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

Submitted by Nicole R. Dorey to the University of Exeter as a thesis for the degree of Doctor of Philosophy in Animal Behaviour in the faculty ofscience, June 2008.

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Nicole R. Dorey

Abstract

Imitation is considered to be an efficient method of conveying information between individuals. It is believed to be among the least common and most complex forms of animal learning. After almost a century of studying social learning in animals, scientists still have not been able to give a clear answer to the question "Do animals imitate?". Although there have been some studies that have shown certain species under certain conditions unequivocally imitate (e.g. Zentall, et al., 1996), these studies have not been successfully replicated in a wide range of species. This thesis expands the social learning literature extending the range of settings and species in which it has been studied and by drawing links to the field of behaviour analysis.

Four of the current studies used versions of the two-action method to look for imitative learning in both non- human primates and domesticated animals. In this methodology an observer watches a demonstrator manipulate an apparatus with two different parts of their body. Using two different parts of the body and not two different manipulations lets researchers determine if the individual is learning by observation or just learning about changes in the state of the environment. This methodology is the only one that can distinguish local enhancement (learning only to attend to the location of the demonstrator), or stimulus enhancement (learning only to attend to the stimulus which the demonstrator interacts with) from "true" imitation (Campbell, Heyes, and Goldsmith, 1999).

One of the current studies used the "do as I do" methodology. In this method a subject is trained to match a few gestures of the demonstrator for reinforcement (i.e. the demonstrator 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. This methodology is popular because it not only can distinguish between imitation and the other forms of social learning, but it can also show the subjects' ability to generalize this type of learning.

The overall results show very little imitative learning occurring in the various groups of animals studied. The low rate of imitation may not be surprising. For just over 100 years psychologists have been studying social learning and in that time only a handful of researchers have been able to show clear evidence of an animal's ability to imitate the actions of a demonstrator. These results suggest that, though imitative learning may be important in the lives of a few species, or in the acquisition of particular behaviour, it is unlikely that it plays an essential role in the acquisition of behaviour in general, especially behaviour through which animals directly manipulate their environment.

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

There are five studies included in this thesis, all of which have been written up as manuscripts for publication. As detailed below, the substantial contribution to the co-authored papers presented in this thesis was made by the candidate. However, while the candidate is fully responsible for the work presented in this thesis, where the first person is used it is in the plural (i.e., 'we' rather than 'I') as in the original peer-reviewed articles to reflect the collaborative efforts guiding the research process. All chapters that have been written up as manuscripts are presented in the format requested by the respective journal; since each manuscript is meant to stand alone, some information may be redundant.

Paper 1: Chapter 2

Dorey, N.R., Melfi, V. and Lea, S.E.G. (in prep). **Evidence of social learning in Diana monkeys and Sulawesi black crested macaque**

The first manuscript, presented in this thesis as Chapter 2, was submitted as a paper to the *Journal of Applied Animal Behaviour Science*. The paper came back rejected, because it didn't fit into the aim of the journal, but the reviewers gave great suggestions and thus the chapter was corrected. The chapter has been reformatted and is being sent to *Animal Cognition*. The data were collected and analysed by the candidate, with statistical advice from Prof. Stephen Lea. The paper was written with supervisory support from Prof. Stephen Lea and Dr. Vicky Melfi.

Paper 2: Chapter 3

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

The second manuscript, presented in Chapter 3, was sent to the *Journal of Comparative Psychology.* It came back rejected, because the methodologies did not match that of previously published work. However the reviewers gave fantastic feedback and thus the manuscript was changed accordingly. The candidate designed the methodology of data collection as well as collected and analysed the data. Prof. Stephen Lea contributed to the analysis of the data. The paper was written with supervisory support from Prof. Stephen Lea and Dr. Vicky Melfi.

Paper 3: Chapter 4

Dorey, N.R., Lea, S.E.G., & Melfi, V. (in prep.). **Indication of imitative learning from conspecifics in a dog (*Canis familiaris*).**

The third manuscript, presented in Chapter 4, was sent to Dr. Clive Wynne for review, who gave some very useful comments. The candidate designed the methodology of data collection as well as collected and analysed the data. Prof. Stephen Lea contributed to the analysis of the data. The paper was written with supervisory support from Prof. Stephen Lea and Dr. Vicky Melfi.

STATEMENT OF THE SUPERVISORS' CONTRIBUTION TO CO-AUTHORED PAPERS

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

Prof. Stephen E.G. Lea (first supervisor)

Dr. Vicky Melfi (second supervisor)

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