# The 'Do as I Do' as a new method for studying imitation in dogs: Is the dog a copycat?

Claudia Fugazza[*], Ádám Miklósi

*Department of Ethology, Eötvös Loránd University, Budapest*

*Abstract*: The study of imitation in non-human animals has always been challenging, especially from a methodological perspective. Recently, the Do as I Do method – and modified versions of it – have provided solid evidence of imitation in dogs and constitute the basis for more in-depth studies on different topics related to imitation. The Do as I Do method is especially advantageous for testing imitation of novel actions, action sequences, intransitive actions as well as deferred imitation, while excluding other possible practical problems which could be the cause of some negative results (i.e. subjects' lack of understanding of the task). The combination of the Do as I Do method with the two-action procedure also allows to control for other non-imitative processes that may result in behavioural similarity between demonstrator and observer. Modified version of the Do as I Do method can unfold dogs' cognitive abilities that could not be revealed by other methods (e.g., episodic memory, generalization of imitation). In this paper, first we review the methods used so far for testing imitation, focusing on the critical issues, then we discuss how the use of modified versions of the Do as I Do method can avoid some of the methodological drawbacks. Finally, we discuss dogs' cognitive abilities that could be investigated by the application of this method, as well as their limitations.

*Key Words*: Imitation; Do as I Do; dog; two-action method; social learning.

*\* Corresponding Author*: claudia.happydog@gmail.com

## Defining imitation

Imitative learning has long been considered a uniquely human ability (e.g. Whiten, 1998; Byrne, 2002; Csibra & Gergely, 2005), perhaps only shared to a certain extent by a bunch of other primates (Thorndike, 1898; 1911) and the study of imitation in other species has always met with mixed feelings (e.g., Heyes, 2001). Over 100 years of research (Whiten & Ham, 1992) imitation has been defined in various ways. The definitions range from blind and mindless copying to cognitively complex types of social learning, relying on some form of cross-modal matching which, in turn, is believed to be linked to sophisticated cognitive processes. Thorpe (1963) defined imitation as the acquisition of a novel or otherwise improbable action by the observer based on the observation of another individual performing it. He suggested that this term should be restricted to song learning in birds, if the acquired vocalization does not have a major instinctive component and to animals performing actions that would be otherwise improbable in that species. In the case of species with a very flexible and wide-ranging behavioural repertoire, like dogs, it is evident that measuring how probable an action is for a certain individual can be challenging, making this definition difficult to use from a methodological point of view. Although for some authors (e.g., Heyes, 1995) novelty of the learned information is an important feature of imitation, the novelty of an act for a given subject can be difficult to determine. It is highly unlikely that the complete behavioural repertoire of a subject can ever be listed. According to some authors

(Whiten & Custance, 1996; Whiten, 1998) novelty is a relative concept that may refer to different aspects of behaviour, such as shape, orientation or extent. Moreover, the action might have been performed before, but in a different context. Whiten & Ham, (1992) defined imitation as learning some part of the form of a behaviour by observing another individual. This definition does not specify what is actually learned socially. To make the picture even more complex, recently some other phenomenon related to imitation have been described, such as overimitation (e.g., Lyons et al., 2011; Nielsen & Tomaselli, 2010; Johnston et al., 2016) automatic imitation (e.g., Heyes et al., 2005; Range et al., 2011), selective imitation (e.g., Range et al., 2007) and true imitation (e.g., Voelkl & Huber, 2000). The term functional imitation (Topál et al., 2006) was introduced to take into account differences in the behaviour repertoire and morphological differences when similarity in the action is assessed between two different species.

For the purpose of this paper, similarly to Whiten & Ham (1992), we define imitation as acquiring specific information about actions (i.e., executing a specific form of a motor action) through observation. This definition differentiates imitation from all other information acquiring processes such as stimulus enhancement, defined as acquiring information about objects (Galef, 1988), local enhancement, defined as acquiring information about the environment or places in the environment (Thorpe, 1963) and goal emulation, defined as learning what is the goal to be reached (Wood, 1989; Tomasello, 1990).

## Comparison of experimental methods

Even when using this simple definition of imitation, the exclusion of non-imitative processes is necessary before assuming that similarity between the behaviour of the demonstrator and that of the observer relies on the ability to execute a specific form of a motor action after observation. Perceptual factors may increase the attention of the observers towards the object manipulated by the demonstrator and thus increase the probability of a similar behavioural response by chance. One possibility to exclude those factors is to test imitation of intransitive actions (i.e., body movements, actions not performed on objects). Testing body movements matching can also provide interesting insights into the capacity of representing other's intransitive actions and own and others' body schema. Mixed results have been obtained so far when testing imitation of intransitive actions in dogs. Tennie et al. (2009) failed to find evidence of imitation of this type of actions. The subjects observed a human rewarding another dog for performing body movements that were familiar to the observer. The observer dogs were later tested to find evidence of copying the model's action. The authors concluded that dogs lack the cognitive ability to copy intransitive actions. This interpretation is in accordance with the greater difficulty found in great apes (e.g., Miles et al., 1996; Call, 2001) in the imitation of human intransitive actions, compared to actions performed on objects (e.g., Huber, 2009). However, it is probable that this experimental procedure did not allow dogs to realize that they were required to attend the interaction and to copy the action of the demonstrator.

To exclude non-imitative processes, some authors (e.g. Heyes et al., 1994; Miller et al., 2009) introduced the so called bidirectional procedure in which an object or a part of it is moved by the conspecific demonstrator in one direction or in the opposite one[1]. This method relies on the assumption that moving the object in the same direction where the demonstrator moved it would constitute a case of imitation. However, the direction of an object's movement is one component of the executed action. It could be argued that matching the direction to which an object moves is not conceptually equal to matching the action in terms of body movement. For example, the

[1] In the 'bidirectional procedure' the demonstration involves moving an object in one of two possible directions (e.g., pushing an object to the left or to the right); In the 'two-action procedure' the demonstrator displays one of two possible actions on the same object (e.g., pushing an object with paw or muzzle).

observer may push the object in the same direction, but using a different body part, so that the body movement performed would differ from the one performed by the demonstrator. Thus, if the commonly agreed definition of imitation involves learning socially about a specific form of an action (i.e., body movement) after observation, this method does not seem to completely fulfil the criteria. Moreover, the movement of the object in space, the location where the demonstrator acts and the part of the object manipulated are likely to have a local enhancement effect. As a consequence, the mere fact of contacting the same part of the object may provoke the movement in the matching direction.

In this respect, a flawless method for testing imitation, while excluding other non-imitative processes that may increase the probability of behavioural similarity, is the two-action procedure (Dawson & Foss, 1965; Akins & Zentall, 1996; van de Waal et al., 2012). With this method two different actions on the same object and with the same consequence are shown to two groups of observers. This method allows to find evidence of imitation or, alternatively, of other non-imitative processes because different processes lead to differential predictions (e.g. if the behavioural similarity relies on stimulus enhancement, then the observer is expected to match the object used by the demonstrator but not the action, whereas if the behavioural similarity relies on imitation, the observer is expected to match also the action in terms of body movement). To further exclude that different demonstrated object movements lead to similar behavioural response between demonstrator and observer due to processes other than imitation, as mentioned above with regard to the bidirectional procedure, we suggest that the object movement should be identical in the two demonstrations (or the object should not move at all). A control for goal emulation can be introduced if the object is moved remotely - so called ghost control (Miller et al., 2009), because in this case the observer can only witnesses the final outcome of the situation, without observing any action performed. Thus copying in the latter case would suggest that the observer relies on emulation.

Bearing in mind the issues related to the criterion of novelty in imitation described in the introduction, novel actions can also be demonstrated with the two-action procedure.

Although imitation can emerge between conspecifics as well as between individuals of different species (e.g., Russon & Galdikas, 1993, 1995; Tayler & Saayman, 1973), testing imitation of a heterospecific model poses some challenges in measuring behavioural matching, because the behaviour repertoire and body schema of model and observer may differ (e.g., Topál et al., 2006). Nevertheless, testing imitation of a heterospecific model constitutes a particularly interesting case, because it provides insights in how the observer represents the actions of the heterospecific model (e.g., how and if it represents and maps its different body parts as related to its own).

## The Do as I Do paradigm

The Do as I Do method was first used to study imitation of human demonstrated actions in a home raised chimpanzee by Hayes & Hayes (1952). With this method, the subject is initially trained to match his behaviour to a small set of familiar actions demonstrated by the trainer by using an operant training procedure. Then the subject is tested to apply this 'imitation rule' to various behaviours and situations, including novel actions or action sequences. The main advantage of this method is that the subject is specifically trained to imitate the action(s) of the demonstrator, thus other confounding factors (e.g., lack of understanding of the task, lack of motivation) can be excluded. The Do as I do method has proven efficient as a means to test imitation, not only in chimpanzees (Tomasello et al., 1993; Custance et al., 1995; Myowa-Yamakoshi & Matsuzawa, 1999) and orangutans (Call, 2001), but also in other species, such as dolphins (Herman, 2002), parrots (Moore, 1993), killer whales (Abramson et al., 2013) and dogs (Topál et al., 2006).

Topál et al. (2006) were the first to train and test a dog with the Do as I Do method. Their results showed that the dog was able to match its behaviour to several human demonstrated ac-

tions, including (relatively) novel actions, and these results were later replicated and extended by Huber et al. (2009). Due to the differences in the specie-specific behaviour repertoire of humans and dogs, the dogs' copying ability was labelled as 'functional imitation', defined as reaching the same goal and doing it in a similar way, but taking into account the differences in the behaviour repertoire of the two species (e.g., if the human demonstrator grabs an object using his hand, the dog grabs it using his mouth). Interestingly, the dog also showed some ability to reproduce goal directed sequences (e.g., picking up an object and carrying it to another location), suggesting that dogs may be able to represent the goal-directed actions of others, at least when the actions are within a range of behaviours of which they have some experience.

Recently the Do as I Do method has been combined with the two-action procedure with the aim of controlling for the possibility that the subjects would rely on other non-imitative processes for succeeding in the behavioural matching task (Fugazza & Miklósi, 2014a; Fugazza et al., 2015, 2016a; 2016b). Fugazza & Miklósi (2014a) also tested dogs with a modified version of the two-action method. The same subjects were exposed to two different actions on the same object. This way, in order to succeed in the Do as I Do task, a dog had to modify the actions it performed on a given object from trial to trail, based on what action was demonstrated. The dogs succeeded, thus corroborating with even stronger evidence the previous results on their ability to imitate.

## Application of the Do as I Do in the study of dog imitation

One of the advantages of the use of the Do as I Do paradigm is that it allows researchers to investigate mental phenomena that were previously very elusive for experimental investigations. For example, by inserting a delay between the demonstration and the command to imitate, it is possible to test dogs' (short and long-term) memory of others' actions (e.g. Fugazza & Miklósi, 2014a, Fugazza et al., 2015). For this purpose dogs need to be trained to wait for a short interval to elapse, before being allowed to imitate, so that they learn what demonstration they are required to remember. Without this preliminary training they fail in deferred imitation tasks even with very short delays (Huber et al., 2009), probably because they learned to match the action that was shown immediately before the 'Do it!' command.

When dogs are trained to wait for a short interval to elapse before the imitation command is given, they can imitate even after delays as long as 10 minutes (Fugazza & Miklósi, 2014a) and some dogs still remember and imitate actions that were shown 12 and 24 hours before (Fugazza et al., 2015). These studies did not leave any doubt about the imitative abilities of dogs because they excluded completely that dogs could rely on facilitative processes in which the demonstration triggers a similar behaviour at the same time or after a very short interval. Moreover, the combination of the Do as I Do method with the two-action procedure provides strong evidence of imitation as the process underlying the observed behavioural similarity. These studies suggested that dogs are able to form a mental representation of the demonstrated action and rely on this memory as the basis to perform a matching action after a delay. Fugazza & Miklósi (2014a) and Fugazza et al. (2015) prevented the dogs' view of the objects used for the demonstration during the retention interval, so that the possibility that dogs could keep their mind active on the demonstration by looking at the target object was excluded. The observed successful performance in this task provided evidence of declarative memory because the dogs were prevented from motor practicing (even mentally) the action during the retention interval. Dogs were also successful in deferred imitation if distracted on purpose with different activities during the delay, showing evidence of a stored enduring mental representation of the demonstrated action.

Dogs are known to be keen on relying human given cues, thus it is fundamental to ensure that dogs do not rely on such proxies to succeed in the imitation task (Clever Hans effect). In the case when the imitation of novel actions is tested, even if the demonstrator would give cues as to

where (on what object) the dog should act, there would not be much possibility to indicate what action to perform on it just by cueing. Fugazza & Miklósi (2014a) specifically tested dogs for the possible Clever Hans effect in a deferred imitation task. The imitation command was issued by a person that did not know the previously demonstrated action. All dogs imitated in this condition, therefore excluding that dogs trained with the Do as I Do method rely on such subtle cues in imitation tasks.

## Application and limitations of the Do as I Do in the study of dog cognition

The Do as I Do method can be successfully applied to investigate different kinds of mental functioning. Fugazza et al. (2016a) have recently reported evidence of episodic-like memory of others' actions in dogs. Dogs that were previously trained with the Do as I Do were exposed to an additional training phase, in which they were not required to imitate any more. Instead, after the demonstrations they were always required to lie down. This way the dogs' expectation of receiving the command to imitate was substituted with the expectation of receiving the 'lay down' command. Episodic memory is the ability to remember events that were encoded incidentally (i.e., when it was not known they are important). Thus, to find evidence of episodic memory in dogs, the 'Do it!' command was given unexpectedly, once dogs had learned that the demonstrated actions were not relevant to solve the task of laying down. This type of memory is thought to be linked to complex cognitive skills in humans (e.g., self-awareness – Tulving, 1985; Suddendorf & Corballis, 2012). The Do as I Do method has proved quite flexible and efficient when it comes to testing cognitive skills related to imitation and representation of others' actions. For example, it was used to investigate dogs' generalization of imitation to various contexts (Fugazza et al., 2016b) and demonstrators (Topál et al., 2006). The behaviour of dogs trained to imitate can also provide insights about how they represent the actions of others, because the actions they perform when requested to imitate depends not only on how they perceive the visual input of the demonstration but also on how they process (represent) it. For example, the Do as I Do method can be employed to infer whether dogs represent others' action in a framework that also includes their goals and intentions.

While Do as I Do studies with other species involve 'enculturated' animals that do not live in their own natural environment (Tomasello et al., 1993; Custance et al., 1995; Myowa-Yamakoshi & Matsuzawa, 1999; Call, 2001; Herman, 2002; Moore, 1993; Abramson et al., 2013), dogs evolved in the human milieu, which can be considered their own natural environment. Well-socialized family dogs can typically be trained with the Do as I Do method. Thus, these experiments can be considered as conducted on typical family dogs, tested in their own natural environment and consequently the results of these studies can be generalized to the 'wild' population of family dogs.

As with any study requiring some preliminary training of the subjects, limitations of the use of the Do as I Do method mainly pertain the time needed to train large number of subjects, due to the necessity of a skilled trainer or experimenter to explain the training procedure to the owners and also of enthusiastic owners willing to train their dogs. For this reason, it is unlikely that large sample sizes can be reached with limited time and resources.

## Limitations in dogs' imitative abilities emerging from Do as I Do studies

Relatively few data are available about dogs' ability to imitate human novel intransitive actions. In the case of familiar (i.e., trained) body movements, it seems that dogs can reliably imitate those (Topál et al., 2006; Huber et al., 2009). In the case of novel (i.e., not previously trained) body movements, while Huber et al. (2009) did not find evidence of dogs' ability to match 'exotic'

actions (i.e., actions that the dogs is not likely to have performed before, but that are still theoretically possible), Fugazza & Miklósi (2015) obtained mixed results when testing dogs' ability to match a non-trained body movement (jump in the air). In this case, some dogs could not match the behaviour, but 70% of the dogs tested could do so and did it after a relatively short time (i.e., after few demonstrations). Only this action was tested in this study, thus more data is needed before being able to draw conclusions on the imitation of body movements in general. However, the results obtained so far seem to indicate that the ability to imitate intransitive actions might be present in dogs to a certain extent. It should be mentioned that the range of possible actions for a dog is rather restricted, compared to the possibilities in humans. Moreover, if researchers use the Do as I Do method, they should take into account that the similarity between a given human body movement and a dog's body movement is not always straightforward, due to the different body-schema of the human demonstrator and the dog observer (e.g., the way the human moves its body in space to lay down, is different from the way the dog would move its body to lay down). Testing dog-dog imitation would probably solve this issue and modified versions of the Do as I Do method have the potential to be applied for this purpose.

Other limitations in the dogs' imitative abilities emerge from the results of studies investigating on the imitation of sequences of actions. In this case, unless the demonstrated sequence has a clear goal (Fugazza & Miklósi, 2014b), there seems to be a difficulty in copying the exact order of the various parts of the sequence, most likely due to a recency effect (Huber et al., 2009). According to Byrne & Russon's (1998) classification of the forms of imitation of action sequences, data obtained so far (Fugazza & Miklósi, 2014b; Topál et al., 2006) probably indicate presence of some form of program-level imitation in dogs and seem to point to the lack of action-level-imitation.

## Conclusion

In the human literature, much research has focused on the development of the ability to imitate. According to Piaget (1962), it is the sensory-motor stage of human development that produces this ability in human infants. They learn to coordinate visual inputs with motor outputs, so that they can reach for objects that they can see and would be able of transparent imitation (e.g. scratching one's arm). However imitating 'opaque' actions (e.g. scratching one's own head) would require additional processes such as visualizing the appearance of one's own head and it is not clear how this would happen (Zentall, 2006). The Do as I Do method, given the extensive training necessary to teach dogs the imitation task, might not be suitable for testing the development of imitative skills in young puppies and researchers will have to design different methods for investigations on the developmental aspects of imitation.

## Acknowledgements

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# Il "Do as I Do" come Nuovo metodo per studiare l'imitazione nel cane: il cane è un copione?

Claudia Fugazza, Ádám Miklósi

*Dipartimento di Etologia, Eötvös Loránd University, Budapest*

*Sintesi*

Lo studio dell'imitazione negli animali è stato sempre complicato, soprattutto da un punto di vista metodologico.

Recentemente il metodo del "Do as I do", e la sua versione modificata, ha fornito delle prove certe sulla capacità di imitazione del gatto e ha gettato le basi per studi più approfonditi su aspetti differenti correlati a questa capacità.

Il "Do as I Do" è particolarmente utile per valutare l'imitazione di nuove azioni, sequenze di comportamenti ed eventi differiti di imitazione, eliminando inoltre possibili problemi pratici che possono provocare risultati negativi (ad esempio, incapacità del soggetto di capire la prova da effettuare).

La combinazione del metodo "Do as I do" con la procedura "two-action" permette inoltre di controllare la presenza di processi non imitativi che possono provocare una somiglianza tra dimostratore ed osservatore. Questo metodo può rivelare abilità cognitive che non potrebbero essere svelate con altri metodi (ad esempio la memoria episodica, la generalizzazione dell'imitazione).

In questa review, dapprima sono passati in rassegna i metodi utilizzati per testare l'imitazione, focalizzando l'attenzione sui loro aspetti critici, quindi sarà discusso come il "Do as I do" può evitare alcuni inconvenienti metodologici.

Infine, sarà discusso come le abilità cognitive del cane potrebbero essere investigate con l'applicazione di questo metodo e le relative limitazioni.