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BY JEAN PIAGET AND BARBEL INHELDER

*The Child's Conception of Space*  
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THE ORIGINS  
OF INTELLIGENCE  
IN CHILDREN

JEAN PIAGET

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shakes it in the same way and looks at the window. She continues for a while in spite of failure while attentively watching the window.

At 1;6 (20) Jacqueline brings down a watch chain from the top of a quilt by hitting the latter. I then place the chain on a chair, 50 cm. from the bed. She strikes the quilt three times while watching the chain but without conviction and as though "to see if" that can yield something.

Thus it may be seen how directed groping as well as the application to the experiment of schemata due to tertiary circular reaction can, in situations of which the child does not understand the particulars, be extended in "applications of familiar means to new situations" and even in "procedures to make an interesting spectacle last" reminiscent of the behavior patterns of the fourth and third stages.

In conclusion, the behavior patterns characteristic of the fifth stage constitute a homogeneous totality: The "tertiary circular reaction" marks the beginning of experimental behavior, whereas the "discovery of new means through active experimentation" utilizes the method thus found by the child for the solution of new problems. As we shall see in Volume II, moreover, this more advanced adaptation of intelligence to the real is accompanied by a structurization of the external environment into permanent objects and coherent spatial relations as well as by a correlative objectification and spatialization of causality and time.

## CHAPTER VI

### THE SIXTH STAGE:

#### The Invention of New Means Through Mental Combinations

The ensemble of intelligent behavior patterns studied hitherto—secondary circular reaction, application of familiar means to new situations, tertiary circular reaction and discovery of new means through active experimentation—characterizes a single, big period. To be sure, there is progress from one type to another behavior pattern and so one can consider the three main groups which we have delineated in the preceding chapters as forming three sequential stages (it being understood that the advent of each new stage does not abolish in any way the behavior patterns of the preceding stages and that new behavior patterns are simply superposed on the old ones). But the facts remain so complicated and their sequence can be so rapid that it would be dangerous to separate these stages too much. On the other hand, with the behavior patterns, which we are now going to describe, begins a new period which everyone will concur in considering as appearing tardily, much later than the preceding behavior patterns. We can therefore speak of a sixth stage which does not mean that the behavior patterns hitherto under study will disappear, but merely that they will henceforth be completed by behavior patterns of a new type: invention through deduction or mental combination.

This new type of behavior patterns characterizes systematic intelligence. Now it is the latter which, according to Claparède, is governed by awareness of relationships and no longer by em-

pirical groping. It operates, according to Köhler, by sudden structurizations of the perceptual field or, according to Rignano, is based on purely mental experience. In short, all writers, whether associationists like Rignano, believers in "structures" like Köhler or, like Claparède, believers in a more or less directed groping, agree that there exists an essential moment in the development of intelligence: the moment when the awareness of relationships is sufficiently advanced to permit a reasoned prevision, that is to say, an invention operating by simple mental combination.

We are consequently confronted by the most delicate problem which any theory of intelligence has to treat: that of the power of invention. Hitherto the different forms of intellectual activity which we have had to describe have not presented particular difficulties of interpretation. Either they consisted in apprenticeships during which the role of experience is evident, discovery consequently surpassing true invention, or else they consisted in simple applications of the familiar to the new. In both cases, thereafter, the mechanism of adaptation is easy to explain and the play of assimilations and of primitive accommodations suffices to explain all the combinations. On the other hand, as soon as real invention arises the process of thought baffles analysis and seems to escape determinism. Will the schemata to which the preceding facts have accustomed us fail in the task, or will the new facts which we are about to describe appear once more to be prepared by all the functional mechanism of earlier activities?

Let us observe at the outset, in this connection, but without wishing to find an explanation ahead of time, that real invention arises as a function of a sort of rhythm conditioned by the ensemble of the preceding behavior patterns. This rhythm determines the sequence of acquisitions and applications. With secondary circular reaction we are in the midst of acquisition: New schemata are constructed through reproductive assimilation and accommodation combined. With the application of familiar means to new situations, these same schemata give rise to some original applications (through generalizing assimilation) without actual acquisition being involved. With tertiary circular reac-

tion and the discovery of new means through apprenticeship, we are once again in a period of apprenticeship but, in this case, the very complexity of acquisition involves a constant intervention of all that has been acquired earlier. With invention through mental combination we can at last speak of a new process of application, for all invention presupposes a mental combination of already elaborated schemata, but an application on a par with acquisition since there is invention and consequently there are original combinations. Given this rhythm, invention is therefore comparable to the "application of familiar means to new situations" since, like the latter, it operates by deduction; but this deduction, being creative, also partakes of the processes of acquisition hitherto under study and, oddly enough, of the discovery of new means through active experimentation.

§1. THE FACTS.—First, here is a series of observations beginning with those most reminiscent of the discoveries due to directed groping. It happens that the same problem, such as that of the stick to be brought through the bars, can give rise to solutions through real invention as well as to solutions involving simple experimental groping. Analysis of such cases will enable us to see right away both the originality of the new behavior patterns and their relationship to the preceding ones. This relative contrast of solutions can be observed either in passing from one child to another or in the same child several months later.

*Observation 177.*—In order to explain the difference between the present and preceding behavior patterns it can be instructive to examine the way in which Laurent all at once discovered the use of the stick after not having known how to utilize that instrument for several months.

In contradistinction to Jacqueline and Lucienne whom we know were subjected to numerous experiments during which they had opportunity to "learn" to use the stick, Laurent only manipulated it at long intervals until the time when he knew how to use it spontaneously. It is therefore worth while, in order to characterize that moment, briefly to retrace the ensemble of Laurent's earlier behavior patterns relating to the stick.

As early as 0;4 (20), that is to say, at the beginning of the third stage, Laurent is confronted by a short stick which he assimilates to some object. He shakes it, rubs it against the wicker of his bassinet, draws

himself up, etc. In a general way he makes it the equivalent of the paper knife in Observation 104. But, at 0;4 (21), when Laurent is holding the stick, he happens to strike a hanging toy and immediately continues. But during the next hours Laurent no longer tries to reproduce this result even when I put the stick back into his hand.—This first situation, then, is not an example of the "behavior pattern of the stick." Laurent confined himself to momentarily inserting a new element in an already constructed schema (the schema of striking). But the fortuitous intervention of the latter gave rise to no immediate comprehension or even experimentation. The following days I give him the stick again and try to make him associate it to the activity of the various schemata. But Laurent does not react then or in the following weeks. The "behavior pattern of the stick," that is to say, the utilization of the stick in the capacity of intermediate or instrument, does not seem able to be acquired during the stage of the secondary circular reactions, even when chance has favored the momentary insertion of the stick in an already existing schema.

In the course of the fourth stage, characterized by the coördination of the schemata, the use of the stick makes no progress. However, during this stage, the child comes to use the hand of another person as an intermediate to act upon distant objects, thus succeeding in spatializing causality and preparing the way for experimental behavior. But when, at 0;8 or even 0;9 I give Laurent the stick, he only uses it to strike around him and not yet to displace or bring to him the objects he hits.

At 1;0 (0)—that is to say, well into the fifth stage (it is during this stage that Jacqueline and Lucienne succeeded in discovering the utilization of the stick)—Laurent manipulates a long wooden ruler for a long time, but only arrives at the three following reactions. In the first place, he turns the stick over systematically while transferring it from one hand to the other. Then he strikes the floor, his shoes and various objects with it. In the third place, he displaces it by pushing it gently over the floor with his index finger. Several times I place, at a certain distance from the child, some attractive objective to see whether Laurent, already holding the stick, will know how to use it. But each time Laurent tries to attain the object with his free hand without having the idea of using the stick. Other times I place the stick on the floor, between the objective and the child, in order thus to provoke a visual suggestion. But the child does not react to that either.—There does not yet exist, therefore, any trace of the "behavior pattern of the stick."

At 1;0 (5), on the other hand, Laurent is playing with a little child's cane which he handles for the first time. He is visibly surprised at the interdependence he observes between the two ends of this object. He displaces the cane in all directions, letting the free end drag along the floor, and studies the coming and going of this end as

function of the movements he makes with the other end. In short, he begins to conceive of the stick as a rigid entity. But this discovery does not lead him to that of the instrumental signification of the stick. In effect, having by chance struck a tin box with the cane, he again strikes it but without the idea either of making it advance in that way or of bringing it to him.—I replace the box with various more tempting objectives: the child's reaction remains the same.

At 1;2 (25) I give him back the stick because of his recent progress. He has just learned to put objects on top of one another, to put them into a cup and turn it upside down, etc.: the relationships which belong to the level of the behavior pattern of the stick (see Vol. II). He grasps the stick and immediately strikes the floor with it, then strikes various objects (boxes, etc.) placed on the floor. He displaces them gently but it does not occur to him to utilize this result systematically. At a given moment his stick gets caught in a rag and drags it for a few moments in the course of its movements. But when I put various desirable objectives 50 cm. or 1 m. away from Laurent he does not utilize the virtual instrument he holds.—It is apparent that, if I had repeated such experiments at this period, Laurent, like his sisters, would have discovered the use of the stick through directed groping and apprenticeship. But I broke off the attempt and only resumed it during the sixth stage.

At 1;4 (5) Laurent is seated before a table and I place a bread crust in front of him, out of reach. Also, to the right of the child I place a stick about 25 cm. long. At first Laurent tries to grasp the bread without paying attention to the instrument, and then he gives up. I then put the stick between him and the bread; it does not touch the objective but nevertheless carries with it an undeniable visual suggestion. Laurent again looks at the bread, without moving, looks very briefly at the stick, then suddenly grasps it and directs it toward the bread. But he grasped it toward the middle and not at one of its ends so that it is too short to attain the objective. Laurent then puts it down and resumes stretching out his hand toward the bread. Then, without spending much time on this movement, he takes up the stick again, this time at one of its ends (chance or intention?), and draws the bread to him. He begins by simply touching it, as though contact of the stick with the objective were sufficient to set the latter in motion, but after one or two seconds at most he pushes the crust with real intention. He displaces it gently to the right, then draws it to him without difficulty. Two successive attempts yield the same result.

An hour later I place a toy in front of Laurent (out of his reach) and a new stick next to him. He does not even try to catch the objective with his hand; he immediately grasps the stick and draws the toy to him. Thus it may be seen how Laurent has discovered the use of the stick almost without any groping when, during the preceding stages, he



handled it without understanding its usefulness. This reaction is therefore distinctly different from that of his sisters.

*Observation 178*—We recall Jacqueline's gropings at 1;3 (12) when confronted by a stick to be brought through the bars of her playpen (Obs. 162). Now it happens that the same problem presented to Lucienne at 1;1 (18) gives rise to an almost immediate solution in which invention surpasses groping. Lucienne is seated in front of the bars and I place against them, horizontally and parallel to the bars (half way up them) the stick of Observation 162. Lucienne grasps it at the middle and merely pulls it. Noticing her failure, she withdraws the stick, tilts it up and brings it through easily.

I then place the stick on the floor. Instead of raising it to pull it directly, she grasps it by the middle, tilts it up beforehand and presses it. Or else she grasps it by one end and brings it in easily.

I start all over again with a longer stick (30 cm. long). Either she grasps it by the middle and tilts it up before pulling it, or else she brings it in by pulling on one end.

Same experiment with a stick 50 cm. long. The procedure is obviously the same but, when the stick gets caught, she pulls it away briefly, then lets it go with a groan and begins over again in a better way.

The next day, at 1;1 (19), same experiments. Lucienne begins by merely pulling (once), then tilts up the stick and so rediscovers the procedures of the day before. At 1;2 (7) I resume the observation. This time Lucienne tilts up the stick before it touches the bars.

It may thus be seen how these attempts are reminiscent of Jacqueline's, taking place through groping and apprenticeship. Lucienne begins by merely pulling the stick and repeats this once the next day. But, in contrast to her sister's prolonged efforts, Lucienne at once profits from her failure and uses a procedure which she invents right away through simple representation.

*Observation 179*—The example of the watch chain to be put into an aperture 16 x 34 mm. is more complex. Here again we remember Jacqueline's gropings (Obs. 173 and 173 repeated). But Lucienne has solved the problem by sudden invention:

At 1;4 (0) without ever having contemplated this spectacle, Lucienne looks at the box which I bring nearer and return without her having seen the contents. The chain spreads out on the floor and she immediately tries to put it back into the box. She begins by simply putting one end of the chain into the box and trying to make the rest follow progressively. This procedure which was first tried by Jacqueline, Lucienne finds successful the first time (the end put into the box stays there fortuitously), but fails completely at the second and third attempts.

At the fourth attempt, Lucienne starts as before but pauses, and after a short interval, herself places the chain on a flat surface nearby

(the experiment takes place on a shawl), rolls it up in a ball intentionally, takes the ball between three fingers and puts the whole thing in the box.

The fifth attempt begins by a very short resumption of the first procedure. But Lucienne corrects herself at once and returns to the correct method.

Sixth attempt: immediate success.

Thus one sees the difference between the behavior patterns of Jacqueline and of Lucienne. What was, in the former, the product of a long apprenticeship, was suddenly invented by the latter. Such a difference is surely a question of the level. So it is that at 2;6 (25) Jacqueline, with whom I repeat the experiment, solves the problem unhesitatingly. By grasping the chain in both hands she puts it in with her left hand while holding the remaining part in her right, to prevent it from falling. In the event that it gets caught, she corrects the movement.

*Observation 180*—Another mental invention, derived from a mental combination and not only from a sensorimotor apprenticeship was that which permitted Lucienne to rediscover an object inside a matchbox. At 1;4 (0), that is to say, right after the preceding experiment, I play at hiding the chain in the same box used in Observation 179. I begin by opening the box as wide as possible and putting the chain into its cover (where Lucienne herself put it, but deeper). Lucienne, who has already practiced filling and emptying her pail and various receptacles, then grasps the box and turns it over without hesitation. No invention is involved of course (it is the simple application of a schema, acquired through groping) but knowledge of this behavior pattern of Lucienne is useful for understanding what follows.

Then I put the chain inside an empty matchbox (where the matches belong), then close the box leaving an opening of 10 mm. Lucienne begins by turning the whole thing over, then tries to grasp the chain through the opening. Not succeeding, she simply puts her index finger into the slit and so succeeds in getting out a small fragment of the chain; she then pulls it until she has completely solved the problem.

Here begins the experiment which we want to emphasize. I put the chain back into the box and reduce the opening to 3 mm. It is understood that Lucienne is not aware of the functioning of the opening and closing of the matchbox and has not seen me prepare the experiment. She only possesses the two preceding schemata: turning the box over in order to empty it of its contents, and sliding her finger into the slit to make the chain come out. It is of course this last procedure that she tries first: she puts her finger inside and gropes to reach the chain, but fails completely. A pause follows during which Lucienne manifests a very curious reaction bearing witness not only to the fact that she tries to think out the situation and to represent to herself through mental combination the operations to be performed, but also