

# NEW DIRECTIONS IN PIAGETIAN THEORY AND PRACTICE

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# 7 Cognitive Development: Construction of New Structures or Construction of Internal Organizations

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The purpose of this chapter is to present the hypothesis that cognitive development can be considered as the construction of *internal* organizations of contents (construction of internal models) and *not* as the construction of new structures as Piaget states since the formal structures of our actions and our reasoning (Piaget's general coordinations of action) are preformed. It is on the basis of these preformed structures, that internal organizations of contents (representations) occur if new coding capacities appear. As we know, Piaget considers that structures or coordinations of our actions and thinking are constructed. He defines them as what is general or common to all our actions, all our reasoning, and all subjects . . . epistemic subjects! He specifies that he refers to the *form or structure* of our behavior, independent of different contents to which they apply.

This position gives the environment a secondary and nonspecific role: it may accelerate or decelerate the construction of structures.

To begin with, we shall examine how Piaget studies the problem of cognitive development in terms of constructions of new structures. It is possible to distinguish two principal origins of his way of studying cognitive development: his epistemological project and his structural approach.

## PIAGET'S EPISTEMOLOGICAL THEORY

Piaget cannot be considered a psychologist. In fact, he refuses to be considered as such. His theory is not a psychological theory but is essentially an epistemological one, his main interest being in biology. From his biological-epistemological point of view, I consider myself in Piaget's camp even though I have developed a strong critique of the psychological aspect of his work.

Historically, the essential problem for Piaget was to explain the *appearance of new forms or structures* in the living world. This was the main concern of many biologists at the end of last century. When he was observing limnetic watersnail, mollusks in Swiss lakes, he was investigating the influence of different environments on the form of the snails. The particular emerging form was considered a result of the interaction between genotype and phenotype, i.e., between the genetic structure and its appearance. The emergent form or structure of the snails was considered a new and original one. In his actual research on sedum (a plant), that he tirelessly transplanted, Piaget always tried to solve the same problem: how new forms appear, how the hereditary aspects of the plant can be affected by the present conditions of the new environment that have produced the actual phenotype. To solve that kind of problem, he had to study many generations of the same plant. In the biological area, Piaget does take the environment into consideration, attending to its specificity and particularities. The environment affects evolution of the species and is related to the appearance of new forms, whereas in any view in psychology the environment does not have this specific action influence.

Let me show how Piaget transposes the problem of the advent of new forms using a biological model for the field of psychology. He starts by considering cognitive development as successive advents of new structures. For him, these structures are determined by the interaction between the subject's previous structures and properties of the environment. But from the biological to the psychological level an important change takes place. For Piaget, the initial structures of the child's behavior at birth are considered as equivalent in all individuals. Piagetian structures can be defined as *formal* because they can be to some degree independent of the content and of the context to which they are applied. As for the environment, Piaget only takes into consideration the physical aspects of reality which he considers equivalent around the world. Piaget therefore concludes that interactions between equivalent structures and constant environmental features produce new equivalent structures for all subjects. At a biological level, interactions between the individual and the environment account for the emergence of new *specific* forms because environments are particularized. At a psychological level, however, the emergence of nonspecific new forms or structures are attributed to interaction with common environmental features. Paradoxically, the effect of the environment is nonspecific in the case of cognitive development of the child whereas the environmental effects are specified in the development of various plants and animal forms. The only variations in development that can occur are those of speed of development but never of form. Yet, in development, individual differences are observable in regard to ways of acting and reasoning to physical and social reality. We also accept the notion that certain aspects of our way of reasoning are determined both by hereditary factors and by characteristics of the environment (specific as well as general, social as well as physical aspects). In order to understand these individual differences, we must reject the hypothesis that the children build common formal structures.

Let us see how Piaget explains the advent of new structures through this method.

### PIAGET'S STRUCTURAL APPROACH

For understanding the sensorimotor period, Piaget uses his observations of the behavior of children as the basis for his inferences regarding development of structures. Behavior was analyzed in terms of epistemological categories such as objects, space, causality, time, etc.

In his study of the period of concrete operations (2 to 10 years), Piaget emphasized his structural approach. Specific *situations* were designed in order to gather evidence of the formal structures of the reasoning of the child for each separate category of time, speed, space, and so on.

These specific situations consist of a simplification of a situation focusing on a particular dimension selected by the researcher. In this context, the object is considered *one-dimensional*, as if no longer possessing other significant attributes. The purpose of the method is to determine if the child understands the object and the particular dimensions selected by the experimenter. Objects, for example, become "lengths" and the experimenter observes if the child can make a series of "lengths" defined by a particular attribute; or if the child can conserve "length" after modifications of the state of the object are made such as moving the object, e.g., translation or rotation.

The aim of such a method is to discover at what age the child handles a particular transformation. Further, it is assumed that it is possible to infer the subject's cognitive structures or operations from his/her behavior in these particular situations. Piaget infers the achievement of a structure by the way the child handles a given situation and at what age he/she does it. If the child cannot handle such a situation it means that he has not yet achieved that given structure.

### COGNITIVE DEVELOPMENT AS A CONSTRUCTION OF NEW FORMAL STRUCTURES

If we consider psychological development as the construction of new structures, difficulties appear when behavior of different levels are described by the same formal structures. Piaget was confronted with this difficulty when he discovered that matter, weight, and volume conservations were not achieved by the child at the same age, even though there was an equivalent formal structure. It is because of this problem that Piaget defined the horizontal decalages, as a characteristic of children's reasoning during the concrete operations period.

This problem is also relevant during the formal operation period. A subject can reason in a formal way in a given situation and not in another. It becomes difficult therefore to say whether a given structure is present or not on the basis of a given behavior or reaction to a particular situation.

This problem was also encountered in the study of the sensorimotor period. Piaget, using the idea of the structural equivalence between different stages, demonstrated that the sensorimotor coordination in sucking behavior at birth and locomotion at 18 months could be described by the same mathematical structure (the displacement group) at all the stages of this period. To distinguish these organizations Piaget characterized them as "practical," "subjective," and "objective" organizations, thereby introducing distinctions between the child's point of view and the observer's point of view as well as between child and external world. Further, when Piaget studied later stages of development the objective displacement group (or the sixth stage) has been renamed "practical group." From this point of view it becomes difficult to talk about construction of *new* structures and above all to consider that these formal structures result from the interaction between the subject and the environment.

From careful observation of babies' behavior, we concluded that the formal structures of actions, in the sense of general coordination of action, are *preformed*. Our rationale for such a conclusion is as follows: the coordinations for activities such as walking, handling, imitating, and visual exploration, etc. are observed among young children. The baby does not build these coordinations, he does not construct the complex structures which determine the sequences of contraction and decontraction of various muscular groups (antagonistic and synergist) and of several organs simultaneously. These structures exist already. They are the ones that will define the form or pattern of subsequent actions. They define the pattern of reflex and voluntary walking, of first prehension and of voluntary prehension, or pseudoimitation or of real imitation.

To summarize, we have discussed the way in which Piaget has tried to grasp the structures, the formal instruments of knowledge, without taking into consideration the content of the activity. From our point of view he has studied the elaboration of certain contents that are common to a great number of objects that are the least specific. He has studied how certain properties of objects isolated by the experimenter are mastered by the child, but he did not take into account the process by which the child extracts or identifies these attributes. Therefore, it is not possible to talk about the genesis of structure but rather of structuring or of organizing contents more or less generally, more or less specifically, by means of structure that we consider preformed.

### COGNITIVE DEVELOPMENT AS A CONSTRUCTION OF INTERNAL ORGANIZATIONS (MODELS)

The interaction between the subject and his environment is organized in a complex way at every level of development and particularly at the time of birth. It is evident that birth cannot be considered as an absolute beginning. At birth the exchange between the child and the environment is defined by a reflex organiza-

tion that we will call *sensorimotor internal organization* (or sensorirepresentation). This sensorimotor organization is responsible for all the baby's movements (sucking movements, arm, hand, eye movements, etc.). In other words, this sensorimotor organization specifies the movements in relation to the information given by the sensori receptors. It is not an abstract formal structure, detached or indetermined from contents. Rather, it is a specific organization where the way the object will be handled, i.e., gathering information, is already specifically defined. This organization contains a formal structure involving central processing and coordination. It is in the sense of a programmed processing and coordination that we consider the formal structure of the sensorimotor period preformed. Nevertheless, even though there is development or construction (which we do not doubt), that behavior is only partially determined, that is to say, the subject tries to attain goals that he can only partially achieve.

Behavior is only *partially determined* because *new internal* coding capacities appear by maturation. Consequently, information defined by the initial sensorimotor organization will have to be redefined by means of these new capacities. This leads to the construction of a *new internal organization* that will be called *perceptivomotor*. This *perceptivomotor* organization partly corresponds to what some psychologists call mnemonic traces, configurations of perceptual indices, gestalts or meanings. From this perspective, behavior of the newborn can be considered simultaneously as *entirely determined* by the internal sensorimotor organization and as *partially determined* by the newly constructed *perceptivomotor* organization. This new organization is built upon the previous internal organization and the characteristics of the environment by means of new coding capacities.

This reorganization will be more or less satisfactory or complete depending on the particularities of the situations, the people encountered and the integrity of the initial organization. It is evident that the environment plays a specific and determinant role in this conception.

Let us briefly mention that development is characterized by a succession of internal reorganizations. For example, around 18 months of age new coding capacities appear. These new capacities entail a new reorganization of contents. This new internal organization will be called *conceptuomotor* and it is constructed in a similar way as the previous perceptivomotor organization.

These internal organizations or reorganizations (sensorimotor, perceptivomotor, conceptuomotor, etc.) can be more or less structured according to the nature of the situations encountered. But *these internal organizations will never become formal structures detached from content*, nor will they differ from the structures hereditarily given.

What we have described as internal organizations of contents does not correspond to figurative thought which Piaget defines as knowledge of states and properties of objects, rather than knowledge of transformations of objects. As for the study of formal structures (or operative thinking), Piaget has tried to grasp the

development of figurative mentations as a general means to translate or represent states of objects (coding capacities). In fact, what Piaget has studied is the development of representation of the more general aspects of objects and not the development of coding capacities. This is the reason why most of the experiments designed to study the development of mental image and language are the same as those designed to study the structures of operative thought (Piaget & Inhelder, 1966; Sinclair, 1967). In this field Piaget and collaborators have again adopted the structuralist method. For Piaget, the figurative aspects of thought are symbols, signs, and perceptual indices but not organized by transformation rules. How is it possible to study signs, symbols, perceptual indices without these transformation rules? As Piaget has stated, these two figurative and operative aspects of knowledge are indissociable. Moreover, we think that they cannot be studied as general aspects of thought. Once again what Piaget has studied is the development of representation (figuration) *of the more general contents* and not the development of general figurative thought and consequently certain aspects of internal organization of contents.

We will now make some comments on the different methods used in the study of development.

## METHODS OF STUDY OF COGNITIVE DEVELOPMENT

We have seen how Piaget developed a method that we have called structuralist for the study of formal structure of behavior. The child is faced with a simplified situation where a property or a transformation of an object is isolated as far as possible. The generality of organizations put in evidence depends on the universality of preformed structure and on the general aspects of the chosen reality (the common aspects to a great number of objects).

For studying more directly the construction of internal organization (representations) it is necessary to face the child with objects that have *multiple properties* (Osiek, 1977), in opposition to unidimensional objects. Presenting the child with such objects, we can identify aspects of the problem the child must solve in organizing his or her reality. First the child must dissociate, isolate, and identify the different properties of the object prior to organizing them. To understand how the child accomplishes these dissociations and compositions, it is necessary to present the child with *purposeful situations* in which the object becomes the means to obtain or realize a goal. With this type of realistic situation we can understand how the child discovers a property or a dimension of an object and how they vary. While acting on an object to obtain a goal, the child will discover or rediscover the properties which will first be isolated and then composed. While modeling plasticine to make a sausage the child will discover the different properties of this object, their variations and their covariations.

## EXPERIMENTAL APPROACH

## A. Construction and Use of Tools

Ten years ago I studied the construction and use of tools with children from 4 to 8 years of age. One of the experimental situations consisted of pulling out a piece of wood with a ring from a bottle with a narrow neck using different tools. In such a situation, it is possible to understand how the child discovers simultaneously the characteristics of his action and those of the situation. It is very instructive to study how the child uses the adequate tool for a given task. Most children solve the problem in a certain number of their attempts. Their behavior shows that they are capable of taking into account and organizing the different aspects of the situation. That is, by means of what we have called perceptivomotor organization. On the other hand, the way the children justify their failure or their success reveals *another type of organization*. The justification of the 4-year-olds referred generally to their actions or to their own capacities. But very quickly it was the length of the tool that was declared responsible for the result even though the tool used was long enough to touch the bottom of the bottle. All tools estimated as being longer than the others were considered to be the best. These justifications reveal the construction of the conceptuomotor organization. By means of this organization the 4-year-old children take into consideration only this particular aspect of the situation, the "length." This aspect gives the situation its conceptual meaning. We distinguish the simultaneous presence of two internal organizations that determine the behavior of the child:

—On one hand, the conceptuomotor organization (or conceptual representation) revealed by the children's verbalizations. At 4 years of age their organization takes into consideration only some aspects of the situation which determines the modifications, the corrections and choices made.

—On the other hand, the perceptivo motor organization (or perceptual representation) directs and controls their actions in the use of tools, and takes into consideration the relevant aspects of the situation.

The way the child handles the situation makes it possible to understand how he discovers a particular property of the object—the length—as a distance to overcome. The tool is considered as long enough or not long enough according to the success or failure of the child's action, independently from the fact of touching or not the bottom of the bottle. The whole situation is assimilated to this aspect (partial organization). We can ask what meaning the experiment of length conservation has for a 4-year-old child. This dimension—length—can only be studied in the context of a goal-seeking action. The aspects "longer" or "shorter" are directly related to the success or failure of the action and not to the relationship between the tool and the bottle. What we consider important to



understand is precisely the way in which the child can *dissociate and isolate the characteristics of his action and the properties of the objects*.

At around 5 years of age the child focuses his interest in the prehensive aspects of the tool and of his action. If he fails in the use of a tool he will ask for another one that "pinches" or "grasps" the object. The conceptomotor organization is improved by another aspect of the situation and of his action. These different aspects are discovered and isolated by the child but they are still not coordinated.

It is only around 6 years of age that the different properties of objects and the different categories of actions (reaching, grasping, etc.) involved in the situation are regrouped or coordinated. The child can anticipate a tool that fulfills the function of reaching, grasping, etc. and usually he refuses every object that does not correspond to his internal organization (representation). Usually the tool anticipated (or chosen) by the child is not adequate because the child does not yet master the necessary relationships between the different parts of the tool and the situation. At this stage around 6 years, the tool is more a substitute for action than for association.

Between 6 and 9 years of age the child progressively masters the relationships that the different parts of the tool should have to solve the problem. The conceptomotor organization loses progressively its rigidity and becomes more flexible or general.

We have understood the construction of an internal organization because we have confronted the child with purposeful situations with multiple properties objects. The conceptomotor organization is constructed on the basis of the perceptivomotor organization that directs initially the activity of the child. Justifications, corrections of mistakes, choice, are progressively determined by the conceptomotor organization.

Parallel with this research on concrete problem solving, Piaget and I have done several studies on causality (Piaget & Mounoud, 1969a, 1969b; Piaget et al., 1972a, 1972b, 1973a, 1973b). From these studies, it was possible to understand through discourse with the children the conceptual organization they built. But we could not generate evidence to indicate how the organizations were constructed. I believe this is due to the artificiality or simplicity of the tasks. Piaget also seems aware of this difficulty. More recently Piaget has also used purposeful situations in his research (Piaget, 1974a, 1974b).

Studying cognitive development only on the basis of the child's verbalizations has led to great misunderstanding. Most of the studies done on children during the concrete operation period ignore completely the perceptivomotor organizations of the situations observed. It is in the perceptive elaboration, more precisely in his *activities* that the child discovers the new properties (of his actions and of objects) that he elaborates conceptually. From our point of view, the dynamics of the development are based on the divergences between the perceptivomotor and the conceptomotor organization (Mounoud, 1968, 1970). It is then possible to

reject the hypothesis of equilibrium (Piaget, 1947, 1957, 1975) as well as the hypothesis of conflicts between operations of the same level (Inhelder, Sinclair, & Bovet, 1974). The famous improvement Piaget and Inhelder (1968) reported in memory performance can be better understood if a perceptivomotor organization (of the situation) is recognized and if regulations between the different organizations (perceptivomotor and conceptuomotor) of the same reality are taken into account (Mounoud, 1978).

After the research on the use of tools we wanted to study the perceptivomotor organization of content that determines the activity of the child under 3 years of age, and particularly the way the baby acts progressively on objects.

## B. Prehension of Objects

Our main problem is to find out how certain physical and spatial properties of an object are taken into consideration by the child in the preparation for and performance of relevant actions. Variations in physical and spatial properties of objects perceived by visual means (texture, height . . .) may or may not be correlated with variations in their respective weights. Thus, from the subject's point of view, the weight of an object *may or may not be predictable* depending on the visual information available to him and on his internal organization or models (Mounoud, 1973; Mounoud & Bower, 1974).

The subject will become aware of the object's weight through the characteristics of his action. When he is holding or lifting objects, his movements will vary in amplitude, rapidity and regularity. Variations in these different parameters result simultaneously from the properties of the object and from the motor command initiated by the child. The child has to discover and control the *variations in the characteristics of his own actions* (force, amplitude, velocity, etc.) on the one hand, and the *variations in properties of objects* (weight, height, etc.) on the other hand. It is only by taking hold of objects, lifting them and so forth that the child can explore weight perceptually and process proprioceptive and tactile information as they relate to visual information. It is important to note that these proprioceptive indications of weight perception are necessarily bound to a motor action.

Our aim is to characterize the degrees of preparation for movement in terms of *perceptual-motor programming*. Let us clarify what we mean by program. The behavior of lifting objects is the result of a series of contractions by antagonist and synergist muscular groups. We suggest using the word "program" for these *sequences of contractions and their coordination*. The varying dimensions of these programs are the intensity and the length of contractions or relaxations. These dimensions can only be defined by a certain number of *parameters* relative to the situation (position, height, weight, destination of the object, etc.) and to the body itself (position of the arm, amplitude, direction, speed of displacements, etc.).

We will take into consideration two types of programs:

1. *Preprogramming* of the action (totally determined before its performance) which engenders rapid, precise, smooth movements.
2. *Programming* of the action (requires *picking up information during the course of action*), which engenders slow, irregular, awkward movements in opposition to the preceding type (Evarts, Bizzi, Burke, Delong, & Thach, 1974; Teuber, 1974; White, Castle & Held, 1964).

However, we do not envisage development as the mere passage from an initial level of partial programming to a later level of preprogramming. We believe that the entire development consists in a *succession* of transitions leading the child: (1) from an initial level of preprogramming to a level of programming, and then (2) from this level of programming to a new level of preprogramming. Each of these levels is bound to the degree of elaboration of internal organization (Mounoud, 1976).

In order for preprogramming or programming to be possible in holding and lifting movements, the physical properties of the objects (such as weight and volume) must be predictable mainly from visual information. Such predictions result from the degree of elaboration of internal organization. These are accomplished at various levels of processing an object's properties during development.

We have studied the following movement: lifting objects of constant or variable weight and height. The subject sits facing the experimenter and lifts objects vertically placed on a support in front of him. The behavior is recorded on videotape (subject in profile). Videotape analyses (recording on the TV screen the position of the object every 100 ms. from the beginning of movement) makes it possible to study more exactly the characteristics of the carrying phase in the movement (displacement, velocity, time).

I will discuss the results of one specific item called the substitution item. In the *substitution item* we present the subject with an object (150 gr. or 330 gr.) several times and we then substitute a visually identical but lighter object (10 gr. or 30 gr.). Let us examine the performances of subjects between 6 months and 5 years of age in this substitution item.

In this figure, we have represented six examples of velocity curves for the substitution item (lifting phase). The dotted lines represent the first three liftings of the heavy object. The black lines represent the first lifting of the light object. The effect of substitution manifests itself in two ways: (1) a more or less large *increase* in the velocity of the liftings of the light object (Fig. 7.1a); (2) *no significant increase* in the velocity of liftings of the light object (Fig. 7.1b).

Three examples at different ages are given, for each of these categories of effect, in the Fig. 7.1.

Seventy-five children were subjects in the experiment under conditions that were not entirely systematic. Most of the subjects have been tested twice giving a

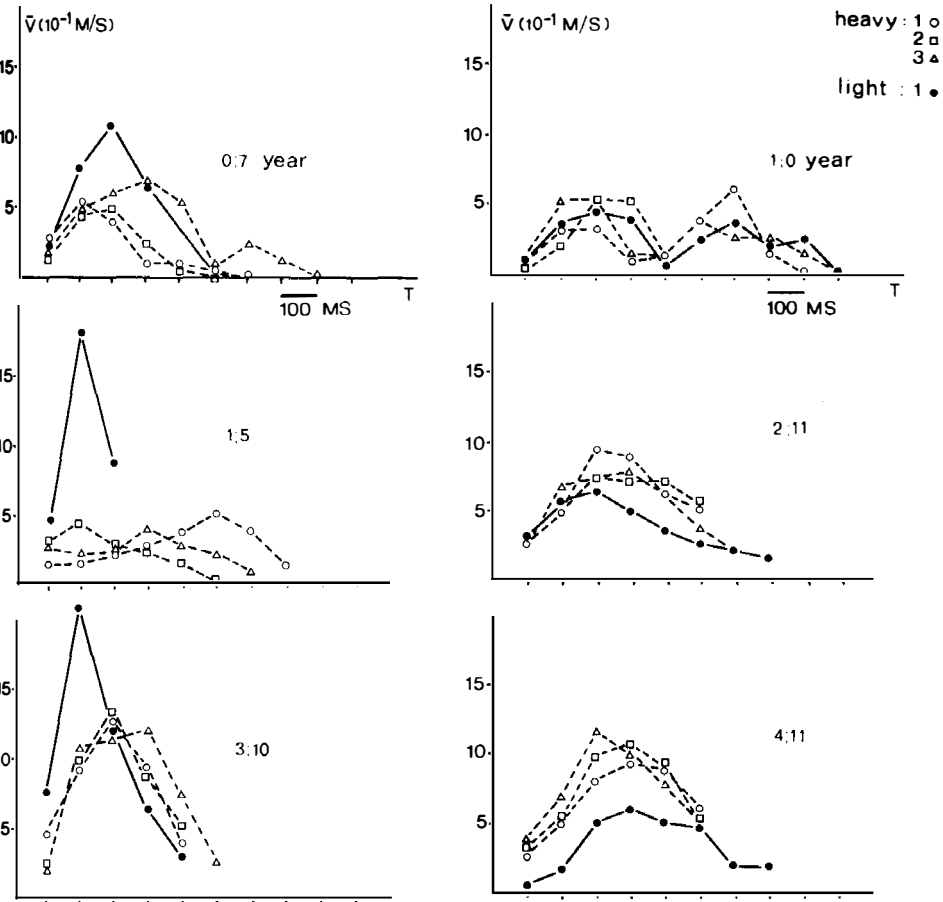


FIG. 7.1. 6 examples of the substitution item. Dotted lines: three liftings of the heavy object; black lines: one lifting of the light object. 1a: 3 subjects with whom we observe an increase in velocity when the heavy object is substituted by the light one; 1b: 3 subjects with whom we observe no increase in velocity when the heavy object is substituted by the light one.

sum of 137 substitutions. These data are summarized in Fig. 7.2, giving us indications relative to development.

It appears that the development of subject's performance in the substitution item is not linear. At 6 to 10 months, 15 months to 2:5 years and 3:6 to 4:5 years, we obtain an increase in the velocity for the light object. At 11 to 14 months, 3:0 to 3:5 years and 4:6 to 4:11 years, there is no such effect. The fact that a performance is globally the same at different moments during development means that the same reality is organized several times. It should not be consid-

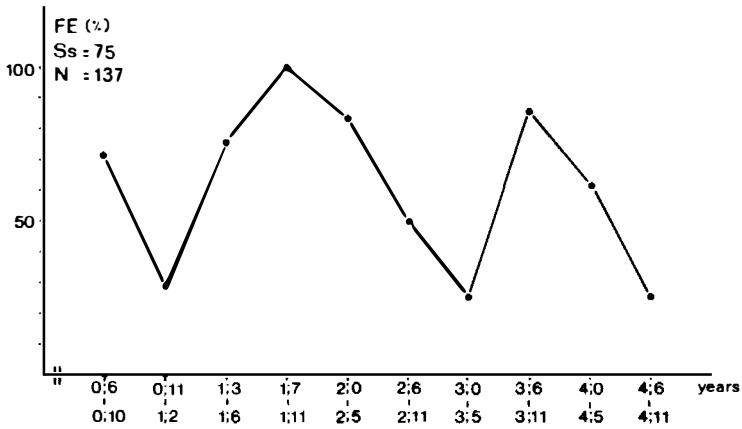


FIG. 7.2. Percentage of items per age group (FE) showing an increase in velocity for the light object after substitution.

ered as regressions. On the contrary, the reappearance of partially comparable performances reflects a new internal organization of the same content.

We have tried to look not only at the global aspect of the reaction of the child in the substitution item but also at the intrinsic characteristics of action, the morphology of the velocity curves and we have tried to classify them.

Methodologically it appeared that the videotape analysis had to be improved. Subsequently, we started using a potentiometer, allowing us to record a signal corresponding to the lifted object's displacement. The object is bound to a rod moving the potentiometer. The parameters of acceleration and velocity are obtained from the signal which is treated numerically. From these recordings we have been able to define six types of velocity curves that we have regrouped following Brooks (Brooks, Cooke & Thomas, 1973) in two categories: continuous and discontinuous movements.

The lifting movements will be called "continuous" when they have only one maximum velocity, and "discontinuous" when they present more than one maximum velocity.

Sixty-two children from 2;0 to 4;11 years were studied with the new device (Hauert, 1980). This population is divided into six groups (of six monthly intervals).

Figure 7.3 shows the evolution with age of the continuous movements when lifting the heavy object (330 gr.) in the substitution item. The black line refers to all the lifting movements of this object and the dotted line refers to the last lifting movement (before the substitution). We should point out that the highest percentage of continuous movements is found at the end of the third year (3;6—3;11). At this age we have also found the highest percentage of acceleration effect to substitution.

The difference between discontinuous and continuous movements is the kind of control the subject uses. Discontinuous curves depend upon a series of feedback loops relative to the intermediate states of the course of action. They are *locally programmed* and require picking up information on intermediate states of action so that performance can continue.

Continuous movements are preprogrammed before performance. The regularity of velocity curves means that the movements are preprogrammed.

The different morphologies in velocity curves explain various degrees of *action preparation and programming* as well as different *degrees of knowledge of the object's physical properties*. This morphological diversity is typical of children of 6 months to 5 years of age (the population on which we worked until now), in contrast with adults, in whom we found continuous movements. With adults discontinuous movements appear occasionally in the first trials of a new item.

We have described briefly the way in which we now study the cognitive development of the child by a detailed analysis of the characteristics of

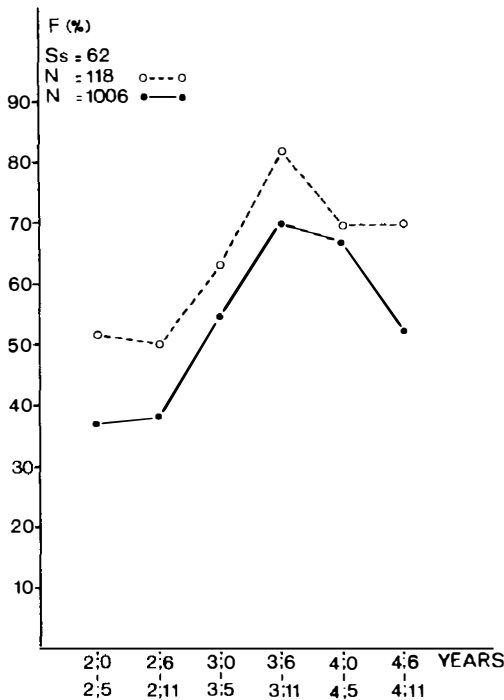


FIG. 7.3. Percentage of continuous movements in the lifting of the heavy object (substitution item) per age group. Black line: all the lifting movements; dotted line: the last lifting movement.

movements. This method allowed us to describe a series of stages relative to diverse possibilities of action programming. These possibilities of action programming can be related to different levels of internal organization of properties of objects and characteristics of actions.

A program can be already built or in the process of elaboration. The stages of partial programming are of great importance to understand the process of development. During these stages of partial programming, the child actively controls his behavior. He experiences the effects of his actions on objects as well as the effects of objects on his actions. His activities are locally programmed and need picking up information during the course of action. These intermediate stages are the stages of reconstruction of new internal organizations.

## CONCLUSION

Following Piaget, we have previously interpreted our research work in terms of structure development. Presently we consider structures as *performed*. By means of new capacities of representation the child constructs *internal organizations* (representations) resulting from the application of these preformed structures to reality. *Thus, our conception of development is an elaboration of successive internal organization of content, instead of a construction of successive structures.* Structures characterize only the formal aspects of behavior without specifying objects or situations. On the contrary, internal organization of contents (representations) characterize the organization of specific objects and situations including the goals to be attained.

Logical structures of our actions and our thinking are preformed. The new coding capacities to construct internal organizations appear successively by a process of maturation which depends to a small degree upon the environment. We have tried to reinterpret the development in this perspective.

What we call internal organization of contents (representation) is partly similar to traces, schemas. It is important to make a clear distinction between structures or general cognitive functions that we actually consider as preformed and the results of their application to reality that we call internal organization (representation) (Mounoud, 1977).

This distinction is almost nonexistent in Piaget's theory except in a few places where he writes of traces or figurative remembrances, but they are mainly static (Piaget, 1961; Piaget & Inhelder, 1968).

We suggest defining internal organization (representation) as analyzing (sampling) and organizing aspects of reality and their variations, or as analyzing and organizing object's properties and their relations, or moreover as analyzing and organizing a person's characteristics and their interrelations. These analyses and organizations are progressively built by means of preformed structures, previous organizations and new coding capacities.

Internal organizations or representations are theoretical constructs, they can only be inferred from the different types of activity (gestural, facial, verbal expressions). Some activities can be materialized in the form of drawings, writings, object construction like tools, etc. Since expressive activities are a sequence or a succession of actions, we analyze them by means of programs (algorithms, strategies). A program is an indicator of the degree of elaboration of internal organizations (Mounoud, in press).

With this new perspective, we have seen how the characteristics of the internal organization are determined by the *specific* and *nonspecific aspects* of environments. At the end we have given experimental data to illustrate our approach.

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