teleological theory, observers relate an observed action to a goal, by evaluating the surrounding environment and any constraints toward achieving that goal (Csibra & Gergely, 2003). The teleological theory greatly concerns the rationality principle which claims that: 1. “Actions function to bring about future goal states” and 2. “Goal states are realized by the most rational action available to the actor within the constraints of the situation” (Csibra & Gergely, 2003). Thus, observing individuals can use all three of these factors (actions, goal states, and situational constraints) to explain and predict observed actions (i.e. rational versus irrational) (Csibra & Gergely, 2003). Furthermore, observers can act on this information and imitate what they have seen. In a study by Gergely et al. (2002), preverbal infants rationally imitated experimenters: experimenters used their forehead to turn on a light while their hands were occupied (hands occupied condition) and when their hands were free (hands free condition). The infants more often imitated the head action, in the hands free condition, implying that they connect rational behaviors to actions, goals, and contextual constraints (Gergely et al., 2002). In a study by Glynn et al. (2007), cotton-top tamarins were able to discern between goal-directed and accidental actions by evaluation of contextual constraints: presented with two containers, subjects more often chose the container intentionally acted upon (hand grasp) over the container unintentionally acted upon (hand flop), by a human experimenter. However, follow-up studies in our lab have cast doubt on these findings (Weiss, Chapman, & Loken, in prep).

Several of the studies on primate intentionality are limited to interspecific interactions (primate versus human). Thus, behaviors may be biased toward human experimenters, in that the tested primates are not exhibiting their normal behaviors among conspecifics. In fact, according to the literature, primate species react more often to conspecifics than to human experimenters (Basile et al., 2002). Our study involves the interactions between cotton-top

tamarins and conspecifics and tests for intentionality, in the context of food choice. We believe that trying this new method may provide better insight to a primate's ability to perceive the intentions of others.

Learning about Social Preferences

In this study, testing for intentionality through food choice attempts to see if cotton-top tamarins can distinguish volitional from non-volitional choices. In a social learning context, individuals must decide which behaviors are relevant and advantageous to adopt or execute. They make these decisions based on a socially influenced belief system (Behne et al., 2005). As an opportunistic foraging species, Norway rats decide which foods to consume by observing the food selections of other members of their communal burrow; they believe that the food consumed by a conspecific is safe to eat (Galef & Heyes, 1996).

Several studies on social learning have investigated the social transmission of preferences, in the context of food and mate selection. Much focus has been on social learning and rat feeding behavior, concerning social transmission about food type, palatability, location, possession, and processing. In one study, social learning has shown to enhance foraging efficiency among rats. In this experiment, observer rats were paired with demonstrator rats that were either trained or not trained to dig for chunks of buried carrots. After watching trained demonstrators, observers dug up carrot chunks faster and more frequently than did observers who watched untrained demonstrators (Laland & Plotkin, 1990). Another study, rather similar to this experiment, looked at the interactions between observer and demonstrator rats, where both were given physical access to each other, following the demonstrator's consumption of one of two foods. More specifically, demonstrator rats were given access to cinnamon-flavored rodent

chow before being placed in a cage, with an observer rat. Thirty minutes following their interactions, observer rats were given access to chocolate and cinnamon-flavored rodent chow. Results showed that the observer rats consumed more of the cinnamon-flavored rodent chow (Galef & Whiskin, 2000). Studies have further shown that observer rats learned to eat what the demonstrator rats had eaten, even to the extent of reversing a previously learned food aversion (Galef & Giraldeau, 2001). However, studies investigating these behaviors found that Demonstrator rats' food choices influenced Observer rats' food choices for only a short time. This extinction of the Demonstrator's influence was likely because the Observers eventually ate both foods over time. Additionally the researchers found that adding more Demonstrators and increasing the number of demonstrations by the Demonstrator(s) lengthens the effects of the Demonstrator's influence on the Observer (Galef & Whiskin, 1998).

Nonhuman primates have also exhibited food behavior changes, after watching an agent consume novel food. Young marmosets are more likely to consume an unfamiliar food, in the presence of an adult consuming a novel food (Queyras & Vitale, 1997). Similarly, capuchin monkeys ate novel foods in social contexts: capuchin monkeys were tested in both an Individual condition (alone) and a Social condition (with conspecifics), with familiar and novel foods. Subjects consumed more familiar foods than novel foods in the Individual condition. Conversely, they were more likely to consume novel foods in the Social condition. This study showed that capuchins learn through the social facilitation of eating, though only with novel foods (Fragaszy & Visalberghi, 1995). In a study on object recognition and categorization, rhesus macaques watched as an experimenter selected one of two items and then either acted upon or ate that item. Importantly, rhesus macaques were likely to make a selection similar to the item eaten by the experimenter; the macaques selected the item that matched the color of the

experimenter's food item, but not its shape (Santos et al., 2001). The results of these studies suggest that individuals are more likely to consume novel foods if already acted upon and eaten by other agents.

Similar findings occur in mate choice copying, where an individual's mating preference is altered through the observation of mating conspecifics (Freeberg, 2000). For instance, in some species of guppies, females express more interest in males that have previously courted and mated with another female (Dugatkin, 1992). Similarly, female Japanese Quail often select males seen copulating with other females (Galef & White, 1998). Several of the aforementioned studies on social preferences imply that, given the right environmental conditions, novel individuals have the ability to learn from more experienced conspecifics (Freeberg, 2000). However, it is not known if this behavior is due to a perception of intentions or just social learning. Consequently, we have applied this idea to our study.

Experimental Questions, Procedure, and the Theory Behind our Predictions

The two main questions in this study are: a) "Do cotton-top tamarins engage in social transmission of food choice preferences?" and b) If so, "do tamarins make a distinction between volitional and non-volitional choices?" Despite differing conclusions on primates' abilities to understand agency (Glynn et al., 2007; Hauser & Santos, 1999), we have decided to test for intentionality in the context of social food preference with novel foods. Since data depicting a species' natural behaviors has been generated from intraspecific interactions (between conspecifics), versus interspecific interactions (i.e. between human and nonhuman primate) (Basile et al., 2002), we believe that studying agency between the interactions of conspecifics may provide more realistic data. Additionally, experiments focusing on social food preferences have shown that conspecifics consume more novel foods in social contexts; if rats, marmosets,

and capuchins exhibit this behavior, then cotton-top tamarins may too (Galef & Whiskin, 2000; Laland & Plotkin, 1990; Queyras & Vitale, 1997; Fragaszy & Visalberghi, 1995). To test these suppositions, we have divided our study into two conditions to explore the influence of choices made by a demonstrator monkey (hereafter Demonstrator) on a conspecific observer (hereafter Observer).

Both conditions assess the tamarins' abilities to distinguish between volitional and non-volitional actions. The first condition (the Volitional condition) tests whether or not Observers understand that a Demonstrator is intentionally selecting one food type over another. This is conducted by secretly blocking access to one of two foods; from the Observer's view, the Demonstrator has physical access to both foods, yet decides to consume only one of the two foods. The second condition (the Non-volitional condition) tests whether or not Observers understand when a Demonstrator cannot access one of two foods (where one is made conspicuously inaccessible). In this condition, the Demonstrator is compelled to select only the one food type accessible to him. Thus, he is acting unintentionally. In both conditions, the Demonstrator is allowed to consume of one of the two food types and, after some time, is physically blocked off from the food. The Observer is then given access to both food types, and is allowed to make only one food selection. The only major difference between these two conditions is that, in the Non-volitional condition, the Demonstrator is conspicuously blocked off from one of the two experimental foods whereas, in the Volitional condition, the Demonstrator is secretly blocked off from one of the two foods. Consequently, Observers have no visual access to the hidden barrier between the Demonstrator and one of the foods.

Problems with running the Volitional condition resulted in changing the experimental apparatus. For this reason we have two Experiments (1 and 2) for the Volitional condition and

only one Experiment (3) for the Non-volitional condition. For Experiments 2 and 3, the Observer's holed plexiglass barrier was altered from two holes to one hole. The purpose was to position each Observer between the experimental food tray's petri dishes to prevent side-biasing. Another alteration from Experiment 1 to Experiments 2 and 3 was the visual occlusion of the Demonstrator, once the Observer was given access to the experimental food tray. This was done by placing a white Plexiglass barrier between the Demonstrator and the experimental food tray, thus blocking physical and visual access between the tray and Demonstrator; this was in attempt to omit possible confounding social cues from the Demonstrator (Basile et al., 2002). Experiment 3 only differed from Experiment 2 by placing black duct tape over one hole of the Demonstrator's Plexiglass barrier and on one tube of the experimental food tray. This was in attempt to make the Demonstrator's physical barrier obvious to the Observer, while equating the tube size of both sides on the experimental food tray.

Observers were never tested with the same combination of food color and type; the experimental foods per session differed only in color (Santos et al., 2001). Certain colors were matched (i.e. dark purple and light yellow) to accommodate the differing color perceptions between test subjects (Buchanan-Smith et al., 2005). Since some nonhuman species are sensitive to the food preferences of other agents, particularly novel foods (Galef & Whiskin, 2000; Frigaszy & Visalberghi, 1995; Santos et al., 2001; Queyras & Vitale, 1997), we propose that cotton-top tamarins (*Saguinus oedipus*) are too, where they would consume novel foods consumed by conspecifics. The food choices that they make, with accordance to a Demonstrator's food selection, may also suggest a sensitivity to the intentions of others (Fragaszy & Visalberghi, 1995; Galef & Whiskin, 2000; Galef & Giraldeau, 2001; Santos et al., 2001).

To reiterate, individuals are more likely to exhibit species typical behaviors and interactions with conspecifics, than with individuals from other species (Basile et al., 2002). Also, they are more likely to use another's body orientation and visual gaze to locate food (Basile et al., 2002; Hauser & Santos, 1999). Finally, in social contexts, conspecifics are more likely to consume more novel foods (Galef & Whiskin, 2000; Laland & Plotkin, 1990; Queyras & Vitale, 1997; Frigaszy & Visalberghi, 1995). By connecting these findings together and integrating them into our study, we predict that Observers will make the same food choice as the Demonstrator, in the Volitional condition. Studies arguing for nonhuman primates' understanding of intentions have showed that observers do not follow unintentional actions as readily as they do intentional actions (Call & Tomasello, 1998). Additionally, Observers are less likely to go after one food while another is being acted upon. Similarly, when an agent is oriented toward one of two foods, Observers are less likely to go after the other food (Basile et al., 2002; Call & Tomasello, 1998; Hauser & Santos, 1999). Thus, the expected outcome for the Non-volitional condition is that there will be no pattern between the Demonstrator's and Observer's food selections; the Observer will make random food choices, as compared to the Demonstrator.

Chapter 2

Methods

Subjects

We tested four female and three male cotton-top tamarins. All of the primates were born in Southborough, MA, at the New England Regional Primate Research Center. In 2005, they were

transported to The Pennsylvania State University. Excepting one tamarin, all monkeys were housed in mated pairs; the lone individual was housed singly due to the death of his mate.

Stimulus and materials

In each experiment, the tamarins were given the choice between two foods that were identical in all traits except color; texture, shape, size, etc. were identical. All food forms are viewable in Table 1. Food type and color changed to prevent familiarization with the foods; we did not want the tamarins to realize that they received were choosing between the same food differing only in color. The foods included forms of yogurt chips, lemon chips, fondant, mochi, and fruity pebbles (see Table 1).

Table 1: Experimental Food Form and Appearance

Food type	Color	Shape
Fondant	Lavender	Cube
Fondant	Light Green	Cube
Fondant	Bright Pink	Rod
Fondant	Dark Purple	Rod
Fondant	Dark Blue	Rod
Fondant	Teal Blue	1/4 Circle
Fondant	Light Orange	1/4 Circle
Fondant	Bright Yellow	Triangle
Fondant	Light Blue	Triangle
Fondant	Lime Green	Rectangle
Fondant	Periwinkle	Rectangle
Mochi	Dark Green	1/4 Cylinder Chunk
Mochi	Light Pink	1/4 Cylinder Chunk
Mochi	Dark Red	1/4 Cylinder Chunk
Mochi	Deep Blue	1/4 Cylinder Chunk
Mochi	Light Red	1/4 Cylinder Chunk
Mochi	Blue-Grey	1/4 Cylinder Chunk
Mochi	Light Gold Yellow	1/4 Cylinder Chunk
Mochi	Indigo Purple	1/4 Cylinder Chunk
Yogurt Chips	Plum Purple	Mini Chip
Yogurt Chips	Tangerine Orange	Mini Chip

Yogurt Chips	Bright Gold Yellow	Mini Chip
Yogurt Chips	Sky Blue	Mini Chip
Yogurt Chips	Cobalt Blue	Mini Chip
Yogurt Chips	Coral Pink	Mini Chip
Yogurt Chips	Magenta	Mini Chip
Yogurt Chips	Forest Green	Mini Chip
Lemon Chips	Pale Yellow	Swirl
Lemon Chips	Dark Burgundy	Swirl
Lemon Chips	Light Olive Green	Thin Square
Lemon Chips	Dark Burgundy	Thin Square
Fruity Pebbles	Common Purple	Oval
Fruity Pebbles	Dark Yellow	Oval
Sugar Pellets	Hot Pink	Flat Circle
Sugar Pellets	Hunter Green	Flat Circle

All monkeys were tested in their individual transport box, with dimensions 30 cm x 23 cm x 30 cm. These “transport boxes” are small, portable cages connected to each home cage. They enable experimenters to transport each monkey outside of their homeroom for the running of experiments.

Apparatus

The transport boxes were made of two Plexiglass walls, one metal grated wall, and a metal floor. Each box’s opening was closed off by a Plexiglass barrier (one-holed or two-holed for the Observer’s barrier (see Figure 5A and 5B), two-holed for the Demonstrator’s barrier (see Figure 5C)) and another sheet of Plexiglass for blocking access to the experimental food tray. The holed Plexiglass barrier gave the Demonstrator and Observer individual access to the experimental food tray. The second Plexiglass barrier did not contain any holes as its purpose was to prevent the Demonstrator or Observer from selecting any foods off of the experimental food tray, until the experiment allowed; only one subject was given physical access to the food tray, while access for the other subject was blocked off(see Figures 4 and 6).

The Demonstrator's experimental food tray was constructed with white foam board, white duct tape, white Velcro, two short, plastic, white PVC pipes, and two plastic petri dishes without tops. The PVC pipes were located on the foam board directly in front of the Demonstrator, with petri dishes placed on the opposite side, but adjacent to each other, all attached by Velcro. The PVC pipes used across all experiments were 2.3" long with a diameter of 1.25". The petri dishes were 2.3" in diameter and 0.5" deep. In Experiments 1 as well as 2 and 3, the dimensions of the Demonstrator's tray were 7.2" x 7.0" x 4.1" (see Figure 1) and 7.2" x 5.5" x 4.0" (see Figure 2), respectively.

Figure 1: Demonstrator's Tray in Experiment 1

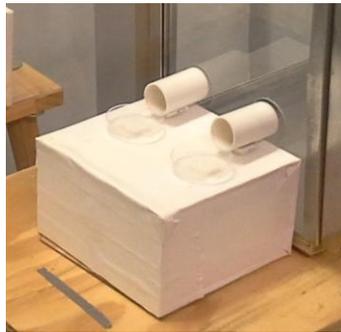
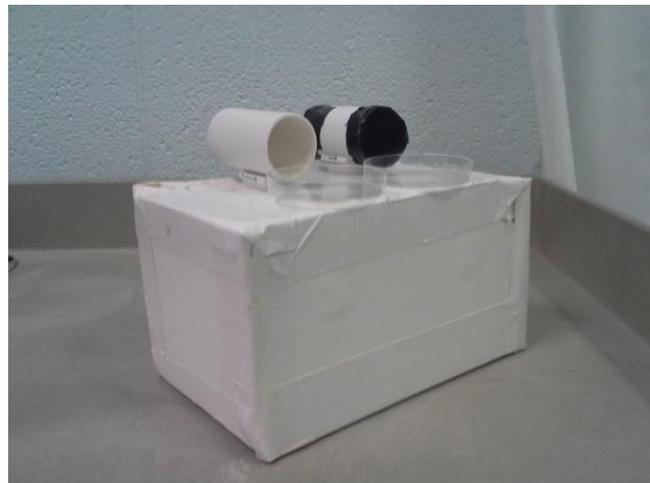


Figure 2: Demonstrator's Tray in Experiments 2 and 3



In Experiment 1, for the Demonstrator's tray, the PVC pipes were spaced 2.85" apart and the dishes were spaced 1.55" apart. In Experiments 2 and 3, the PVC pipes were spaced 1.35"

apart and the dishes were adjacent to one another. Dimensions for the Observer's tray, in Experiment 1, were 7.3" x 4.5" x 4.1", with the dishes spaced 1.55" apart (see Figure 3).

Figure 3: Observer's Tray in Experiment 1



Procedure

In each experiment, one Demonstrator and one Observer were run per session. The Demonstrator is the monkey who is first given access to the experimental food tray, whose selections (of *one* food type) are viewed by the Observer. The Observer is the monkey who is given access to the experimental food tray, after viewing the Demonstrator's food selections. One male Demonstrator and three Observers (2 males, 1 female) were used in Experiment 1 (which was a volitional experiment (Condition 1)). The same Demonstrator and three Observers (2 different females, 1 different male) were used for Experiment 2, which was also a volitional experiment. The same Demonstrator and three Observers (2 females and 1 male from Experiment 2) were used for Experiment 3, which was a non-volitional experiment (Condition 2). All experiments were recorded with a Canon Vixia HG20 camcorder and Logitech® HD Pro Webcam C910, recorded through Logitech® Webcam Software.

Experiment 1 – Condition 1

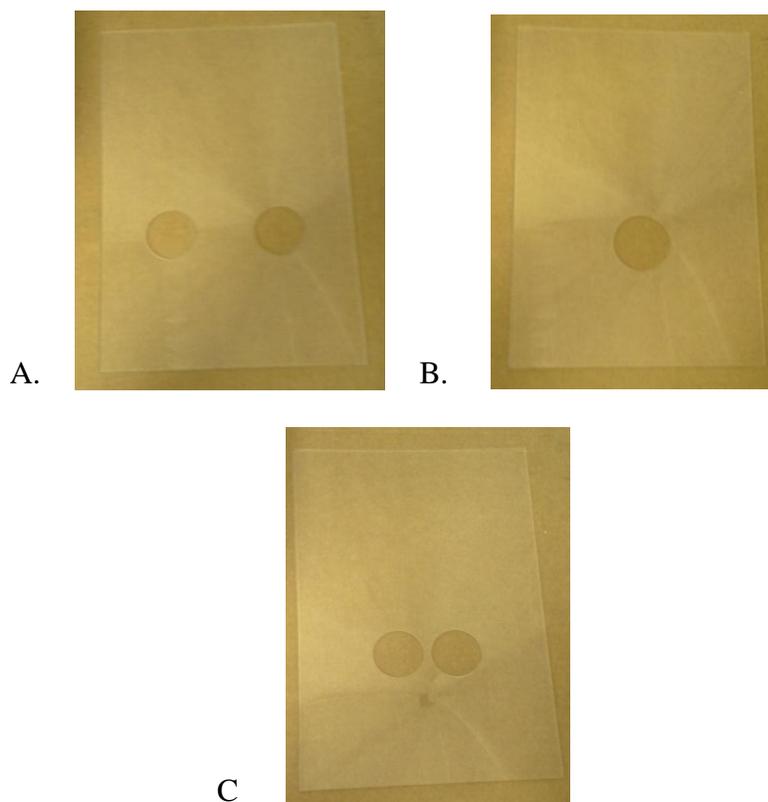
In Experiment 1, transport boxes were arranged such that the Observer was located 1” above, 2.75” in front of, and 9.4” to the right of the Demonstrator (Figure 4).

Figure 4: Set-up of Experiment 1



The Observer was placed directly to the right of the Demonstrator’s tray, from the Demonstrator’s perspective. In Condition 1, the Demonstrator and Observers were each given access to their food trays through a Plexiglass barrier with two holes (diameter of 1.85”, spaced 2” apart; Figure 5A).

Figure 5: Two-holed Plexiglass Barriers of Observer and Demonstrator



Each session began with the monkeys located in transport boxes at their designated locations. The experimenter placed a tray in front of the Demonstrator's cage. The experimental food was then shown to the Observer and Demonstrators and poured into each tray simultaneously to avoid recency effects. The amount of experimental food for each session was sufficient to support a level of demonstrating; the numerical range of food items per tray was eight to ten items. The Demonstrator was then allowed to select from the tray, through the unblocked PVC pipe. Once the Demonstrator consumed at least half of its allotted food, a Plexiglass barrier was placed to block him from making additional grabs. The Observer was then shown and the same foods (one of each in separate dishes) and allowed to select from one of them. Observers were not given access to their food tray until they were centered in order to ensure that the Observer was roughly equidistant from each choice; this was accomplished by

vertically lifting the tray up and down in front of the Observer, making them to move in between the Plexiglass holes. Once the Observer selected a food, the session ended.

During each session, the Demonstrator was given a maximum of 2.5 minutes to select the food. The Observer was provided a maximum of 30 seconds to select the food. Sessions were run to completion only if the Demonstrator grabbed and ate at least half of the food (6+ if 10 food items, 5+ if 8 or 9 food items). Also, the Observer was required to watch the Demonstrator grab the food at least once (monitored through a webcam, the two experiments assessed whether the Observer was watching the Chooser while it consumed the food. The Observer was then required to select one of the two foods. If any of these conditions was not met, the session was terminated and rerun on a subsequent day.

Experiment 2 – Condition 1

Experiment 2 is similar to Experiment 1, with a few exceptions. The cages for the Observer and Demonstrator were placed directly facing each other, with a distance of 5.6” apart. The Observer’s cage was situated slightly above the level of the Demonstrator’s cage, to avoid visual access through each PVC pipe. The cages were also placed closer to each other, which allowed both monkeys access to one set of trays (Figure 6).

Figure 6: Set-up of Experiments 2 and 3





For Experiment 2, the PVC pipes and petri dishes on the Demonstrator's tray were placed closer together. The Demonstrator's Plexiglass barrier had two holes (diameter of 1.85", spaced 0.3" apart), closer together to match the PVC pipe placement (Figure 5C). The Observer's Plexiglass barrier contained only one hole (diameter of 2.1"), centered between the two petri dishes, on the Demonstrator's tray (Figure 5B).

Each session began with the monkeys in their respective cages. The experimenter placed the Demonstrator's tray, in between both cages. The Observer and Demonstrator were then shown the experimental foods, which were distinguished by different colors, each contained in a clear, uncapped petri dish. Both foods were then poured into each petri dish on the food tray, simultaneously. The Demonstrator was then allowed to select from the tray, through the unblocked PVC pipe. Once the Demonstrator grabbed at least half of its allotted food, a 12.5" x 8.75" white Plexiglass barrier was placed to block him from making additional grabs and to block visual access between the monkeys. The barrier blocking the Observer from grabbing food from the tray was then removed by a second experimenter. Once the Observer selected a food, the session ended.

The allotted experimental running times were identical to those in Experiment 1. Running each session to completion depended on the same factors in Experiment 1. The only

differing requirement in Experiment 2 was that the Observer needed to watch the Demonstrator grab the food at least twice. If any of these conditions were not met, the session was terminated.

Experiment 3 – Condition 2

The second condition of this experiment was identical to the first condition in Experiment 2 except for one PVC pipe which was covered with black duct tape to block the Demonstrator from accessing one of the food dishes (Figure 7). Running each session to completion was dependent upon the same factors in Experiment 3. In all other respects, this Condition was similar to Condition 1.

Figure 7: Experiment 3 – Observer’s Plexiglass Barrier



Chapter 3

Results

All Observers were run for a total of five sessions, in either condition 1 or condition 2. Only one Observer (Mulva) was run for a total of ten sessions, or five sessions per condition. Twenty-three sessions total (6 from the Non-Volitional condition and 17 from the Volitional condition) were terminated. Results for one Observer (George) were not considered due lack of attention to the Demonstrator as well as side-biasing. There was no apparent side-biasing nor color

preferences in the Observers in Tables 2, 3, and 4, each of which display the Demonstrator's and Observers' color and location of their chosen food, for each session.

Experiment 1 – Condition 1

In Experiment 1, two Observers were tested. Table 2 lists their results through the comparison of food selections, of the Demonstrator and Observers. The color represents the color of the food selected (given two colors to choose between) and the “Right/Left” in parentheses represents the side that the food was placed, from the perspective of the monkey making the choice (i.e. Demonstrator or Observer).

Table 2: Demonstrator and Observer Food Choice, Experiment 1

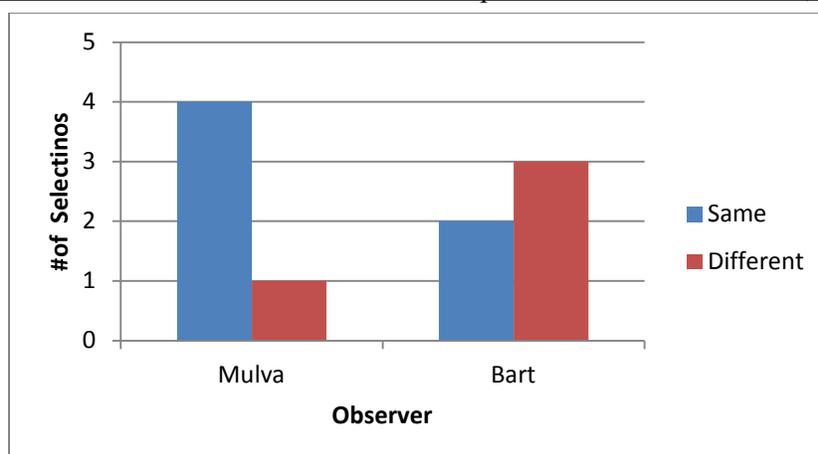
Session	Observer	Demonstrator's Food Choice	Observer's Food Choice	Compared
1	Bart	Lavender (Right)	Light Green (Left)	Different
2	Bart	Dark Red (Left)	Dark Red (Right)	Same
3	Bart	Tangerine Orange (Right)	Plum Purple (Right)	Different
4	Bart	Light Gold Yellow (Left)	Indigo Purple (Right)	Different
5	Bart	Bright Gold Yellow (Left)	Bright Gold Yellow (Left)	Same
1	Mulva	Bright Pink (Left)	Bright Pink (Right)	Same
2	Mulva	Hot Pink (Left)	Hunter Green (Left)	Different
3	Mulva	Deep Blue (Left)	Deep Blue (Right)	Same
4	Mulva	Lavender (Right)	Lavender (Right)	Same
5	Mulva	Tangerine Orange (Right)	Tangerine Orange (Left)	Same

Bart selected the same food choice as the Demonstrator 40% (2 out of 5) of all five sessions.

Mulva selected the same food choice as the Demonstrator 80% (4 out of 5) of all five sessions.

A graphical form can be viewed in Figure 8.

Figure 8: Observer's Food Selection Compared to Demonstrator's (Exp 1)



Experiment 2 – Condition 1

In Experiment 2, three Observers were tested. Table 3 lists their results through the comparison of food selections, of the Demonstrator and Observers. The color represents the color of the food selected (given two colors to choose between) and the “Right/Left” in parentheses represents the side that the food was placed, from the perspective of the monkey making the choice (i.e. Demonstrator or Observer).

Table 3: Demonstrator and Observer Food Choice, Experiment 2

Session	Observer	Demonstrator's Food Choice	Observer's Food Choice	Compared
1	Homer	Bright Yellow (Right)	Bright Yellow (Left)	Same
2	Homer	Dark Red (Left)	Deep Blue (Left)	Different
3	Homer	Dark Orange (Left)	Dark Orange (Right)	Same
4	Homer	Periwinkle (Right)	Lime Green (Right)	Different
5	Homer	Dark Burgundy (Left)	Pale Yellow (Left)	Different
1	Susan	Light Blue (Left)	Light Blue (Right)	Same
2	Susan	Dark Red (Right)	Dark Red (Left)	Same
3	Susan	Light Green (Right)	Light Green (Right)	Same
4	Susan	Green (Left)	Purple (Left)	Different
5	Susan	Coral Pink (Left)	Cobalt Blue (Left)	Different
1	Elaine	Bright Yellow (Right)	Bright Yellow (Left)	Same
2	Elaine	Deep Blue (Left)	Deep Blue (Right)	Same
3	Elaine	Light Green (Right)	Periwinkle (Right)	Different
4	Elaine	Pale Yellow (Right)	Burgundy (Left)	Different
5	Elaine	Coral Pink (Left)	Cobalt Blue (Left)	Different

Homer selected the same food choice as the Demonstrator 40% (2 out of 5) of all five sessions.

Susan, selected the same food choice as the Demonstrator 60% (3 out of 5) of all five sessions.

Elaine, selected the same food choice as the Demonstrator 40% (2 out of 5) of all five sessions.

A graphical form can be viewed in Figure 9.

Figure 9: Observer's Food Selection Compared to Demonstrator's (Exp 2)

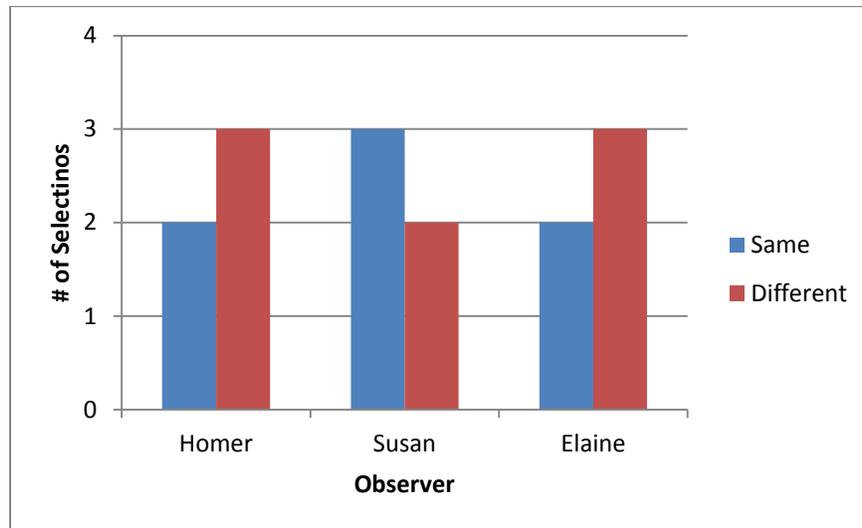
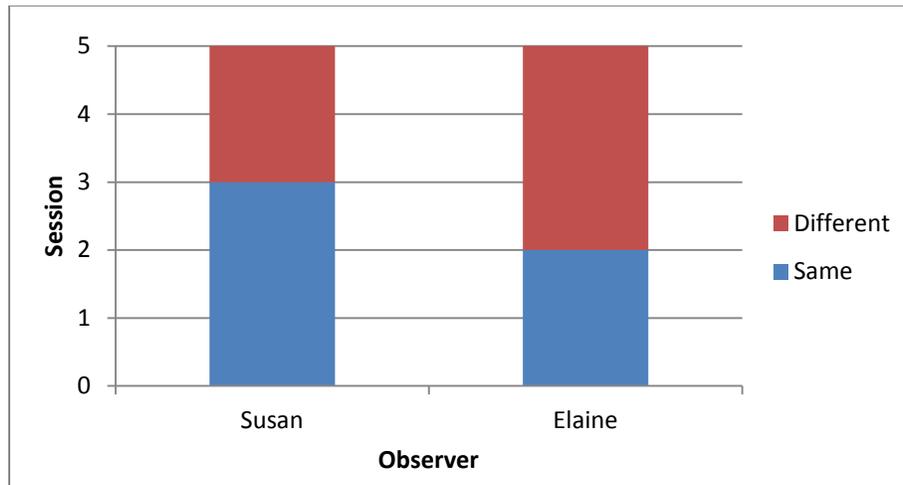


Figure 10 displays Observer food selections made by Susan and Elaine, specific to the session.

The areas between the graph's horizontal lines refer to a session; the area between 0 and 1 represents session 1, the area between 1 and 2 represents session 2, etc. The color in these areas represent whether the Observer's food choices were identical or different to the Demonstrator's food choices.

Figure 10: Observer Food Choices Across Five Sessions (Exp 2)



Experiment 3 – Condition 2

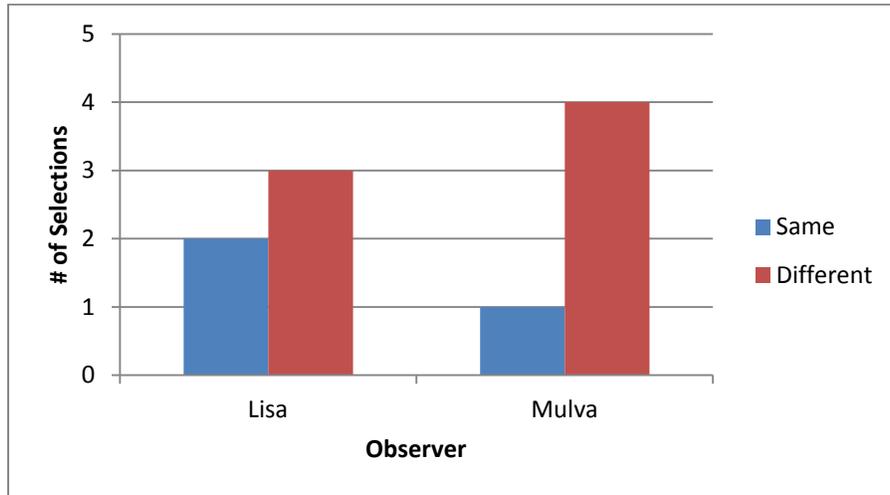
In Experiment 3, two Observers were tested. Table 4 lists their results through comparison of the food selections of the Demonstrator and the Observers run. The layout of Table 4 is identical to that of Tables 2 and 3.

Table 4: Demonstrator and Observer Food Choice, Experiment 3

Session	Observer	Demonstrator's Food Choice	Observer's Food Choice	Compared
1	Lisa	Plum Purple (Left)	Plum Purple (Right)	Same
2	Lisa	Light Blue (Right)	Light Blue (Left)	Same
3	Lisa	Light Olive Green (Right)	Dark Burgundy (Right)	Different
4	Lisa	Sky Blue (Left)	Tangerine Orange (Left)	Different
5	Lisa	Blue-grey (Left)	Light Red (Left)	Different
1	Mulva	Cobalt Blue (Left)	Cobalt Blue (Right)	Same
2	Mulva	Light Olive Green (Right)	Dark Burgundy (Right)	Different
3	Mulva	Light Blue (Right)	Bright Yellow (Right)	Different
4	Mulva	Light Red (Left)	Blue-grey (Left)	Different
5	Mulva	Forest Green (Left)	Magenta (Left)	Different

Observer Lisa selected the same food choice as the Demonstrator 40% (2 out of 5) of all four sessions. Mulva selected the same food choice as the Demonstrator 20% (1 out of 5) of all five sessions. A graphical form can be viewed in Figure 11.

Figure 11: Observer's Food Selection Compared to Demonstrator's (Exp 3)



Comparison Between Conditions

The following figures (Figure 12 & 13) display a graphical view of the collective number of food choices made by each Observer, in Condition 1 (Experiments 1 & 2), and how they compare to the food choices made by the Demonstrator. Calculated averages and standard deviations of the data from Figures 12 and 13 can be viewed in Table 5.

Figure 12: Volitional Choices by Observers Compared to Demonstrator (Condition 1)

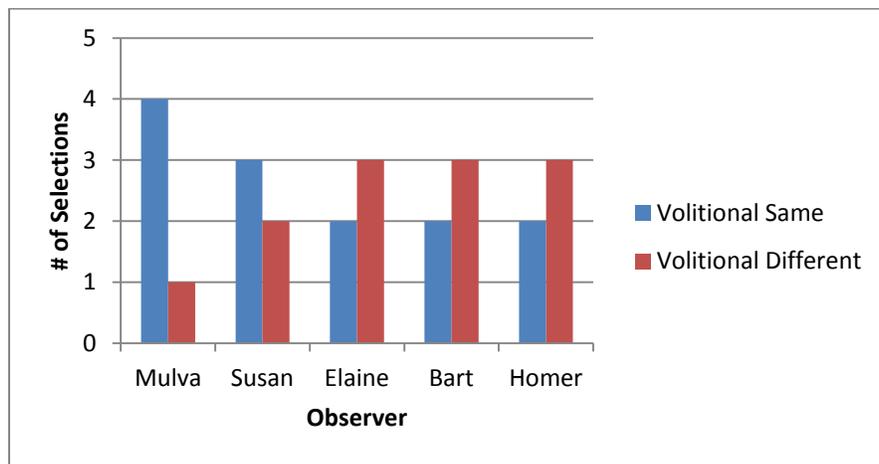


Figure 13: Non-volitional Choices by Observers Compared to Demonstrator (Condition 2)

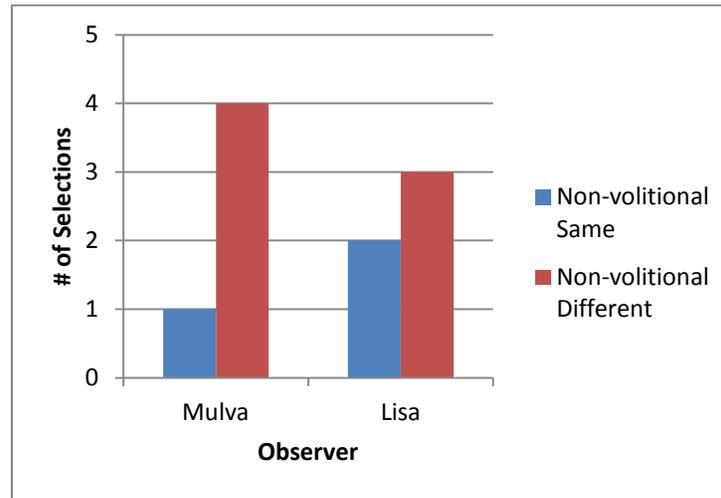


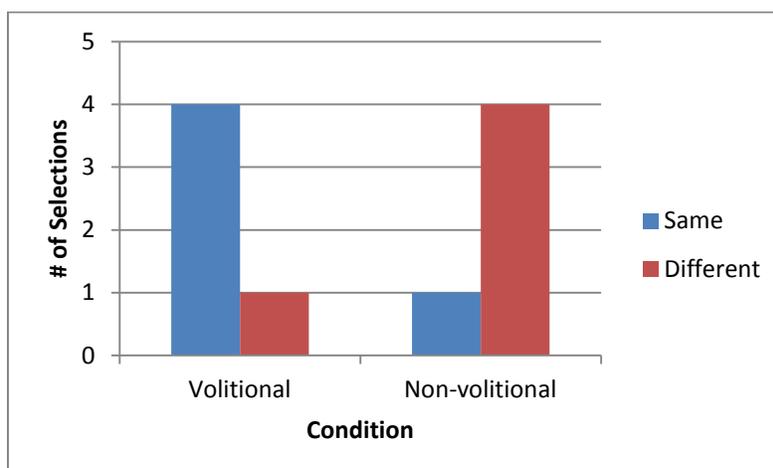
Table 5: Averages and Standard Deviations of all Observers Between Conditions

Condition	Average		Standard Deviation	
	Same	Different	Same	Different
Volitional	2.6	2.4	0.89	0.89
Non-volitional	1.5	3.5	0.71	0.71

In Table 5, the average number of times that Observers chose the same food as chosen by the Demonstrator was 2.6 ± 0.89 (Condition 1, Volitional) and 1.5 ± 0.71 (Condition 2, Non-volitional). Thus, the confidence ranges are 1.70 to 3.45 (Condition 1, Volitional) and 0.80 to 2.2 (Condition 2, Non-volitional). The average number of times that Observers chose the food not chosen by the Demonstrator was 2.40 ± 0.89 (Condition 1, Volitional) and 3.50 ± 0.71 (Condition 2, Non-volitional). Thus, the confidence ranges are 1.50 - 3.30 (Condition 1, Volitional) and 2.80 - 4.20 (Condition 2, Non-volitional).

Data was also compared between conditions for one test subject (Mulva), as she was the only observer run on both conditions. The data can be viewed collectively in Figure 14, below.

Figure 14: Volitional versus Non-volitional Choices by Observer Mulva



Chapter 4

Discussion

There were two main questions in this study. First, we sought to investigate whether cotton-top tamarins engage in the social transmission of food choice preferences. If they do, we wanted to determine whether they make a distinction between volitional and non-volitional choices. To investigate this, we divided our study into two conditions: Volitional (Experiments 1 and 2) and Non-volitional (Experiment 3). In Experiment 1, the Demonstrator was given the choice between two foods, but selected only one since he was secretly blocked off from one of the food types. Following a few food grabs by the Demonstrator and glances from the Observer, the Demonstrator was blocked visually and physically from the trays of food with the use of a clear Plexiglass barrier. Then, observing conspecifics were given access to the two foods (from their own tray), but were permitted to select only one food type. Experiment 2 follows the same sequence of events, except the subjects were closer together, the Demonstrator was blocked from the food tray with a white Plexiglass barrier, and the Observers were given access to the

Demonstrator's tray, rather than their own tray. In Experiment 3, the same procedure as that of Experiment 2 was implemented, however the Demonstrator was conspicuously blocked off from one food type with the use of black duct tape.

Most of the data generated from our experiment cannot support affirmative answers to either of these questions; there were no significant patterns found in either condition or between conditions. Likewise, we cannot make definitive conclusions on our predictions. However, three subjects (Mulva, Elaine, and Susan) produced some data suggesting a possible understanding of the social transmission of food preference and discrimination between volitional and non-volitional choices. Nevertheless, as discussed below, there may be alternative variables underlying their behaviors.

In the Volitional and Non-volitional conditions, all but one of the Observers (Mulva) produced a 2:3 or 3:2 pattern, across their 5 sessions (Tables 2 through 4); they chose the same food as selected by the Demonstrator three times (twice) and chose the opposite food selected by the Demonstrator twice (three times). Despite this common pattern, the first few food selections of two of the three Observers run in Experiment 2 matched that of the Demonstrator's: Elaine and Susan chose the same food as the Demonstrator for only their first two and first three sessions, respectively. Following these sessions, they always chose the food that the Demonstrator did not choose: Elaine and Susan chose the other food for their last three and last two sessions, respectively (see Table 3 and Figure 10). Observers Homer and Bart, run in the Volitional condition, did not follow any potentially significant pattern; as compared to the Demonstrator, Bart and Homer selected the same food only during sessions 2 & 5 and 1 & 3, respectively.

Similar to the first few trials of Elaine and Susan, one subject (Mulva) chose almost all of the same food as the Demonstrator in Experiment 1. Additionally, her food choices were completely flipped between conditions: in the Volitional condition, she chose the same food as the Demonstrator 4 out of 5 times versus in the Nonvolitional condition, where she chose the same food as the Demonstrator 1 out of 5 times. Despite the fact that there is no statistically significant difference between Mulva's data, there is still a difference in trend.

However, although the data from Mulva produce a trend in the predicted direction, we cannot rule out simpler explanations for this pattern of findings. For example, the layout of Experiment 1 was different from that of Experiments 2 and 3. Specifically, in Experiment 1, Observers had their own tray and were given the choice between two foods of the same abundance (1 versus 1). In Experiment 3, Observers shared a tray and were given the choice between two foods of differing abundances. Only a few of the Observers run in Experiments 2 or 3 consistently demonstrated a higher interest in the more abundant food: Susan and Elaine in Experiment 2 (mentioned above) and Mulva in Experiment 3. In Experiment 3, Mulva chose the more abundant food (not selected by the Demonstrator) 80% of the time. Thus, choosing the food not selected by the Demonstrator could be attributed to the appeal of a larger amount of available food. Tamarins naturally act on impulse (Buchanan-Smith et al., 2005). Compared to the other Observer, Mulva may have been less impulsive in her food choice, thus giving her some time to compare the relative magnitudes of the two food piles (though this is just speculation). To validate this assumption, it is necessary to run Elaine and Susan on Experiment 3 as well as Mulva on Experiment 2, since it is nearly identical to Experiment 3, thus controlling for any confounds in Experiment 1.

Due to time constraints, Mulva was not run in Experiment 2. Following a period of rest, she will be run in Experiment 2, where results will be compared with that of Experiment 1. Similarly, no other subjects were run on both conditions due to time constraints, but will be run following a resting period of at least one month. Though this data will not be retrieved before the submission of this paper, it will be available subsequently.

In general, there was little indication that Observer food choices were influenced by social transmission. In the context of social learning, the Demonstrator's actions toward one particular food would have presumably elicited a similar response from the Observers (Buchanan-Smith et al., 2005; Snowdon & Boe, 2003). In a study by Buchanan-Smith et al. (2005), saddle-backed tamarins (*Saguinus fuscicollis*) were faster to sample a conspecific's preferred food choice when given the chance to interact as compared to those not given the chance to interact. Also, saddle-backed tamarins (*Saguinus fuscicollis*) and moustached tamarins (*Saguinus labiatus*) changed a previously learned food aversion by watching conspecifics consume the (once learned unpalatable) palatable food (Buchanan-Smith et al., 2005). Specific to this experiment, in the Volitional condition, the Demonstrator's actions offered information about which food was better to choose or which was more palatable and safe to eat. If the Observers had learned this, it was assumed that they would have used this new information while making their own food choices; the Observers could have selected the same food as the Demonstrator (Buchanan-Smith et al., 2005). Since this pattern was not consistently seen in the Volitional condition, across all Observers, we cannot assume that social transmission influenced Observer food choice. Looking at the natural feeding behaviors of cotton-top tamarins may help explain why the Observers may not have used the Demonstrator's information on food preference.

The typical diet of wild cotton-top tamarins consists of insects, fruit, plant exudates, nectar, and sap. Hunting for insects is a rather individualistic behavior and necessitates acting with impulse (i.e. pouncing, rapidly moving for prey acquisition, etc.) (Garber, 1993). However, cotton-top tamarins have been reported as opportunistic feeders while feeding on sap. Nevertheless, the tree gouging behaviors required to retrieve the sap have not been reported in tamarins raised in captivity (Savage, 1995). Moreover, the diets of our housed tamarins are comprised of cooked proteins, fruits, vegetables, and seeds – all of which are placed in a bowl and so are easily acquired. In other words, they do not need to search for insects, dig for sap, or rely on conspecifics to taste novel foods since they are frequently given familiar foods. Thus, for the most part, the Observers may have ignored most of the food selections made by the Demonstrator.

Since the Observers were not likely influenced by food choice, it is unlikely that they made a distinction between volitional and non-volitional actions. Thus, we conjecture that Observer food choice could have been attributable to understanding the environmental constraints placed on the Demonstrator (Csibra & Gergely, 2003, Glynn et al., 2007). Specifically, Mulva, Elaine, and Susan may have been sensitive to how the environmental constraints affected the Demonstrator's food choice: in the Volitional condition, the Demonstrator was free to select both foods versus in the Non-volitional condition, where he was restricted to selecting only one food type. It may further be proposed that if specifically Mulva, Susan, and Elaine understood the environmental constraints of each condition, then they may have made food selections through rational decision making and, subsequently, rational imitation; rational decision making can manifest itself as rational imitation (Csibra & Gergely, 2003). Imitation itself is a kind of social learning, where an Observer learns a behavior and

matches some part of that behavior (Whiten, A., 2000). It would be rational for Observers imitate the Demonstrator's food choice when the Demonstrator exhibited a preference for only one food, despite having access to two foods (Volitional condition). Through these actions, observing conspecifics should have recognized that the Demonstrator's goal was to retrieve a specific food type. Conversely, Observers would not have made any rational decisions in the Non-volitional condition, where environmental constraints were placed on the Demonstrator; since the Demonstrator was blocked off from one food, he had no choice but to select the only food made accessible to him. Thus, if the Observers had rationally imitated the Demonstrator, they would have done so only in the Volitional condition and would have made random food selections in the Non-volitional condition. Most of the data from the Volitional condition, from Mulva, Elaine, and Susan, support this theory: in sessions 1 & 3-5, sessions 1-2, and sessions 1-3, Mulva, Elaine, and Susan made the same food choice as the Demonstrator.

This pattern of selecting the same food as the Demonstrator could be explained on even simpler terms, with regard to stimulus enhancement. In stimulus enhancement, an Observer may adopt a behavior through the facilitation of watching a conspecific perform an action (Heyes et al, 2000). More importantly, after watching an agent perform an action, Observers are more likely to direct their resulting behaviors toward the area or object of the agent's behavior (Spence, 1937). Therefore, if Observing conspecifics focus their attention toward a Demonstrator's actions, then they are more likely to reproduce actions similar to the Demonstrator.

The lack of a continuous trend in Observer food selection (i.e. always selecting the same food choice as the Demonstrator) may have been attributable to individual variance. Though, confounds could have also emerged during the running of this experiment. In general, the

Observers may have realized the set-up of the experiment: during the Volitional sessions, we assumed that the Observers would understand that one food was a higher quality than the other food, since the Demonstrator was always selecting one food type per session. There may have been a gradual understanding that, despite their color differences, the food items per session were the same. Observers' food selections could have also been affected by experimental fatigue or extinction of the Demonstrator's influence on their food choices. For instance, Galef & Whiskin (1998) noticed that Demonstrator rats' food choices influenced Observer rats' food choices for only a short period of time, but that increasing the number of Demonstrators and demonstrations helped to extend the Demonstrator's influence on the Observer. Therefore, perhaps implementing a greater number of food selections by the Demonstrator and running the subjects less frequently (i.e. testing each Observer once per week or biweekly) would yield data to better support these conclusions.

One of the constraints to making conclusions in our study was the fact that few sessions were run for each Observer; half of the subjects were difficult to catch, which decreased the time available for running each Observer. Additionally, when a test subject was caught, they were not always run to the completion of their session; i.e. some sessions were excluded (23 total) because Observers did not watch the Demonstrator make at least two food choices, the Demonstrator ate all of one food type, or Observers did not make a food selection. Most issues occurred in Experiment 1, where the Observer was too far away from the Demonstrator and the Observer's two-holed Plexiglass barrier provided opportunities for side-biasing. As a result, several sessions were terminated due to either a lack of the Observer watching the Demonstrator, lengthy sessions, side-biasing, or a combination of the three. To shorten session running time, the Observers were positioned so that they directly faced the Demonstrator to increase vigilance

(Basile et al., 2002). To decrease the distance between the two monkeys, the experimental food tray was shortened. These modifications were the impetus for Experiment 2. Consequently, sessions were significantly shorter and the Observers' looking times were appreciably longer and more frequent. Additionally, altering the Observers' holed Plexiglass barrier from two holes to one hole helped eliminate side-biasing behaviors.

Given the results and the aforementioned modifications to the set-up and execution of this experiment, additional experiments are necessary to come to firmer conclusions. For instance, extending and improving this experiment by using more Observers, running more sessions, and using larger time gaps between sessions could improve performance. Further studies also could include testing the influence of several Demonstrators on one Observer and comparing results to only one Demonstrator, as conducted in this experiment. Another study could test for the influence of a Demonstrator's gender on Observers food preferences, since only one male Demonstrator was used. These experiments may provide a bit of more insight on the factors that contribute to social food preference among cotton-top tamarins.

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Academic Vitae

Nicole Anderson

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Education

2013 Bachelor's in Animal Sciences
Minor in Wildlife and Fishery Sciences
The Pennsylvania State University, University Park PA

Academic Honors and Awards

2009-2013 Schreyer Honors College Scholar, Dean's List
2010 & 2011 American Society of Animal Science Scholastic Achievement Award
2010-2013 National Society of Collegiate Scholars Member

Research Experience

2011-2013 Primate Psychology Research Lab, University Park PA
Research Assistant and Scientist: Conducting social transmission of intentionality in Cotton-top tamarins for Schreyer Honors Senior Thesis, assisted in data collection of in-lab research projects, coded experimental data.

2012 Work Study, University Park PA
Research Assistant: Handled Penn State horses, collected urine and blood samples for analysis of sugar metabolism, organized and recoded inventory into Microsoft Excel, transcribed recorded, verbal lectures into word documents.

Externships and Internships

2012 Hanover Shoe Farms, Hanover PA
Extern: Shadowed equine vet, observed surgeries, mare-foal checks, plasma transfusions, castration, and foaling. Assisted in sperm collection for subsequent artificial insemination.

2011 General Livestock Management Internship, Brittany and Normandy, France
Intern: Worked on several swine, cattle, and goat facilities. Tasks involved general caretaking, milking cows and goats, assisting in farrowing and calving. Travelled with cattle geneticists and learned about regular employment expectations.

2011 Centre County Wildlife Care, Port Matilda, PA
Extern: Maintained general organization of facility, cleaned animal housing and cages, fed and handled wildlife, administered medication.

Executive Positions

2011-2013 Penn State Small and Exotic Animal Club *President*
2012 Penn State Cooking and Baking Club *Secretary*
2010-2011 Penn State Small and Exotic Animal Club *Secretary*

Community and College Service

- 2012 Little International and Dairy Expo, Ag Arena, University Park, PA
Aided in the planning, assembly, and running of the concession stand.
- 2012 Canine Agility Trials, Ag Arena, University Park, PA
Helped assemble obstacle courses, leashed dogs following each trial.
- 2012 Pet Food Pantry
Organized club fundraiser for pet food donation to local church pet food pantry
- 2010-2011 Centre County PAWS, State College, PA
Weekly Volunteer: *cleaned, walked, and administered medication to dogs.
Transported dogs to room for neutering, shaved and sterilized dogs for surgery,
monitored dogs post-surgery.*
- 2011 T&D's Cats of the World, PA
Counted and stored winter inventory for establishment's shop.
- 2011 Hearthside and Brookline Nursing Homes, State College, PA
Provided pet therapy to residents
- 2009 Fresh Start Day of Service, State College, PA
Set up rummage church sale, weeded gardens
- 2008-2009 Young Life Work Crew, Lake Champion, NY & Rockbridge, VA
Prepared and served meals to campers
- 2006-2009 American Cancer Society Relay for Life, Milford, PA
*Organized group, formulated and carried out several fundraising events,
prepared for Relay for Life 24 hour event as captain of a registered group*
- 2008 United Way Day of Caring, Pike County Humane Society, Shohola, PA
Washed dogs, painted facility, cleaned kennels, handled caged animals.

Work Experience

- 2012-2013 Kildare's Irish Pub, State College, PA
Waitress
- 2010-2012 Relais & Châteaux Hotel Fauchère, Milford, PA
Waitress, Bus girl, Hostess, and Housekeeper
- 2008-2010 Riverside Creamery, Port Jervis, NY
Waitress

Grants

- Summer 2012 Schreyer Summer Research Grant
- Summer 2011 Schreyer Ambassador Travel Grant
- 2009- 2012 Schreyer Honors Academic Excellence Scholarships