

THE

PSYCHOLOGICAL BULLETIN

IMITATION IN MONKEYS.¹

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The literature dealing with natural history abounds in anecdotes concerning the imitative power of monkeys. Thorndike, in his experimental study of the mental life of monkeys, denies that imitation plays an important rôle in the life of the primates. Students of behavior were inclined to accept the conclusions of Thorndike until Hobhouse's experiments were reported. As is well known, the latter finds that many animals, especially the monkey, learn both by 'perception of result' and by imitation.

Believing that a thorough reworking of the field was desirable, I began experiments upon four monkeys in the summer of 1906. From that time on to the present, the behavior of these monkeys has been observed incidentally under environmental conditions more or less resembling those offered by their native habitat, as well as under conditions of experimental control. In taking up the study, several essential factors were kept in mind. In the first place, the animals were *purchased shortly after importation*. They were kept, under the best conditions of housing, until they had become used to handling and until a complete knowledge of their repertoire of 'chance associations' had been obtained. Hobhouse experimented upon garden monkeys whose opportunities for the formation of coördinations of the most diverse kind had been legion. This fact, coupled with his rather loose type of experimentation, is enough to make one accept his somewhat eulogistic conclusions with a grain of caution.

¹This MS. was prepared essentially in the present form for presentation before the Western Branch of the American Psychological Association in October, 1906. For a statement of recent literature upon imitation see review section of this number of BULLETIN, edited by the present writer.

In the second place, the animals were kept under normal conditions of hunger. During the period of experimentation, they were fed the usual amount of food. The stimulus used was always some form of food for which the monkeys had a special fondness, such as malaga grapes or bananas. These animals, after having been fed to satiety both with bananas and with bread and milk, will eagerly attack a problem-box if it contains grapes.

The four monkeys were selected from a group of nine on account of their gentleness or alertness. Of these, one was a baboon (*Cynocephalus*),¹ one a capuchin (*Cebus*), while the other two were rhesus (*Macacus*). The first two animals need no commentary. They were healthy and characteristic of their respective species. The two rhesus monkeys have a rather interesting history. Jimmie, a large male, was obtained from an importer; Billy, a small male, was a stray, probably from some circus. He and his mother (?) were found one day in the yard of a large apartment house. At the time, Billy was nursing and was carried everywhere by his mother in the characteristic maternal monkey fashion. On account of the fierceness of the mother, Billy was weaned and put into a large cage which housed Jimmie. An attachment sprang up almost immediately between these two monkeys. At this period of his life, Billy was very wild and restless. When excited, he would cry and attempt to attach himself to Jimmie as he had customarily attached himself to his mother. This Jimmie soon discouraged by severe nips and cuffs. A little later, after the friendship had been established, Jimmie, whenever Billy became excited, would run to him, assume a sitting posture and put his forelegs around Billy's neck. Billy, on his part, would nestle up to Jimmie and clasp him around the chest. If Billy did not become placid under this treatment, Jimmie would gently rock him from side to side and at times would pat him, giving out a soft companionable chatter. This friendship has continued up to the present time.

On account of the peculiar relationship existing between these two animals, a close watch of their daily life was kept. It soon became evident that Jimmie's reactions influenced Billy's to an enormous extent. When Jimmie goes to one part of the cage, Billy follows. If a pan of water or a bowl of milk be held out to them, Billy will come down to drink if Jimmie will precede him, never otherwise. Jimmie has formed the habit of jumping to my shoulder when I enter the cage and call; Billy has formed the same habit, but if Jimmy for any rea-

¹ This animal was so stupid in all his reactions that results obtained from him will not be considered specifically.

son refuses to come when I call, Billy will refuse also. If Billy is loose in the room when I pass with Jimmie on my shoulder, he will run to me immediately when I call, but on the other hand, if Jimmie is not with me, Billy will pay absolutely no attention to my commands. At times, Jimmie and Billy are left loose in the animal room. When I desire to force them to enter their cage, I get a long stick and threaten Jimmie with it. He usually stalks around the cage two or three times before entering it, but always just out of reach of the stick. Billy invariably 'tags' him and when Jimmie finally darts through the cage door, Billy plunges in too. It is almost impossible to force Billy to enter unless Jimmie has preceded him. On the other hand, if Jimmie is left in the cage and Billy is forced out into the room, the latter is unhappy and will reënter the cage the moment the door is opened wide enough to admit him.¹ Both monkeys are restless and excitable when they are in different rooms. At such times calls are frequently made to each other. When again united, they cuddle together in the manner described above, and both chatter in a way which is hard to describe, but which seems to be an expression of emotional satisfaction.

I have entered into a description of the companionship between these two animals, because under such conditions surely, if anywhere, we ought to be able to demonstrate intelligent imitation, provided such a function be possessed by them.

Problems of the manipulation type, and of a type involving for their solution, apparently, the presumable perception of a simple relation, were presented to all of these animals. These latter problems are designed after those employed by Hobhouse. Indeed, in some instances, I have tried to duplicate Hobhouse's conditions.

The following is a partial list of problems presented to each of the four monkeys:

A. Problems depending for their solution upon the perception of relation:

- I. Drawing in food with a rake — animal to imitate me.
- II. Drawing in food with a cloth — animal to imitate me.
- III. Obtaining food from bottom of bottle by use of fork — animal to imitate me.
- IV. Pushing out food from middle of long glass cylinder by means of light sticks — animal to imitate me.

B. Problems of manipulation type:

¹ As Billy increased in age many of his babyish habits tended to disappear. Recently he has manifested a certain independence in coming to the door of the cage for his food.

V. Old-fashioned latch — animal to imitate *Billy* or me.

VI. Box with door in top — not held in place by any fastening. Animal to pull open door by means of handle — *Billy* to imitate *Jimmie*.

VII. Box with door in top held in place by push-button. Push-button was attached to door and ran through guide in frame of door. Door opened (pulled up) when latch had been slipped back far enough to clear guide — *Billy* to imitate *Jimmie*.

Without entering into details concerning the learning process involved in these problems of the manipulation type, I unhesitatingly affirm that there was never the slightest evidence of inferential imitation manifested in the actions of any of these animals. There was never imitation either of my movements or of the movements of the animal which was successfully manipulating the mechanism. In problems VI. and VII. *Jimmie* almost immediately hit upon the successful movements. For three weeks he procured all of his own food in this way. *Billy*, who had previously easily learned box V., was present 'watching' all of his movements, but could never at the conclusion of the tests with *Jimmie* manipulate these boxes alone at his imitation-test (once each day for five minutes or longer, immediately at conclusion of *Jimmie's* exposition).

Jimmie is the quickest animal in learning mechanisms I have ever observed. When a box worked by any variety of mechanism is placed before him, he tests the various movable parts with teeth and paws with lightning-like rapidity. Nevertheless, after watching his young companion manipulate box V. for three days, he showed not the slightest familiarity with the mode of procedure required to open it. He learned it perfectly of his own accord, however, by a hit or miss method, in five trials.

Most of the tests of the manipulation type made with the cebus, *Harry*, were on box V. At intervals, for over a month, I presented this box to him: I would attract his attention to the food in it when he was within a few inches of the door; and while he was apparently attending to my movements, I would slowly raise the latch and allow the door to fly open. Over 100 trials of this kind were given him during the course of the experiment. During all this time, he failed to profit by my tuition. He was always given his imitation-test immediately after I had opened the box.

Another cebus, lately purchased by me, failed after 60 trials to open a small metal box which is opened by means of a small handle (similarly to VI.). A grape was placed in this box and the lid was

then opened and shut before him several times. Invariably, when he tried to open the box alone, he clawed and bit at the edges of the junction point between lid and box until by chance his movements were successful. Not for the first 60 trials did he use the handle to pull the lid open.¹

The results from the first four problems, which involve apparently the perception of relation, gave no better indications of the presence of imitation.

Problem I. was presented to Jimmie, Billy and Harry (the cebus) at intervals, for more than three months. In detail, the method was as follows: The animal was tethered in an open floor space. A grape was placed out of reach. A light, ten-inch stick with a two-inch T-piece fastened to one end was left near. In order to get the grape, the monkey would have to hook the T-piece behind the grape and pull in. As is known, Hobhouse found that his monkeys (rhesus and chimpanzee) would use a rake, a crooked stick, and even a piece of cloth for this purpose. I have been wholly unable to verify his results.

When the animal is placed in this situation, it at once begins to strain at the tether and to reach out with the paw as far as possible. All three of the monkeys were given several hundred trials without receiving aid from me. Never once was the slightest effort made to utilize the rake in the proper way. They would often pick up the rake, bite it and then discard it. I oftentimes left them in this situation for hours at a time. The food had never been reached upon my return.

Finally, I began showing the monkeys how to draw in the food. I would wait patiently until I apparently had their attention, then slowly hook the T-piece around the grape and slowly draw in the food. The moment the grape rolled near, the animal began to strain

¹This box was to be used later as the food box in a discrimination test on spectral light. I thought the test on discrimination would be facilitated if the monkey were allowed to open the box in the daylight. After failing to teach him as above described, I gave up in despair and decided to try him in the discrimination test in the dark room, trusting that the conditions there, offering less distraction, might after all hasten the association. Strange to say, he manipulated the box perfectly from the first trial. The reason was apparent. In the dark room, a faint red light was presented with the box. Under these conditions, the animal began 'peering' about, with his head close to the floor, and accidentally struck the handle with his mouth, and immediately opened the box. Ever afterwards, he adopted this method. Harry, the other cebus, also learned to open the box with his mouth. The rhesus monkeys, on the contrary, opened it with the paw without any apparent learning process.

at the tether and to attempt to grasp the grape with the paw. The situation was again immediately arranged as before and the rake left near.¹ *Never once did any one of the animals push out the rake, hook the blade around the grape, and then pull in*, nor did they in any other way ever show any signs of perceiving the relation which ought to exist between the two objects. After many tests, the rake became associated with food and the animals began eagerly to pick up the rake and to drag it about the moment I came near with the food, only to drop it, and begin straining to get the food with the paw the moment the grape was put down on the floor. No effort was made to set up the association by the trial and error method, since it was desired to test only the possible presence of a higher form of learning.

The above test was repeated *ad nauseam* and I finally came to the conclusion that Hobhouse must have experimented upon a far more intelligent group of animals than the above; or that he was testing animals which had already learned a variety of such tricks, and consequently the apparently new reactions which he obtained were really due to extremely slight modifications of associations already existing; or, finally, that he was inclined to read more into the monkeys' use of the stick than was really present (the monkey will *pull in* a rope or stick with great rapidity and dexterity). It would be idle speculation on my part to decide among these possibilities.²

Problems II., III. and IV. gave identical results. In problem II. the cloth was drawn in if it were anywhere within reach, regardless of whether it were in a position to catch the grape in passing or not. Jimmie was fond of taking the cloth, putting it over his head and then dancing round the room. None of the animals made the slightest effort to throw the cloth out over the grape and then draw in, although they were shown the trick by me many, many times.

¹ At the first test, the monkeys would draw in the stick if it were left near the grape; but they would pull in just as eagerly if the blade was not hooked around the grape as if it were. Indeed, they would strain to reach the stick and pull in even when no food was near. It is an inveterate habit with them to pull in any object which can be reached and manipulated.

² To show Jimmie's level of intelligence, it may be worth while to mention the fact that he soon learned that by turning round and facing the tether and using the hind legs instead of the fore legs, he could increase his reach by several inches. In the later trials he adopted this method exclusively, gaining great adroitness in the use of the grasping powers of his hind feet. He succeeded many times in getting the grape because the experimenter would forget Jimmie's 'method' for the moment and would place the grape too near. Billy, his companion, never caught this trick, although he was constantly near Jimmie during the trials.

In problem III. a piece of banana was placed in the bottom of a tall bottle. A stick, roughened and sharpened at the end, was stuck into the banana. The end of the stick protruded from the bottle three or four inches. The animals on their first trial immediately grasped the stick and jerked out the banana. The experiment was then repeated, but the stick was not plunged into the banana. The monkeys as before jerked out the stick, but threw it down immediately and plunged the forearm into the bottle and attempted to reach the food by the more natural method. Not succeeding, they knocked the bottle down and rolled it around until the food dropped out. Jimmie, after several trials, learned to pick up the bottle by the lower end and to shake the food out. I tried patiently to teach them the use of the stick but failed signally.

In problem IV. the animal had to push a piece of banana from the middle of a 15-inch glass cylinder of $1\frac{1}{2}$ -inch bore. The glass cylinder was securely fastened to a table top. A light 16-inch stick was placed near. The monkeys, on being admitted to the apparatus, immediately began clawing and biting at the cylinder at a point nearest the banana. Later in their first trial, they came to one end of the cylinder and began a frantic struggle to reach the food with the paw. Their own unaided efforts were all of this random type. Day after day I took the light stick, put it into the cylinder and then slowly forced the banana out: The sight of the moving banana made them eager — they followed it down the cylinder until it came within reach of the ubiquitous paw. Meeting no success with this procedure, I changed the method by putting the stick inside the cylinder and just in contact with the banana. The monkey, in order to reach the food, would simply have to force the stick on in. Invariably, after my oft-repeated lesson, the monkey on his imitation-test first jerked out the stick, then began his random instinctive efforts to extract the food by means of his paw.

One other test, involving also for its solution apparently the perception of a simple relation, was given to Jimmie and Billy. Early in the history of their friendship, Jimmie formed the habit of taking Billy's food away from him — going oftentimes even to the length of poking his paw into Billy's cheek pouches. I thought it possible to test whether Jimmie would in time learn to push Billy out for food. The method was as follows: Jimmie was tethered short to one corner of the large living cage; Billy was left untethered but had a two-foot chain attached to his collar.¹ Food was placed in a box in the corner furthest

¹ It needs to be mentioned in this connection that the two monkeys were ordinarily kept in the cages with their chains on but unattached. In their play, consequently, Jimmie had already learned to haul Billy about the cage by using the latter's chain.

from Jimmie. Billy usually remained near Jimmie until food was placed in the box. He would then dash to the box (provided the experimenter would withdraw) and pick up a bit of food. Jimmie would immediately grasp the end of Billy's chain, draw him in and rob him of the food. He became extremely adept in doing this and during a day's experiment (ten to twelve separate tests) Billy rarely kept possession of a morsel of food unless he swallowed it instantly. Jimmie soon began to grasp and to hold the end of Billy's chain the moment I brought in food. The performance of this trick looked at first as though it called for the actual perception of relation on the part of the animal, but closer observation showed that Jimmie would pull Billy back before he obtained food as often as he would allow him to get food before pulling him in. Billy finally learned to circle — to leave from a position where Jimmie could not grasp his chain; after getting the food, he would climb upon a board near the top of the cage. In doing this his chain hung down, whereupon Jimmie would catch the chain immediately and pull Billy down. Billy on his part never learned to keep his chain out of Jimmie's reach.

For three weeks Jimmie was forced to get all of his food in this roundabout way. The next step in the problem was to test Jimmie's behavior when Billy had been surfeited and would no longer go to the food box. In order to arrange this, Billy was taken out and fed until food would no longer tempt him to move. He was then put back into the cage with Jimmie and food was placed in the food box as before. I desired to see whether there would be any effort on Jimmie's part, under these circumstances, to force Billy to go towards the food-box (pushing and pulling Billy about was one of Jimmie's pastimes). Under the conditions mentioned Jimmie would begin immediately to draw in Billy by his chain and to haul him back and forth, but this random activity was all — *there was no tendency present to push Billy toward the food.*¹

Such are the experiments which closely engaged my attention for about a year (June, 1906 to April, 1907) and incidentally for more than two years. From all this observation, I am forced to conclude that imitation in its higher forms has not been a very powerful or efficient means of aiding the monkey in reaching its present high place in the mammalian series. The reason for the primate's superiority is to be sought for in his greater sensitiveness to an extremely wide range

¹ Nor did Billy ever gratuitously attempt to supply Jimmie with food. Garner states that when one of his pet monkeys became sick, its playmate and companion carried food to the invalid.

of stimuli and to his superb power of muscular response rather than to any ability on his part to construct stimuli into definite objects which can be analyzed and synthesized by him, later, at will.

The above represents the results obtained from my controlled experiments. In my long association with these and other monkeys, I have incidentally observed certain types of reaction which are circular in character and which are suggestive of a low order of imitation. I append examples of these below. The examples chosen are by no means exhaustive.

EVIDENCE FOR CIRCULAR TYPES OF REACTION.

Looking Through a Crack.—One monkey discovered a hole in a window-frame where a sash-cord had formerly run. This one would 'peek' and then another one would push him aside and 'peek' in turn. This was observed several times when several monkeys (rhesus) were brought up from the dealer for examination and selection. It was later observed in two monkeys which had been in the laboratory for some time (Kinnaman has observed the same type of reaction).

Dropping a Spoon.—While the monkeys were at liberty on Bird Key (Dry Tortugas), I was disturbed one day by a noise: I found that Harry (cebus) had filched a large tablespoon. He was standing the spoon on one end and immediately releasing it. The dropping seemed to be not accidental but an actual part of the act as a whole. (The cebus is extremely adept in the use of his paws.) He repeated the act fifteen times in unvarying order and (as well as I could judge) at definite time intervals. This corresponds, in my opinion, very closely to the child's act in repeatedly hammering its spoon against a dish.

Hammering with Nut (or any small, hard, preferably round object).—The cebus, Harry, will take a hickory nut to some hard surface and hammer with it at intervals for several moments. Short series of taps, averaging four to six separate taps to each series, take place in quick succession—150 such series were once counted in one half hour. Another cebus, Sammy, exhibited the same reaction. In the forest, this act is probably connected with some kind of food-getting process. It has no significance in the present environment of the animals, but seems to have been retained for its value as a circular form of play. A spoon, piece of metal, small rock, etc., will often be taken to the window-pane by Sammy and used as a hammer in this way.

The rhesus, Jimmy, also gives evidence of such a type of reaction: Occasionally (but rarely) he will sit and play with a hard object and

let it slip idly through his fingers to the board upon which he sits, pick it up again, and again drop it. Putting a handkerchief or towel over his face, then removing it, and repeating the process over and over again is another form of Jimmie's play.

I have found it possible to instigate Jimmie to perform one rather interesting instinctive act: Flea-catching, regardless of what the sociologist may have to say, is the most fundamental and basal form of social intercourse between rhesus monkeys! The act is well known. As the monkey works over the body of his companion with his paws, he smacks his lips together continually and occasionally brings one paw to the mouth. This smacking sound is the invariable accompaniment of the act. It can be imitated easily and perfectly. I was able to get Jimmie, on one occasion, to come to me and to let me 'pick' him. After I had performed the act satisfactorily to him, he perched upon my shoulder but made no attempt to 'pick' me. I held up the hairy part of my arm to him, but he still made no effort in that direction. I then began to make the smacking sound with my lips. He immediately made the sound in turn and began searching my arm and then proceeded to my neck (I was wearing a rubber cap over my hair). On two or three other occasions, I was able to repeat this, but I cannot produce the act at will.

The examples cited, taken in connection with the behavior of Jimmie and Billy described in the early part of this paper, will serve to show that we have in the reactions of the monkeys, at least a rudimentary type of imitation.

The anecdotal material which I have collected would compare favorably with that presented by Romanes and others, but close examination of such acts, especially during the period of their genesis, does not lead me to think that the higher forms of imitation are present in them.¹

¹Dr. Karl T. Waugh has undertaken to repeat the experiments of Berry (see review section) upon these monkeys. The writer wishes it understood that his present conviction upon the subject of imitation stands ready to be changed as soon as the evidence calls for it.