JEAN PIAGET

THE ORIGIN OF INTELLIGENCE IN THE CHILD

TRANSLATED BY
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FOREWORD

This work, a second edition[1] of which has very kindly been requested, was followed by *La Construction du réel chez l'enfant* and was to have been completed by a study of the genesis of imitation in the child. The latter piece of research, whose publication we have postponed because it is so closely connected with the analysis of play and representational symbolism, appeared in 1945, inserted in a third work, *La formation du symbole chez l'enfant.* Together these three works form one entity dedicated to the beginnings of intelligence, that is to say, to the various manifestations of sensorimotor intelligence and to the most elementary forms of expression.

The theses developed in this volume, which concern in particular the formation of the sensorimotor schemata and the mechanism of mental assimilation, have given rise to much discussion which pleases us and prompts us to thank both our opponents and our sympathizers for their kind interest in our work. It is impossible to name here all the authors on whose observations we would like to comment, but we should single out for mention the remarkable studies made by H. Wallon and P. Guillaume.

In his fine work *De l'acte à la pensée,* H. Wallon did us the honor of discussing our work at length; we have already commented on this in *La formation du symbole chez l'enfant.* Wallon's main idea is the distinction which he makes between the realm of the sensorimotor (characterized by the "understanding of situations") and that of expression (verbal intelligence). His remarkable study on *Les origines de la pensée chez l'enfant,* published since, places the origins of thought at the age of four, as if nothing essential transpired between the attainments of the sensorimotor intelligence and the beginnings of conceptual expression. It is apparent how antithetical to everything we main-

[1] This refers to the Second (French) Edition.

tain in this book this radical thesis is, and we can answer it today by invoking two kinds of arguments.

In the first place, meticulous study of a definite area, that of development of spatial perceptions, has led us with B. Inhelder to discover an even greater correlation than there seemed to be between the sensorimotor and the perceptual. Doubtless nothing is directly transmitted from one of these planes to the other, and all that the sensorimotor intelligence has constructed must first be reconstructed by the growing perceptual intelligence before this overruns the boundaries of that which constitutes its substructure. But the function of this substructure is no less apparent. It is because the baby begins by constructing, in coördinating his actions, schemata such as those of the unchanging object, the fitting in of two or three dimensions, rotations, transpositions, and superpositions that he finally succeeds in organizing his "mental space" and, between preverbal intelligence and the beginnings of Euclidean spatial intuition, a series of "topological" intuitions are intercalated as manifested in drawing, stereognosis, the construction and assembling of objects, etc.; that is to say, in the areas of transition between the sensorimotor and the perceptual.

In the second place, it is primarily preverbal sensorimotor activity that is responsible for the construction of a series of perceptual schemata the importance of which in the subsequent structuring of thought cannot, without oversimplification, be denied. Thus the perceptual constants of form and size are connected with the sensorimotor construction of the permanent object: For how could the four-year-old child think without having reference to objects having form and invariable dimensions, and how would he adapt his belief without a long preliminary development by the sensorimotor?

Probably the sensorimotor schemata are not concepts, and the functional relationship which we stress in this book does not exclude the structural opposition of these extremes, despite the continuity of the transitions. But, without preliminary schemata, nascent thought would be reduced to mere verbalism, which would make one suspicious of many of the acts mentioned by Wallon in his latest work. But it is precisely on the concrete

plane of action that infancy makes its intelligence most manifest until the age of seven or eight, when coördinated actions are converted into operations, admitting of the logical construction of verbal thought and its application to a coherent structure.

In short, Wallon's thesis disregards the progressive construction of performance and that is why it goes to extremes in stressing the verbal at the expense of the sensorimotor whereas the sensorimotor substructure is necessary to the conceptual for the formation of the operational schemata which are destined to function finally in a formal manner and thus to make language consistent with thought.

As far as P. Guillaume's[2] very interesting study is concerned, it, on the other hand, agrees in the main with our conclusions, except in one essential point. In accordance with his interpretations influenced by "the theory of form," P. Guillaume presents a fundamental distinction between the perceptual mechanisms and the intellectual processes which explains the second in terms of the first (the reverse of Wallon). This controversy is too lengthy to consider in detail in a preface. Let us limit ourselves to answering that the systematic study of the child's perceptions, in which we have since collaborated with Lambertier[3] has, on the contrary, led us to doubt the permanence of perceptual constants in which P. Guillaume believes (the invariability of size, etc.) and to introduce a distinction between instantaneous perceptions which are always passive and a "perceptual activity" connecting them with each other in space and time, according to certain remarkable laws (in particular a mobility and reversibility increasing with age). This perceptual activity, which the theory of form partially disregards, is but one manifestation of the sensorimotor activities of which preverbal intelligence is the expression. In the development of the sensorimotor schema in the first year of life, there is undoubtedly a close interaction between perception and intelligence in their most elementary states.

[2] P. Guillaume, L'intelligence sensori-motrice d'après J. Piaget. *Journal de psychologie*. April–June 1940–41 (years XXXVII–XXXVIII, pp. 264–280).

[3] See Recherches sur le développement des perceptions (I–VIII), *Archives de psychologie*, 1942–1947.

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INTRODUCTION*

The Biological Problem of Intelligence

The question of the relationships between mind and biological organization is one which inevitably arises at the beginning of a study of the origins of intelligence. True, a discussion of that sort cannot lead to any really definite conclusion at this time, but, rather than to submit to the implications of one of the various possible solutions to this problem, it is better to make a clear choice in order to separate the hypotheses which form the point of departure for our inquiry.

Verbal or cogitative intelligence is based on practical or sensorimotor intelligence which in turn depends on acquired and recombined habits and associations. These presuppose, furthermore, the system of reflexes whose connection with the organism's anatomical and morphological structure is apparent. A certain continuity exists, therefore, between intelligence and the purely biological processes of morphogenesis and adaptation to the environment. What does this mean?

It is obvious, in the first place, that certain hereditary factors condition intellectual development. But that can be interpreted in two ways so different in their biological meaning that confusing the one with the other is probably what has obfuscated the classic controversy over innate ideas and epistemological *a priorism.*

The hereditary factors of the first group are structural and are connected with the constitution of our nervous system and of our sensory organs. Thus we perceive certain physical radia-

* Another translation of this chapter was published in *Organization and Pathology of Thought,* by David Rapaport (New York: Columbia University Press, 1951). The footnote commentary to that translation provides an introduction to Piaget's thinking, and may serve as an introduction to the investigations and thinking contained in this volume.

tions, but not all of them, and matter only of a certain size, etc. Now these known structural factors influence the building up of our most fundamental concepts. For instance, our intuition of space is certainly conditioned by them, even if, by means of thought, we succeed in working out transintuitive and purely deductive types of space.

These characteristics of the first type, while supplying the intelligence with useful structures, are thus essentially limiting, in contradistinction to the factors of the second group. Our perceptions are but what they are, amidst all those which could possibly be conceived. Euclidean space which is linked to our organs is only one of the kinds of space which are adapted to physical experience. In contrast, the deductive and organizing activity of the mind is unlimited and leads, in the realm of space, precisely to generalizations which surpass intuition. To the extent that this activity of the mind is hereditary, it is so in quite a different sense from the former group. In this second type it is probably a question of a hereditary transmission of the function itself and not of the transmission of a certain structure. It is in this second sense that H. Poincaré was able to consider the spatial concept of "group" as being *a priori* because of its connection with the very activity of intelligence.

We find the same distinction with regard to the inheritance of intelligence. On the one hand, we find a question of structure: The "specific heredity" of mankind and of its particular "offspring" admits of certain levels of intelligence superior to that of monkeys, etc. But, on the other hand, the functional activity of reason (the *ipse intellectus* which does not come from experience) is obviously connected with the "general heredity" of the living organism itself. Just as the organism would not know how to adapt itself to environmental variations if it were not already organized, so also intelligence would not be able to apprehend any external data without certain functions of coherence (of which the ultimate expression is the principle of noncontradiction), and functions making relationships, etc., which are common to all intellectual organization.

Now this second type of hereditary psychological reality is of primary importance for the development of intelligence. If

there truly in fact exists a functional nucleus of the intellectual organization which comes from the biological organization in its most general aspect, it is apparent that this invariant will orient the whole of the successive structures which the mind will then work out in its contact with reality. It will thus play the role that philosophers assigned to the *a priori;* that is to say, it will impose on the structures certain necessary and irreducible conditions. Only the mistake has sometimes been made of regarding the *a priori* as consisting in structures existing ready-made from the beginning of development, whereas if the functional invariant of thought is at work in the most primitive stages, it is only little by little that it impresses itself on consciousness due to the elaboration of structures which are increasingly adapted to the function itself. This *a priori* only appears in the form of essential structures at the end of the evolution of concepts and not at their beginning: Although it is hereditary, this *a priori* is thus the very opposite of what were formerly called "innate ideas."

The structures of the first type are more reminiscent of classic innate ideas and it has been possible to revive the theory of innateness with regard to space and the "well-structured" perceptions of Gestalt psychology. But, in contrast to the functional invariants, these structures have nothing essential from the point of view of the mind: They are only internal data, limited and delimiting, and external experience and, above all, intellectual activity will unremittingly transcend them. If they are in a sense innate, they are not *a priori* in the epistemological sense of the term.

Let us analyze first the functional invariants, and then (in §3) we shall discuss the question raised by the existence of special hereditary structures (those of the first type).

§1. THE FUNCTIONAL INVARIANTS OF INTELLIGENCE AND BIOLOGICAL ORGANIZATION.—Intelligence is an adaptation. In order to grasp its relation to life in general it is therefore necessary to state precisely the relations that exist between the organism and the environment. Life is a continuous creation of increasingly complex forms and a progressive balancing of these forms with the environment. To say that in-

telligence is a particular instance of biological adaptation is thus to suppose that it is essentially an organization and that its function is to structure the universe just as the organism structures its immediate environment. In order to describe the functional mechanism of thought in true biological terms it will suffice to determine the invariants common to all structuring of which life is capable. What we must translate into terms of adaptation are not the particular goals pursued by the practical intelligence in its beginnings (these goals will subsequently enlarge to include all knowledge), but it is the fundamental relationship peculiar to consciousness itself: the relationship of thought to things. The organism adapts itself by materially constructing new forms to fit them into those of the universe, whereas intelligence extends this creation by constructing mentally structures which can be applied to those of the environment. In one sense and at the beginning of mental evolution, intellectual adaptation is thus more restricted than biological adaptation, but in extending the latter, the former goes infinitely beyond it. If, from the biological point of view, intelligence is a particular instance of organic activity and if things perceived or known are a limited part of the environment to which the organism tends to adapt, a reversal of these relationships subsequently takes place. But this is in no way incompatible with the search for functional invariants.

In fact there exist, in mental development, elements which are variable and others which are invariant. Thence stem the misunderstandings resulting from psychological terminology some of which lead to attributing higher qualities to the lower stages and others which lead to the annihilation of stages and operations. It is therefore fitting simultaneously to avoid both the preformism of intellectualistic psychology and the hypothesis of mental heterogeneities. The solution to this difficulty is precisely to be found in the distinction between variable structures and invariant functions. Just as the main functions of the living being are identical in all organisms but correspond to organs which are very different in different groups, so also between the child and the adult a continuous creation of varied structures may be observed although the main functions of thought remain constant.

These invariant operations exist within the framework of

the two most general biological functions: *organization* and *adaptation*. Let us begin with the latter, for if everyone recognizes that everything in intellectual development consists of adaptation, the vagueness of this concept can only be deplored.

Certain biologists define *adaptation* simply as preservation and survival, that is to say, the equilibrium between the organism and the environment. But then the concept loses all interest because it becomes confused with that of life itself. There are degrees of survival, and adaptation involves the greatest and the least. It is therefore necessary to distinguish between the state of adaptation and the process of adaptation. In the state, nothing is clear. In following the process, things are cleared up. There is adaptation when the organism is transformed by the environment and when this variation results in an increase in the interchanges between the environment and itself which are favorable to its preservation.

Let us try to be precise and state this in a formal way. The organism is a cycle of physicochemical and kinetic processes which, in constant relation to the environment, are engendered by each other. Let a, b, c, etc., be the elements of this organized totality and x, y, z, etc., the corresponding elements of the surrounding environment. The schema of organization is therefore the following:

$$(1)\ a + x \longrightarrow b;$$
$$(2)\ b + y \longrightarrow c;$$
$$(3)\ c + z \longrightarrow a, \text{etc.}$$

The processes (1), (2), etc., may consist either of chemical reactions (when the organism ingests substances x which it will transform into substance b comprising part of its structure), or of any physical transformations whatsoever, or finally, in particular, of sensorimotor behavior (when a cycle of bodily movements a combined with external movements x result in b which itself enters the cycle of organization). The relationship which unites the organized elements a, b, c, etc., with the environmental elements x, y, z, etc., is therefore a relationship of *assimilation*, that is to say, the functioning of the organism does not destroy it but conserves the cycle of organization and coördinates the given

data of the environment in such a way as to incorporate them in that cycle. Let us therefore suppose that, in the environment, a variation is produced which transforms x into x'. Either the organism does not adapt and the cycle ruptures, or else adaptation takes place, which means that the organized cycle has been modified by closing up on itself:

$$(1)\ a + x' \longrightarrow b';$$
$$(2)\ b' + y \longrightarrow c;$$
$$(3)\ c + z \longrightarrow a.$$

If we call this result of the pressures exerted by the environment *accommodation* (transformation of b into b'), we can accordingly say that *adaptation is an equilibrium between assimilation and accommodation.*

This definition applies to intelligence as well. Intelligence is *assimilation* to the extent that it incorporates all the given data of experience within its framework. Whether it is a question of thought which, due to judgment, brings the new into the known and thus reduces the universe to its own terms or whether it is a question of sensorimotor intelligence which also structures things perceived by bringing them into its schemata, in every case intellectual adaptation involves an element of assimilation, that is to say, of structuring through incorporation of external reality into forms due to the subject's activity. Whatever the differences in nature may be which separate organic life (which materially elaborates forms and assimilates to them the substances and energies of the environment) from practical or sensorimotor intelligence (which organizes acts and assimilates to the schemata of motor behavior the various situations offered by the environment) and separate them also from reflective or gnostic intelligence (which is satisfied with thinking of forms or constructing them internally in order to assimilate to them the contents of experience)—all of these adapt by assimilating objects to the subject.

There can be no doubt either, that mental life is also *accommodation* to the environment. Assimilation can never be pure because by incorporating new elements into its earlier schemata the intelligence constantly modifies the latter in order

to adjust them to new elements. Conversely, things are never known by themselves, since this work of accommodation is only possible as a function of the inverse process of assimilation. We shall thus see how the very concept of the object is far from being innate and necessitates a construction which is simultaneously assimilatory and accommodating.

In short, intellectual adaptation, like every other kind, consists of putting an assimilatory mechanism and a complementary accommodation into progressive equilibrium. The mind can only be adapted to a reality if perfect accommodation exists, that is to say, if nothing, in that reality, intervenes to modify the subject's schemata. But, inversely, adaptation does not exist if the new reality has imposed motor or mental attitudes contrary to those which were adopted on contact with other earlier given data: adaptation only exists if there is coherence, hence assimilation. Of course, on the motor level, coherence presents quite a different structure than on the reflective or organic level, and every systematization is possible. But always and everywhere adaptation is only accomplished when it results in a stable system, that is to say, when there is equilibrium between accommodation and assimilation.

This leads us to the function of *organization*. From the biological point of view, organization is inseparable from adaptation: They are two complementary processes of a single mechanism, the first being the internal aspect of the cycle of which adaptation constitutes the external aspect. With regard to intelligence, in its reflective as well as in its practical form, this dual phenomenon of functional totality and interdependence between organization and adaptation is again found. Concerning the relationships between the parts and the whole which determine the organization, it is sufficiently well known that every intellectual operation is always related to all the others and that its own elements are controlled by the same law. Every schema is thus coördinated with all the other schemata and itself constitutes a totality with differentiated parts. Every act of intelligence presupposes a system of mutual implications and interconnected meanings. The relationships between this organization and adaptation are consequently the same as on the organic level.

The principal "categories" which intelligence uses to adapt to the external world—space and time, causality and substance, classification and number, etc.—each of these corresponds to an aspect of reality, just as each organ of the body is related to a special quality of the environment but, besides their adaptation to things, they are involved in each other to such a degree that it is impossible to isolate them logically. The "accord of thought with things" and the "accord of thought with itself" express this dual functional invariant of adaptation and organization. These two aspects of thought are indissociable: It is by adapting to things that thought organizes itself and it is by organizing itself that it structures things.

§2. FUNCTIONAL INVARIANTS AND THE CATEGORIES OF REASON.—The problem now is to ascertain how these functional invariants will determine the categories of reason, in other words, the main forms of intellectual activity which are found at all stages of mental development and whose first structural crystallizations in the sensorimotor intelligence we shall now try to describe.

It is not a matter of reducing the higher to the lower. The history of science shows that every attempt at deduction to establish continuity between one discipline and another results not in a reduction of the higher to the lower but in creating a reciprocal relationship between the two terms which does not at all destroy the originality of the higher term. So it is that the functional relations which can exist between intellect and biological organization can in no way diminish the value of reason but on the contrary lead to extending the concept of vital adaptation. It is self-evident that if the categories of reason are in a sense preformed in biological functioning, they are not contained in it either in the form of conscious or even unconscious structures. If biological adaptation is a sort of material understanding of the environments, a series of later structures would be necessary in order that conscious and gnostic image may emerge from *this* purely active mechanism. As we have already said, it is therefore at the end and not at the point of departure of intellectual evolution that one must expect to encounter rational concepts