

COMMENTARIES

Do rats ape?

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(Received 9 December 1994; accepted 10 February 1995; MS. number: sc-1054)

Heyes (1993) asserts that in all of the literature on the social learning of animals there are only two studies, those by Heyes et al. (1992) and Galef et al. (1986), that provide convincing evidence of non-vocal imitation in animals (henceforth abbreviated to 'imitation'). This is a surprising statement, not so much because it questions the trustworthiness of formerly accepted signs of imitation among non-humans (this has been done repeatedly in recent years: e.g. Green 1975; Galef 1988; Tomasello 1990; Visalberghi & Fragaszy 1990; Whiten & Ham 1992) but because the studies singled out as adequate evidence of imitation use budgerigars, *Melopsittacus undulatus*, and rats, *Rattus norvegicus*, not normally thought of as great imitators. Any surprising claim deserves careful scrutiny, and in this note we argue that Heyes' claim does not in fact stand up to scrutiny: neither Galef et al. (1986) nor Heyes et al. (1992) is a convincing demonstration of imitation, as normally understood. Certainly, interpretation of these studies will depend on what is meant by the term imitation, and this is currently a very controversial issue. We shall attempt to spell out our views on this issue as we examine Heyes' claims.

First, Galef et al. (1986) found that when budgerigars observed a conspecific removing a food-cover using its beak or feet they followed suit and used the same appendage when presented with a closed food-cover. The problem is that by everyone's definition imitation (or imitative learning) should involve the animals learning a new response. This is true even of Heyes' own definitions. In her most specific formulation, for

example, she says that in imitative learning 'individuals *acquire*, as a result of observing a conspecific's behaviour X, the capacity to execute a behaviour that is topographically similar to X, and, in some cases, the information that X has a certain consequence or outcome' (Heyes 1993, page 1000, our italics). But there is no suggestion anywhere that Galef et al.'s subjects were learning a new type of behaviour; the target behaviour patterns are both part of the budgerigar's foraging repertoire. Our explanation for the findings is thus in terms of some form of enhancement or priming, for example, 'social facilitation' (in the sense originally intended by Spence 1937) or 'response facilitation' (Byrne 1994). In response facilitation, the probability of occurrence of an established behaviour pattern is temporarily increased in the individual's spontaneous repertoire after observation of the same behaviour pattern in a conspecific. Consistent with this interpretation, Galef et al. found that the observed tendency of their budgerigars to increase the frequency of one of the two target behaviour patterns was weak and transitory.

In Heyes' series of studies with rats, it is unclear whether response facilitation is an important part of the explanation because in none of these studies did she actually observe the rats' behaviour. In an initial study, Heyes & Dawson (1990) had observer rats in one cage watch demonstrator rats in an adjoining cage push a joystick to the right or left for a food reward. The cages were separated by a wire grid, and the joystick (which could move only in a single plane) was positioned so close to the grid that the demonstrator could not approach it from against the grid. The point of this arrangement was that the demonstrator had to approach and push the joystick from the main part of its cage. This meant when it pushed the joystick to its right that joystick would, in the observer's

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perceptual field, move to the left (and vice versa). When given their chance with the joystick in the demonstration/test cage, the observers most often pushed in the same direction as the demonstrators, as recorded automatically by a device attached to the joystick (and even though all subjects at test were rewarded all pushes in either direction). Heyes & Dawson's interpretation of this result is that the observer must have performed a perspective transformation in which it identified with the demonstrator's behaviour vis-à-vis the joystick from its (the demonstrator's) point of view; the rat perceives at the more abstract level of 'object-centred' as well as 'viewer-centred' movements (see Perrett et al. 1989). Since we do not know precisely how the demonstrator pushed the bar (perhaps straight-ahead with its nose from one side, perhaps sideways with its nose from in front, perhaps with its paws or tail from any direction) what is really at issue here is not the precise behaviour involved, but how the observer learned the direction in which it should push the joystick.

One possibility is simply that the rats have an allocentric sense of space and observed which way the bar moved before food arrived, with the direction of the joystick's movement being coded relative to any number of possible landmarks (including the food tray in the demonstrator's cage, the wire grid that separated the cages, or even external cues in the testing room). This explanation might be thought of as one instance of what Tomasello (1990) called emulation learning in which the observer simply learns as a result of another's behaviour something about an affordance or transformation in the environment, with the behaviour of the other animal being totally irrelevant. The trick in this case is simply that what is learned depends on the rat's excellent sense of space (e.g. Olton & Samuelson 1976; Gallistel 1990). Even simpler, the rats' behaviour might result from local enhancement (Thorpe 1956), increasing the salience or attractiveness of the particular point in space where the joystick is when a reward is delivered. (Heyes & Dawson refer to this as 'stimulus-reinforcer association' learning.) In both accounts, the animal learns something about the environment, not about the behaviour of a conspecific.

The experiments that are supposed to handle this type of explanation are reported by Heyes et al. (1994). In those studies, observers were

exposed to the joystick moving automatically at random intervals in one direction or the other. In experiment 1 there was no rat in the demonstration cage when this was taking place. It was found that observers did not learn the correct direction to push the joystick in this condition (whereas they did in a standard condition similar to that of the previous experiment). The problem is that since the actual behaviour of subjects was not observed it is possible that they did not watch the joystick moving in this condition, whereas subjects in the standard condition did watch it because a conspecific was moving it, and conspecifics are more interesting than moving sticks. The second experiment was meant to control for this effect. In this study there was an experimental group for whom the joystick moved automatically, but there was also a rat in that cage (to make looking in the cage more interesting). But what the rat in the demonstration cage did was sit next to the food tray and grab the pellets as they automatically came out when the joystick moved (the latency of the rat to get the pellet averaged 1.69 s after delivery). If rats are really more interested in rats than moving sticks they would have watched the rat grabbing the food across the cage and ignored the joystick against the near wall altogether. We thus believe that both the emulation learning explanation (supplemented by the rat's allocentric spatial code), or the local enhancement (stimulus-reinforcer associations) explanation, are still viable alternatives in the Heyes & Dawson (1990) original experiment.

In a third and final study in this series Heyes et al. (1992) attempted to rule out something like these alternative explanations by showing that when the joystick was moved in the demonstrator's cage after the demonstrations, but before the observer has had its chance to perform, the rats still learned to push in the correct direction. In this study, as the observer was being moved from the observation cage to the demonstration/test cage (i.e. between observation and test), the joystick was moved through a right angle to the side wall of the test cage. What they found was that at test the observers tended to push in the same direction as the demonstrator had pushed relative to its own (the demonstrator's) body, even though this was not in the same absolute direction (relative to any external landmarks) in which it had observed the joystick moving. As in the original study, the explanation is that the observer

has coded the direction of pushing in terms of the demonstrator's bodily actions and has reproduced the behaviour by mapping its own body onto the demonstrator's.

But this is truly an odd finding. Consider a human who has observed, by looking in through an outside window, that a hanging rod must be pushed to actor-right (viewer-left) in order to raise a blind. If when that human later enters this room, he or she notices that the rod is now hanging alongside a different wall, the question arises as to which way he or she should push it to raise the blind, left or right? The answer surely depends on whether the rod has been moved around the edge of the room, or swung and translated through the middle of the room. Who knows? A human, able to imitate, might very well be bewildered by this transfer condition. All we can imagine in the case of the rat is that the joystick itself, and its position relative to a wall (any wall) is used as a landmark for orientation. Then, on the emulation explanation, the observer notes the position of the stick and how it moves relative to the wire grid wall and then transfers that orientation to the joystick in its new position relative to the new wall it is up against. On the local enhancement explanation, the rat is still pushing towards what it perceives (wrongly) to be the same point in space as in the non-rotated condition.

All of this does not mean that we consider imitative learning of novel behaviour to be impossible or even restricted to humans. Imitation, in the limited sense of copying for its own sake divorced from normal behaviour (which we prefer to call 'mimicking'; see Tomasello 1990), has been observed repeatedly in a number of great ape individuals who have been reared and/or trained by humans (e.g. Hayes & Hayes 1952; Russon & Galdikas 1993; Custance & Bard 1994; and other sources listed in Whiten & Ham 1992). Human-reared chimpanzees, *Pan troglodytes*, and bonobos, *Pan paniscus*, have recently even provided some evidence of imitation of object-directed actions (Tomasello et al. 1993), as have wild gorillas, *Gorilla gorilla*, in their reproduction of the cause-and-effect, programmatic structure of their complex food preparation skills ('program-level imitation', Byrne & Byrne 1993; see also Byrne 1995). None of these various capabilities can be easily explained away as facilitation effects or products of emulation learning only. We should add that in each case the findings rely on careful

observations of behaviour sufficiently complex that whether an action is 'novel' or 'the same' can be objectively judged. We have several times pointed out the ambiguity of Heyes' data given the complete absence of such observations, and we suggest that the way forward in the study of imitative learning will not be reliance on superficially rigorous experiments in which only rather trivial sorts of behaviour are performed but not observed.

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