

A Demonstration of Observational Learning in Rats Using a Bidirectional Control

C. M. Heyes and G. R. Dawson

University of Cambridge, Cambridge, U.K.

Hungry rats observed a conspecific demonstrator pushing a single manipulandum, a joystick, to the right or to the left for food reward and were then allowed access to the joystick from a different orientation. The effects of right-pushing vs left-pushing observation experience on (1) response acquisition, (2) reversal of a left-right discrimination, and (3) responding in extinction, were examined. Rats that had observed left-pushing made more left responses during acquisition than rats that had observed right-pushing, and rats that had observed demonstrators pushing in the direction that had previously been reinforced took longer to reach criterion reversal and made more responses in extinction than rats that had observed demonstrators pushing in the opposite direction to that previously reinforced. These results provide evidence that rats are capable of learning a response, or a response-reinforcer contingency, through conspecific observation.

It is commonly assumed that learning through observation of conspecifics has considerable adaptive significance; that it plays an important role in the development of communication, foraging behaviour, diet selection, and predator avoidance in free-living animals (e.g. Zentall & Galef, 1988). It is further assumed that, in some cases, observation of a conspecific's behaviour allows animals to acquire information or to learn associations that could not be acquired through exposure to the same contingencies in the absence of that behaviour. Specifically, it has been claimed that animals such as rats and pigeons can, like humans, imitate responses and learn response-reinforcer contingencies, or action-outcome relationships, by observation (e.g. Will, Pallaud, Soczka, & Manikowski, 1974; Palameta & Lefebvre, 1985).

Correspondence should be addressed to Dr. C. M. Heyes, Department of Psychology, University College London, Gower Street, London WC1E 6BT.

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Although the adaptive significance of observational learning may be assessed on the basis of field studies, it is clear that laboratory experiments are necessary in order to evaluate these claims.

A number of laboratory studies have shown that observation of a trained conspecific (demonstrator) can facilitate subsequent response acquisition by rats and pigeons in both simple instrumental and discrimination learning tasks (e.g. Biederman & Vanayan, 1988; Edwards, Hogan, & Zentall, 1980; Huang, Koski, & DeQuardo, 1983; Kohn & Dennis, 1972; Palameta & Lefebvre, 1985). If observational learning is broadly defined as occurring whenever an animal "... watches another individual solve a problem one or more times and then, without the demonstrator's being present and without ever having previously made the correct responses, solves the same problem more readily" (Osgood, 1953, pp. 658-659), then these studies provide evidence of observational learning. However, they do not show unequivocally that animals can imitate or learn about a response-reinforcer contingency by observation. The vast majority of existing evidence of observational learning has been obtained using procedures that allow at least two alternative explanations of the effects.

First, "local enhancement" (Thorpe, 1956) may be responsible. The demonstrator's presence near the manipulandum may increase its salience for the observer and thereby affect the rate at which the observer either acquires an S-R habit or learns about the response-reinforcer relationship through its own efforts once it is given access to the test environment. For example, local enhancement may account for Huang and colleagues' (1983) finding that when two groups of rats were exposed to a positive contingency between lever pressing and food for the first time, the group that had previously observed a trained demonstrator performing on this contingency had a higher response rate than the other group that had been confined in the apparatus for the same length of time in the absence of a demonstrator.

Second, observational learning effects may be due to the observer learning about stimulus-reinforcer rather than response-reinforcer relationships by observation. That is, the subjects may be "autoshaping" (Hearst & Jenkins, 1974). This may have been the case in Biederman and Vanayan's (1988) experiment in which pigeons were pre-trained to make a key-pecking response before being given observational discrimination training. After pre-training, birds that were allowed to observe a partially trained demonstrator performing an erect vs inverted triangle discrimination acquired the same discrimination faster than birds that had observed an over-trained demonstrator. Kohn and Dennis (1972) have reported an analogous effect in rats and, like Biederman and Vanayan, interpreted it as clear evidence of stimulus-reinforcer learning by observation. This interpretation is firmly supported by the results of experiments in which observational discrimina-

Bell, & Clos, 1983). In these studies, rats observed two distinctive levers, A and B, moving automatically, with movement of either A or B signalling the delivery of food to the observer. After this observation training the rats were given access to the levers and allowed to make 10 responses with no food available. Denny et al report that the rats showed a significant tendency both to press the S+ lever first, and to press it more than the S- lever overall.

Other observational learning effects, that have been attributed to response-reinforcer learning or imitation, may also be due to stimulus-reinforcer learning. For example, Palameta and Lefebvre (1985) allowed pigeons to observe a conspecific either pecking open the paper cover of a food cup and eating the grain inside, or eating grain through a large, pre-existing hole in the paper cover. When both groups of observers were subsequently given access to intact cup covers, those that had observed piercing and eating were more likely than those that had observed eating alone to pierce the covers themselves. Palameta and Lefebvre interpreted this as evidence that pigeons can learn aspects of a foraging technique by observation, i.e. that they had learned by observation of the conspecifics' behaviour what to do in order to gain access to grain covered by paper. However, the effect could simply be an example of autoshaping—that is, the pigeons that had observed piercing and eating may have pecked the paper more forcibly on test because the sight of the intact cover had regularly preceded the sight of food during observation.

The present experiment sought evidence of response-reinforcer learning by observation in the following way: Hungry rats observed a demonstrator pushing a single manipulandum, a joystick, to the right or to the left for food reward and were then allowed access to the joystick from a different orientation. That is, the observers were facing in one direction during observation, and in the opposite direction during testing. The experiment examined the effects of right-pushing vs left-pushing observation experience on response acquisition, reversal of a left-right discrimination, and responding in extinction.

This procedure was designed to minimize any effects of local enhancement and to allow the effects of stimulus-reinforcer learning and response-reinforcer learning by observation to be distinguished. It has two features that are particularly important with respect to these aims: First, following Grindley (1932), we studied directionality of responding with a single manipulandum in order to eliminate any effect that the demonstrator's presence or behaviour might have on stimulus salience. If, as we predicted, the direction of a demonstrator's responses affects the direction of its observer's responses, then this could not be due simply to the demonstrator's presence or behaviour having attracted the observer's attention to the joystick.

Second, subjects were located in different positions, relative to the joystick, during observation and on test in order to distinguish the effects of stimulus-reinforcer learning from those of response-reinforcer learning. Stimulus-reinforcer learning would occur if, during observation, subjects learned that movement of the joystick to a certain place, or in a particular direction, signalled reward. The place or direction could be defined by the observers relative to either their own bodies as they observed (egocentrically), or to features of the apparatus surrounding the joystick (allocentrically). For example, when a demonstrator moved the joystick to the right across its own visual field, the observer might define the joystick movement egocentrically as "left across visual field" or allocentrically as "toward food tray". We predicted that if subjects learned a stimulus-reinforcer contingency during observation, then they would either tend to push the joystick in the opposite direction to that in which their demonstrators had been responding (egocentric case), or their test performance would not be affected by the directionality of the demonstrators' behaviour (allocentric case). We thought it unlikely that allocentric stimulus-reinforcer learning would have an effect on the directionality of observers' responses in the present experiment because most of the stimuli that could be viewed in conjunction with the joystick during observation, and therefore could be used to define the location of the joystick that signalled reward, were not visible to the subjects when they were responding on test. For example, the tray to which food pellets were delivered was to the left of the joystick in each observer's visual field during observation, but it was behind them when they pushed the joystick on test. Response-reinforcer, rather than stimulus-reinforcer, learning would occur if, during observation, the subjects learned that action of a certain kind on the joystick was followed by reward. We predicted that if the rats in the present experiment learned a response-reinforcer contingency by observation, then they would show a significant tendency to push in the same direction as their demonstrators.

Collins (1988) has used a bidirectional control procedure similar to that of the present experiment to investigate observational learning in mice. He found that male mice pushed a pendulum door to the left more often after observing a (female) demonstrator push it to the left than after observing a demonstrator push it to the right. The subjects in this experiment viewed the manipulandum from the same orientation during observation and while responding on test. Thus, the present experiment may be viewed as an attempt to replicate Collins' findings with rats, and to extend them by investigating both what is learned during observation and the effects of directionality of demonstrator responding on discrimination reversal and extinction performance as well as on initial response acquisition.

Method

Subjects. Sixteen male hooded Lister rats, obtained from Harlan Olac Ltd. (Bicester, Oxon.) were approximately six months old when they served as subjects. In a prior experiment all 16 animals had been trained, by conventional methods, to lever press and chain pull for food pellets and sucrose solution. In the present experiment 8 rats were randomly assigned to the role of demonstrators, and the remaining 8 were observers. Throughout the experiment the animals were housed in observer-demonstrator pairs, with water freely available. They were fed for 90 min following each daily session.

Apparatus. The animals were trained and tested in two identical operant chambers. The front wall and ceiling of each chamber was made of clear Perspex, and the remaining walls were of blackened metal. As Figure 1 illustrates, each chamber was divided into two compartments of equal size by a 1-cm-gauge wire-mesh partition.

In the operant compartment, used for demonstrations and testing, an aluminium joystick (0.6 cm in diameter) was suspended from the middle of the ceiling. The free end of the joystick, which was 4.5 cm above the floor when the joystick was in a vertical position, could only be moved to the left or to the right in a plane parallel to that of the partition. The joystick was separated from the partition by a distance of only 4.5 cm. This distance between the manipulandum and the partition was chosen for two reasons.

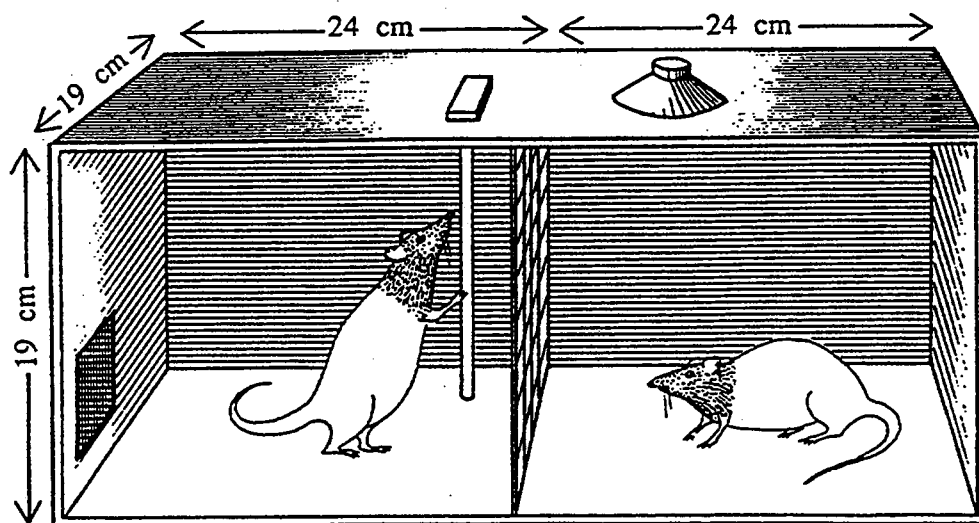


FIG. 1. Diagram of the apparatus, showing the position and orientation of the demonstrator (left) and observer (right).

First, it was great enough to prevent an observer rat from reaching through the partition and contacting the joystick during observation. Second, it was small enough effectively to prevent an animal in the demonstration/test compartment from manipulating the joystick from the partition side. The latter arrangement ensured that when observers were responding on test, they were facing in the opposite direction to that from which they had viewed the demonstrators' behaviour. Microswitches were used to record movements of the joystick, and these could be adjusted so that the extent of joystick displacement necessary for a response to be registered could be varied. When demonstrators were being observed, they had to displace the free end of the joystick by at least 5.5 cm in order for a response to be recorded. When observers were being tested, the necessary displacement was 3.5 cm.

The demonstration/test compartment also contained a food tray situated at floor level on one side of the wall opposite the partition. The food tray was illuminated on the inside by a 24-V, 2.8-W bulb and covered by a lightly hinged clear Perspex flap. A 45-mg food pellet of mixed composition was delivered to the food tray whenever a subject made a correct response (variously defined below).

The other compartment, from which each subject observed its demonstrator's behaviour, was featureless save for a loudspeaker in the ceiling adjacent to the partition. Each time the pellet dispenser operated, this loudspeaker delivered a 1000-Hz, 90-dB tone of 0.2-sec duration, and the tray light went on. The light went out again the next time the tray flap closed.

A BBC Master computer running Spider on-line control language controlled the equipment and collected the data.

Procedure. Each session began with illumination of the house light and ended, after 50 food pellets had been delivered (unless otherwise stated), when that light was extinguished.

A response was scored as "left" if it resulted in a displacement of the joystick towards the front of the operant chamber, and as "right" if it resulted in displacement of the joystick in the opposite direction. As observers and demonstrators faced one another on opposite sides of the partition and of the joystick, when a demonstrator made a "right" response the joystick moved to the left in its visual field and to the right in the observer's visual field.

Demonstrator Training. In 15 daily sessions, half of the demonstrators were trained to push the joystick to the left and half to push it to the right. The extent of joystick displacement necessary for the delivery of a food pellet and the number of reinforcements per session were increased gradually until, from Session 5 onwards, each displacement of 5.5 cm or more in one

direction was reinforced, and the session terminated after 50 food pellets had been delivered.

Observer Training and Testing. Initially observers received three daily sessions of magazine training in the demonstration/test compartment from which the joystick had been removed. Thirty food pellets were delivered on a Random Time 60-sec schedule in each session.

1. *Acquisition:* Before being allowed access to the joystick for the first time, each observer was placed in the observation compartment while the demonstrator pushed the joystick to the left (Group LEFT) or to the right (Group RIGHT) for reinforcement. When the demonstrator had completed the session, it was removed from the apparatus, and the observer was immediately transferred to the demonstration/test compartment where joystick displacements in both directions were reinforced. This acquisition test session ended when the observer had made 25 responses in the direction in which their demonstrator had been responding.

2. *Reversal:* On the day after the acquisition test each observer was rehoused with a new demonstrator and received the first of four daily discrimination training sessions. No further observation experience was given during this period. In each discrimination training session only left responses were reinforced for animals in Group LEFT, and only right responses were reinforced for animals in Group RIGHT. On the day after the fourth session, the rats were given a reversal test, i.e. one session in which responses were reinforced only if they were in the opposite direction to those reinforced during training. Immediately prior to this test session, each animal observed the demonstrator with which it had been housed since the acquisition test making 50 reinforced responses either to the left or to the right. Half of the observers saw demonstrators responding in the direction that was to be reinforced on test (Group NEW), and the other half saw demonstrators responding in the direction that had been reinforced during discrimination training (Group OLD). Half of the observers in each of these groups had been assigned to Group LEFT for the acquisition test.

3. *Extinction:* The reversal test was followed by further discrimination training without additional observation experience. During each of 10 daily sessions reinforcement was given for responses in the opposite direction to those reinforced during initial discrimination training. On the day after the tenth session the observers were given an extinction test, i.e. one 5-min session in which reinforcement was withheld. Immediately prior to the

the observers in each of these groups had been assigned to Group NEW for the reversal test.

Results

Acquisition Test. All demonstrators except one showed perfect discrimination while being observed by the subjects prior to the acquisition test. The remaining animal, which demonstrated for an observer in Group RIGHT, made just two non-reinforced responses. We predicted that if the observers learned a response-reinforcer relationship during observation, then during the first session in which they had access to the joystick they would show a response bias in favour of the direction in which their demonstrator had been responding. This was the case, despite the fact that observers were reinforced on test for responses in both directions. A discrimination ratio was calculated for each animal by dividing the number of left responses by the total number of responses made by that animal during the test session. The mean discrimination ratio for Group LEFT, observers of left-pushing demonstrators, was 0.86 ($SD=0.12$, $N=4$), and for Group RIGHT was 0.29 ($SD=0.16$, $N=4$), $F(1, 6)=32.8$, $p<0.01$.

Reversal Test. While being observed by the subjects prior to the reversal test, all demonstrators showed perfect discrimination. One observer, in Group OLD, was not given the reversal test because its discrimination performance was still poor after the four training sessions following the acquisition test. In the last two of these sessions, 60% and 38% of this animal's responses were reinforced, whereas no less than 95% of each of the other observers' responses were reinforced. Training of this animal terminated at this point, and therefore it does not appear in the results of either the reversal test or the extinction test.

We predicted that if the observers learned a response-reinforcer relationship by observation, then those in Group NEW would show faster reversal than those in Group OLD, and this prediction was confirmed. The rats in Group NEW that had observed demonstrators responding in the direction to be reinforced on test attained a criterion of 50 reinforced responses after making fewer responses than those in Group OLD. The mean number of responses to criterion for Group NEW was 87.5 ($SD=13.4$, $N=4$), and for Group OLD was 133.7 ($SD=28.4$, $N=3$), $F(1, 5)=8.46$, $p<0.05$.

Extinction test. While being observed by the subjects prior to the extinction test, all demonstrators showed perfect discrimination. We predicted that if subjects learned a response-reinforcer relationship by observation, when reinforcement was withheld, the rats that had observed demonstrators responding in the direction that had been reinforced (Group SAME) would

make proportionally more previously reinforced responses than the rats that had observed demonstrators responding in the opposite direction (Group DIFFERENT). The results did not confirm this prediction. A two-way analysis of variance, which included RESPONSE TYPE (previously reinforced vs previously non-reinforced) as a within-subjects variable, revealed significant main effects of GROUP, $F(1, 5) = 25.85$, $p < 0.01$, and of RESPONSE TYPE, $F(1, 5) = 12.76$, $p < 0.025$, but no interaction [$F(1, 5) = 0.50$]. The mean total number of responses made by Group SAME was 52.0 ($SD = 7$, $N = 3$), and the mean total number of responses made by Group DIFFERENT was 27.5 ($SD = 5.8$, $N = 4$). Thus, the rats in Group SAME made more responses in total than the rats in Group DIFFERENT, but the groups did not differ in terms of the distribution of their responses to the previously reinforced and previously non-reinforced sides.

DISCUSSION

Effects of observation experience on acquisition, reversal and extinction of a directional response were found: (1) Rats that had observed demonstrators pushing to the left for reinforcement made more left responses during their first acquisition session than rats that had observed demonstrators pushing to the right for reinforcement. Furthermore, rats that had observed demonstrators pushing in the direction that had previously been reinforced took (2) longer to reach criterion reversal and (3) made more responses in extinction than rats that had observed demonstrators pushing in the opposite direction to that previously reinforced.

Denny, Clos, and Bell (1988) have reported bidirectional response observational learning effects similar to the acquisition effect reported here. Conspecific demonstrators were not used in their study. Prior to being given access to a joystick manipulandum, their rats observed the joystick being moved automatically to both the right and left of its vertical starting position. For half of the animals, the left movement signalled the delivery of food to the observer (S+) and the right movement signalled food omission (S-); the other half of the animals had the reverse assignment. Five of the six rats tested pushed the joystick in the S+ direction when they made their first response, but the reliability of this effect is difficult to determine on the basis of the information provided in the experimental report.

Denny et al. (1983; 1988) attempted to explain this effect, and apparently similar effects involving a discrimination between two manipulanda, by suggesting that the rats learned a stimulus-reinforcer, or S-S, contingency during observation, and that when they were tested they acted "purposefully" such that the event that signalled reward would come about. This raises the question of whether the effect on acquisition and reversal observed in the present experiment can be similarly attributed to S-S contingency

learning by observation. To test this hypothesis it would be necessary (but not sufficient) to repeat the procedure used in the present experiment with the joystick moving automatically, rather than through the agency of conspecific demonstrators, during observation. However, as things stand, there is some reason to doubt that the processes responsible for the present effects are identical to those underlying the examples of observational learning reported by Denny and his associates. Their animals were in the same position relative to the manipulandum during observation and testing, whereas the animals in the present experiment were on the opposite side during testing. This means that while our animals may have performed on the basis of an S-S association acquired during observation, they would have to have encoded the first stimulus allocentrically, relative to some other component of the apparatus, whereas the animals in previous experiments could have encoded it egocentrically, relative to their own vantage point. Although it is unlikely that the joystick's movement was encoded allocentrically in our apparatus, it is not impossible. For example, since the front and back walls were of different materials, the joystick might have been viewed in conjunction with different visual cues when moved to left and to the right. Such reward-correlated stimuli, contingent upon responding, could have played a role in strengthening those of the observer's responses that matched the demonstrator's. Even if this were the case, as an explanation of the initial occurrence of such matching responses, our account in terms of response learning may be regarded as no less parsimonious than that of Denny et al.

Although it is likely that stimuli arising from the delivery of food to the demonstrator would have been involved in any response learning by observation that occurred in this experiment, further studies would be necessary to confirm this and to identify their role. For example, food-related stimuli may simply sustain attention to the demonstrator's behaviour, i.e. have non-associative effects, or they may function as reinforcers in the vicarious acquisition of an S-R habit by the observer. If this were the case, one would expect response learning by the observer to be sensitive to the contingency between the demonstrator's responses and food-related stimuli.

The observation of a reversal effect, in addition to an acquisition effect, is of interest because it indicates that performance can be influenced by observational learning both when the task is novel and when it is familiar. In contrast, Denny et al. (1988) have consistently found that observation of a reversed S-S contingency affects performance only if the animals have not been tested (allowed access to the manipulanda) prior to observation. The fact that the animals in the present experiment had been tested prior to showing an effect of observation experience on reversal therefore casts further doubt on the possibility that the observational learning reported here is of the same kind as that reported by Denny and his associates. It is impossible to determine on the basis of the present experiment whether the

rats in Group NEW reached criterion reversal faster than those in Group OLD because they observed demonstrators pushing in the to-be-reinforced direction, or because they did *not* observe demonstrators pushing in the previously reinforced direction. The latter possibility is, on the face of it, less likely, because it suggests that additional training retarded reversal in Group OLD. This is not what would be predicted on the basis of numerous experiments showing that additional, conventional training tends to facilitate reversal (Mackintosh, 1974).

The results of the extinction test may, like those of the reversal test, be due primarily to one of two factors. The rats in Group SAME may have responded more in extinction than rats in Group DIFFERENT because they had observed the previously reinforced response or because they had not observed the opposite response immediately prior to the extinction test. The former possibility is apparently less likely given that additional conventional training has rarely been found to increase response rate in extinction (Mackintosh, 1974) and would only have received some support in this experiment if Group SAME had emitted proportionally more previously reinforced responses than Group DIFFERENT. This is the effect of observation experience on extinction performance that we predicted, but little can be concluded from our failure to find it as responses in both directions had been reinforced at some point during training.

Taken together, the results of this experiment suggest that the bidirectional response paradigm is well suited for the task of analysing, rather than merely demonstrating, the capacity for response learning by observation—a form of learning that may be distinctively social in nature.

REFERENCES

- Biederman, G. B. & Vanayan, M. (1988). Observational learning in pigeons: The function of quality of observed performance in simultaneous discrimination. *Learning & Motivation*, *19*, 31–43.
- Collins, R. L. (1988). Observational learning of a left-right behavioral asymmetry in mice (*Mus musculus*). *Journal of Comparative Psychology*, *102*, 222–224.
- Denny, M. R., Bell, R. C., & Clos, C. F. (1983). Two-choice, observational learning and reversal in the rat: S-S versus S-R effects. *Animal Learning & Behavior*, *11*, 223–228.
- Denny, M. R., Clos, C. F., & Bell, R. C. (1988). Learning in the rat of a choice response by observation of S-S contingencies. In T. R. Zentall & B. G. Galef (Eds.), *Social learning: Psychological and biological perspectives* (pp. 207–223). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Edwards, C. A., Hogan, D. E. & Zentall, T. R. (1980). Imitation of an appetitive discriminatory task by pigeons. *Bird Behaviour*, *2*, 87–91.
- Grindley, G. C. (1932). The formation of a simple habit in guinea-pigs. *British Journal of Psychology*, *23*, 127–147.
- Hearst, E. & Jenkins, H. M. (1974). *Sign-tracking: The stimulus-reinforcer relation and directed action*. Austin, Tx: Psychonomic Society.

- Huang, I., Koski, C. A., & DeQuardo, J. R. (1983). Observational learning of a bar-press by rats. *Journal of General Psychology*, 108, 103–111.
- Kohn, B. & Dennis, M. (1972). Observation and discrimination learning in the rat: Specific and nonspecific factors. *Journal of Comparative and Physiological Psychology*, 78, 292–296.
- Mackintosh, N. J. (1974). *The psychology of animal learning*. London: Academic Press.
- Osgood, C. E. (1953). *Method and theory in experimental psychology*. New York: Oxford University Press.
- Palameta, B. & Lefebvre, L. (1985). The social transmission of a food-finding technique in pigeons: What is learned? *Animal Behaviour*, 33, 892–896.
- Thorpe, W. H. (1956). *Learning and instinct in animals*. London: Methuen.
- Will, B., Pallaud, B., Soczka, M., & Manikowski, S. (1974). Imitation of lever pressing 'strategies' during the operant conditioning of albino rats. *Animal Behaviour*, 22, 664–671.
- Zentall, T. R. & Galef, B. G. (1988). *Social learning: Psychological and biological perspectives*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

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Démonstration d'un apprentissage par observation chez le rat, mettant en jeu un comportement bi-directionnel.

Des rats privés de nourriture pouvaient observer un congénère poussant une manette vers la droite ou vers la gauche pour obtenir de la nourriture. Ils avaient ensuite accès à la manette, mais dans une orientation différente. On a étudié les effets de l'observation, selon que le comportement consistait à pousser la manette vers la gauche ou vers la droite, sur trois variables: 1) apprentissage de la réponse, 2) inversion d'une discrimination gauche-droite, 3) extinction de la réponse. Les rats qui avaient observé la situation "manette vers la gauche" répondent plus souvent vers la gauche que ceux soumis à la situation "manette vers la droite". Par rapport aux rats qui avaient observé

naron los efectos de las experiencias observacionales sobre: (1) adquisición de la observación, (2) inversión de una discriminación izquierda-derecha y (3) respuesta durante extinción. Las ratas que habían previamente observado movimientos hacia la izquierda respondieron más hacia la izquierda durante adquisición de la respuesta que aquellas que habían observado el movimiento contrario. Las ratas que habían observado demostradores respondiendo en la dirección que había previamente sido recompensada tardaron más en alcanzar el criterio de inversión de la respuesta y respondieron más durante extinción que aquellas que habían observado demostradores respondiendo en la dirección opuesta a aquella que había sido previamente recompensada. Estos resultados proveen evidencia de que las ratas son capaces de aprender una respuesta, o una contingencia respuesta-reforzamiento, a través de observación de conespecíficos.