Experimental investigation of social learning in domestic animals and non-human primates.

[redacted] to the University of Exeter as a thesis for the degree of [redacted] Behaviour in the faculty of science, June 2008.

[redacted] rstanding that is copyright material and [redacted] ithout proper acknowledgement.

[redacted] has been identified and [redacted] ferred upon me.

[redacted]

Abstract

Imitation is considered to be an efficient method of conveying information between [redacted] It is believed to be among the least common and most complex forms of [redacted] After almost a century of studying social learning in animals, scientists [redacted] to give a clear answer to the question “Do animals imitate?”. [redacted] some studies that have shown certain species under certain [redacted] (e.g. Zentall, et al., 1996), these studies have not been [redacted] of species. This thesis expands the social learning [redacted] species in which it has been studied and by [redacted] two-action method to look for [redacted] animals. In this [redacted] with two [redacted] two different [redacted] or just [redacted] one [redacted]

behaviours a novel behaviour is added that has not been trained to see if the subject will [redacted] imitate the behaviour. Successfully copying a novel demonstration is taken [redacted] of understanding the rule needed for imitative performance. This methodology [redacted] it not only can distinguish between imitation and the other forms of [redacted] can also show the subjects' ability to generalize this type of learning. [redacted] show very little imitative learning occurring in the various [redacted] low rate of imitation may not be surprising. For just over [redacted] social learning and in that time only a handful [redacted] evidence of an animal's ability to imitate the [redacted] though imitative learning may be [redacted] of particular behaviour, it is [redacted] in general, especially [redacted]

[redacted]

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Chapter 5

STATEMENT OF THE CANDIDATE’S CONTRIBUTION TO CO-AUTHORED PAPERS

[redacted] five studies included in this thesis, all of which have been written up as [redacted] As detailed below, the substantial contribution to the co- [redacted] this thesis was made by the candidate. However, while the [redacted] work presented in this thesis, where the first person is [redacted] ‘I’) as in the original peer-reviewed articles to [redacted] process. All chapters that have been [redacted] requested by the respective journal; [redacted] may be redundant.

[redacted] Diana

[redacted]

Paper 2: Chapter 3

[redacted] N.R., Melfi, V. and Lea, S.E.G. **No evidence of imitative learning in a** [redacted] **Goeldi's monkey (*Callimico goeldii*)**

[redacted] manuscript, presented in Chapter 3, was sent to the *Journal of* [redacted] It came back rejected, because the methodologies did not match [redacted] However the reviewers gave fantastic feedback and thus [redacted] The candidate designed the methodology of data [redacted] the data. Prof. Stephen Lea contributed to the [redacted] supervisory support from Prof. Stephen [redacted]

[redacted] **learning from** [redacted]

As outlined in the candidate's statement above, the substantial contribution to the [redacted] papers presented in this thesis was made by the candidate. This includes the [redacted] the literature presented in each paper, study design, statistical analyses and [redacted] of the data, together with the write-up for publication. The supervisors [redacted] by advising on statistical analyses and interpretational issues, [redacted] style. Moreover, the theoretical framing of the empirical [redacted] of the papers is a product of a concerted discussion [redacted] and supervisors.

Acknowledgments

[redacted] grateful to my supervisor Dr. Stephen E.G. Lea for all his advice, criticism, and [redacted] the entire thesis. I always enjoyed our meetings, from sitting in the [redacted] the pond via webcam, they were the time we could bat ideas around [redacted] writing (which is where I needed the most help ☺). I know [redacted] teaching and constant encouragement I would not [redacted] ottom of my heart.

[redacted] port and suggestions to the [redacted] ning, without her support and [redacted] zoo. I enjoyed our [redacted] complete this thesis. I [redacted] help me with [redacted] ternally [redacted]

American, was also someone I was lucky to have met. It was nice to have a lunch buddy
[redacted] the times I was working hard in my office at the Uni. No matter how long it has been
[redacted] last conversation we always pick up were we left off. Thank you for always being
[redacted] needed you. I would like to thank my officemates (Kirsten, Lucy and Holly)
[redacted] hen I needed one.

[redacted] ton zoo staff for all of their support, help, time out of their
[redacted] ld not have done it without them. They all were truly
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[redacted] like to thank Julian Chapman, Nicky Jago,
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[redacted] aignton zoo. I was
[redacted] the department for
[redacted] e meetings
[redacted] e never
[redacted]

biggest supporter and allowed me to dabble in areas outside of my research. I enjoyed
[redacted]king with her and will continue to use the knowledge I gained from her for a lifetime☺;
[redacted]n Pullen kept my head above water many many times. I thank her for her undying
[redacted]without her, life in England just wouldn't have been as fun ☺ I would
[redacted]k her for always being the one I can turn to at all hours of the night
[redacted]ights of wine and Dr. Who, for making me just a little more
[redacted](even if it took me a while to adjust when I went back
[redacted]ories of England that I will cherish for the rest of
[redacted]d back to the states because his
[redacted]ned I no longer felt safe
[redacted]e to live that would
[redacted]ame to my rescue
[redacted]nd and
[redacted]thank
[redacted]

like to thank my brother for always thinking about me and sending me holiday trinkets and
[redacted]ny emails; My sister for giving me the strength to continue and for reminding me that I
[redacted]h and come back home sooner than later; My parents,for their undying love,
[redacted]t and support even when they didn’t fully understand.

[redacted]last. It gives me great pleasure to express my deepest gratitude to
[redacted]my life, my best friend, and the man I can’t wait to spend
[redacted]upport and encouragement I can honestly say I
[redacted]hink it was crazy to sell everything we owned
[redacted]my dream and further my career. He never
[redacted]roughout the process I questioned it
[redacted]on, a person to talk with and a
[redacted] along the way. I am
[redacted]to grow old with. Ti
[redacted]

1.1 Social learning from Psychological and Biological perspectives.

Social learning is said to have occurred when an observer's behaviour changes after [redacted] a demonstrator. It is considered to be "intrinsically fascinating often because of [redacted] about an animal's cognitive abilities" (Caldwell and Whiten, 2004, p. 77). [redacted] differ in the way they approach the study of social learning. [redacted] the adaptive value of behaviour, suggesting that imitation may [redacted] species-typical, genetically predisposed behaviour and [redacted] 335). Biologists typically study social learning of [redacted] food preference (Zentall, 2006). Psychologists [redacted] and thus manipulate the environment to [redacted] psychologists, Biologists have [redacted] mammalian taxa which have a [redacted] Biologists and [redacted] Biologists study the [redacted] study [redacted] the [redacted] description of imitation was published (Whiten and Ham, 1992; Zentall and Galef, 1988). [redacted]manes and his followers soon “incorporated a diverse collection of phenomena under the [redacted] of “imitation” (Whiten and Ham, 1992, p. 239). Thorndike (1898) was the first to [redacted]nitation formally: he defined it as “learning to do an act from seeing it done” [redacted]n imitation has been defined in various ways (see Whiten and Ham, [redacted]ntall and Galef (1988) attempted to distinguish imitation [redacted]However, others disagreed with the fundamental [redacted]e Whiten and Ham, 1992). Zentall (2004) takes a [redacted]ribing what imitation is not. Thus, [redacted]en one has ruled out or controlled for [redacted] learning, stimulus/local [redacted]copied response” [redacted]rm that [redacted], social [redacted]

Mazur and Seher, 2008) 2) Tomasello's definition requires one to accept that animals [redacted]ssess a theory of mind, which this author doesn't fully accept (see section 1.3). For the [redacted]er of this chapter and the thesis as a whole, we will focus on the social learning [redacted] taxonomy.

[redacted] Whiten and Ham (1992) social learning is defined as occurring when [redacted]ed from A the basis of a subsequent similarity between their [redacted]re are a number of ways (three according to Whiten and [redacted] a demonstrator. The first is called local or stimulus [redacted] Ham is the category that is "most often [redacted] enhancement occurs when an observer [redacted]hich stimulus to direct its behaviour [redacted] is similar to stimulus/local [redacted]ational conditioning [redacted]iten and Ham, [redacted]the context of [redacted] initially [redacted]

In a more recent article Fredman and Whiten (2008) add to this list the term [redacted] Canalization is defined as occurring when an observer before watching a [redacted] produces a wide range of actions including that of a demonstrator, whereas [redacted] the demonstrator the behaviour chosen is mostly that of the demonstrator. [redacted] of the demonstrator's behaviour channels that of the observer, but [redacted] of a behaviour that is already in the observer's repertoire. [redacted] within psychology has been to choose a novel behaviour [redacted] that watches a demonstrator perform this behaviour [redacted] a demonstrator. However, "many studies of [redacted] problems" (Zentall, 1988, pg. [redacted] for following a conspecific [redacted] as a cue that elicited the [redacted] to control for other [redacted]

Some scientists in the field of animal psychology, research the area of animal [redacted] sciousness (e.g. Woodruff and Premack, 1979; Povinelli, et al., 1993; Gallup, 1997). As [redacted] 2001) states so eloquently “It seems positively foolhardy for an animal [redacted] rush in where even philosophers fear to tread” (pg. 15). However, some [redacted] need to understand how much one animal understands the actions of [redacted] of mind” or ToM for short, is at the heart of this research. ToM is [redacted] and explain behaviour by attributing mental states” [redacted]). In other words how much does one animal [redacted] of another? Although I will not in this thesis be [redacted] the ToM concept, I think it is important to [redacted] been used to address these types of [redacted] server’s understanding of the [redacted]

[redacted] “social glue [redacted] thus [redacted] when the environment changes rapidly, individual learning is favoured and when the [redacted] is changing at an intermediate rate, social learning is favoured (Boyd and [redacted], 1998). Thus studying which species learn by imitation could indicate the rate at [redacted] is changing.

[redacted], was the first to develop a methodology to study imitation in an [redacted] anecdotal evidence for its occurrence that was piling up at [redacted] and Galef, 1988; Whiten and Ham, 1992). In his [redacted] of cats who had been given the opportunity to [redacted] had never seen the puzzle box being [redacted] of learning. Whiten and Ham [redacted] in rigor and [redacted] procedure can be [redacted] limitations to [redacted] the [redacted] the [redacted]

1.4.1 Two-Action Method

The two-action test procedure is an attempt to improve on the “Thorndike-like” [redacted]es. This methodology is the only one that can distinguish local enhancement [redacted] to attend to the location of the demonstrator), or stimulus enhancement [redacted]end to the stimulus which the demonstrator interacts with) from “true” [redacted]es, and Goldsmith, 1999). The first study to use the two action [redacted](1965). In this study a group of budgerigars were given a [redacted] learn a way to remove the lid. They found that the [redacted] ways: pushing the lid off with the beak, [redacted]ith the foot. A second group of budgerigars [redacted]se groups to see how they would [redacted]s who saw a demonstrator [redacted]onstrator they had [redacted]two action”. [redacted] object, [redacted]ff [redacted] of the body on the same object. An example of this would be the budgerigars pulling the lid [redacted] with either their foot or beak. This methodology has been the most widely accepted [redacted] Fawcett, et al., (2002) states that this procedure significantly advanced [redacted] behaviour.

[redacted] procedure rules out the possibility of stimulus enhancement, it cannot [redacted] and stimulus-reinforcer learning (Whiten [redacted] in the field (Premack and Woodruff, 1979; De Wall, 1992; [redacted] Theory of Mind (ToM) and that imitation is [redacted] this theory, animals that imitate should [redacted] demonstrator. If this is the case, being [redacted] should not be an important [redacted] should not be essential [redacted] "psychologists have [redacted] and Zentall, [redacted] control for the [redacted] because [redacted] they were found to push the joystick in the direction they observed (although they would [redacted] obtained the food by pushing the joystick in either direction). Hayes and Dawson [redacted] that rats showed “non-vocal imitation of response learning through observation”. [redacted] suggested, however, that these results may have been due to olfactory cues [redacted] & Dawson, 1999).

[redacted] control experiment was conducted with marmosets by [redacted] this experiment a subject was trained as a demonstrator to [redacted] observers were allowed to watch the [redacted] In addition control studies were carried out with [redacted] to see how they would open the door. [redacted] group explored less than the [redacted] likely to match the behaviour [redacted] to show if a [redacted] using a series [redacted]

In this study an experimenter demonstrated to each subject a different pattern of [redacted]ions on how to open the device. Two subjects saw the sequence in which both bolts were [redacted] (farthest first), pin then handle. Each of the two subjects saw different ways to [redacted]ch of the latching devices. The remaining two subjects saw the sequence pin, [redacted]lts (farthest first). Each of the two subjects saw different ways to [redacted]tching devices.

[redacted]of the subjects imitated the sequence of behaviours in the [redacted]sequence on the second trial. However some of the [redacted]he demonstrator.

[redacted]fruit apparatus in a similar fashion to study [redacted]ence from the procedure used with [redacted] instructions). All subjects in [redacted]The children even copied [redacted]ing the pin).

[redacted]inforcer [redacted]

The researchers found that none of the observers was able to open the artificial [redacted] however the time spent manipulating the apparatus varied according to the type of [redacted] they saw. For example the subjects that saw the full demonstration spent [redacted] the apparatus then the subjects that saw a partial demonstration. In [redacted] the full demonstration touched the particular parts of the apparatus [redacted] manipulate, which the authors conclude was localized [redacted] this sequential methodology has not gotten the criticisms [redacted] it still hasn't gotten the accolades that the "gold [redacted]

[redacted] manipulate an apparatus [redacted] of the body and not two [redacted] is learning by [redacted] The first [redacted] In this [redacted]

Akins and Zentall (1996) tested Japanese quail using the two-action method. In this [redacted]periment they trained two birds to be pecking and stepping demonstrators. The remaining [redacted] were used as observers. As in the procedures of Zentall et al (1996) birds watched [redacted]g or a stepping demonstrator for 10 min. at a rate of one response every 10 s. [redacted]tor was removed the observer was given access to the manipulandum [redacted]

[redacted]lear evidence of imitative behaviour in Japanese quail. [redacted]behaviours, they were more likely to imitate pecking [redacted]night have been because of ease of the behaviour [redacted] than step on it).

[redacted]' methodology was conducted by [redacted]xperiment they had two [redacted]with their mouths or with [redacted]was used to assess [redacted]is group were [redacted]nisters

[redacted]

their hands and four out of the six subjects who watched a mouth demonstrator opened the [redacted]nister with their mouths.

[redacted] as I Do

[redacted]ntioned earlier the two action methodology is widely used to study imitation, [redacted]cedure that is gaining popularity is the “Do as I do” methodology. In [redacted]ained to match a few gestures of the demonstrator for [redacted]rator raises her/his hand and the subject raises his/her hand) [redacted] or “Do it”. After the subject reaches criterion on the [redacted]ded that has not been trained to see if the subject [redacted]ssfully copying a novel demonstration is [redacted] imitative performance. This [redacted] between imitation and the other [redacted] to generalize this type of [redacted]ns between a [redacted] model [redacted]

(Burgess, Burgess, & Esveldt, 1970) and as a key concept in theoretical analyses of [redacted]guage development (Brigham& Sherman, 1968).

[redacted]o as I Do with Humans

[redacted]rocedure was apparently first used in a scientific context with humans by [redacted]1964) who used social reinforcement with a puppet to train three [redacted]nodding, mouthing, and strange verbalizations) in children. A [redacted]r pressing, which was never reinforced, increased in [redacted]imitative responses increased in strength. In the next [redacted]y reinforced imitative responses were placed on [redacted]ished and so was the bar pressing response [redacted]a non-modelling condition (where [redacted]ented with two other children, [redacted]her responses. When [redacted]uced, the bar- [redacted]hildren. [redacted]I [redacted]ve [redacted] imitative responses only in the presence of one stimulus and not in the presence of another

mulus (Furnell & Thomas, 1976), while others have explored conditions which might

un-reinforced imitative behaviour in children by having the experimenter absent

e complexity of the stimulus situation (Peterson, Merwin, and Moyer, 1971).

e experiments have given their subjects instructions, making their

from those used with animals.

animals

first to use the "Do as I do" procedure with non-

trated imitative learning in one subject, a

d to imitate on the command "Do

ting the researchers' behaviour

imental procedure the

performed while

e was given a

hers

(1995) argue that Hayes and Hayes' research is flawed by the lack of adequate detail on [redacted] their procedure and results.

[redacted]s a result, Custance et al. (1995) replicated the Hayesand Hayes procedure. Their [redacted] two nursery-reared chimpanzees, which were given a novel instruction 3 or 4 [redacted] instruction or shaping. They also used inter-observer reliability [redacted] of their behaviour observations.

[redacted] experiment the researchers taught the chimpanzees to [redacted] 15 different actions through food reinforcement and [redacted] subjects could make the transition from taught [redacted] Each novel behaviour was demonstrated [redacted] chimpanzees every week. No food [redacted] (or non-functional) [redacted] suggest two [redacted] humans; [redacted] been [redacted] predisposition to the objects before the experiment began. In the demonstration phase the [redacted]del (a familiar caretaker) demonstrated the target toward each object behaviour several [redacted] the participant. The deferred imitation trial in phase three involved the [redacted]f the same object that had been used during the demonstration phase. [redacted]alization phase involved presentation of similar, but not identical [redacted] the presentation of new materials not presented in phase three. [redacted]e 2 the participant was encouraged to manipulate the object [redacted]o during these phases the model made no gestures and [redacted]f the participant displayed the target behaviour. [redacted]pants displayed deferred and generalized [redacted]e behaviours required for [redacted]y the model it was unlikely that [redacted]udy “provides the best [redacted]anzees”(p. 56). [redacted]002); Custance [redacted]ent is the [redacted] to untrained behaviours. The dog was taught nine actions over the course of 10 weeks using [redacted] conditioning. Once he reached 80% correct on all behaviours the testing phase [redacted]

[redacted] in the testing phase 16 behaviours werechosen by action type (body- [redacted], etc.) and complexity (number and length of action sequences). In [redacted] than three complex or simple actions were given in a sequence. [redacted] that overall the dog matched the human demonstrator's [redacted] et al. (2000) tested the sequence of the action [redacted]. For example, in the first experiment, they [redacted] the floor. The demonstrator would pick [redacted] would then pick up the second [redacted] is that the researcher [redacted]. The dog could have [redacted] imitating [redacted] that [redacted] by chance. The overall conclusion is that the subject shows ability to imitate and is able to [redacted] human demonstrations onto its corresponding motor schemes.

[redacted]iscussion

[redacted]thodologies that researchers have used to study imitation in human and non- [redacted]r. For example, in human studies the two-action method is not used. [redacted]act humans have verbal behaviour and can be given instructions [redacted]rue of the participants in the experiments cited about, even [redacted] for the two-action paradigm, suggests that [redacted] and can conclude that some animals can [redacted]hiten, 2002 pg. 189-190).

[redacted] command in hopes to elicit an [redacted]e procedures differently; [redacted] however not only [redacted]al studies of [redacted]einforced [redacted] their own attention might also be reinforcement for the behaviour. It is highly possible that [redacted]ce the subjects were enculturated with humans, the researchers' reaction to the imitation [redacted]eir presence could have been a reinforcer for the chimpanzees. Nevertheless, this [redacted]r explored by the authors.

[redacted]mitation research Baer et al. (1964) concluded that imitation acquires [redacted]roperties since it is often followed by reinforcement. Since this [redacted]the generalized imitation paradigm have been recognized. [redacted]repertoires of response types. Some of the subjects [redacted]ponses because these behaviours were outside [redacted]ond, subjects might not have been [redacted]4; Peterson, 1968; Brigham et al., [redacted]onfounds such as: other [redacted]esence (Peterson et al., [redacted]rement of other [redacted]ot occur) [redacted]

Because of the results of these studies some authors have attempted to broaden [redacted]er et al.'s (1964) definition of generalized imitation. Peterson (1971) suggests "it would [redacted]der if the word generalized were restricted to those examples where it can be [redacted] that a single variable applied to one of two classes of behaviours is the [redacted]he term un-reinforced may serve in other situations" (p. 125). Young et [redacted]e definition of generalized imitation should be restricted to [redacted]ies of response type.

[redacted]n of Zoos and Aquariums (WAZA) "zoos and [redacted]the research community" (WAZA, 2005, [redacted]e terms cognition and zoo bought up [redacted]ognition and laboratory which [redacted]cognition studies are [redacted]et zoos offer a [redacted]ttings in [redacted]y zoos [redacted]

suffer from limited sample size, but in zoos this can be ameliorated by collecting data from
ltiple zoos, termed multi-zoo studies (Mellen, 1991). The questions which can be
d in zoo research are increased further given the long-term data which may be
e form of records or studbooks for multiple populations and even
oks are also a great source of information about captive animals
ransfers, census data, mortality of infants and founder allele
d this information is available across many generations
r variety of investigations (Melfi, 2006; Pullen,
s can be looked at either within a species across
llowing the impact of environmental
, with reasonably consistent
ht into focus (see Melfi, 2005).
when data are collected
to laboratories, and
laboratory
heir wild
is

Finally, zoos offer a unique training venue for future field or laboratory researchers. [redacted]dents can learn and observe specific behaviours displayed in a wide range of species [redacted]imum time and financial costs, compared to those incurred in field studies or [redacted]earch laboratories housing unusual species. Students can also learn data [redacted]nd implement them in research projects that they have created. It [redacted]research in zoos frequently has an immediate application both to [redacted] zoo and to the conservation of their conspecifics in the [redacted]ages to collecting data in a zoo that may [redacted]ent; for the most part these are [redacted]tage to overcome is zoo [redacted]animals' environment. This is [redacted] researchers (Hosey, [redacted]her's priority is the [redacted]trol. These [redacted]ds/day, [redacted]s to [redacted] including traditional topics such as conservation and animal welfare, but also supporting [redacted] areas like cognitive research, parasitology, and nutrition (for examples see Melfi, [redacted] and Caldwell, 2006).

[redacted] that one of the topics that would benefit from the naturalistic setting and the [redacted] maintained in zoos is research on social learning.

[redacted] live in social groups were chosen for this thesis. Since [redacted] species that would be more likely to learn from [redacted]. This thesis was naturally split further into [redacted] were chosen because as far back as [redacted] the key to finding human-like [redacted] animals were studied [redacted] contact with humans [redacted] with [redacted] generating [redacted]

1997). In captivity, Goeldi's monkeys are most successful living in breeding pairs with [redacted]ir offspring (Pruett-Jones, 1998). In these groups infants learn what to eat from the [redacted]nd juveniles learn from watching group members' proper parental and sexual roles [redacted]ik and Pooke, 1981). Young juvenile males that were separated from the [redacted]g these behaviours sired offspring but did not help in the raising of the [redacted]981). Furthermore, females taken from the group were also found [redacted]vations suggest that Goeldi's monkeys might learn through [redacted] know they have not been used in an experimental [redacted]arch on other species in their subfamily have [redacted]lso been found to possess other [redacted]1980) defined tool use "as the [redacted]lter more efficiently the [redacted] user itself when the [redacted] for the proper [redacted]g tool use [redacted] authors theorized that the reason why they preferred this was because it minimized the [redacted]tor movement needed, expending less energy. After this condition, the authors then [redacted] generalization to novel canes. They placed canes that varied in size, colour, [redacted] and material to see which ones the subjects would pick out. They found the [redacted] on the basis of their purpose (to pull in the food). Hauser concluded [redacted]ave a concept of at least some of the function involved in using [redacted]

[redacted]study with naive infants using the same methodology [redacted]etween functionality could be innate. However, [redacted]captivity has not been seen in tamarins or [redacted]rchers suggest that an alternative [redacted]ction by trial and error during [redacted]szy, 2005; Spaulding and [redacted]icated Hauser's [redacted]in the cane). [redacted]ets [redacted]," [redacted]

less mobile and less manipulative. They found species that are more explorative (lion
[redacted]arins, *Leontopithecus*) were less neophoic compared to species that are less mobile
[redacted]et, *Callithrix* and tamarins, *Saguinus*).

[redacted] Miller and Hauser (2003) showed tamarins different shaped and coloured
[redacted]ther if tamarins need to have physical experience with the tool to
[redacted]ies are important. In this procedure they showed tamarins an L-
[redacted] L-shaped tool and a straight tool (not functional) to see
[redacted]ey found the tamarins attended to the more functional
[redacted]when they didn't have access to the tool.
[redacted]ive in large groups of 15-30 normally
[redacted]ales (both related and unrelated) and
[redacted]owledge social learning in
[redacted]ve been found to follow
[redacted] and Byrne, 2004).
[redacted]ure and have
[redacted]earn
[redacted]

macaques (Baker and Estep, 1985; O'Brien and Kinnaird, 1997). However, to our [redacted]owledge there has not been a study of social learning or cognitive abilities of Sulawesi [redacted]sted macaques.

[redacted] have, however, been studies of social learning with other species of [redacted]hers studied Tonkean macaques (*Macaca tonkeana*) in two studies for [redacted] (Ducoing and Thierry, 2005). In the first study juveniles were [redacted]eat novel fruits and then given access to these fruits. There [redacted]arned feeding technique socially from their mothers in [redacted] to see if these subjects would learn socially if [redacted]ecifics' behaviour" (pg.116). They found [redacted] from members of their group, [redacted]ing.

[redacted] a semi-free environment. [redacted] climbit and then [redacted]is behaviour. [redacted]ld cause [redacted] different human facial gestures for 20 s preceded by a neutral face for 20 s they found that [redacted] macaques would imitate two (mouth open and tongue protrusion) of the five facial [redacted] To our knowledge this is the only study that has shown imitation in macaques.

[redacted]ition to tool use, macaques have been found to posses other cognitive [redacted]e of this is numerical abilities. According to Judge, Evans and Vyas [redacted]onvincing series of experiments with nonhuman primates is a [redacted] macaques by Brannon and Terrace (2000). In their [redacted] stimuli (pictures and dots of various sizes) in [redacted]ties of 1-9. They showed that rhesus monkeys [redacted] generalized this behaviour to numbers 1- [redacted]ical attributes of stimuli to determine [redacted]nding sequences" (Brannon [redacted]

[redacted] numerical symbols [redacted]et of two [redacted]ct could [redacted]ith [redacted] different amount of apples placed in one of two boxes, after which they could approach and [redacted] from one of them. In order to calculate which box contained the most apples, subjects [redacted]ep the information in their working memory because they could not see the pieces [redacted] placed in the box after the first trial (Sulkwoski et al., 2001). The authors [redacted]t picked out the larger amounts when given values up to four. [redacted] choose the larger amounts when given values larger than five. [redacted]ksi et al., (2001) studied subtraction in a semi-free ranging [redacted] showed the subject two platforms with varying [redacted] view of the subject and took a plum from one [redacted] or fewer plums then and took data on [redacted]ubject choosing only the side in [redacted]latforms where one side had less [redacted] then let the subject [redacted]keys can subtract [redacted]eriment).

[redacted]

There is much debate about what distinguishes domestication from the kind of [redacted] or training which can take place when wild animals have a close relationship with [redacted] (Zeder, 2006). The main topic in this debate is the difference between four [redacted] types: tame domesticated animals, individuals of domestic species that have [redacted] festyle (e.g. feral dogs), or wild-type-not domesticated- yet tame [redacted] d by humans or are tolerant of human approach), also referred to [redacted] imals, (Udell, Dorey, Wynne, 2008).

[redacted] famous study begun by Dimitri Belyaev in the late [redacted] om wild stock who were aggressive and fearful [redacted] ntense human interaction, emerged after [redacted] ation elite" (Trut et al., 2004). The [redacted] gressive-fearful reactions to [redacted] true in foxes it could be [redacted] s.

[redacted] it is [redacted]

[redacted] they could be part of a domestication elite); the species concerned all have the capability to [redacted] domesticated, and are domesticated to some extent in other parts of the world.

[redacted] our knowledge elephants and camels have not been studied in any experimental [redacted]tigate social learning. Although elephants have been tested in discrimination [redacted]hmidt, Nadal, and Squier, 1975; Savage, Rice, Branagan, Martini, [redacted] our knowledge camels have not been studied for any kind of [redacted]se species because of their history of close association [redacted]e in social groups.

[redacted]fferent setting than the rest of the thesis, we felt [redacted]luded. Using this species allowed us to [redacted]f the experiments described in the [redacted] zoos. A search in Web of [redacted] review of the literature [redacted] for objects [redacted]nd Dube, [redacted]a-

[redacted]

1.7 Discussion

One of the intentions of this thesis is to expand on current methodologies so that [redacted] be used in different settings. More specifically, the research will aim to find ways [redacted] cial learning from a psychologist's point of view in a zoo setting. Current [redacted] at many zoos state that separating social animals, even for a short [redacted] ed. Thus these methodologies need to be changed to [redacted] ot be separated. To solve this problem, we propose to train [redacted] two different behaviours in the presence of two [redacted] bjects to stay with their group and by having [redacted] a particular stimulus, will help differentiate [redacted] Furthermore, to deflect the criticism [redacted] is not (see Miklosi, 1999), we [redacted] so that we can determine [redacted] ose different [redacted] he spontaneous [redacted] haviour [redacted]

(Campbell, Heyes, and Goldsmith, 1998), ravens (Fritz and Kotrschal, 1999), carib [redacted] (Lefebvre, Templeton, Brown and Koelle, 1997), pigeons (Zentall, Sutton and [redacted] 1996), budgerigars (Dawson and Foss, 1965; Galef, Manzig and Field, 1986)], [redacted] (Whiten and Custance, 1996; Hayes and Hayes, 1952), gorillas (Byrne [redacted] (Russon and Galdikas, 1993)], monkeys [marmosets [redacted], capuchins (Custance, Whiten and Freidman, 1999)], and [redacted] Johnson, 1994)]. However, most of these studies have been [redacted] (for a list of criticisms, see Caldwell and Whiten, [redacted] (Zentall, Sutton, and Sherburne, 1996); [redacted] (Custance, 1999; Hayes and Hayes, [redacted] subjects in studies where results [redacted] and Whiten, 2002). So [redacted], which are mostly [redacted] is decreased even [redacted] literature, [redacted] include [redacted]

Another opportunity this research offers is helping to advance the animal cognition [redacted] by introducing the idea of imitation as an operant class. The field of behaviour [redacted] where most of the research on human imitation has emerged, uses similar [redacted] as animal cognition, but the two fields are not referencing each others' [redacted], the methodological rigour of behaviour analysis should be helpful [redacted] that has proved elusive in the way imitation has. For example, if [redacted] the first instance of an imitative behaviour subsequent [redacted] then be considered operantly conditioned, rather than [redacted] observer (which wasn't the case in our [redacted] has been found that imitation will [redacted], 1988; Heyes et al, 1993; [redacted] have avoided reinforcing [redacted] (1964) found that in [redacted] functional relations [redacted] responses [redacted] range of settings and species studied in this discipline. In addition, we intend to develop [redacted] methodology so that imitative learning research can be conducted in settings outside the [redacted] without the need to separate animals from their social groups. All of the above [redacted]pplement my overall topic, in which we hope to ask if, in the species studied, [redacted] generalized imitative behaviour and higher order operants can be

CHAPTER 2

[redacted]vidence of social learning in Diana monkeys and Sulawesi black crested macaque

[redacted]duction

[redacted]m of this study it to increase our knowledge of which species may show
[redacted]g two zoo housed Old World monkey species, Diana monkeys
[redacted]d Sulawesi black crested macaques (*Macaca nigra*), neither of
[redacted]nitation research previously.

[redacted]s have discussed the possibility of imitative learning
[redacted] claim to observe imitative learning are the
[redacted]imals are found to posse behaviours not
[redacted](for classic examples see, Fisher and
[redacted]f additional data to support
[redacted]conclusive evidence for
[redacted]orgen, et al, 2003).
[redacted]nowledge, has
[redacted]he group
[redacted]

Sulawesi black crested macaques (*Macaca nigra*). These species were chosen not only [redacted] they live in naturalistic social systems and living condition, but also because they [redacted] higher cognitive abilities.

[redacted] monkeys live in large social groups of 15-30 individuals (Bshary and Noe, [redacted] knowledge research on social learning in Diana monkeys has not [redacted] they have been known to watch other conspecifics in their group [redacted] and learn certain behaviours via social responses from [redacted] Seyfarth, 1997) and other species (Zuberbuhler, [redacted] *nigra*) live in groups of between 5 to 97 [redacted] availability (O'Brien & Kinnaird 1997; [redacted] social behaviour among [redacted] 1985; O'Brien and Kinnaird, [redacted] the cognitive abilities of [redacted] has shown that [redacted] trained to operate a manipulandum using different parts of their body, e.g. to open a [redacted] with foot or mouth, for which they obtain a reward. Naïve animals (observers) [redacted] into two groups. One group watches the first demonstrator operate the [redacted] using one method (e.g. open with foot) and the other group watches the [redacted] operate the manipulandum using the second method (e.g. open with [redacted] of observers have watched the demonstrators, they are given [redacted] observed. If more observers operate the manipulandum [redacted] use, more often than an alternative method, [redacted] observers has occurred. In the current [redacted] behaviours with either his mouth or hand [redacted] imitative if the observer's [redacted] demonstrator performed the [redacted], if the cue for choke [redacted] obtained a [redacted] any [redacted]

The Diana monkeys' inside enclosure measured 8m x 12m x 10m and contained a [redacted] swing, a rope hammock, various enrichment items, and a pool that was either empty, [redacted] water, or filled with enrichment items. The Sulawesi black crested macaques' [redacted] measured 8m x 12m x 10m and contained various rope hammocks, various [redacted] a pool that was filled similarly to the Dianas' pool.

[redacted] with the consoles were observed and recorded during: [redacted] consoles were available to all the monkeys, but [redacted] from each group was trained [redacted] to perform five different [redacted] cues; the number of training [redacted] eachbehaviour [redacted] dominated the [redacted] is most [redacted] was [redacted] of [redacted]

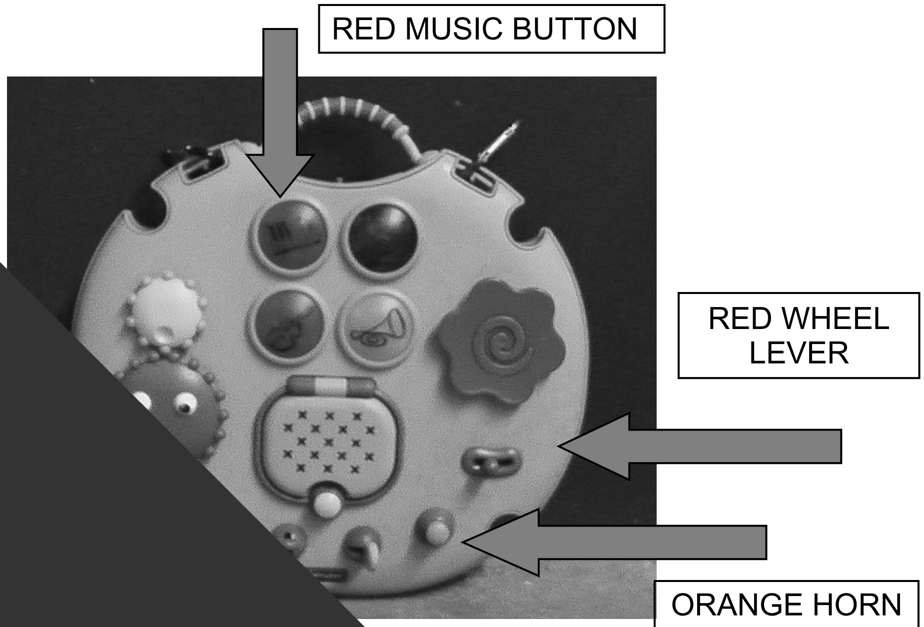
iv) Control sessions (n = 5), in this phase the session was conducted exactly like the [redacted] phase. The difference was that the demonstrator was not present in the inside [redacted], but lured outside; if he did come inside the session was suspended and restarted [redacted]. Grapes were given before the session began so that the others in the group [redacted] During these sessions grapes were given for any interaction [redacted] experimental session was over this had no effect on the [redacted]

[redacted]	Definition of behaviour
[redacted]	[redacted] digits flat on the gear [redacted] it in a vertical [redacted] direction.
[redacted]	[redacted] the choke [redacted] it in a [redacted] out [redacted] away [redacted]
[redacted]	[redacted]

attached to the wire windows, whichever came first. Training and experimental sessions [redacted] when the demonstrator correctly touched the left console with the correct part of the [redacted] (i.e. choke) with the correct part of his body.

[redacted] was first trained as a free operant (meaning it was not associated [redacted] and expression of the desired behaviour was rewarded with a [redacted] responded several times a cue was introduced and thereafter [redacted] after the appropriate cue had been given. The stimuli [redacted] cards, which showed different shapes and colours [redacted] the behaviour occurred reliably on cue, the [redacted] behaviours. When the probability of [redacted] of other trained behaviours [redacted] continued until all five [redacted]

[redacted] 12.7 x [redacted]



[redacted] *manipulanda the demonstrator was* [redacted]

[redacted] toys, which housed [redacted] affording the [redacted] observations [redacted] to the observer monkeys, so could be used by the observer monkeys at the same time that [redacted] demonstrator was interacting with 'his' console.

[redacted]**lts**

[redacted]

[redacted]trator was trained to perform five behaviours on cue. The number of [redacted]cording to how long it took to train the demonstrator to perform [redacted]monkey it took the demonstrator two sessions to trian the [redacted] gear, seven sessions to train red music button, four [redacted]sions to train red wheel lever.

[redacted]keygroup, one (Akea- the youngster) was [redacted]server console (Table 2.2). Of the [redacted]own to imitate two of them (the [redacted] $(1) = 11.37$, $p < 0.001$). [redacted]ions when the [redacted]made a [redacted]into the [redacted]

Akea					
Cue given to [redacted]	Number of time the demonstrator performed the behaviour in the presence of the observer	Number of times the observer was the next subject to respond (less than 20 sec) after the demonstrator	Number of times the observer responded to other cues	hand	mouth
[redacted]	116	21	5	11	5
[redacted]	26	0	0	0	0
[redacted]	[redacted]	0	0	0	0
[redacted]	[redacted]	23	1	21	1
[redacted]	[redacted]	0	0	0	0

[redacted] monkey, Akea, imitated the demonstrator; performed [redacted] body part and the incorrect behavior with the [redacted] the demonstrator performed the behaviour. It [redacted] performed the behaviour in the presence [redacted] respond was the observer and of the [redacted] to other cues. The other Diana monkey [redacted]

[redacted] the correct behaviour

[redacted] used the correct part of

[redacted] the console

[redacted]

Douglas					
[redacted]	[redacted]	Number of times the observer was the next subject to respond after the demonstrator	Number of times the observer responded to other cues	hand	mouth
[redacted]	[redacted]	99	81	16	2
[redacted]	[redacted]	23	16	1	6
[redacted]	[redacted]	16	7	8	1
[redacted]	[redacted]	[redacted]	0	0	0
[redacted]	[redacted]	[redacted]	0	0	0

[redacted]					
[redacted]	[redacted]	[redacted]	[redacted]	hand	mouth
[redacted]	[redacted]	[redacted]	[redacted]	4	0
[redacted]	[redacted]	[redacted]	[redacted]	0	0
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	0
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

imitate, matched the demonstrator's behaviour for a few of the five behaviours performed [redacted] the demonstrator. Douglas imitated three of the behaviours performed by the [redacted] (the gear cue χ^2 (1) =6.04, $p< 0.01$, hand to red wheel lever cue χ^2 (1) =32.31, [redacted] mouth to red music button cue χ^2 (1) =13.91, $p< 0.0002$). Whereas Aspen [redacted] behaviours, but his behaviour was not significant χ^2 (1) =1.46, $p< 0.2$ [redacted] $p< 0.1$ for red wheel lever.

[redacted] (Jasmine, Puzzle and Teak) of the 11 observers [redacted] cue given. Only 2 observers (Teak and Puzzle) [redacted] manipulanda (gear and red wheel lever) with the [redacted] (Jasmine) touched the correct [redacted]. All three fell below chance with [redacted] the apparatus being [redacted] during the [redacted]

[redacted] we [redacted] has [redacted]

then shown a novel behaviour to see if they will copy it. Previous research has shown that [redacted] infants are very good at this and will readily imitate an adult demonstrator between [redacted] of the time (Poulson and Kymissis, 1988). Although chimpanzees (*Pan* [redacted] also been found to readily imitate humans, studies have shown that they [redacted] actions of a behaviour they observe and don't seem to master, [redacted] of the behaviour; for example when the experimenter touches his [redacted] may touch his nose with this whole hand [redacted] is to see if we could train one of the [redacted] same behaviour they were observing) [redacted] and imitate other behaviours [redacted] behaviours of the [redacted] first [redacted]

Douglas and Akea were trained by using successive approximation and positive [redacted]nforcement. After the behaviour was occurring readily, the experimental condition [redacted]he experimental condition lasted 10 sessions. Akea was rewarded for touching the [redacted]r on the right console with her hand while the demonstrator was performing [redacted]e left console. Douglas was rewarded for touching the orange horn on [redacted] his hand while the demonstrator was performing this behaviour

[redacted] behaviour after the demonstrator a total of [redacted]ndition after seeing it performed by [redacted]ished after the third session and [redacted]Douglas was not seen to [redacted] imitation did not

[redacted] of 13 [redacted]

behaviours did not seem to depend on the total number of times the observer saw the [redacted] Rather, if imitative responding was seen at all, it emerged early in the [redacted] condition, and if anything it faded away rather than growing stronger with [redacted] Although only a minority of the observers (two Sulawesi black crested [redacted] monkey) spontaneously imitated some of the behaviours, these [redacted] for imitative learning within the species' repertoire. [redacted] across behaviours even after these subjects were [redacted] the demonstrators' behaviour.

[redacted] that have used the two action methodology [redacted] from the rest of the group; so the [redacted] at a distance from them and can [redacted] that this separation is [redacted] 1999, pg. 360), because [redacted] should include the [redacted] the current [redacted] stimulus enhancement. However, we controlled the other forms of social learning in other [redacted] First we used two identical consoles, one exclusively used by the demonstrator and [redacted] for the observers, thus controlling for stimulus/local enhancement. Second, the [redacted] were only trained to perform the behaviour as defined by its end result (e.g. [redacted] did not train specifics of the behaviour (e.g how they moved the [redacted] Third, we made sure that we only counted behaviours as imitative [redacted] the demonstrator had performed. If the demonstrator [redacted] then the observer had to do so as well for the [redacted] Even though there could have been slight [redacted] the reality was that the behaviours were [redacted] manipulate the console; because of [redacted] necessary. This may seem to [redacted] we would consider [redacted] "since the [redacted] methods [redacted] the fact that they were not in the subject's repertoire before the start of the experiment and [redacted] they did not receive reward after touching the apparatus, makes a strong case that the [redacted] that we did find is imitative learning. All of these additional controls allowed us [redacted] the behaviour we observed was imitative learning and not another form of [redacted]

[redacted] observers that were seen to imitate the behaviour performed by [redacted] Whether the age of the animals which successfully [redacted] performance of this phenomenon is hard to compare [redacted] methodology, because they either used [redacted], or do not compare the results of the older [redacted] of the researchers in this field [redacted] ability on the part of the [redacted] not finding it [redacted] change their [redacted] to imitate to [redacted] aspects of cognition, has been studied. Conducting imitation research in zoos will also [redacted] the animals to be studied in a more naturalistic environment where social animals are [redacted] contact with each other as they are in nature.

[redacted] next chapter I sought evidence for social learning in Goeldi's monkey, an [redacted] which belongs to a monotypic genus and has not hitherto been tested [redacted] methodology was used, however the apparatus needed to be [redacted] experiment to fit the species in manipulability and size.

CHAPTER 3

No evidence of imitative learning in a callitrichine, Goeldi's monkey (*Callimico goeldii)*

[redacted]ion

[redacted] explained previously, social learning is the process by which behaviour [redacted]uence the future actions of the same or similar behaviour in [redacted]pecies. In lay terms, all such social learning is grouped [redacted]re are several distinct mechanisms that can underlie [redacted] the interactions underlying the mechanisms [redacted]ng, scientists have defined terms like local [redacted]e will only describe the few terms [redacted]

[redacted]al enhancement (Thorpe, [redacted]onstrator draws the [redacted]ment is when [redacted]timulus. [redacted] do [redacted] learning such as “object movement re-enactment”. Social facilitation can induce capuchins [redacted] eat, but does not alter their choice of food items (e.g. Visalbergi & Addessi, 2000). It has [redacted] found that capuchins avoid toxic food from observing other members in the group [redacted] Addessi, 2001) and infants do not learn about novel foods from adults [redacted] & Galloway, 1997). Similarly a study with squirrel monkeys (*Saimiri* [redacted] they learned to avoid noxious foods, it was most likely done [redacted] evidence of social learning among the group (Fairbanks, [redacted]

[redacted] findings are very different. Golden lion tamarin [redacted] food by observing conspecifics, and [redacted] often then familiar foods [redacted] Offspring are less likely to [redacted] than being given it by an [redacted] (*S. labiatus*) [redacted] who had [redacted] has [redacted] correct part of the apparatus compared to those that observed a partial demonstration and [redacted] demonstration conditions. Similarly, Voelkl and Huber (2000) found that marmosets [redacted] *ix jacchus*) after observing a trained demonstrator opened a canister lid with either [redacted] hand, would imitate the method demonstrated.

[redacted] in social learning, between callitrichinae and other cebids, may be [redacted] in natural history, for example in group size or parenting [redacted] 2004). Marmosets and tamarins live in small family [redacted] of which assist in infant caretaking. In contrast, [redacted] ty individuals, where females raise their [redacted] di's monkey is more like that of the [redacted] Leigh, 1997). Thus we believe that [redacted] al learning. Those species of [redacted] for some forms of social [redacted] of family Cebidae) [redacted] 2004; [redacted] her [redacted] dominant member of the group to monopolize the apparatus. It also allowed imitation, if it [redacted] to be distinguished from other forms of social learning. Imitation was considered [redacted] if a monkey who observed a trained demonstrator's performance of a [redacted] matched the same pattern of body part and behaviour toward a [redacted] of social learning, such as stimulus or local enhancement, occurs [redacted] an incorrect behaviour (or the behaviour they were themselves [redacted]

[redacted] studied at the Paignton Zoo [redacted] three females (Kink 21 years old, [redacted] human contact the monkeys [redacted] of their enclosure. [redacted] of plexiglass [redacted]

The reason why the Legos differed in both shape and colour was to ensure that the
[redacted] fferences between them were salient for all individuals. Goeldi monkeys have
[redacted] phic colour vision, meaning that some individuals only have medium and long
[redacted] oto pigments (see Surridge et al., 2003). Although this should not affect the
[redacted] it might make colour differences less salient to some individuals than
[redacted] ifferences were intended to offset any such effect. *Preference*
[redacted] Fernandez, Dorey, & Rosales-Ruiz, 2000) was
[redacted] ld make the best reinforcer for the subjects
[redacted] ealworms, bananas, grape, bread, and
[redacted] ne were conducted, in
[redacted] n to interact with
[redacted] ink) went
[redacted] rst one to
[redacted]

baseline and were considered naive. The number of sessions, the targets presented, and the
[redacted]ponses reinforced at each stage are shown in Table 3.1.
[redacted]t the beginning of each session the appropriate numbers of targets were put in
[redacted] lasted 10 min. from when one of the subjects correctly touched their
[redacted]ddition to the assigned targets a black square target was always
[redacted]) to ensure that even from the beginning, the subject who was
[redacted]tween two tagets and 2) to allow the recording ofany
[redacted] it, as a measure of stimulus generalisation, bearing
[redacted]ver reinforced.
[redacted] successive approximations to the target
[redacted]ly reinforced with a conditioned
[redacted]f grape.
[redacted]ds, respectively a red
[redacted]haviourally defined
[redacted]me time. Tuff
[redacted]are with
[redacted]g
[redacted]

Stage	Sessions took to train individual	Number of sessions before behaviour was stable and new target was added	Targets available	Subjects reinforced
[redacted]	[redacted]	5	Black Red Green Yellow Blue	none
[redacted]	[redacted]	[redacted]	Black Red	Kink
[redacted]	[redacted]	[redacted]	Black Red Green	Kink Tuff
[redacted]	[redacted]	[redacted]	[redacted]	Kink Tuff Neat
[redacted]	[redacted]	[redacted]	[redacted]	Kink [redacted]

[redacted] *age of the* [redacted]

Generalized modelled response: the monkey's trained response was made to a [redacted]mulus other than its target, when another monkey had been reinforced for making that [redacted] to that target.

[redacted]alized non-modelled response: the monkey's trained response was made to a [redacted]its target, when no other monkey had been reinforced for making that [redacted]ch responses could be made either to a target to which another [redacted] making the alternative response (there were two such [redacted]ack target, which no monkey had been reinforced for [redacted]key's non-trained response was made to [redacted]einforced for making that response [redacted] response was made to a [redacted] for making that [redacted]nse was [redacted] explained by stimulus generalization, each kind of generalized responding should occur at [illegible] higher rate than the corresponding kind of non-generalized responding. Thus, this design [illegible] for the independent detection of stimulus generalization, stimulus enhancement, [illegible]tion.

[illegible] were successfully trained to perform the assigned behaviour to [illegible]ing the sessions spent attempting to train Neat's foot [illegible]sions to achieve their target behaviour. After training, [illegible]r assigned target and perform the correct [illegible]

[illegible]n five food items for each of the [illegible]l grapes (both chosen 6 of the 8 [illegible]out of 8 times they were [illegible]ad and grapes (both [illegible] times they [illegible]nted).

[illegible]

	Monkey				
	Kink	Tuff	Neat	Cork	Cork Example
[redacted]	Hand Red Vertical rectangle	Nose Green square	Hand Yellow horizontal rectangle	Nose Blue rectangle with curved extension	Nose Blue rectangle with curved extension
[redacted]	2.021 (2264)	2.383 (2431)	0.535 (332)	3.519 (1478)	Nose blue
[redacted]	0.013 (15)	0.011 (12)	0.000	0.014 (6)	Handle blue
[redacted]	0.150 (399)	0.048 (64)	0.017 (49)	0.016 (108)	Nose green
[redacted]	[redacted]	0.011 (64)	0.016 (49)	0.031 (108)	Nose yellow or red
[redacted]	[redacted]	[redacted]	0.005 (49)	0.032 (108)	Nose black
[redacted]	[redacted]	[redacted]	[redacted]	0.000	Handle green
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Handle yellow or red

[redacted]

[redacted] To a non-target	0.000	0.000	0.000	0.000	Handle black

[redacted]*le 3.2: Summarizes the rates of responding per minute* (number of responses for the [redacted] experiment divided by the total number of sessions that the target was available and [redacted]ssion length (10)). *made by each subject to all targets, during the entire* [redacted] *according to the response categories. Numbers in parenthesis are the total* [redacted]*onses made by that subject.*

[redacted]onses for each category were averaged across all sessions in which the [redacted]here a given class of response could be made to more than one [redacted]oloured stimuli (reinforced targets for other monkeys) are [redacted](not reinforced for any monkey) are shown as a [redacted]ch response(s) Cork would need to make for [redacted]he alternative response to their own targets [redacted]rpreted as imitative, but there is no [redacted]parison is available, there is no [redacted]onses were higher than [redacted]Neat there is a small [redacted]to stimuli that [redacted]er two [redacted] hand there is a small tendency for both modelled and non-modelled generalized responding [redacted]ccur at a higher rate than the corresponding type of non-generalized responding, so that [redacted] generalization does appear to have played a part in the monkeys' behaviour [redacted]get set.

[redacted] sample size was small (n=4), the design of the experiment aimed to [redacted] for subjects to observe each other interacting with the targets, [redacted] for us to observe any form of social learning. The subjects [redacted] with the targets through the entire experiment. [redacted]rvers and demonstrators at roughly the same [redacted]within the vicinity of the targets at times [redacted]ut the experiment, it was common to [redacted] but when this happened, the [redacted]never saw two subjects [redacted]reward by [redacted]ned, [redacted]em [redacted] confusing; it seems unlikely that it is explained either by phylogeny, or by the social [redacted]vironment. In both of these Goeldi's monkeys are closer to the other callitrichines, [redacted] imitate, than to the other cebids, which do not.

[redacted]rse the monkeys were never reinforced for imitative responding, if it had [redacted] not have been expected to be sustained. But if they had a strong [redacted]ould have shown at least a measurable rate of imitative [redacted] a measurable rate of generalized responding, despite the [redacted]or this either. Furthermore, in some ways the present [redacted] imitation, because the animals were kept [redacted], to “show the real effects of imitation in [redacted]this phenomenon in interacting [redacted] used allowed data to be [redacted]he experiment to see if [redacted] subordinate [redacted]baseline [redacted]eline. In [redacted] case) do not imitate the behaviour of a conspecific as readily as those that are food [redacted]rived (Dorrance & Zentall, 2001)

[redacted]ore types of social learning research should be conducted with Goeldi's monkey, [redacted]iased learning is always a collective outcome of interacting physical, social, [redacted]rs" (Fragaszy & Visalberghi, 2004, p. 24). It is necessary to try a [redacted]imental designs before concluding that a species is not capable of [redacted] at present, we must conclude that there is no evidence that [redacted]learning.

[redacted]mesticated animal chapters. Studies reporting [redacted]t with humans are better imitators than [redacted]ith humans could play a substantial [redacted]ing imitative ability (Galef and [redacted]fferent species (dogs, [redacted]dogs, none of [redacted]r these [redacted]any. [redacted]

CHAPTER 4

Indication of social learning from a demonstrator in a dog (*Canis familiaris*).

[redacted]duction

[redacted] previous chapters we tested the evidence of social learning in two Old World [redacted]d one New World primate species in a zoo. In the current chapter we [redacted]f social learning in dogs.

[redacted]easingly popular subjects for studies in animal cognition in [redacted]i, Topali and Csanvi (2004) studies using dogs have [redacted]. In fact, Bloom (2004, pg. 1605) says “For [redacted]” The increased popularity for using dogs [redacted]uch as they are easy to work with, [redacted]environments to humans, [redacted]domestication as the [redacted]ts of the [redacted]e over [redacted]ial [redacted] food in one of several opaque containers (all arecontrolled for smell). The experimenter [redacted]her looks at or points at the container that holds the obtainable piece of food. Human [redacted]an complete this task at about 14 months of age (Hare and Tomasello, 1999). [redacted]ave found that chimpanzees have difficulty solving this task (Call, Agnetta, [redacted]). However, dogs have demonstrated that they can follow a human- [redacted] al., 1998). To date, domestic dogs have been shown to use a [redacted]in locating a hidden item including: Variations on pointing [redacted]m (Miklosi et al. 1998; Miklosi, Pongracz, Lakatos, et [redacted]001; Hare and Tomasello, 1999) , head turning [redacted]998;), bowing (Miklosi et al. 1998;) and [redacted]

[redacted]hip dogs have with each other. A [redacted]llow the actions of a [redacted]ies could learn a task [redacted], 28, 38 and [redacted]od. After [redacted]at [redacted] puppies were placed into groups depending on how long they were raised by their mothers [redacted] whether their mother was trained to retrieve narcotics or untrained. Group one puppies [redacted] raised (taken from mother at 6 wks of age) and had untrained mothers. [redacted] had extended maternal care (taken from mothers at 12 wks of age) and [redacted] Group three puppies were standard raised and had trained mothers [redacted] mothers and had extended maternal care. In addition, for two [redacted] allowed to watch their mother be praised for retrieving [redacted] times a week for 15 min. a day.

[redacted] into standard police dog training classes for [redacted] At 6 months of age the puppies were [redacted] was scored (on a scale of 1-10) on [redacted] at hand) and how well they [redacted] and success of [redacted] of narcotics for [redacted] later.

around a fence were more likely to follow that way than dogs who did not watch a [redacted]monstrator (Pongracz et al., 2001, 2003, 2005; Kubinyi et al., 2003).

[redacted]ooney and Bradshaw (2006) conducted two experiments to examinewhat dogs [redacted]hing dog-human interactions. In the first experiment dogs watched a [redacted]trator and a human playing tug of war during which various outcomes [redacted]g and signalling indicating play vs. non-signalling. For the [redacted]t in a chair and gently stroked the demonstrator dog. [redacted]thought to contain little status related to social [redacted]ted how the observer dogs reacted to each of the [redacted]d that observer dogs gained information [redacted]he players (e.g. submissive behaviour [redacted]h observers were more likely to [redacted]roach sooner than they [redacted]

[redacted]ifics and [redacted]

gone through domestication they have most likely undergone neotenisation, the [redacted]olutionary process whereby juvenile characteristics are retained into adulthood, which [redacted]w them to increase their learning capability. Their third theory, and one that has [redacted]d in a number of papers (Hare & Tomasello, 2005; Miklosi, et al., 2004; [redacted]Vida, & Csanyi, 2005), is that dogs live in a human environment and [redacted] ability to interpret some human behaviours through natural or [redacted]volution of the species (Miklosi et al., 2004).

[redacted]hapter was conducted to see if dogs would imitate [redacted] a conspecific demonstrator perform a pedal [redacted] A two-action methodology (see chapter [redacted]ll (2003) states that this method can [redacted] (pg. 92) and “provides for the [redacted]Zentall, 2006, pg. 344).

[redacted] none of these [redacted] with a [redacted]th [redacted]

A total of 27 dogs (*Canis familiaris*) were used in this experiment of which two dogs were [redacted]igned the role of demonstrator with the remaining 25 dogs were categorised as [redacted]s. The observers varied in breed and age (see Table 4.1 for details); and were all ≤ [redacted]nd 11 different breeds were represented.

Dog's name	Breed Type	Age	Dog's name	Breed Type	Age
[redacted]	Springer Spaniel	2 years	Tesse	Jack Russell	10 years
[redacted]	Springer [redacted]	1 year	Daisy	Boxer	7 months
[redacted]	[redacted]	2 years	Paddi	Border Terrier	3 years
[redacted]	[redacted]	[redacted]	India	Weimeraner	2 years
[redacted]	[redacted]	[redacted]	Cholmondley	Labrador	7 months
[redacted]	[redacted]	[redacted]	[redacted]	Lurcher	5 years
[redacted]	[redacted]	[redacted]	[redacted]	Labrador	1 year and 5 months
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	7 months
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	9 months
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

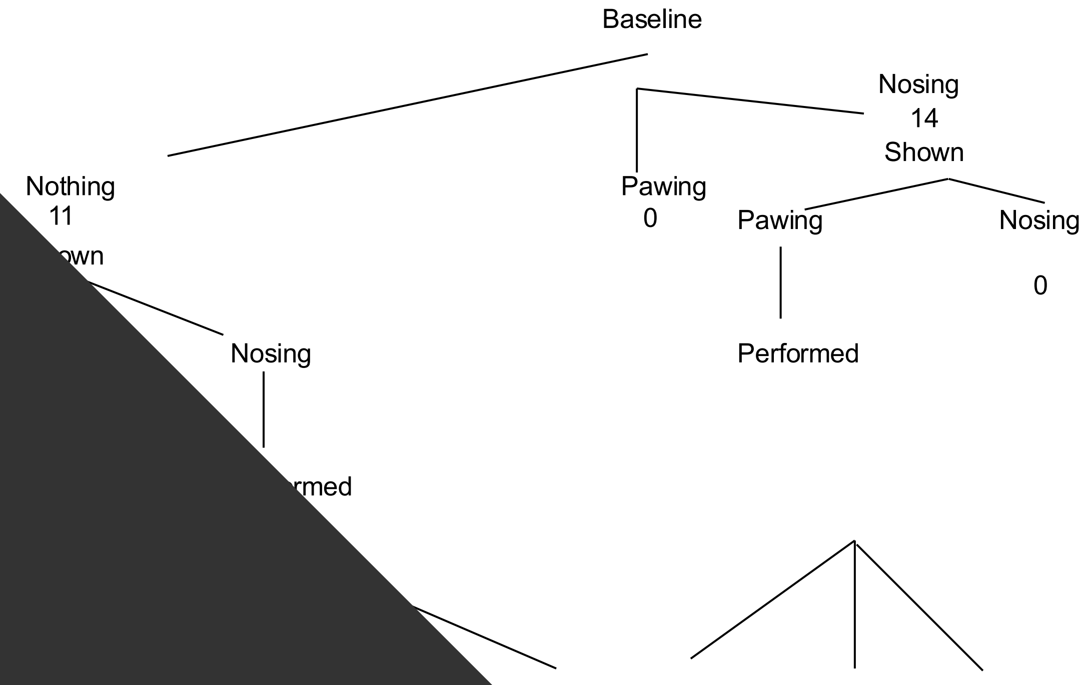
The experiment was held in a room within the Canine Etiquette facility. The room [redacted] 7 m x 7 m and contained chairs, video cameras and the testing apparatus. During the [redacted]here were four people (caretaker of the dogs, videographer, time keeper and [redacted] in the room along with the demonstrator dog.

[redacted] a wooden box (0.6 X 0.6 m) with a pedal that could be pushed [redacted]he apparatus was placed in the middle of the room so that [redacted] pedal was pushed down and what part of the dog's [redacted]

[redacted] down fully either with their nose or [redacted]ximations with positive [redacted]eriment began and were [redacted]

[redacted]eline, [redacted]

Following baseline, the appropriate non familiar demonstrator dog was brought in.
[redacted] observer had to be looking in the general direction of the demonstrator before a
[redacted] ation began. The observer saw the demonstration 5 times. Observers in the nose
[redacted] demonstrator push down the pedal with its nose five times and those in the
[redacted] emonstrator push down the pedal with its paw five times. Food reward
[redacted] nstrator once the pedal was fully down. The reinforcement
[redacted] otdogs. After the observation sessions the demonstrator dog
[redacted] ed down (Clorox hand wipes) and the observer dog
[redacted] bserver dog was given 5 min. in the room to
[redacted] ng conditions was identical to those in the
[redacted]). None of the observer
[redacted] All of them
[redacted] aw
[redacted] ter these
[redacted]

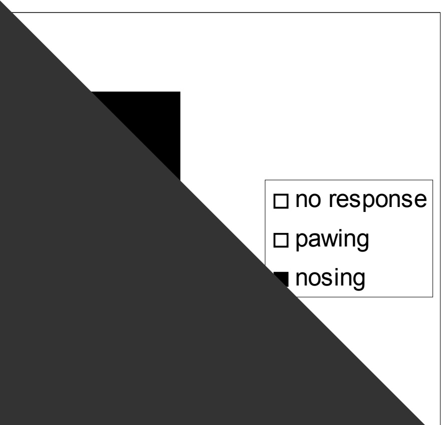

Baseline
Nosing
14
Shown
Nothing
11
Pawing
0
Pawing
Nosing
0
Nosing
Performed
[redacted]

[redacted] Nosing Pawing Nothing
[redacted] 7 1 6

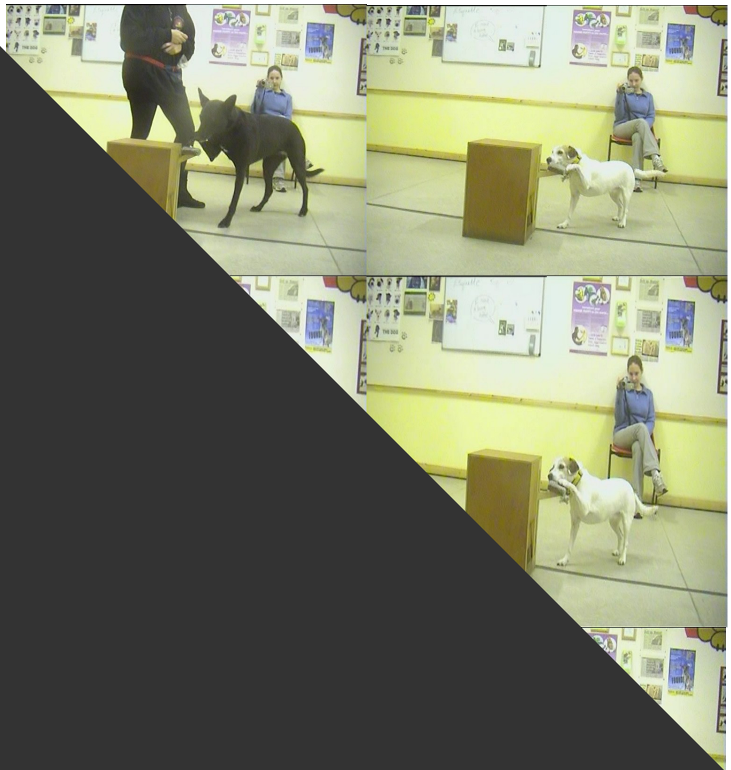
[redacted] wing Nothing Nosing Pawing Nothing
[redacted] 2 4 0 1

[redacted] *break down of the observers' response during baseline, what behaviour*
[redacted] *the demonstrators and their responses after watching the*
[redacted]

[redacted] logs that saw a paw appeared to press the pedal down with
[redacted]) or not respond (occurred in 2+6=8 dogs) as opposed
[redacted] tor (occurred 0+1=1dog). Similarly, dogs that
[redacted] pedal down with their nose (occurred in 4
[redacted] osed to pressing the pedal with their
[redacted]



[redacted]



performing paw push and Tessa pushing the pedal with her pawafter seeing the demonstrator.

[redacted]fter seeing the demonstration, Tess began to use her paw and Cholmodley began [redacted] to press down the pedal. However, we could only class one of these as [redacted]ecause imitation is judged by how closely the movement of the [redacted] movement of the observer (Miklosi, 1999). Chomodley did not [redacted] that of the demonstrator (Fig. 4.3). He used his nose to [redacted] demonstrator dog used more of its chin to push the [redacted]Cholmodley possibly showed emulation [redacted]sion of the pedal, rather than attempting to [redacted]cement (responding to the same [redacted]tor); whereas Tessa showed [redacted] Tessa used a different [redacted]

[redacted]the pilot study [redacted]uire [redacted]

1997). Furthermore, many studies have shown that dogs learn from watching humans [redacted]iklosi et. al. 1998; Pongracz et al.2001, 2003, 2005; Kubinyi et al., 2003; Miklosi et al., [redacted]proni et. al. 2001; Hare and Tomasello, 1999).

[redacted] this we conducted another experiment.

[redacted]vas run for a number of reasons. First, to see if there was a [redacted]seline (run with the same subjects as are subsequently used [redacted]ondition (run with different group of subjects). Both [redacted] tendencies of the species.A baseline was used [redacted]nstrator's behaviour was not novel, but the [redacted] second reason why this experiment [redacted]eady be in the dogs' repertoire [redacted]vas to see if there would [redacted] we wanted to see if [redacted]lemonstrators.

[redacted]

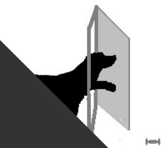
	Observer			Observer			Control group	
[redacted]	[redacted]	Age	Dog's name	Breed Type	Age	Dog's name	Breed Type	Age
[redacted]	[redacted]	2 yrs. old	Enzo	Retriever	2 yrs. old	Resse	Dachshund	3 yrs. old
[redacted]	[redacted]	3 yrs. old	Cider	Springer spaniel	4 yrs. old	Rex	Pitt	5 yrs. old
[redacted]	[redacted]	[redacted]	Merlin	Shi tzu	3 yrs. old	Gibson	Boxer	6 yrs. old
[redacted]	[redacted]	[redacted]	Xochitl	Australian Shepard	11 yrs. old	Jackson	Unknown mix	5 yrs. old
[redacted]	[redacted]	[redacted]	Jack	Lab mix	18 mon.	Chloe-3	Bichon Frise	3 yrs. old
[redacted]	[redacted]	[redacted]	[redacted]	Lab mix	3 yrs. old	Wookie	Bichon Frise	2 yrs. old
[redacted]	[redacted]	[redacted]	[redacted]	Husky	2 yrs. old	Jesse	Lab mix	1 yrs. old
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	3.5 yrs. old	Lolita	Pit bull	4 yrs. old
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Arlo	Austrailan shepard	5 yrs. old
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Kia	Huskey	2 yrs. old
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Unknown mix	10 yrs. old
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	Rhodesian Ridgeback	7 yrs. old

collie			Collie	
[redacted]oodle	2 yrs. old	Larry	Unknown mix	16 mon.
[redacted]og	3 yrs. old	Camilo	Tenn. Mt. dog	9 yrs. old

[redacted]*s table shows a summary of the dogs used as observers and ones used in the* [redacted] *It includes their names, breed type and age (rounded to the nearest* [redacted]

[redacted]or measuring 0.6 m x 0.6m with a baby gate (1.5m [redacted]ehind the door. The apparatus was placed as [redacted]oms varied in size from 4.3m x 5.5m to [redacted]

[redacted]frame with the door [redacted] through the [redacted] with no [redacted]from [redacted] removed from the room and the observer dog was placed in the gated area. The dog was [redacted] called to come through the door by saying the dog's name and "come on." No other [redacted] or reinforcement was offered. The observer dog was given 2 min. to open [redacted]



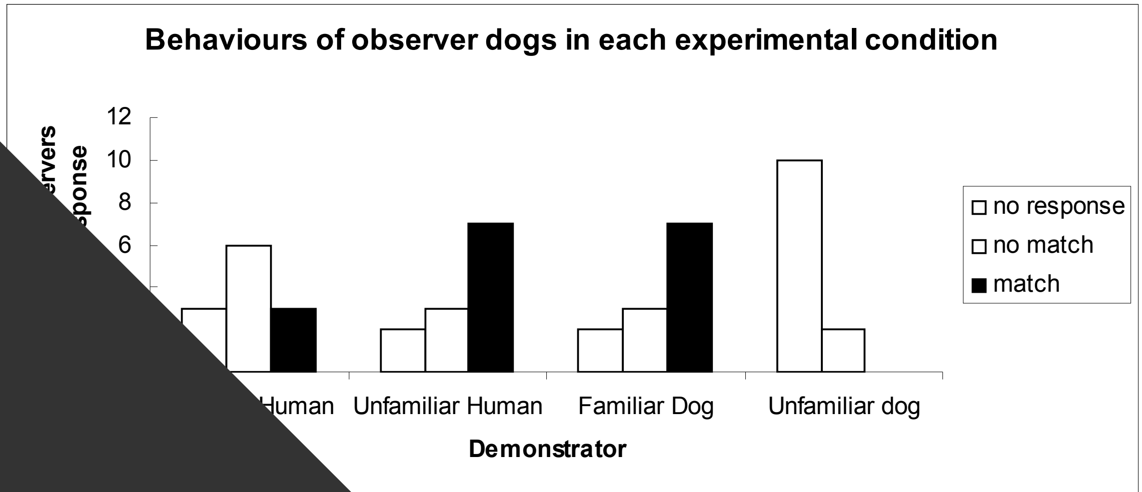
[redacted] *opening the door with her paw as* [redacted]

[redacted] Dog [redacted] recognized [redacted] demonstrator was the author. In this condition the human opened the door on instruction, [redacted] experimenter said "good," gave the demonstrator a piece of cheese and closed the door [redacted]

[redacted]ition

[redacted]l condition a naive group of 12 dogs saw no demonstrator. Prior to [redacted] each dog was led through the door frame with the door open, [redacted]ation. The dog was then placed in the gated area and called [redacted]in the testing conditions).

[redacted]e significance of the effects of [redacted] exact tests were used because [redacted]d frequencies were less than [redacted]te. Figure 4.5 shows the [redacted]ponse or a matching [redacted]sponse as the [redacted]



[redacted] making responses after watching either a [redacted] human demonstrator, a familiar dog [redacted]

[redacted] demonstrator, we found three [redacted] of the demonstrator and six [redacted] was an [redacted] the demonstrator [redacted] not [redacted] those that made a matching response and those that made a non-matching response. The [redacted] tribution between these two groups did not differ between experimental groups.

[redacted] igure 4.6 shows the proportion of responses made for each type of demonstrated [redacted] e, nose or paw) pooled across the four demonstrator types (dog and human; [redacted] liar). Of the 12 dogs in the control condition (where there was not a [redacted] ened the door with their nose and 6 dogs paw. Dogs that watched [redacted] ith her paw, opened the door more with their nose then they [redacted] all. When watching a nose demonstrator, the [redacted] more than they did with their paw or not respond [redacted] icantly different between experimental and [redacted] tor affected the likelihood of making [redacted] onse, watching a demonstrator [redacted] l groups, the [redacted] by the observer [redacted] nstrator.

[redacted]

4.4 Overall Discussion

An interesting finding is that in both experiments very little imitation was found [redacted]mitation that was found was not statistically significant with both human and [redacted]monstrators. These results could be due to the fact that we used a variety of [redacted]imals that came from different living arrangements. Research has [redacted]rences among breeds and differences in the same breed depending [redacted]e breedlives in (i.e. same breed could be either a show dog, [redacted]ent (Scott and Fuller, 1965) and differences within [redacted] trainability (Serpell and Hsu, 2005).

[redacted]w “some imitative abilities” after [redacted]rchers state that “there is less direct [redacted]Bradshaw, 2006, pg. 72). It is [redacted]y age they have a short [redacted] et al. (2003) [redacted] they are less [redacted]

An interesting finding is that both experiments show the observer dogs using their
[redacted]es to manipulate the apparatus more than they used their paws. This could be due to
[redacted] the demonstrator repeatedly get food for opening the door. Research has shown
[redacted]ometimes associate a stimulus with food and thus treat it the same way
[redacted]and King, 1982; Timberlake, 1983). In a few studies with rats,
[redacted] they used bal bearings as a token to obtain food, the rats
[redacted] it into their mouth, and run to the end of the chamber near
[redacted]ewed, dropped, and retrieved the bearing for lengthy
[redacted]lake, 1983, pg. 309). Further research needs to
[redacted]sing their mouth more was because they
[redacted]hed the demonstrator receive.
[redacted]dogs that are used to working
[redacted]on is more frequent in
[redacted]decrease in
[redacted] new and has
[redacted]n how
[redacted]

to manipulate objects like dogs, we went for a simpler methodology, but still incorporating slightly altered two action method.

[redacted]HAPTER V

[redacted]idence of social learning in a group of Bactrian camels (*Camelus bactrianus*)

[redacted]ion

[redacted]ction plays an important role in assisting the development of adaptive [redacted]th humans and other social animals (Boyd and Richerson, 1988; [redacted] social interactions can provide an opportunity for social [redacted]s by which behaviour by one individual can influence [redacted]haviour in another individual of the same [redacted]at can underlie social learning, and in an [redacted]anisms involved within the broader [redacted] local enhancement, stimulus [redacted]w terms that are pertinent [redacted]

[redacted] and stimulus [redacted]he

[redacted]

humans are better imitators than their wild-born conspecifics, suggesting that experience [redacted] humans play a substantial role either in enhancing imitative performance or in [redacted] imitative ability (Heyes and Galef, 2004); there is also the possibility that [redacted] to domestic condition has led to a greater tendency to imitate (Heyes and [redacted] definition of domestication has not be agreed upon by researchers, [redacted] will be defined as the relationship between humans and [redacted] all aspects of the protection, movement, reproduction and [redacted] done over several generations.

[redacted] in close proximity to humans have been [redacted] These studies have found that these [redacted] et al., 2001, 2003, 2005; [redacted], Viranyi, and Huber, 2007); [redacted], 1995; Topal, Byrne, [redacted] the [redacted], 1984). [redacted]

Palestine around 1100 BC. At least since then, camels have been a major part of human life [redacted] parts of Asia, Africa and the Middle East and have been used for military operations, as [redacted] or riding animals and as a source of milk or even food (Wilson, 1984; [redacted] and Dagg, 1981).

[redacted] live in social groups up to 30 that are found in mountainous, rocky [redacted] in size and composition with each area and season [redacted] They have more body mass and shorter legs than the [redacted] which makes them more suitable for cold climates. [redacted] Afghanistan, Siberia, Mongolia, and Northern [redacted] meters), but coexist and may interbreed [redacted] 1981).

[redacted] abilities. However, there has [redacted] claim that camels [redacted] to live or were [redacted] Dagg, 1981).

[redacted] desert, it [redacted]

older group members. The zoo housed Bactrian camels (*Camelus bactrianus*) were trained [redacted]perform different responses (nose and hoof) to different stimuli (targets placed on the [redacted]nd on the fence). These responses were chosen to facilitate the zoo's husbandry [redacted]mme.

[redacted]eriment, changes needed to be made from that of other social learning [redacted]th domesticated animals. These changes ensured that the camels [redacted]t possible in the zoo environment where they were studied) [redacted] the group to monopolize the apparatus. Finally, these [redacted]ure to the stimuli and the opportunity to respond, [redacted]erved, it would be possible to say with [redacted]ent of the social life of the species.

[redacted]ianus) housed at [redacted]rmel (7 year [redacted]ghter).

[redacted]

Apparatus

Targets consisted of a wooden 0.6 m x 1.27 m pole with a wooden shape at the end of it (each shape was painted a different colour). In total there were six targets, three used for nose training (white triangle and blue square) and three used for hoof training (red triangle, white square, blue circle). Three of the targets were assigned to a camel, and the other two (red triangle hoof target and a white triangle nose) were used to control for stimulus/local enhancement. All targets were attached to the fence by a carabiner clip and rope. Nose targets were hung at a height of 1.2 m and foot targets were laid on the ground (see figure 5.1 for diagram).

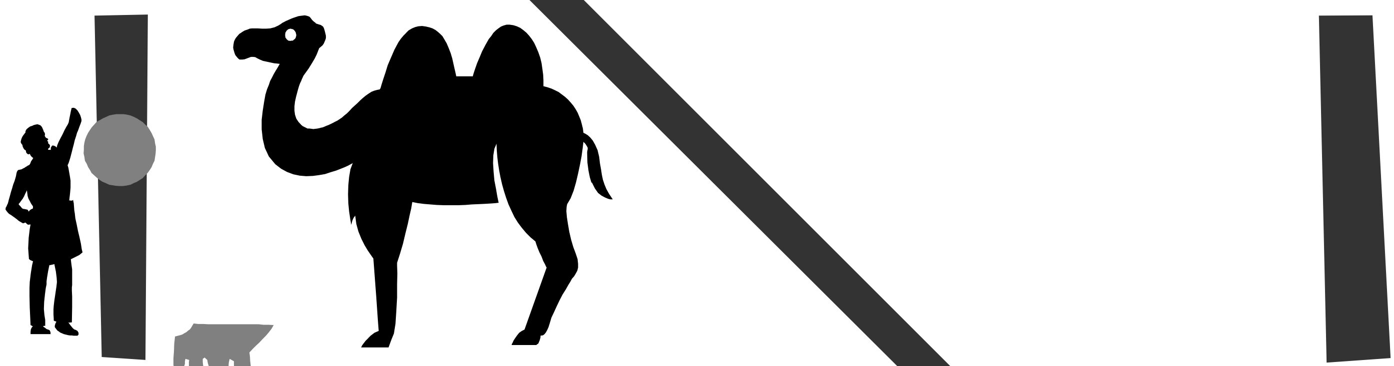


Figure 5.1: Shows a diagram of the experiment all set up. The experimenter was behind the chain link fence while the nose and hoof targets were assessable to the camel.

Procedure

Before training began, five sessions of baseline were conducted in which all five targets were present, to see if there was any predisposition to interact with any of them. In training, a multiple baseline across subjects design (see Hersen and Barrow, 1976) was used.

Each behaviour was trained using successive approximations to the target behaviour (Johnston and Pennypacker, 1993). Each correct approximation was immediately reinforced with a conditioned reinforcer (click) and a primary reinforcer of a

[redacted]

firs[redacted]

D[redacted]

behaviour to a[redacted]

order Carmel, Osca[redacted]

nose. Nosing was defined [redacted]

second. Carmel and Alice were [redacted]

respectively, with their right hoof to p[redacted]

hoof touching the target for more than a se[redacted]

and hoof behaviours at the end of the experimen[redacted]

behaviours.

In addition to the assigned targets a red triangle hoo[redacted]

nose target were always present, for two reasons: 1) to ensure tha[redacted]

the subject who was being trained had to choose between two targets ([redacted]

discrimination) and 2) to allow the recording of any trained behaviours, from[redacted]

and untrained subjects, that might occur to it, bearing in mind that no behaviour to[redacted]

them was ever reinforced for any subject.

[redacted]

[redacted]	[redacted]
Blue Circle hoof target	[redacted]
Blue Square nose target	[redacted]
Red Triangle hoof and White Triangle nose	[redacted]

Table 5.1: Shows the targets assigned to [redacted] *targets used as controls.*

After the behaviour of the camel currently [redacted] next camel and their target were added and training began[redacted] subjects' targets were still present until the end of the experime[redacted] Carmel's behaviour was well established, training Oscar began, but [redacted] reward making correct responses to her target. The number of sessions, the [redacted] presented, and the responses reinforced at each stage are shown in Table 5.2.

[redacted]

2	[redacted]		
3	Carmel and Oscar	[redacted]	
4	Carmel, Oscar, and Alice	77-116	[redacted]

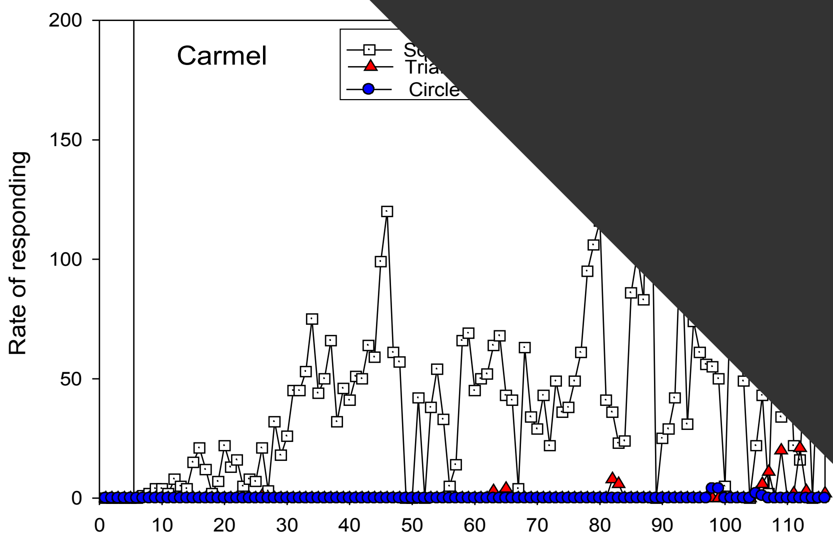
Table 5.2: The sessions each subject could participate in, and [redacted] available, at each stage of the experiment.

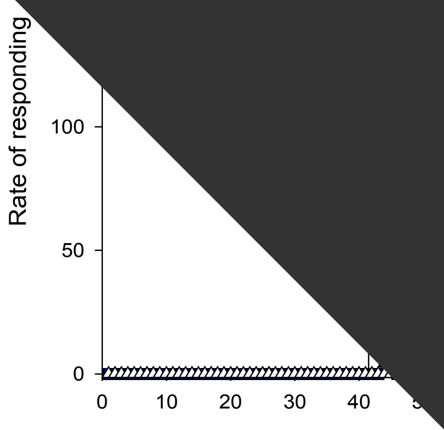
At the beginning of each session the appropriate numbers of targets were put [redacted] place. Sessions lasted 10 min. from when one of the subjects correctly touched their assigned target. All sessions were video taped and data were collected from the tapes after the session was completed.

5.3 Results

All four subjects were successfully trained to perform the assigned behaviour to their assigned target. It took the subjects between five to 14 sessions to achieve this. The subjects were more likely to respond to their assigned target and perform the correct behaviour than any another combination of events.

the[redacted] training) [redacted] the white squa[redacted] increase in the 29th [redacted] 86th session before averag[redacted] starting training.




Rate of responding
100
50
0
0
10
20
30
40

[redacted]

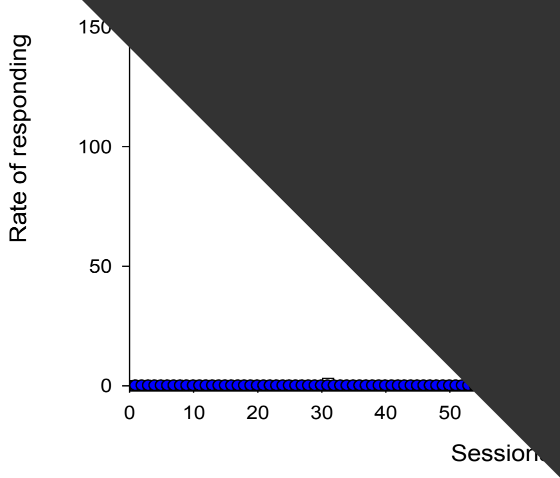


Figure 5.2: Shows the rate of responding per sessi[redacted]
trained behaviour. It also shows James' responding a[redacted]
training) towards the targets available. Note that James[redacted]
demonstration. Vertical lines show the transition from base[redacted]

After 36 sessions of Carmel's initial training, Oscar was [redacted] touching his nose to the blue square target. Oscar started to increase h[redacted] average of five responses to 35 in the eighth session. Oscar's highest respon[redacted] responses in the 100th session, whereas, in a couple of session Oscar didn't respon[redacted] target at all. Oscar only touched his hoof to the target twice in the entire experiment; a[redacted] behaviour he was not trained to perform and responded to the incorrect nose target (white triangle) 57 times during the experiment.

After 38 sessions of training Carmel and Oscar, Alice's blue circle hoof target was added and she was trained to touch her hoof to this target. Alice started to touch herhoof to the blue circle target in the first training session with 11 responses which increased to a high of 86 responses in session 109 before averaging about 48 responses in the final 5 sessions prior to James starting training. In addition to Alice responding to her own target correctly she also nosed Oscar's target twice and the unassigned white triangle nose target

[redacted]

tria [redacted]

Ja [redacted]
perform both ([redacted]
performing those be [redacted]
triangle target and after fiv [redacted]
make sure he could discriminat [redacted]
sessions James exclusively responded [redacted]
per session. After he was trained to respons [redacted]
put his nose to a circle target. After his respondin [redacted]
session) the circle target was added to the rest of the o [redacted]
responded the circle nose target exclusively with a rate of 1 [redacted]

Table 5.3 shows rate of responses per minute made by Ca [redacted]
all targets and the type of social learning each would indicate. It should [redacted]
physically impossible for the camels to a touch their hooves to the nose targe [redacted]
response could be made to the hoof targets. Two of the non-target stimuli (white tr [redacted]
for nose behaviour and red triangle for the hoof behaviour), were not assigned to any ca [redacted]
in the group. Thus no behaviour towards them could be either imitative or stimulus/local enhancement. The other targets were assigned to other camels with in the group. If the camels are able to imitate, each kind of modelled response should occur at a higher rate than the corresponding kind of non-modelled response. For James, modelled responses should have occurred more on assigned targets than non assigned targets. If local or stimulus enhancement occurs, non-modelled responses should occur at a lower rate to the non-assigned targets than to the other targets. Different stimuli were available for different

[redacted]

[redacted]

[redacted]

stimulus other than [redacted]

response to that target [redacted]

Generalized [redacted]

stimulus other than its target, when [redacted]

response to that target. Such responses [redacted]

camel had been reinforced for making the [redacted]

for Oscar and one such target for Carmel and Alice), [redacted]

camel had been reinforced for contacting.

Incorrect response to own target: This could only occur [redacted]

non-trained response (nose) was made to their own target.

Non-generalized modelled response: Oscar's trained response (nose) [redacted]

stimulus other than his target.

Non-generalized, non-modelled response: This could occur if Alice, Oscar, or Carmel made a non-trained response to a stimulus other than its target, when no other camel had been reinforced for making that response to that target (i.e. touching the triangle targets) or if Oscar made an untrained response to any of the nose targets. Such responses could be made either to a target to which another camel had been reinforced for making a different response, or to the non-assigned targets.

not [redacted]

correct st[redacted]

[redacted]

[redacted]				
Incorrect response [redacted] target	[redacted]			
Generalized modelled response	[redacted]			
Generalized non-modelled response				
To another animal's target	N/A	[redacted]		
To a non-target	0.079	[redacted]		
Non-generalized modelled response	0.00	N/A	[redacted]	
Non-generalized, non-modelled response				
To another animal's target	0.000	0.002	0.002	[redacted]
To a non-target	0.000	0.000	0.005	Nose to [redacted] Triangle

Table 5.3: Responses averaged across all sessions in which they were available. Where a given class of response could be made to more than one stimulus, rates to the different stimuli (reinforced targets for other camels) are added, and rates of the unassigned stimulus (not reinforced for any camel) are shown. The final columns shows which response(s) by Carmel would fit each category, as an example.

Oscar had the highest response rate at 4.5 responses per min. for his trained behaviour to his target. Oscar did perform the trained hoof behaviour to Carmel's target, but at a very low rate of 0.002 responses per minute. Other then his assigned target, the of [redacted]

C[redacted]

rate of 4.0 [redacted]

but did respond to [redacted]

0.079 responses per [redacted]

Alice had the lowest [redacted]

responding at 3.6 responses per [redacted]

behaviours on most targets, but rates of [redacted]

responses per minute to the white square hoof [redacted]

Table 5.4 shows rates for James's responding. [redacted]

responses per minute for the hoof target and 1.8 responses [redacted]

Before training his rates were very low with the highest rate of [redacted]

responses per minute on Oscar's blue square target.

Reinforced response	Nose	Hoof	Stimuli [redacted]
After training	1.850	1.400	[redacted]
Before training (No reinforcement)			[redacted]
Possible imitation			
To hoof targets	N/A	0.003	Hoof to White Square or Blue Circle
To nose target	0.017		Blue square
Possible stimulus enhancement			
Nose to hoof target		0.005	White square, blue circle or red triangle

Table 5.4: Rates of responding per minute across all sessions in which they were available for James.

[redacted]

watching [redacted] been any expe[redacted]

This experim[redacted] learn the behaviour of the [redacted] social groups have been found [redacted] chimpanzees) what food to eat (for ex[redacted] vocal calls to make (for example, Powell, [redacted] adult members.

This experimental design meant that James wa[redacted] experiment and was trained only at the end to prove that he[redacted] hoof touching behaviours at a high rate. During the experiment J[redacted] group members' targets. However, the highest response rate was 14 no[redacted] Oscar's target across the 80 sessions that the target was available and the lo[redacted] Carmel's hoof target (4 touches across the 116 sessions the target was available). [redacted] one of these responses are above chance rate.

Rates at which Alice and Carmel made alternative responses to Oscar's target were non-negligible, and these responses could be interpreted as imitative, but there is no standard of comparison for them. Where there is a standard of comparison, there was no evidence of imitation: There is no sign that rates of modelled responses were higher than rates corresponding non-modelled responses. There is also little evidence for local or stimulus enhancement: for all the camels as the rate of responding to targets assigned to other camels were no higher than to the corresponding non-assigned targets.

[redacted]

soc [redacted]

would be [redacted]

could be that c [redacted]

at other tasks to see [redacted]

evidence makes it less like [redacted]

life of domestic camels, or in th [redacted]

In the next chapter I investiga [redacted]

I found very little evidence for social learni [redacted]

one more domesticated species. However, this pa [redacted]

elephant thus making it difficult to use a two action m [redacted]

other “gold standard” method for investigation imitation, th [redacted]

This methodology also let me test any evidence of a higher order [redacted]

[redacted]

6.1 Intro[redacted]

In the [redacted] we conducted an ex[redacted] experiment we found imi[redacted] generalized imitation can be vi[redacted] individual behaviour may be under a [redacted] the group (see section 1.4.1 for explanation[redacted] in a well trained animal with centuries of domes[redacted] one hand, adapted to be responsive to human comman[redacted] Udell, Dorey, and Wynne, 2008), and on the other might ha[redacted] order strategies for dealing with new commands through formal t[redacted]

The “do as I do” methodology has been used for investigating [redacted] in children for decades (Baer & Sherman, 1964; Poulson, Kymissis, Reeve,[redacted] Reeve, 1990; Young, Krantz, McClannahan, & Poulson, 1994). In this method a [redacted] trained to match a few gestures of the demonstrator for reinforcement (i.e. the demonstr[redacted] raises her/his hand and the subject raises his/her hand) on the verbal command of “Do this” or “Do it”. After the subject reaches criterion on the trained behaviours a novel behaviour is added that has not been trained to see if the subject will spontaneously imitate the behaviour. Successfully copying a novel demonstration is taken as evidence of understanding the rule needed for imitative performance.

To our knowledge the first formal experiment with animals to use the ‘do as I do’ methodology was Hayes and Hayes (1952). In this experiment they taught a chimpanzee

[redacted]
acti[redacted]
the subj[redacted]
behaviours tha[redacted]
well in response to t[redacted]
mentioned, the Hayes an[redacted]
scientifically adequate detail o[redacted]
(pg. 841)”. Thus since this study a[redacted]
(Moore, 1993), dolphins (Herman, 2002a,[redacted]
Myowa-Yamakoshi & Matsuzawa, 2000). The [redacted]
few behaviours under the command ‘do this’. After th[redacted]
(which varies between experiments) the subject is shown n[redacted]
the demonstrator with the command ‘do this”. If the subject ma[redacted]
response to the human performing the behaviours and the verbal comm[redacted]
be evidence of generalized imitative learning.

The “do as I do” methodology is advantageous for three reasons. First, it [redacted]
to the two action methodology, both of which control for local/stimulus enhancem[redacted]
(when the actions of the demonstrator draws the attention of the observer to a particular stimulus) because “arbitrary actions were presented instead of solutions to technical problems” (Custance et al., 1995, pg. 840), so the researcher can tell true imitation from other types of social learning. Second, this methodology also controls for contagion (a behaviour -probably instinctive- performed by the demonstrator tends to act as a releaser for the same behaviour in an observer e.g. yawning), because a large number of actions can be reproduced. With each added action the likelihood that the behaviour is being produced

the [redacted] imitation, [redacted] generalized [redacted] behaviour the [redacted] across many different [redacted] subject learns this relationship [redacted] operant. Finally, with this method [redacted] just looking to see if it does so [redacted]

There are many responses that animals [redacted] merely, if ever, emitted spontaneously. By putting [redacted] repertoire we are increasing the likelihood that this type of [redacted]

Elephants were chosen for this experiment for four [redacted] been previously used to study social learning in an experimental [redacted] anecdotal evidence in field studies (see Sukumar, 2003 for examples), [redacted] animals, they have been domesticated and researchers have shown they [redacted] cognitive ability. In the following paragraphs we will elaborate on these facts.

Elephants are among the most advanced social organizations known amongst mammals (Norton, 1994; Lee and Moss, 1999). Group sizes range from 2-35 individuals for African elephants (*Loxodonta africana)* and fewer than 5 individuals for Asian elephants (*Elephas maximus)*. However these group sizes can vary and have been known to reach over 100 individuals. Group size has been known to decrease due to the lack of food and water and increase for protection, mainly against humans (Sukumar, 2003). Calves are thus born into a stable family unit where females stay with the group their entire lives and

[redacted]

The [redacted] to it, from its long [redacted] for her family group. [redacted] and survival of her family. [redacted] by her daughters and [redacted] generations this knowledge (Sukumar, [redacted] complex social life that reaches into this [redacted] 2003, pg 125).

Domestic animals are important in studying social [redacted] Researchers have found that chimpanzees who have had [redacted] better imitators than their wild-born conspecifics, suggesting that [redacted] play a substantial role either in enhancing imitative performance or in [redacted] ability (Heyes and Galef, 2004); there is also the possibility that genetic [redacted] domestic condition has led to a greater tendency to imitate (Heyes and Galef, 2004). A single definition of domestication has not be agreed upon by researcher, so for this paper domestication will be defined as the relationship between humans and animals in which humans control all aspects of the protection, movement, reproduction and food (Clutton-Brock, 1994) and have done over several generations. Elephants are thought to have been domesticated as early as 3000 B.C. (Sukumar, 2003). Even though elephants are skittish by nature they can be trained to put up with just about anything if they trust their handler

[redacted]

goo[redacted]

In[redacted] mammals (Na[redacted] 1994; Romanes, 188[redacted] elephants have been show[redacted] 1994), use tools such as twigs f[redacted] (Sukumar, 2003) and are able to reco[redacted] Reiss, 2006). However, self recognition in [redacted] argued against the existence of self recognition, [redacted] Povinelli's study did not find evidence of self recogni[redacted] mirrors that the elephants couldn't touch.

In summary, elephants live in complex social world and a[redacted] research in cognition (Schulte, 2000). The purpose of the present study [redacted] wanted to see if generalized imitation could be learned through the "do as I d[redacted] methodology. Second we wanted to see if the subjects were able to discriminate be[redacted] the different commands given to them. Discrimination tasks have been the favoured method of assessing perceptual and cognitive capabilities in animals (Jeffery, 2007). This could be because "discrimination tasks are easy to administer and score, and provide ready data in the form of easily quantified learning curves" (Jeffery, 2007, pg 213).

6.2 Method

Subjects and Setting

The subjects in this experiment were one Asian elephant (*Elephas maximus*), Gay and one African elephant (*Loxodonta africana*), Dutchess aged 30 and 38 respectifvely.

Env [redacted] were dur [redacted] sessions were [redacted] decade. All the train [redacted] head keeper. The role of t [redacted]

Sessions were conducte [redacted] m² and consisted of heavy iron walls [redacted] there was a cage that was filled with hay d [redacted] enclosure there was a blue barrel that was used a [redacted]

During the training phase, (though not the bas [redacted] reward (apple and/or banana) was used along with a conditi [redacted] of these were also used in the daily training sessions conducted fo [redacted]

Procedure

Behaviours that were going to be used for the subjects to model and t [redacted] which these behaviours were presented for both phases were chosen by the trainer [redacted] experimenter. Both had prior experience of the elephants' behaviour gained from them [redacted] watching the behaviour of the elephants. They independently ranked the behaviours in order from easy to difficult, and a final order was determined by discussion. These behaviours were then presented to the elephants in an order so that the level of difficulty was alternated. The reason for alternating the behaviour difficulty was so that if a learning curve was seen it should not be due to the fact that the behaviours were getting easier, and also so that we wouldn't lose the elephants' interest by giving them a series of difficult behaviours.

[redacted]

tra[redacted]

trainer [redacted]

were counted [redacted]

resembled the [redacted]

that the trainer had [redacted]

would have been considered [redacted]

than 5 correct behaviours occurred [redacted]

approximations. Once the percent correct [redacted]

behaviour was added to the pool of already [redacted]

started for a new behaviour. During baseline there [redacted]

All but a few sessions were video taped. Data were [redacted]

were checked for accuracy later from the video.

Phase two: Gay was the only subject that participated in this [redacted]

we used the same behaviours that were used in the first phase except we [redacted]

together, thus the elephant was to perform two behaviours simultaneously (lift [redacted]

cross legs). This phase was conducted to see if the would be easier for imitation or discrimination if the behaviours were sequences of elements that were already in the animal's repertoire. The procedures were the same as phase I, except the behaviours were combinations of those trained in phase one.

6.3 Results

Dutchess, the African elephant, continued in this experiment until it was recognised that cataracts were affecting both of her eyes and she could no longer see the experimenters clearly. Thus all the data presented are of Gay's performance.

beh[redacted]

behaviou[redacted]

were presente[redacted]

Demonstrated Beha[redacted]		
Single behaviours		[redacted]
Lift leg (LL)	[redacted]	[redacted]
Cross legs (CL)	[redacted]	[redacted]
Lift trunk (LT)	[redacted]	[redacted]
Lift something w/trunk (LST)	18[redacted]	[redacted]
Shake head (SH)	153	[redacted]
Lower head (LH)	61	[redacted]
Combination behaviours		[redacted]
Lift trunk and Lift leg (LTLL)	175	[redacted]
Cross legs and Shake head (CLSH)	192	[redacted]
Lower head and lift trunk (LHLT)	83	[redacted]
Lower head and Shake head (LHSH)	47	

Table 6.1: The number of trials for each behaviour after training for the entire experiment in the order they were trained for both phase one and phase two.

Table 6.2 shows the percent of hits (correct behaviours made by Gay) and false positives (behaviour was made but was incorrect for the command given, e.g. demonstrator lifted his leg and Gay crossed her legs) for each behaviour, averaged across all sessions after training had begun with the relevant command. For the single behaviours, *lift trunk* and *lift something with trunk* ended up being the ones that were most reliably expressed con[redacted]

easier fo[redacted]

of *cross legs* a[redacted]

Behaviour performed	[redacted]	[redacted]
Single behaviour		
Lift leg (LL)	[redacted]	[redacted]
Cross legs (CL)	[redacted]	[redacted]
Lift trunk (LT)	[redacted]	[redacted]
Lift something w/trunk (LST)	6[redacted]	[redacted]
Shake head (SH)	60.3[redacted]	[redacted]
Lower head (LH)	76.0%	[redacted]
Combination behaviour		
Lift trunk and lift leg (LTLL)	71.1%	[redacted]
Cross legs and shake head (CLSH)	46.8%	10[redacted]
Lower head and lift trunk (LHLT)	58.3%	16.7%
Lower head and shake head (LHSH)	69.6%	0%

Table 6.2: The percent hits and false positives for each behaviour, averaged across [redacted] *sessions after training had begun with the relevant command. The behaviours are list*[redacted] *the order in which they were trained. Only the first response made after a command was* [redacted] *counted.*

The graphs show the percent correct (number of times the behaviour was performed correctly in the presence of the demonstration/the number of times the demonstration was presented) of each behaviour across all sessions (Figure 6.1). The vertical lines indicate the phase change between baseline and training and the gaps indicate sessions when the behaviour was not modelled, not all behaviours could be modelled in all sessions because of time constraints. As shown by the graphs, Gay did not spontaneous imitate any of the

[redacted]

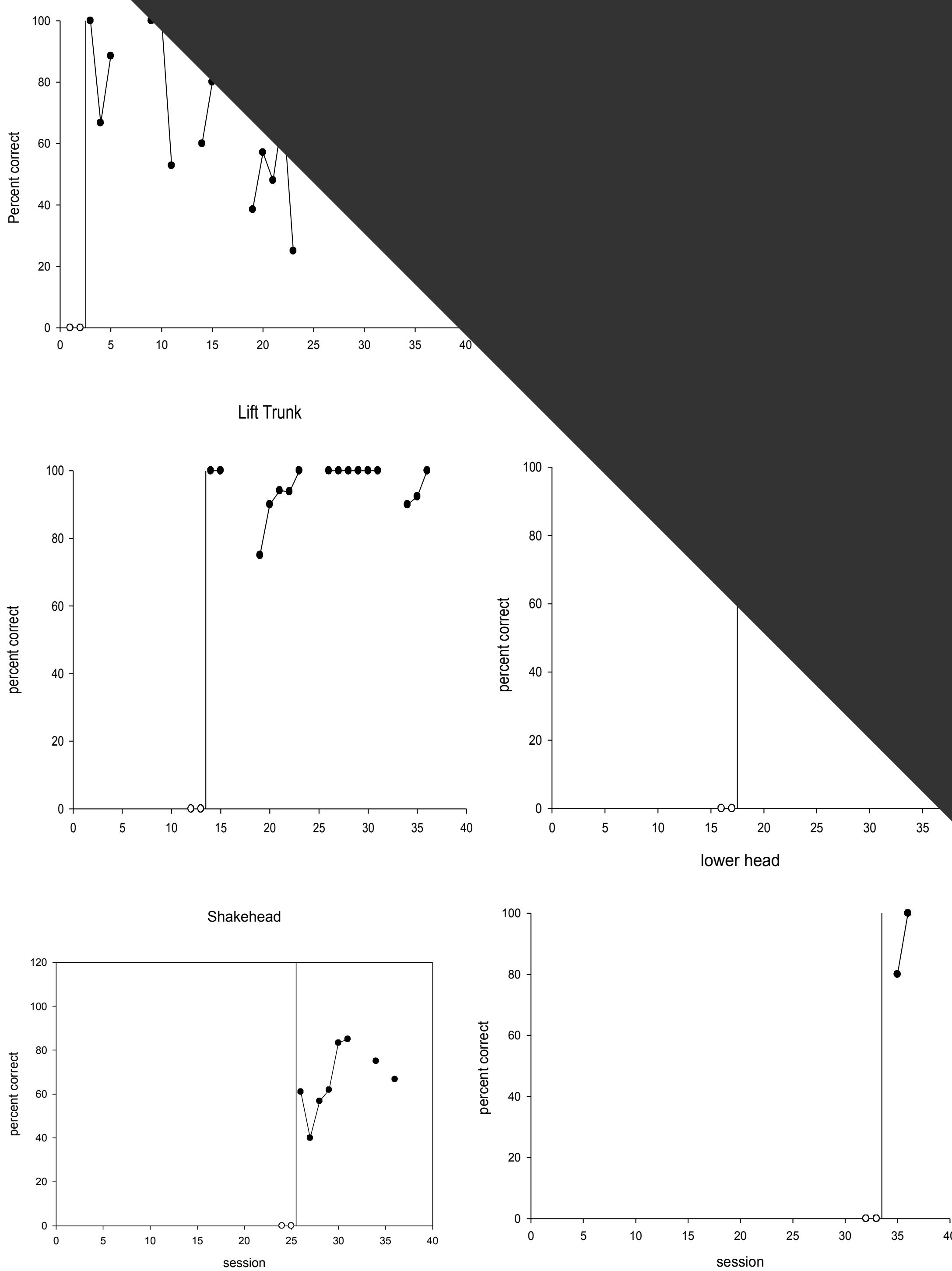


Figure 6.1: The percent correct across sessions for all the behaviours trained in phase one. The vertical lines indicate the phase change betweenbaseline and training and the gaps

[redacted]

behaviours [redacted]

except for the [redacted]

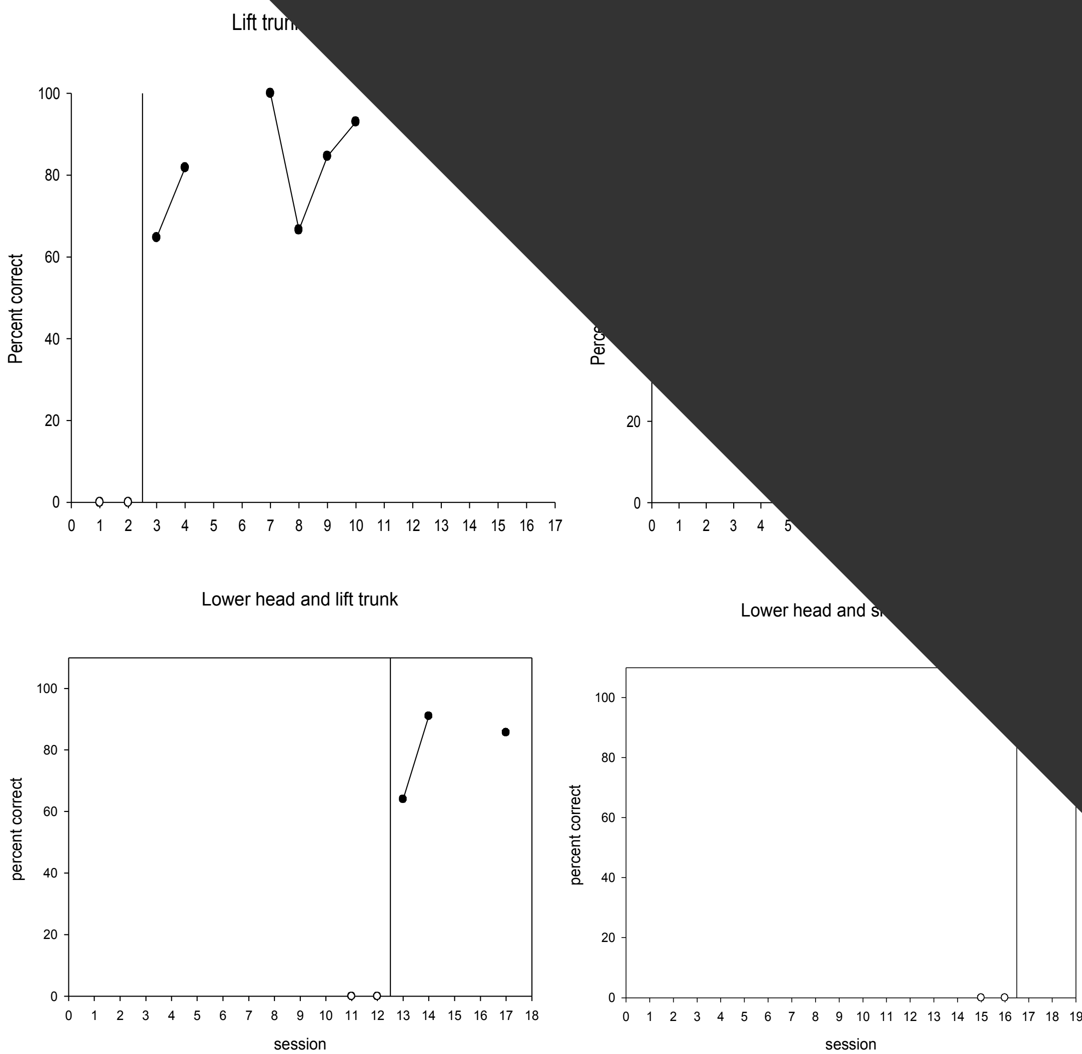


Figure 6.2: Shows the percent correct across session for all the behaviours trained in phase two. The vertical lines indicate the phase change between baseline and training and the gaps indicate sessions when the behaviour was not modelled, not all behaviours could be modelled in all sessions because of time constraints.

6.4 Discussion

Gay was successfully trained to perform all the behaviours, however generalized imitation did not emerge after training 10 behaviours (both single and combination) under [redacted] in t[redacted] behaviou[redacted] behaviours the [redacted] movement. Second, [redacted] leg or the head keeper’s a[redacted] perceived the responses she was [redacted] perception requires a self concept and [redacted] such a concept (Plotnik et al., 2006), this re[redacted] with a single elephant, and a previous study (Pov[redacted] awareness.

Although the results did not show imitation, the res[redacted] Gay’s ability to discriminate between different commands includi[redacted] commands. In previous studies of elephants the level of observed discri[redacted] limited. Elephants have been known to discriminate between light and dark ([redacted] Markowitz, Schmidt, Nadal, and Squier (1975) and objects (Rensch, 1957; Savage [redacted] 1994). We gave Gay 10 commands and found that she had more difficulty discriminating [redacted] between the combination commands than she did with the single commands. The percent correct for the single behaviour phase (with the exception of cross legs) was at 100% in the first sessions after training, whereas with the combination behaviours the percent correct was at 60% or below (with the exception of shake head/lower head combo). The combination commands may have been more distinct because there were two behaviours occurring in sequential order. In Savage et al. (1994) the objects the elephants were asked to discriminate were household objects (soda can, brick, spoon) and they found elephants [redacted] wh[redacted] trials to [redacted] be because ges[redacted] due to elephants' po[redacted] vision and are dichromati[redacted]

This current experiment[redacted] collection, some as long as a month, [redacted] effects. Gay's ability to perform the correct[redacted] than when she was participating in the experime[redacted] remember the commands even after months of not tak[redacted] and perhaps Asian elephants, could possess a rather good lo[redacted] suggested by Markovitz et al. (1975). However more research nee[redacted] the limits of this ability.

Although this study did not succeed to demonstrate imitative learning[redacted] elephant, the results add to the small pool of research on elephant cognitive abilitie[redacted] Further investigation needs to be conducted to find the extent of these abilities. In particular the animals' capacity for discriminating and producing sequences of body gestures seems worth further investigation.

[redacted]

7.1 Over[redacted]

Of 11[redacted] this thesis, only 5 in[redacted] suggest that, though socia[redacted] acquisition of particular respons[redacted] acquisition of behaviour in general, a[redacted] Gibson, 1999), especially behaviour throug[redacted] environment.

Although some psychologists feel the need to [redacted] understands the actions of another, this thesis has not conclu[redacted] being evidence of an animal possessing a theory of mind. Instead [redacted] conclusions from the field of behaviour analysis, who believe that scie[redacted] observerable behaviour and not theorize what is going on in the animals min[redacted] by extending the range of settings and species in which it has been studied. In add[redacted] new variation of the 'two action' method was developed to allow for imitative learning [redacted] research to be conducted in settings outside the laboratory without the need to separate animals from their social groups.

7.2 Summary of results

Only species that naturally live in social groups were chosen for this thesis. Since the topic is social learning, choosing species that would be more likely to learn from watching their conspecifics was the most logical. This thesis was naturally split further into studies of domesticated animals and primates. Primates were chosen because as far back as

[redacted]

beh[redacted] because [redacted] their wild-born [redacted] plays a substantial r[redacted] ability (Heyes and Galef, [redacted] domestic condition has led to a [redacted] 2004).

In the Goeldi's monkey experiment[redacted] which allowed for the independent detection of [redacted] enhancement, and true imitation. No evidence of imit[redacted] found despite extended exposure to the conditions, in contra[redacted] obtained from other callitrichines (e.g. marmosets, *Callithrix jacc*[redacted] lids). It appears that this group of callitricicts do not always show social[redacted]

This outcome makes sense if you consider the natural behaviour of G[redacted] monkeys. In the wild, Goeldi's monkeys are seen to disappear into the trees when a[redacted] observer approaches (Pook and Pook, 1979). In my observation while conducting the experiment we found the monkeys to beevasive at first. Thus I had to spend a few weeks just sitting on the floor in front oftheir enclosure before they habituated to my presence. They are clearly attentive to the presence of other individuals, whether of their own or a different species. However, detailed analysis of video records, and analysis of session by session data, show that, although they interacted frequently with the targets and with each other, at no point did the monkeys give the appearance that they were attending to and copying each other's behaviour. Research is now being conducted at Paignton [redacted] and [redacted]

manipula [redacted]

In the [redacted] both groups. Two su [redacted] the Diana group were fou [redacted] However, imitative behaviours [redacted] Furthermore the tendency to imitate [redacted] were trained and given a reward after imita [redacted] interesting observation made in the experiments [redacted] imitate the demonstrator's behaviour were juveniles. [redacted] sense for the juveniles to be the ones that watch and copy th [redacted] group as this is a faster way to learn about their environment. In [redacted] adults more when they are younger and decrease this time as they age ([redacted] Ritchie, 1994), although other research has found no affect (see Prescott and [redacted] Smith, 1999).

In addition to studying non-human primates we also studied domesticated anima [redacted] In the first study we used one of the longest domesticated species, the dog. We conducted two experiments with this species. In the first experiment we used a pedal as the apparatus and let the subject watch a demonstrator operate it in one of two ways (either with its paw or with its nose). In this condition we found one dog out of 25 showed convincing evidence of imitative learning. This is after a baseline where she did not touch the apparatus, showing that the behaviour wasn't previously in her repertoire.

[redacted]

was [redacted] used in [redacted] Both are [redacted] comparison will [redacted] to deflect the criticism [redacted] condition is the more widely [redacted] conducted was to see if choosing an [redacted] would increase the dogs' chances to learn [redacted] be a difference between human and conspecific [redacted] there would be a difference in responding between [redacted]

Unlike that found with the macaques and Diana's [redacted] show the nose and paw behaviour during baseline in both [redacted] not respond in baseline, we did not find significant signs of social [redacted] the dogs responded significantly less in the presence of an unfamiliar dog. A [redacted] that was found in cats (Chesler, 1969) and such findings have been used to explain [redacted] Thorndike's results (Wynne, 2004). This suggests that dogs find an unfamiliar [redacted] demonstrator distracting. This is a factor that has not been studied with any species, but one that might affect the results when conducting these types of experiments since most social groups live together in hierarchies. It seems worth investigating further what kinds of demonstrators are more likely to be copied. For example, would a subordinate dog pay attention more to another subordinate or a dominate dog? This line of research was not able to be perused within the scope of this thesis.

[redacted]

This [redacted] data were [redacted] any of the [redacted] method used in this [redacted] social learning, but other [redacted] should look at other behaviours [redacted]

The final experiment was [redacted] However, because we were limited in [redacted] by using a 'do as I do' method, which would [redacted] learning.

The results of this experiment did not produce any [redacted] However, this could be due to a number of reasons. First, we were [redacted] subject to follow a human who has a different body shape and has [redacted] to pay attention to their movement before. Second, we were limited on the [redacted] behaviours we could match and perhaps did not have enough behaviours for the [redacted] pick up on what we were asking her to do.

7.3 Is the low rate of imitation surprising?

Thorndike (1898) was unable to find evidence of imitation in chickens, cats, dogs and monkeys that he brought into his laboratory, though all learned by trial and error. He interpreted these failures to imitate and their ability to learn by trial and error as animals' inability to solve problems (Galef, 2004). Today many studies claim they have found imitation and have moved the study of imitation in animals "beyond a theoretical, autonomously motivated search for evidence of a phenomenon to ask what is imitated, who [redacted] 295[redacted] then Gal[redacted]

Within [redacted] all researchers in the[redacted] evidence of theory of min[redacted] others. Of course social learning[redacted] behaviour, but only “true imitation,” [redacted] the action for the demonstrator, can be evid[redacted]

For just over 100 years psychologists, ha[redacted] that time only a handful of researchers have been able [redacted] animal’s ability to imitate the actions of a demonstrator (By[redacted] 2005; Zentall, 2006). In addition, these experiments have rarely b[redacted] replicated. This lack of evidence may not be the result of the lack of be[redacted] repertoire of nonhuman animals, but rather the limited definition that that fie[redacted] confined themselves to and the strict methods that they use in their search.

Since Thorndike’s first and simplest definition of “learning to do an act from see[redacted] it done”, psychologists have sought to answer once and for all whether species can or cannot imitate and in the process havemade the definition more complex. Zentall and Galef (1988) attempted to distinguish imitation from other forms of social learning. However, others disagreed with their fundamental distinctions and have created their own (see Whiten and Ham, 1992). Zentall (2004), however, took a different approach altogether and defined imitation by describing what imitation is not. Thus, “imitation is a form of social learning that remains when one has ruled out or controlled for all of the alternative [redacted] con [redacted] Furtherm [redacted]

In addi [redacted] others have shown [redacted] differences in analysis, in [redacted] been conducted with the “gold [redacted] only four studies have found imitation [redacted] Akins and Zentall, 1996, with Japanese qu [redacted] and Huber, 2000 with common marmosets).

For some of these studies there might be other [redacted] imitation. Voelkl and Huber (2000) showed marmosets either [redacted] its mouth or one that opened a film container with its hand after w [redacted] demonstrator. The authors found that “common marmosets copied the [redacted] of a conspecific demonstrator to open a Kodak film canister” (p 200). Howev [redacted] to the table provided both mouth and hand opening occurred in all but two subjects [redacted] mouth group (see table 7.1).

[redacted]

	[redacted]	[redacted]
Hand	KL	[redacted]
	SU	[redacted]
	VI	[redacted]
	GI	[redacted]
	SH	[redacted]
	Mean	[redacted]
Control	Mean	[redacted]

Table 7.1: Reproduction of table from [redacted] *nose-near-lid approaches, mouth-opening and* [redacted] *and the discrimination ratio (the number of* [redacted] *number of opened canisters) are shown for session 1.* [redacted] *of opened canisters is shown, as all canisters were* [redacted] *control group (N=11) only the mean values are shown" (p* [redacted]

In fact some of the subjects in the mouth group used their [redacted] more (NI for example had 13 hand openings and only 2 mouth openings). [redacted] provided for the first trial which might have given us a true sense of which [redacted] would have occurred naturally after watching the demonstrator. Furthermore, in the [redacted] they counted subjects' data twice. According to the method section they only had 6 observers total for the mouth demonstration condition and 5 observers for the hand demonstration conditions (see Figure 7.1). However if you add the number of subjects

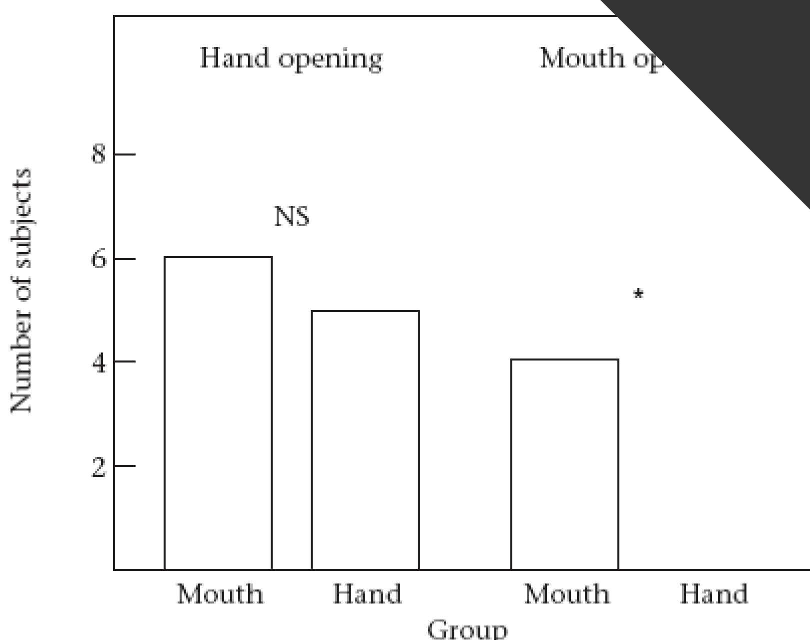


Figure 7.1: Reproduced graph from Voelkl *and Huber, 2000. "Number of observers that opened the canisters at least once by hand (Hand opening) or by mouth (Mouth opening) during the first test session. Six observers saw a mouth-opening demonstrator (group Mouth) and five saw a hand-opening demonstrator (group Hand). * P<0.05." (p 199)*

What they did was let each individual open 15 canisters and counted all the methods of opening the canisters. We wonder what the data would look like if they counted

[redacted]

[redacted] who used a [redacted] method. In this [redacted] watch a demonstrator [redacted] and showed the chimps which [redacted] observed demonstrations there was [redacted] copy the demonstrator's behaviour. The [redacted] learning. However, Tomasello (1996) argues [redacted] to open the device by emulation, and not imitation. [redacted] the observers are not learning the exact way in which to [redacted] only learning the end goal (in this case to obtain food that is in [redacted] (2006) argues that these findings can be accounted for by affordance [redacted] actions of the demonstrator have detectable different effects on the [redacted] experiments that set out find imitative learning most of the time actually find [redacted] of social learning or social facilitation (for example Caldwell and Whiten, 2004).

In looking through the literature there is an interesting trend towards an increase in responses made with the body part the animal would typically use to obtain food. Of the experiments that were conducted using the two-action methodology, most of them show a preference for the behaviour the animal naturally uses to obtain food. Akins and Zentall (1996, p. 318) report "overall mean frequency of pecking was greater than that of stepping". Dorrance and Zentall (2001) found that quail that were food deprived for longer periods of time pecked the treadle more than quail that were not as food deprived. Voelkl

[redacted]

that [redacted]
door wit[redacted]
stepping on th[redacted]

Although al[redacted] instinctive-drift” (Timberl[redacted] “misbehaviour resulted from th[redacted] contingencies into more primitive ph[redacted] gathering behaviours of a particular specie[redacted] conditioned to pair the object that is the discrimi[redacted] pigeons, film canisters for the marmosets) with food a[redacted] typically used to obtain food (see Timberlake, 1983).

7.4 Experimental procedures and imitation

Whether or not imitation is observed has also been found to dep[redacted] extraneous variables, not just the methodology. Dorrance and Zentall (2001) [redacted] occurrence of imitation depends on the motivation of the observer. In this study, th[redacted] used a two-action methodology with two observation conditions. Before the experiment[redacted] began the Japanese quail were food deprived for 22-23 hours for several weeks. During the experiment they were either fed before observation, or deprived of food before observation and fed after testing. Quail were tested either immediately following observation or after a delay. Results show that the delay didn’t have an effect on behaviour, but quail that were hungry imitated and satiated quail did not.

Most of the animals in the present studies were run before their meals (except the Goeldi monkeys, who had access to food during the experiment). However, husbandry [redacted] have [redacted] Dorrance and [redacted]

Additional [redacted] observer has an effect on [redacted] rats as subjects, and allowed [redacted] of a discriminative stimulus. [redacted] observer and from the same strain or [redacted] observers were more likely to match the [redacted] was a stranger rather than if the demonstrator was [redacted]

The human literature has found imitative learning [redacted] one thing that has not been controlled for when comparing this [redacted] given to nonhuman primates. In every study reviewed that used [redacted] instructions were given. At the minimum these instructions consisted of the [redacted] telling the child that they are going to play a game. Even this simple instruction [redacted] cause the child to pay attention to the researcher in the hopes of understanding and [redacted] the rewards associated with the game (Loftus, 1979 for effects with adults). Attending to the demonstrator is the main point of any social learning experiment; we feel that instructions are a major advantage and might be the only reason that these experiments get these results. Would a child imitate an experimenter if he walked into the room and started playing with a toy and obtained a reward, if they weren't told that they were involved in a game?

[redacted]

is [redacted]

the [redacted]

(Wurbel, 2002) [redacted]

early social [redacted]

are housed in, placement [redacted]

the behaviour of subjects in [redacted]

Thus there are many different [redacted]

outside of the methodology.

The zoo environment is not exempt from [redacted]

zoos offer a more naturalistic environment than a [redacted]

observers are able to interact with demonstrators. Wild [redacted]

out or isolated from the group before or after a demonstration. [redacted]

in more natural groups and are raised in a more natural setting than [redacted]

(although this isn't always the case, it was with the experiments described in [redacted]

fact, unlike laboratory housed animals, modern zoo populations have shown [redacted]

activity budgets to their wild counterparts (e.g. Melfi and Feisnter, 2000), increasing the [redacted]

value of research conducted in this type of setting.

Although the zoo environment is a more natural setting than that of a laboratory there are also some disadvantages when studying social learning in such a population. In our research, subjects were expected to manipulate objects after watching a demonstrator. However wild animals use tools less than captive animals (Thierry, 1985) and manipulate objects less in general (Menzel, 1966; Fragaszy and Adams-Curtis, 1991). Also, animals that live in the wild are not as tolerant of each other as animals in a laboratory setting may [redacted] den[redacted] 1973; We[redacted] environment h[redacted] animals have defined[redacted]

Overall, even with thes[redacted] setting, so that these behaviour [redacted] that are controlling the differences in [redacted] environments can be teased apart. Furtherm[redacted] evidence of social learning and even less evidenc[redacted] that would work with zoo housed primates and a possi[redacted] unfamiliar conspecifics. Although both of these projects cou[redacted] scope of this thesis, future projects could look into these areas. In [redacted] could also look further into the differences between juveniles and adults[redacted] what are the best demonstrators to use in a two action method, which type of [redacted] are distracting to different species.

This thesis used a large range of species. The goal was to choose species that liv[redacted] groups and might be adapted to learn by imitation. However, because a range of different species were used the methodologies had to vary to suit each species. Because of the time limit, only a small number of experiments could be conducted. However, given more time we would have concentrated more on other types of social learning such as learning about what foods to eat or vocalizations. We would have also liked to conduct some studies that looked at other forms of social learning to see if once you had the observers learning from the demonstrators in similar tasks (e.g. local enhancement) and then built up to imitation.

[redacted]

for [redacted] capability [redacted] imitative learn[redacted] Some primates will [redacted] is sparsely distributed wha[redacted] resources (Chapman, White and [redacted] "honeypot" resources do approach fe[redacted]

It has been a common theme of this the[redacted] researchers who set out to look for imitation ofte[redacted] are cognitively less demanding, e.g. emulation. From a[redacted] perhaps not surprising. Except for species that specialize in [redacted] prepare food that is difficult to access, emulating (copying the en[redacted] or more useful than imitating the whole behaviour as it takes up less co[redacted] same outcome. Byrne (2007) has argued that the distinctive foraging strategy [redacted] is precisely the use of such complex food preparation technologies (pg. 581). It is p[redacted] not surprising that convincing evidence of "true" imitation in non-ape species has been hard to find.

(*Canis* [redacted]

Agnetta [redacted]
domestic dogs of [redacted]

Akin, C.K. and [redacted]
(*Coturnix japonica*) using [redacted]
316-320.

Akins, C.K., Klien, E.D., a[redacted]
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