Thinking and Speech Chapter 6
The Development of Scientific Concepts in Childhood

The development of scientific concepts in the school-age child is primarily a practical issue of tremendous importance for the school's task of instructing the child in a system of scientific concepts. However, it is also an issue of tremendous theoretical significance. Research on the development of scientific concepts (i.e., true concepts) will inevitably clarify the most basic and essential general laws of concept formation. This problem contains the key to the whole history of the child's mental development. It must, therefore, be our point of departure in studying the child's thinking. Until recently, however, this problem has remained almost entirely unexplored. Our knowledge of the development of scientific concepts is extremely limited. Our own experimental research, which we will cite frequently in the present chapter, is among the first systematic studies of the issue.

This research (carried out primarily by Shif) was a comparative study of the development of scientific and everyday concepts in school-age children. Shif's basic task was to carry out an experimental evaluation of our working hypothesis concerning the unique characteristics of the development of scientific as opposed to everyday concepts. A second basic concern was the more general problem of the relationship between instruction [*obuchenie*] and development. The attempt to study the actual development of the child's thinking in the course of school instruction grew from several basic assumptions: (1) in general terms, concepts or word meanings develop; (2) scientific concepts are not learned in final form – they too develop; (3) findings based on the study of everyday concepts cannot be generalized to scientific concepts; and (4) the problem as a whole must be studied experimentally. A special experimental method was developed. Subjects were presented with problems that were structurally isomorphic, but which differed in that they incorporated materials based on either scientific or everyday concepts. Using a series of pictures, the experimenter told a story that ended with a sentence fragment broken off at the word "because" or "although." This procedure was supplemented by clinical discussion in order to establish levels of conscious reflection on cause-effect relationships and relationships of implication with both scientific and real-world material.

The pictures illustrated a sequence of events based either on materials from lessons in the social science program or common occurrences in everyday life. Problems based on everyday events required children to complete sentences such as: "Kolya went to the movie theater because ...," "The train left the tracks because..." or "Olya still reads poorly, although..." Based on this model, several problems were also constructed using materials from the educational programs of second and fourth grade children.

As a supplementary mode of gathering data, we observed lessons of primary school children that were specially organized for this purpose.

The findings from this study lead to several conclusions concerning both the narrow issue of the development of scientific concepts and the broader issue of the development of thinking in school-age children. A comparative analysis of the results for each age group demonstrates that with the appropriate educational program the *development of scientific concepts outstrips the development of spontaneous concepts*.[*] The table provides empirical support for this conclusion.

The table shows: (1) that there is a higher level of conscious awareness [*osoznanie*] of scientific than everyday concepts, and (2) that there is a progressive development of scientific thinking which is followed by a rapid increase in levels of performance with everyday concepts. This indicates that the accumulation of knowledge leads directly to an increase in the level of scientific thinking and that this, in turn, influences the development of spontaneous thinking. This demonstrates the leading role of instruction in the development of the school child.

[*] When the author uses phrases such as "spontaneous thinking" or "spontaneous concepts," he is referring to phenomena that develop through the child's practical activity and immediate social interaction, not to those that develop with his acquisition of a system of knowledge through instruction. – Editor's note.

The category of adversative relations ('although') develops genetically much slower than the category of causal relations ('because') and presents a picture in Grade IV similar to that of causal relations in Grade II. This is also associated with the characteristics of the materials used in the educational program.

These data lead to an hypothesis concerning the unique processes involved in the development of scientific as opposed to everyday concepts. The development of scientific concepts *begins with the verbal definition.* As part of an organized system, this verbal definition descends to the concrete; it descends to the phenomena which the concept represents. In contrast, the everyday concept tends to develop outside any definite system; it tends to move upwards toward abstraction and generalization.

		Grades	
		II	IV
Tasks		% Completed sentences	
Sentences with the conjunctions			
Because	Scientific concepts	79.70	81.80
	Everyday concepts	59.00	81.30
Although	Scientific concepts	21.30	79.50
	Everyday concepts	16.20	65.50

The development of the scientific social science concept, a phenomenon that occurs as part of the educational process, constitutes a unique form of systematic cooperation between the teacher and child. The maturation of the child's higher mental functions occurs in this cooperative process, that is, it occurs through the adult's assistance and participation. In the domain of interest to us, this is expressed in the growth of the *relativeness* of causal thinking and in the development of a certain degree of *voluntary control* in scientific thinking. This element of voluntary control is a product of the instructional process itself. The earlier maturation of scientific concepts is explained by the unique form of cooperation between the child and the adult that is the central element of the educational process; it is explained by the fact that in this process knowledge is transferred to the child in a definite system. This is also why the level of development of scientific concepts forms a zone of proximal possibilities for the development of everyday concepts. The scientific concept blazes the trail for the everyday concept. It is a form of preparatory instruction which leads to its development.

Thus, at a single stage in the development of a single child, we find differing strengths and weaknesses in scientific and everyday concepts.

Our data indicate that the weakness of the *everyday* concept lies in its *incapacity for abstraction,* in the child's incapacity to operate on it in a voluntary manner. Where volition is required, the everyday concept is generally used incorrectly. In contrast, the weakness of the scientific concept lies in its *verbalism,* in its insufficient saturation with the concrete. This is the basic danger in the development of the scientific concept. The strength of the scientific concept lies in the child's capacity to use it in a voluntary manner, in its "readiness for action." This picture begins to change by the 4th grade. The verbalism of the scientific concept begins to disappear as it becomes increasingly more concrete. This has its influence on the development of spontaneous concepts as well. Ultimately, the two developmental curves begin to merge (Shif, 1935).

How do scientific concepts develop in the course of school instruction? What is the relationship between instruction, learning, and the processes involved in the internal development of scientific concepts in the child's consciousness? Are these simply two aspects of what is essentially one and the same process? Does the process involved in the internal development of concepts follow instruction like a shadow follows the object which casts it, not coinciding with it but reproducing and repeating its movement, or do both processes exist in a more complex and subtle relationship which requires special investigation?

In contemporary child psychology, we find two answers to these questions. First, we find the position that *scientific concepts do not have their own internal history,* that they do not undergo a process of development in the true sense of the word. Rather, they are simply learned or received in completed form through the processes of understanding, learning, and comprehension. They are adopted by the child in completed form from the domain of adult thinking. From this perspective, the problem of the development of scientific concepts is essentially exhausted by that of teaching scientific concepts to the child and by that of learning concepts. This is the most widely accepted – indeed the generally accepted – perspective on this issue in contemporary child psychology. Until recently, it has provided the foundation for the construction of most theories and methods of school instruction.

Even the most rudimentary scientific critique makes the theoretical and practical inadequacy of this view apparent. We know from research on concept formation that the concept is not simply a collection of associative connections learned with the aid of memory. We know that the concept is not an automatic mental habit, but a *complex and true act of thinking* that cannot be mastered through simple memorization. The child's thought must be raised to a higher level for the concept to arise in consciousness. At any stage of its development, the concept is an *act of generalization.* The most important finding of all research in this field is that the concept – represented psychologically as word meaning – develops. The essence of the development of the concept lies in the transition from one structure of generalization to another. Any word meaning, at any age, is a generalization. However, word meaning develops. When the child first learns a new word, the development of its meaning is not completed but has only begun. From the outset, the word is a generalization of the most elementary type. In accordance with the degree of his development, the child moves from elementary generalizations to higher forms of generalization. This process is completed with the formation of true concepts.

The development of concepts or word meanings presupposes the development of a whole series of functions. It presupposes the development of voluntary attention, logical memory, abstraction, comparison, and differentiation. These complex mental processes cannot simply be learned. From a theoretical perspective, then, there is little doubt concerning the inadequacy of the view that the concept is taken by the child in completed form and learned like a mental habit.

The inadequacy of this view is equally apparent in connection with practice. No less than experimental research, pedagogical experience demonstrates that direct instruction in concepts is impossible. It is pedagogically fruitless. The teacher who attempts to use this approach achieves nothing but a mindless learning of words, an empty verbalism that simulates or imitates the presence of concepts in the child. Under these conditions, the child learns not the concept but the word, and this word is taken over by the child through memory rather than thought. Such knowledge turns out to be inadequate in any meaningful application. This mode of instruction is the basic defect of the purely scholastic verbal modes of teaching which have been universally condemned. It substitutes the learning of dead and empty verbal schemes for the mastery of living knowledge.

Tolstoy, who had an extraordinary understanding of the nature of the word and its meaning, saw with both clarity and precision the futility of attempting to transmit concepts directly from teacher to student. He understood that it is impossible to transfer word meaning mechanically from one head to another through other words. Tolstoy experienced the futility of this approach in his own teaching. He attempted to teach children literary language by first translating the children's words into the language of the tale and then translating the language of the tale into a higher level of language. He concluded that it is impossible to teach students literary language as one commonly teaches them French, through forced explanation, memorization, and repetition.

Tolstoy writes:

> We must recognize that the frequency with which we have tried this approach in the past two months and the direct repulsion it encountered in the students proves that it was mistaken. These experiments have convinced me that even for a talented teacher, it is impossible to explain the meaning of a word. The explanations that untalented teachers are so fond of cannot be more successful. To explain a word such as "impression," you must replace it either with another equally incomprehensible word or with a whole series of words whose connection with it is as incomprehensible as the word itself (1903, p. 143).

We find truth and error mixed in equal measure in Tolstoy's categorical position on this issue. The correct aspect of his position is that which flows directly from the experience of any teacher who is struggling like Tolstoy and who analyzes the word as carefully. In Tolstoy's own words, the truth in this position consists in that fact that:

> it is rarely the word itself that is incomprehensible to the student. Rather, the child lacks the concept that the word expresses. The word is almost always ready when the concept is ready. The relationship of the word to thought and the formation of new concepts is such a complex, mysterious, and delicate process of the spirit that any interference with it is a powerful, awkward force which retards development (ibid).

The truth of this position lies in the fact that concepts or word meanings develop and in the fact that this developmental process is complex and delicate.

The incorrect aspect of this position, which is a direct expression of Tolstoy's general views on the issue of instruction, lies in his exclusion of any possibility of direct interference in this mysterious process. Tolstoy attempts to represent the process of concept development in terms of its own internal laws. He isolates the development of concepts from instruction. This condemns the teacher to extreme passiveness in the development of scientific concepts. This position emerges with particular clarity in Tolstoy's categorical formulation of his position, in his statement that "any interference is a crude, awkward force which retards development."

However, Tolstoy understood that not all forms of interference retard concept development. It is only crude, direct interference in the formation of concepts – interference which attempts to move in a straight line along the shortest distance between two points – that leads to injury. A different form of interference, a more subtle, complex, and indirect method of instruction, will lead this developmental process forward to higher levels. Tolstoy writes:

> It is important to give the pupil the opportunity to acquire new concepts and words from the general meaning of speech. The child hears or reads a word that he does not understand in a phrase that he does. Later, he hears or reads it again in another phrase. Through this process, he begins to acquire some vague understanding of it. Ultimately, he begins to feel the necessity of using this word. Once he has used it, the word and concept are made his own. There are a thousand other paths to this same end. I remain convinced, however, that consciously transferring new concepts or word forms to the pupil is as futile as attempting to teach the child to walk through instruction in the laws of equilibrium. Any attempt of this kind will not only fail to move the pupil toward the desired goat, but will interfere with that process, much like the crude hand of a man who attempts to build a flower from petals still contained within a bud because he wants to see it bloom (ibid, p. 146).

Thus, Tolstoy believes that there are a thousand paths other than that characteristic of traditional scholastic instruction through which we can teach new concepts to the child. He rejects only one path, the direct and crude mechanical construction of the new word from its "petals." Tolstoy's argument on this issue is correct. It is, indeed, indisputable, supported by both theory and practice. However, Tolstoy ascribes too much significance to the natural and accidental. He ascribes too much significance to the work of vague representations and feelings, to the internal process of concept formation closed off within itself. He underestimates the potential for direct influence on this process. Stated more generally, he exaggerates the distance between instruction and development.

However, in the present context, we are interested primarily in the kernel of truth that is contained in his position that the attempt to develop the new concept from its "petals" is like trying to teach a child to walk in accordance with the laws of equilibrium. This position is absolutely correct. The path from the child's first encounter with a new concept to the moment when the word and concept are made the child's own is a complex internal mental process. This process includes the gradual development of understanding of the new word, a process that begins with only the vaguest representation. It also includes the child's initial use of the word. His actual mastery of the word is only the final link in this process. We attempted to express what is essentially the same idea in our argument that, when the child first learns the meaning of a new word, the process of development has not been completed but has only begun.

Our research in pursuit of the hypothesis stated at the beginning of this chapter shows that the paths through which we can teach concepts to the child are not limited to the thousand to which Tolstoy refers. *Conscious* instruction of the pupil in new concepts (i.e., in new forms of the word) is not only possible but may actually be *the source for a higher form of development of the child's own concepts, particularly those that have developed in the child prior to conscious instruction.* Our research demonstrates that it is possible to work directly on concepts in school instruction. It also shows, however, that this constitutes not the end but the beginning of the development of the scientific concept. It does not exclude the processes of development but gives them new directions. It places the processes of instruction and development in new and maximally propitious relationships.

It is important to note that when Tolstoy speaks of the concept it is always in connection with the problem of teaching literary language to the child. Tolstoy is not concerned with the concepts that the child acquires in learning a system of scientific knowledge, but with words and concepts that are woven into the same fabric as those that have developed in the child. The examples that he uses make this apparent. He speaks of explaining and interpreting words such as "impression" or "tool." In contrast to the scientific concepts with which our research is concerned, these words and concepts are not learned as part of a well-defined system. Naturally, we must consider to what extent Tolstoy's arguments can be extended to the processes involved in the formation of scientific concepts. To address this issue, we must explore the common characteristics of the processes involved in the formation of scientific concepts and those involved in the formation of the concepts that Tolstoy had in mind because they emerge from the child's own everyday life experience, we will refer to the latter as everyday concepts.

By differentiating scientific and everyday concepts in this way, we do not resolve the issue of whether this differentiation is objectively justified. Indeed, a basic task of our research is to clarify the issue of whether there is any objective difference between the processes involved in the development of scientific concepts and those involved in the development of other types of concepts. If such a difference does exist, we must clarify its nature. We must also identify objective differences which can provide a foundation for the comparative study of the processes involved in the development of scientific and everyday concepts. The task of this chapter is to show that this distinction is empirically warranted, theoretically justified, and heuristically fruitful. Its task is to show that it must function as the corner stone of our working hypothesis. We must demonstrate that *scientific concepts develop differently than everyday concepts,* that the development of these two types of concepts does not follow the same path. Therefore, the task of our experimental research includes acquiring empirical support for the position that there is a difference between the development of scientific and everyday concepts. It also requires the acquisition of data that will permit us to clarify the precise nature of this difference.

This differentiation of scientific and everyday concepts is basic to our working hypothesis and our statement of the research problem. It is not, however, generally accepted by contemporary psychologists. In fact, it contradicts the most widely held views on the matter. We should, therefore, attempt to clarify and support our position.

We mentioned earlier that there are currently two positions on the issue of how scientific concepts develop in the course of school instruction. As we have pointed out, the first position consists of a complete rejection of any internal development in the emergence of scientific concepts. We have already attempted to point out the inadequacy of this perspective. There is, however, a *second position* on this issue. This position – currently the more widely accepted of the two – is based on the idea that the development of scientific concepts *differs in no essential way from that of the concepts* which develop in the course of the child's own experience. This perspective suggests that there is no basis for the differentiation of these developmental processes. From this perspective, the process involved in the development of scientific concepts simply repeats the most basic and essential aspects of the process through which everyday concepts develop. The critical question at this point is whether this second position is well-founded.

If we review the scientific literature, it quickly becomes apparent that nearly all studies of concept formation in childhood have focused on the development of what we call everyday concepts. As we mentioned earlier, our work is one of the first systematic attempts to study the development of scientific concepts. All the established laws and regularities of the development of the child's concepts have been derived from studies of everyday concepts. In spite of the differences in the internal conditions under which these two types of concepts develop, these findings have been extended to the domain of the child's scientific thinking. No attempt has been made to verify the validity of such an extension. That the extension of these findings to the domain of scientific concepts has occurred without any attempt to assess its validity is primarily a function of the fact that the question of the propriety of this extension has never been raised.

Recently, several particularly insightful researchers (including Piaget) have found that they could not ignore this question. Moreover, when the problem presented itself, these researchers were obliged to differentiate sharply between representations that develop primarily through the operation of the child's own thought and those that arise under the decisive and determining influence of knowledge the child acquires from those around him.

Piaget refers to the first of these two types of representations as spontaneous representations.

Piaget demonstrated that these two types of representations have a good deal in common. They both: (1) manifest a resistance to external suggestion; (2) have deep roots in the child's thought; (3) manifest a certain commonality among children of the same age; (4) are maintained in the child's consciousness over a period of several years (giving way to new concepts gradually rather than disappearing suddenly); and (5) manifest themselves in the child's first true answers. These characteristics differentiate these two types of representations from suggested representations and from answers that are provided to the child through leading questions.

In our view, these positions are correct. They recognize that the child's scientific concepts (which clearly belong to the second group of representations discussed by Piaget) undergo a true process of development rather than arising spontaneously. This is made clear by the five features of these representations listed above. Piaget goes further and deeper than other researchers into the problem which interests us. He even recognizes that this group of concepts can become an independent object of investigation.

However, Piaget makes several mistakes that detract from the positive aspect of his argument. *Three interrelated aspects of Piaget's thought are mistaken* and of special interest to us. The first concerns the potential for independent studies of the child's nonspontaneous concepts and the fact that these concepts have roots deep in the child's thought. Piaget is inclined to a make an assertion that directly contradicts these ideas. He asserts that it is only the child's spontaneous concepts and representations which can serve as the source of direct knowledge of the unique qualities of the child's thought. In Piaget's view, the child's nonspontaneous concepts (concepts formed under the influence of the adults who surround the child) reflect not so much the characteristics of the child's thinking as the level and character of the adult thought that the child has learned. In this assertion, Piaget contradicts his own argument that the child reworks the concept in learning it. He contradicts the notion that the specific characteristics of the child's own thought are expressed in the concept in the course of this transformation. Piaget tends to argue that this applies only to spontaneous concepts, generally failing to see that it is equally true of nonspontaneous concepts. This constitutes the first mistake in Piaget's thought on these issues.

Piaget's second mistake flows directly from the first. Once it is accepted that the child's nonspontaneous concepts do not reflect the characteristics of the child's thought, and that these characteristics are contained only in the child's spontaneous concepts, we are obliged to accept the notion that between spontaneous and nonspontaneous concepts there exists an impassable, solid, eternal barrier which excludes any mutual influence. This notion is accepted by Piaget. Piaget succeeds in differentiating spontaneous and nonspontaneous concepts, but does not see that they are united in a single system that is formed in the course of the child's mental development. He sees only the break, not the connection. As a consequence, he views the development of concepts as a mechanical combination of two separate processes, processes which have nothing in common and move, as it were, along two completely isolated or separate channels.

Inevitably, these two mistakes tangle Piaget's theory in contradiction and lead to a third mistake. On the one hand, Piaget asserts that the child's nonspontaneous concepts do not reflect the characteristics of his thought. He asserts that this privilege belongs exclusively to spontaneous concepts. This implies that knowledge of these characteristics of the child's thought can have no practical significance, since the acquisition of nonspontaneous concepts is not dependent on them. On the other hand, a basic thesis of his theory is the recognition that the essence of the child's mental development lies in the progressive socialization of the child's thought. As we have seen, one of the basic and most concentrated contexts for the formation of nonspontaneous concepts is school instruction. If we accept Piaget's views on this matter, the process involved in the socialization of thought that we find in instruction (among the most important processes in the child's development) turns out to be entirely independent of the child's own internal processes of intellectual development. On the one hand, the internal development of the child's thought is deprived of any significance in explaining the socialization of the child in instruction. On the other, the socialization of the child's thought (which moves to the forefront in the process of instruction) is represented as unconnected with the internal development of the child's representations and concepts.

This contradiction constitutes the weakest link in Piaget's theory and is the point of departure for our critical analysis of his theory in the present study. Consequently, both the theoretical and practical aspects of this contradiction deserve to be considered in more detail.

The theoretical aspect of this contradiction has its roots in the way Piaget represents the problem of instruction and development. Piaget does not develop his ideas on this issue explicitly, touching on them only in passing. Nonetheless, a clear position on this issue is a postulate of fundamental importance for the structure of his theory. In fact, his theory as a whole stands or falls with this postulate. Our task is to isolate and develop this aspect of Piaget's theory in order to contrast it with the corresponding aspect of our own hypotheses.

Piaget represents the child's mental development as a process in which *the characteristics of the child's thought gradually die out.* For Piaget, the child's mental development consists of the gradual replacement of the unique qualities and characteristics of the child's thought by the more powerful thought of the adult. The beginning of the child's mental development is represented in terms of the solipsism of the infant. To the extent that the child's adapts to adult thought, this infantile solipsism gives way to the egocentric thought of the child. Egocentric thought is seen as a compromise between the characteristics of the child's consciousness and those of adult thought. This is why egocentrism is stronger in younger children. With age, the characteristics of the child's thought begin to disappear. They are replaced in one domain after another and ultimately disappear entirely. The developmental process is not represented as the continual emergence of new characteristics of thought, of higher, more complex, and more developed forms of thought on the foundations of more elementary and primary forms of thinking. Rather, development is portrayed as a process through which one form of thought is gradually and continuously being forced out by another. The socialization of thought is viewed as an external, mechanical process in which the characteristics of the child's thought are forced out. In this sense, development is comparable to a process in which one liquid – forced into a vessel from the outside – replaces another that had previously filled the vessel. A red liquid is continually forced into a vessel that contains a white liquid. The white, which represents the characteristics that are inherent to the child at the beginning of the developmental process, is forced out as the child develops. It is forced from the vessel as it increasingly becomes filled with the red liquid. In the end, the red liquid inevitably fills the entire vessel. Development is reduced to the dying out of the characteristics of the child's thinking. What is new to development arises from without. The child's characteristics have no constructive, positive, progressive, or formative role in the history of his mental development. Higher forms of thought do not arise from the characteristics of the child, but simply take the their place. According to Piaget, this is the sole law of the child's mental development.

If we extend Piaget's thinking on these issues, it becomes clear that the relationship between instruction and development is represented as one of antagonism in the process of the formation of the child's concepts. From the outset, the child's thinking is placed in opposition to adult thought. One does not arise from the other; one excludes the other. It is not only that the nonspontaneous concepts acquired by the child from adults have nothing in common with his spontaneous concepts. In a variety of ways, the former are in direct opposition to the latter. No relationships are possible between the two except continual antagonism and conflict, except the gradual and continual replacement of spontaneous by nonspontaneous concepts. One must be done away with so that the other can take its place. Thus, during the entire course of the child's development, two antagonistic groups of concepts must exist. All that changes with age is their quantitative relationship. One prevails at the outset, but with the transition from one stage to another the quantity of the other increases progressively. In connection with school instruction, the nonspontaneous concept begins to replace the spontaneous concept. This occurs between the ages of eleven and twelve. In Piaget's view, this completes the child's mental development. The formation of true adult concepts, the decisive act of the whole drama of development and one that extends over the entire epoch of maturation, is dropped from the child's history as a superfluous or unnecessary chapter. Piaget argues that at each step in the development of the child's representations we encounter a real conflict between the child's thought and the thought of those around him. He argues that this conflict leads to a systematic deformation in the child's mind of that which is received from the adult. In accordance with this theory, development is reduced to a continual *conflict between antagonistic forms of thinking;* it is reduced to the establishment of a unique compromise between these two forms of thinking at each stage in the developmental process. This compromise changes with each stage in the process, a process in which the child's egocentrism ultimately dies out.

From a practical perspective, this contradiction in Piaget's thinking makes it impossible to apply findings from the study of the child's spontaneous concepts to the development of his nonspontaneous concepts. On the one hand, the child's nonspontaneous concepts (especially those that are formed in the process of school instruction) have nothing in common with the development of the child's own thought. On the other, an attempt is made to transfer the laws of development characteristic of spontaneous concepts to the development of concepts that results from school instruction. We find ourselves in an enchanted circle.

This emerges with particular clarity in Piaget's article entitled "The Psychology of the Child and the Teaching of History." Here, Piaget argues that if nurturing the child's historical understanding presupposes the presence of a critical or objective approach, if it presupposes an understanding of interdependencies, relationships, and stability, there is no better basis for determining the techniques to be used in teaching history than the study of the child's spontaneous intellectual state, however naive and insignificant that intellectual state may seem (Piaget, 1933). However, in this article, the study of the child's spontaneous intellectual state leads Piaget to the conclusion that that which constitutes the basic goal of the teaching of history – this critical and objective approach and this understanding of interdependencies, relations, and stability – is foreign to the child's thought. On the one hand, we find the argument that the development of spontaneous concepts cannot explain the acquisition of scientific concepts. On the other, we find the argument that there is nothing more important for the technique of teaching than the study of the child's spontaneous state. Piaget resolves this practical contradiction in terms of the antagonism that exists between instruction and development. Knowledge of the spontaneous state is important because it must be supplanted in the process of instruction. We must understand it in the same sense that we must understand an enemy. The ongoing conflict between adult thought (which is the foundation of teaching in school) and the thought of the child must be understood in order to improve teaching techniques.

The goal of the present study, the primary motivation for the construction and experimental verification of our working hypothesis, is essentially to overcome these three limitations in what is one of the best contemporary theories of the development of the child's thought.

Our first basic assumption is the direct opposite of Piaget's first mistaken thesis. *The development of nonspontaneous concepts* (particularly scientific concepts, which we consider a high, pure, and, both theoretically and practically, important type of nonspontaneous concept) *will manifest all the basic qualitative characteristics of the child's thought at a given stage of development.* This position is based on the idea that *scientific concepts are not simply acquired or memorized by the child and assimilated by his memory but arise and are formed through an extraordinary effort of his own thought.*

This implies that the development of scientific concepts must manifest the characteristics of the child's thought. This assumption is fully supported by our experimental research.

Our second assumption is also in opposition to Piaget's. As the purest type of nonspontaneous concept, scientific concepts not only manifest features that are the opposite of those manifested by spontaneous concepts but manifest features that are identical to those manifested by spontaneous concepts. The boundary that separates these two types of concepts is fluid. In the actual course of development, it shifts back and forth many times. If we are to make some assumption at the outset, it must be the assumption that the development of spontaneous and scientific concepts are closely connected processes that continually influence one another. On the one hand, the development of scientific concepts will depend directly on a particular level of maturation of spontaneous concepts. There is evidence for this in our practical experience. The development of scientific concepts becomes possible only when the child's spontaneous concepts have achieved a certain degree of development. This level of development is characteristically attained by the beginning of the school age. On the other hand, the emergence of higher types of concepts (e.g., scientific concepts) will inevitably influence existing spontaneous concepts. These two types of concepts are not encapsulated or isolated in the child's consciousness. They are not separated from one another by an impenetrable wall nor do they flow in two isolated channels. They interact continually. This *will* inevitably lead to a situation where generalizations with a comparatively complex structure – such as scientific concepts – elicit changes in the structure of spontaneous concepts. Whether we refer to the development of spontaneous concepts or scientific ones, we are dealing with the development of a unified process of concept formation. This developmental process is realized under varying external and internal conditions. By its very nature, however, it remains a unified process. It is not a function of struggle, conflict, and antagonism between two mutually exclusive forms of thinking. Once again, if we do not shy away from the results of the experimental research, we will find that this assumption is fully supported by the data.

Finally (in opposition to Piaget's mistaken and contradictory third position), we would argue that – in the process of concept formation – the relationship between the processes of instruction and development must be immeasurably more complex and positive in nature than the simple antagonism proposed by Piaget. It is reasonable to anticipate that research will show that instruction is a basic source of the development of the child's concepts and an extremely powerful force in directing this process. This assumption is based on the generally accepted fact that instruction plays a decisive role in determining the entire fate of the child's mental development during the school age, including the development of his concepts. Further, scientific concepts can arise in the child's head only on the foundation provided by the lower and more elementary forms of generalization which previously exist. They cannot simply be introduced into the child's consciousness from the outside. Again, this third and final assumption is supported by the research findings. This position on the issue allows us to assess the usefulness of psychological research on the child's concepts for teaching and instruction from a perspective that is very different from Piaget's.

We will attempt to develop these theses in more detail later. First, we must address the issue of what evidence is required to justify our distinction between spontaneous or everyday concepts on the one hand and nonspontaneous or scientific concepts on the other. Of course, we could rely exclusively on empirical verification of this distinction. In particular, we could cite the results of the experimental studies presented in the present book. These studies provide direct evidence that these two types of concepts produce different results in tasks that require identical logical operations.

They indicate that they manifest different levels of development at one and the same moment in one and the same child. This alone would be sufficient to justify the distinction between spontaneous and nonspontaneous concepts. However, to construct our working hypothesis and explain this distinction in theoretical terms, we must consider the factors which permitted us to anticipate the difference between these two types of concepts. These considerations fall into four groups.

The First Group: Here we are concerned with our empirical, experiential knowledge rather than experimental research. First, we cannot ignore the fact that the internal and external conditions under which development occurs differ for these two groups of concepts. Scientific concepts have a different relationship to the child's personal experience than spontaneous concepts. In school instruction, concepts emerge and develop along an entirely different path than they do in the child's personal experience. The internal motives that move the child forward in the formation of scientific concepts are completely different than those that direct his thought in the formation of spontaneous concepts. When concepts are acquired in school, the child's thought is presented with different tasks than when his thought is left to itself. In sum, scientific concepts differ from spontaneous concepts in that they have a *different relationship to the child's* *experience,* in that they have a different relationship to the object that they represent, and in that they follow a different path from birth to final formation.

Second, similar empirical considerations force us to recognize that the strengths and weaknesses of spontaneous and scientific concepts are very different in the school child. Just as the strength of the scientific concept is the weakness of the everyday concept, the strength of the everyday concept is the weakness of the scientific. When we compare the child's definitions of everyday concepts with the definitions of scientific concepts that he produces in school, we find that the latter are immeasurably more complex. A difference in the strengths of these two types of concepts emerges clearly here. The child formulates Archimedes' law better than he formulates his definition of what a brother is. This obviously reflects the different developmental paths that have led to the formation of these concepts. The child has learned the concept of "Archimedes law" differently than he has learned the concept of "brother." The child knew what a brother was, and passed through many stages in the development of this knowledge, before he learned to define the word "brother" (if he ever had the occasion to learn this). The development of the concept, "brother," did not begin with a teacher's explanation or with a scientific formulation. This concept is saturated with the child's own rich personal experience. It had already passed through a significant part of its developmental course and had exhausted much of the purely empirical content it contains before the child encountered it in definition. Of course, this was not the case with the concept that underlies "Archimedes' law."

The Second Group: We are concerned here with theoretical considerations and will begin with one on which Piaget himself depends. As evidence of the unique character of the child's concepts, Piaget cites Stern's demonstration that not even speech is learned by the child through simple imitation, that not even speech is borrowed by the child in completed form. The basic principle underlying Stern's arguments is the recognition that the originality and uniqueness of the child's speech cannot emerge through the child's simple adoption of the language of those around him. Piaget finds himself in full agreement with this principle. It is his view that the child's thought is even more original and unique than his language. The role of imitation as a formative factor is obviously of less significance here than in speech development.

Piaget's thesis that the child's thought is more unique than his language would seem indisputable. Given this, it seems reasonable to assume that the higher forms of thought characteristic of the formation of scientific concepts must be even more unique than those that are characteristic of the formation of spontaneous concepts. In other words, everything that Piaget has to say about spontaneous concepts in this connection must apply to scientific concepts as well. It is difficult to believe that the child learns scientific concepts without reworking them, that they simply drop into his mouth like hot cakes. Like the formation of spontaneous concepts, *the formation of scientific concepts is not completed but only begun at the moment when the child learns the first meanings and terms* that function as their carriers. This is a general law of the development of word meaning. It applies equally to the development of spontaneous and scientific concepts. The key is that there is a fundamental difference in the initial moments of the formation of these two types of concepts. This thought can be clarified through an analogy (although, as the further development of our hypothesis and research *will* show, this is something more than a simple analogy).

It is well known that the child learns a foreign language in school in a completely different way than he learns his native language. Few of the empirical regularities or laws characteristic of the development of the native language are repeated when a foreign language is learned by the school child. Piaget is right when he argues that adult language does not represent for the child what a foreign language represents for the adult. Specifically, it is not a system of signs that corresponds point for point with a system of concepts that have already been acquired. Learning a foreign language is profoundly different from learning a native language. This is partly because a set of fully formed and developed word meanings already exist in the former case. These word meanings are simply translated into the foreign language. In other words, this is partly a function of the relative maturity of the native language itself. It is also partially a function of the fact that the foreign language is learned under entirely different internal and external conditions, of the fact that the conditions that characterize the learning process differ profoundly from those that characterize the learning of the native language. Different developmental paths, followed under different conditions, cannot lead to identical results.

It would be odd if the process involved in learning a foreign language in school reproduced that involved in learning the native language, repeating a process that had occurred earlier under entirely different conditions. Nonetheless, the profound differences between these processes must not divert us from the fact that they are both aspects of speech development. The processes involved in the development of written speech are a third variant of this unified process of language development; it repeats neither of the two processes of speech development mentioned up to this point. All three of these processes, the learning of the native language, the learning of foreign languages, and the development of written speech interact with each other in complex ways. This reflects their mutual membership in a single class of genetic processes and the internal unity of these processes. As we indicated above, the learning of a foreign language is unique in that it relies on the semantic aspect of the native language. Thus the instruction of the school child in a foreign language *has its foundation in his knowledge of the native language.* Less obvious and less well known is the fact that the foreign language influences the development of the child's native language. Goethe understood this influence clearly. In his words, he who does not know at least one foreign language does not know his own. This idea is fully supported by research. Learning a foreign language raises the level of development of the child's native speech. His conscious awareness of linguistic forms, and the level of his abstraction of linguistic phenomena, increases. He develops a more conscious, voluntary capacity to use words as tools of thought and as means of expressing ideas. Learning a foreign language raises the level of the child's native speech in much the same way that learning algebra raises the level of his arithmetic thinking. By learning algebra, the child comes to understand arithmetic operations as particular instantiations of algebraic operations. This gives the child a freer, more abstract and generalized view of his operations with concrete quantities. Just as algebra frees the child's thought from the grasp of concrete numerical relations and raises it to the level of more abstract thought, learning a foreign language frees the child's verbal thought from the grasp of concrete linguistic forms and phenomena.

Thus, research indicates that: (1) the learning of a foreign language both depends on the child's native speech and influences it; (2) the course of its development does not repeat that of native speech; and (3) the strengths and weaknesses of native and foreign languages differ.

We have every reason to believe that an analogous relationship exists between everyday and scientific concepts. Two significant considerations support this notion. First, the development of all concepts (both spontaneous and scientific) is part of the more general process of speech development. The development of concepts represents the semantic aspect of speech development. Psychologically, the development of concepts and the development of word meaning are one and the same process. As part of the general process of linguistic development, it can be anticipated that the development of word meanings will manifest the regularities that are characteristic of the process as a whole. Second, in their most essential features, the internal and external conditions involved in the development of foreign languages and those involved in the development of scientific concepts coincide. Perhaps more significantly, they differ from the conditions involved in the development of the native language and spontaneous concepts in much the same way. In both cases, *instruction* emerges as a new factor in development. In this way, just as we differentiate spontaneous and nonspontaneous concepts, we can speak of spontaneous speech development with the native language and nonspontaneous speech development with the foreign language.

If we compare the results of the research discussed in the present book with psychological research on foreign language learning, the analogy we are presenting here is fully supported.

A theoretical consideration of no less importance is the fact that scientific and everyday concepts have different relationships to the object or act that is represented in thought. The development of these two types of concepts presupposes differences in the intellectual processes which underlie them. In receiving instruction in a system of knowledge, the child learns of things that are not before his eyes, things that far exceed the limits of his actual and or even potential immediate experience. To this extent, the learning of scientific concepts depends on the concepts developed through the child's own experience in the same way that the study of a foreign language depends on the semantics of his native speech. Just as the learning of a foreign language presupposes a developed system of word meanings, the learning of a system of scientific concepts presupposes the widely developed conceptual fabric that has emerged on the basis of the spontaneous activity of the child's thought. Finally, learning a new language does not begin with the acquisition of a new orientation to the object world. It is not a repetition of the developmental process that occurred in the acquisition of the native language. The process begins with a speech system that has already been learned, a system that stands between the newly learned language and the world of things. In the same sense, learning a system of scientific concepts occurs only through a similar form of mediation between the conceptual system and the world of objects, only through other concepts that have already developed. This process of concept formation requires entirely different acts of thought, acts of thought which are associated with free movement in the concept system, with the generalization of previously developed generalizations, and with a more conscious and voluntary mode of operating on these existing concepts.

The Third Group: Here we are concerned with heuristic considerations. Contemporary psychological research knows only two modes of investigating concepts. One relies on rather superficial methods but deals with the child's actual concepts. The other relies on immeasurably more sophisticated modes of analysis and experimentation but deals only with concepts that are formed under artificial experimental conditions and designated with what are initially meaningless words. The immediate methodological task in this field of research is to move from the superficial study of actual concepts and the sophisticated study of experimental concepts to the sophisticated study of actual concepts. The significance of research on the development of scientific concepts becomes apparent in this connection. On the one hand, scientific concepts are actual concepts. At the same time, however, they are formed before our eyes in much the same way that experimental concepts are. Thus, scientific concepts combine the advantages of the two existing modes of research. They allow us to use experimental means of analysis in studying the birth and development of actual concepts.

The Fourth Group: Here we are concerned with practical considerations. Earlier, we questioned the notion that scientific concepts are simply learned or memorized. We are obligated, however, to analyze the nature of instruction and its central role in the emergence of scientific concepts. In arguing that the concept is not simply learned as a mental habit, we meant to suggest that *the relationship between instruction and the development of scientific concepts is more complex than the relationship between instruction and the formation of habits.* The immediate practical task of our research is to understand this more complex relationship. The working hypothesis we are developing must open a path for the resolution of this problem.

Only by clarifying the complex relationships that exist between instruction and the development of scientific concepts can we escape from the contradictions in which Piaget's thought is entangled. To his misfortune, Piaget saw nothing in the richness of these relationships other than conflict and antagonism.

These are the most significant of the considerations that caused us to frame our research around the differentiation of scientific and everyday concepts. The basic question that we will attempt to address in our research can be formulated in the following way: Are the paths along which the concepts "brother" and "exploitation" develop identical or different? Does the second concept simply repeat the developmental path of the first, with the developmental process manifesting the same characteristics, or does this concept have a distinct mental character? We must state an assumption that is fully supported by the results of our empirical research: *These concepts will differ both in the paths that their development takes and in their mode of functioning.* This finding opens up extremely rich potentials for the study of the mutual influence of these two aspects of concept formation in the child.

Having rejected the notion that scientific concepts do not develop, we are faced with two tasks. First, on the basis of experimental data, we must assess the validity of the notion that scientific concepts follow the same developmental path as everyday concepts. Second, on an equally empirical basis, we must assess the extent to which there is justification for the thesis that the development of scientific concepts has nothing in common with the development of spontaneous concepts, that it tells us nothing about the unique nature of the child's thought. Our research will respond to both these questions in the negative, demonstrating that neither of these assumptions is corroborated by the empirical data. It will demonstrate the existence of a third alternative which grasps the actual, complex, and two-sided relationship between scientific and everyday concepts.

The only means we have for discovering this third alternative is to compare scientific concepts with everyday concepts, to compare a type of concept that is only now beginning to be systematically studied with a type of concept that has already been studied extensively. In other words, the only means we have for discovering this third alternative is to move from the known to the unknown. However, such a comparative study requires a clear differentiation of these two types of concepts. Relationships can exist only between things that do not coincide with one another. A thing can have no relationship with itself.

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To study the complex relationships between the development of scientific and everyday concepts, we must consider the scale to be used in making this comparison. That is, we must clarify the characteristics of the school-age child's everyday concepts. Piaget has demonstrated that the essential characteristic of the child's thinking and concepts at this age is *his incapacity for reflective awareness of relations that he can use correctly* when no reflective awareness on his part is required, that is, when he acts *spontaneously and automatically.* In Piaget's view, it is egocentrism that prevents the child's conscious awareness of his own thought. Piaget offers a simple example to illustrate the influence of this lack of conscious awareness on the development of the child's concepts. Specifically, Piaget asked children between seven and eight years of age what the meaning of the word "because" is in a sentence such as: "I am not going to school tomorrow because I am sick." The majority answered: "That means that he is sick." Others maintained that: "That means that he will not go to school." In short, these children simply did not have the capacity for conscious awareness of the word's definition, although they are able to use the word spontaneously.

The child's incapacity for conscious awareness of his own thought or for establishing logical connections with conscious awareness extends through the age of eleven to twelve years (i.e., through the first school age). The child manifests an incapacity for the logic of relationships and substitutes his own egocentric logic. Between seven and twelve years of age, these difficulties carry over into the verbal plane. In this way, forces that were present before this stage now influence the child's logic.

Functionally, the child's incapacity for conscious awareness of his own thought is reflected in a basic characteristic of his logic. The child is capable of several logical operations when they arise spontaneously in the course of his thought. He is not, however, able to carry out completely analogous operations if they must be carried out with volition and intention. Children of seven years were asked how the following phrase should be completed: "The man fell from the bicycle because ..." They generally failed at this task. They frequently completed the phrase in the following ways: "He fell from the bicycle because he fell and was then badly injured." "The man fell from the bicycle because he was sick and therefore they picked him up from the street." "Because he broke his arm and his leg." At this age, the child is incapable of establishing a causal connection intentionally and voluntarily. He uses the word "because" correctly and meaningfully in spontaneous or nonvoluntary speech but is in capable of being consciously aware that the phrase cited in the previous paragraph refers to the cause of the child's absence from school, that it does not refer to the isolated facts of non-attendance and illness. In spite of his incapacity for conscious awareness, however, the child does understand the meaning of the phrase; he understands simple causes and relationships. He does not, however, become consciously aware of this understanding. When he uses the conjunction "because" spontaneously he uses it correctly but he cannot apply it intentionally and voluntarily. Thus, we can establish the internal dependency of these two phenomena in the child's thought on a purely empirical basis. The child's thought lacks conscious awareness and is nonvolitional in nature. It is characterized by unconscious understanding and spontaneous application.

These two characteristics of the child's thinking are closely linked with its egocentric nature. They also lead to other characteristics of the child's logic that are manifested in his incapacity for the logic of relationships. They dominate the child's thinking throughout the school age. In development, which consists of the socialization of thought, we find a gradual disappearance of these phenomena. The child's thought is freed from egocentrism.

How does this occur? How does the child achieve conscious awareness of his own thought? How does he master it? Piaget relies on two psychological laws to explain this process. While he did not formulate these laws, they provide the foundation for his theory.

The first is the law of conscious awareness formulated by Claparède. Through a series of extremely interesting experiments, Claparède demonstrated that conscious awareness of similarity appears later in the child than conscious awareness of difference. The child behaves in consistent ways vis-à-vis similar objects. He experiences no need for conscious awareness of this consistency in his behavior. He acts in accordance with similarity earlier than he thinks it out. In contrast, the differences that exist between objects result in nonadaptive behavior on the part of the child. This nonadaptive behavior elicits conscious reflection. This led Claparède to what he called the law of conscious awareness. The more we use a given relationship, the lower the level of our conscious awareness of it. We are consciously aware only to the extent that we are unable to accommodate or adapt. The more extensively a relationship is used in our automatic behavior, the more difficult it is for us to be consciously aware of it.

Still, this law tells us nothing of how conscious awareness is realized. It is a functional law. It indicates only whether the need for conscious awareness is present or absent in a given individual. The structural issues remain unclarified. What is the means of this conscious awareness? What impediments does it encounter? To answer these questions, another law – the law of displacement – is introduced. To become consciously aware of an operation, it must be transferred from the plane of action to the plane of language; it must be recreated in imagination such that it can be expressed in words. This displacement of the operation from the plane of action to the plane of thought is accompanied by the same difficulties and complications that were encountered when the operation was first learned on the plane of action. Only the tempo changes; the rhythm remains the same. This reproduction on the verbal plane of the difficulties encountered in learning operations on the plane of action constitutes the essence of the second structural law of conscious awareness.

We will briefly analyze each of these laws and clarify the actual source and significance of the lack of conscious awareness in the school-age child, of the nonvolitional nature of his operations with concepts. We will also attempt to clarify how the child attains conscious awareness of his concepts and achieves the intentional, volitional use of concepts.

Since Piaget himself noted the fundamental inadequacy of Claparède's law of conscious awareness, our critical analysis of these laws can be brief. Stated simply, to explain the emergence of conscious awareness exclusively in terms of the need for it is much the same as explaining the development of feathers in birds by referring to the fact that birds need feathers to fly. This kind of explanation represents a great step backward in the development of scientific thought. It is based on the assumption that a creative capacity capable of producing that which is needed is present in the need itself. This conception of conscious awareness assumes the absence of any development. It implies that conscious awareness is preformed and always ready to emerge.

Perhaps it is not the child's encounter with the nonadaptive character of his behavior and the resulting need for conscious awareness that causes him to become aware of relationships of difference before he becomes aware of relationships of similarity. Perhaps conscious awareness of relationships of similarity requires a more complex structure of abstractions and concepts than the conscious awareness of relationships of difference. We conducted research which supports this perspective. Experimental analysis indicates that conscious awareness of similarity requires the formation of a concept or generalization which represents the objects between which the relationship exists. Conscious awareness of difference does not require the formation of such a concept; it can arise in a entirely different way. This explains the later development of conscious awareness of relationships of similarity that was established empirically by Claparède. That the sequence in which these two concepts emerge is the reverse of that in which they emerge on the plane of action is merely one example of another, more general phenomenon. For example, we were able to establish experimentally that this same reversed sequence is inherent in the development of meaningful perception of the object and the action.*

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* A single group of pictures were shown to two groups of preschool children who were equivalent in age and level of development. One group acted out the events that were illustrated in the series of pictures presented to them,

Children respond to actions earlier than to differentiated objects, but they give meaning to or comprehend the object earlier than the action. The action develops in the child earlier than autonomous perception. However, meaningful perception leads the development of meaningful action by an entire age grade. Analysis indicates that this is a function of internal causes related to the nature of the child's concepts and their development.

Of course, one could argue that – as a functional law – Claparède's law cannot explain the structural aspect of the problem. This would imply that the key question is only whether it provides a satisfactory explanation of the functional aspect of the problem, that is, whether it is sufficient for Piaget's purposes. The essence of Piaget's argument on this issue is found in the picture he draws of the development of concepts in children between seven and twelve years of age. According to Piaget, it is during this period that the child runs up against the fact that his thought operations are not adaptive to adult thought. The child experiences failure and defeat which reflects the inadequacy of his logic. He bangs his forehead against a wall. In Rousseau's words, these bumps imprinted on the child's forehead are his best teacher. They engender the need for conscious awareness and this need magically opens up conscious awareness and volition in the use of concepts.

Is it possible that the higher level of concept development which is connected with conscious awareness arises only as a consequence of failure and defeat? Is it actually the case that striking one's head against a wall and the bump that results are the child's only teachers as he moves along this developmental path? Is it possible that the nonadaptiveness and inadequacy of the child's spontaneous thought is the source of the higher forms of abstraction that are characteristic of concepts? If these questions are formulated, it immediately becomes apparent that only a negative answer is possible. Just as we cannot explain the emergence of conscious awareness in terms of the child's need for it, we cannot explain the child's mental development in terms of the bankruptcy and failure of his thought.

The second law Piaget incorporates into his explanation of conscious awareness also requires analysis. The mode of genetic explanation fundamental to this law is extremely widespread. The foundation for its explanation of the later stages in the development of a given process is the principle of the repetition or reproduction of the events or laws characteristic of the earlier stages in the development of the same process. It is this mode of explanation that is used, for example, when the development of the school child's written speech is explained by claiming that it parallels the development of oral speech. Of course, when this explanatory principle is applied, the psychological differences between the two processes are overlooked. This principle implies that the dynamics of the development of one process must repeat or reproduce those of the other. The result is that *the differences between the two processes which are a function of the fact that the later process occurs on a higher level* are obscured by their similarities. The result is that we have a representation of the process of development not as a spiral but as a process that continually moves around in a single circle. However, we are not concerned with the detailed analysis of this explanatory principle in the present context. At this point, our concern is its value as a means of explaining the emergence of conscious awareness. Since Piaget himself recognizes the futility of trying to explain the emergence of conscious awareness on the basis of Claparède's law, we must ask whether the explanatory principle on which Piaget does rely – the law of displacement – has more explanatory power.

The very content of this law makes it apparent that its explanatory value is not much greater than that of the first. In essence, it is a law of repetition or reproduction of the characteristics of previous forms thought in a new developmental domain. Even if we were to assume that this law is correct, it does not answer the critical question. It can only explain why the school child's concepts are not characterized by conscious awareness or volition. The lack of conscious awareness and volition that were present in the logic of the preschooler's action reappears in the school child's thought.

This law cannot, however, help us answer the question that Piaget poses: How is conscious awareness realized? It cannot help us understand the nature and source of the transition from

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revealing the pictures' content in action. The children in the other group were asked to relate the content of the pictures verbally, revealing the structure of meaningful perception. In action, the children reproduced the content of the picture fully. With verbal transmission, however, they simply enumerated the objects.

concepts that are not characterized by conscious awareness to those that are. In this respect, the second law is identical to the first. The first may possibly help to explain how the absence of need leads to the lack of conscious awareness. It cannot explain how the emergence of need produces conscious awareness. The second law can perhaps satisfactorily answer the question of why the concept is not characterized by conscious awareness in the school-age child. It cannot explain the emergence of conscious awareness of concepts. This, however, is precisely the problem we need to answer since development consists of the progressive emergence of conscious awareness of concepts and thought operations.

These two laws do not resolve the problem; they constitute it. It is not that they offer incorrect or inadequate explanations of the development of conscious awareness. The problem is that they offer no explanation. We must attempt to formulate a tentative explanation of this fundamental aspect of the school child's mental development, an aspect that is closely connected with the basic problem of our experimental research.

First, however, we must consider whether Piaget – relying on these two laws – has correctly explained why the school child's concepts are not characterized by conscious awareness. Of course, this question is closely connected with the issue of more direct interest to us, the issue of how conscious awareness is realized. These are two aspects of a single general problem, specifically, the problem of *how the transition from concepts that are not characterized by conscious awareness to those that are occurs.* The very statement of the issue of how conscious awareness is realized depends on how we answer the question of why conscious awareness is absent. If we resolve the first issue on the basis of Piaget's two laws, we must search for the resolution to the second on the same theoretical plane where Piaget sought it. If we reject Piaget's resolution of the first question and succeed even tentatively in identifying a different resolution, our search for the resolution to the second problem will take on an entirely different orientation.

For Piaget, the source of the lack of conscious awareness of concepts in the school child lies in the earlier stages of the child's development when the lack of conscious awareness dominated the child's thought to a much greater extent. By the time the child enters school, one part of his mind is freed from this dominance; another remains under its influence. As we descend the developmental ladder, conscious awareness extends the range of its dominance of the child's thought. In the world of the infant, conscious awareness is absent. Piaget characterizes the infant's consciousness as pure solipsism. In accordance with the degree of the child's development, solipsism gives way to socialized thought without struggle or opposition. This socialized thought is characterized by conscious awareness and has its source in the more powerful, encroaching thought of the adult. Solipsism is displaced by the child's egocentrism, which is a compromise between the child's own thought and the adult thought that he has learned.

Thus, Piaget represents *the lack of conscious awareness* we find in the concepts of the school-age child as *a residual of a dying egocentrism* which preserves its influence in the emerging processes of verbal thought. In this manner, Piaget's explanation of the lack of conscious awareness of concepts incorporates the notion of the child's residual autism as well as that of the inadequate socialization of thought. The question we must address, then, is that of whether the child's lack of conscious awareness of concepts is a direct function of the egocentric character of his thinking.

Given what we know of the mental development of the school-age child, this thesis seems doubtful. Theoretical considerations would certainly cause us to question its validity. Empirical research directly refutes it.

Before moving to a critical analysis of this issue, however, a second issue must be clarified. Specifically, we must consider how the path that leads to conscious awareness of concepts is represented within this framework. As we said, a given explanation of the lack of conscious awareness inevitably leads to single mode of explaining its emergence. Piaget nowhere speaks to this issue directly because it was not a problem for him. However, given his explanation for the lack of conscious awareness of concepts in the school child and his theory as a whole, his conception of the course of development is clear. This is precisely why Piaget did not think it necessary to dwell on the question.

In Piaget's view, conscious awareness is realized through the displacement of the remnants of verbal egocentrism by social or mature thought. Conscious awareness does not arise as a necessary higher stage in concept development. It is *introduced from without.* One mode of action simply supplants the other. Just as a snake throws off his skin to grow another, the child throws off or discards one mode of thinking so that he might learn another. This grasps the essence of Piaget's view of the emergence of conscious awareness. This issue does not require the introduction of any laws. The lack of conscious awareness of concepts is explained. It is a function of the very nature the child's thought. However, conscious awareness of concepts exists outside; it exists in the atmosphere of social thought that surrounds the child. It is learned by the child in completed form when the antagonistic tendencies of his own thinking no longer interfere.

At this point, we can consider both these closely connected problems: (1) the initial lack of conscious awareness of concepts, and (2) the subsequent emergence of conscious awareness of concepts. Piaget's resolution of these problems is inadequate in both theoretical and practical terms. An explanation of the lack of conscious awareness of concepts in the child that relies on the notion that the child is incapable of conscious awareness in any context, an explanation that relies on the notion that the child is egocentric, is negated by the fact that the focal point of development for the school-age child is the emergence of *the higher mental functions, functions which are distinguished precisely by intellectualization and mastery, by conscious awareness and volition.*

For the school-age child, the focal point of development is the transition from lower forms of attention and memory to voluntary attention and logical memory. Elsewhere, we have argued that to the extent we can speak of voluntary attention we can also speak of voluntary memory and that to the extent we speak of logical memory we can also speak of logical attention. This reflects the fact that the intellectualization and the mastery of functions are merely two aspects of one and the same process. We refer to this process as the transition to the higher mental functions. We master a given function to the degree that is intellectualized. The voluntary nature of the activity of a function is the reverse side of its conscious awareness. To say that memory is intellectualized in the school-age child is to say that voluntary remembering emerges. To say that attention in the school-age child becomes voluntary is to say (as Blonskii has correctly noted) that it becomes more and more dependent on thought or intellect.

In the spheres of attention and memory, then, the school child manifests a capacity for conscious awareness and voluntary behavior. Indeed, the emergence of this capacity is the central feature of mental development during the school age. We cannot, therefore, explain the school child's lack of conscious awareness of concepts or the involuntary nature of these concepts in terms of the general incapacity of his thought for conscious awareness and mastery, that is, in terms of his egocentrism.

However, one fact established by Piaget is beyond dispute. The school child is not consciously aware of his own concepts. How do we explain the school-age child's manifestation of a capacity for conscious awareness or mastery of important intellectual functions such as memory and attention while he is incapable of the mastery or conscious awareness of his own thinking? How do we explain the fact that during the school age all the intellectual functions except intellect are intellectualized and become volitional?

To resolve this paradox, we must consider the basic laws of mental development in children of this age. Elsewhere, we have considered the changes in the connections and relationships among functions that occur in the course of the child's mental development. In that context, we were able to demonstrate empirically that the child's mental development consists not so much in the development or maturation of separate functions as in changes in the connections and relationships among these functions. Indeed, the development of each mental function depends on these changes in interfunctional relationships. Consciousness develops as a whole. With each new stage in its development, its internal structure – the system of connections among its parts – changes. Development is not a sum of the changes occurring in each of the separate functions. Rather, the fate of each functional part of consciousness depends on changes in the whole.

Of course, the idea that consciousness is a unified whole with the separate functions existing in insoluble connection with one another is nothing new for psychology. Indeed, it is as old as psychology itself. Nearly all psychologists note that the mental functions act in unbroken connection with one another. Remembering presupposes the activity of attention, perception, and the attribution of meaning. Perception requires attention, recognition (or memory), and understanding. In both traditional and contemporary psychology, however, this concept of the functional unity of consciousness – of the insoluble connections among the various aspects of its activity – has consistently remained on the periphery. Its most important implications have not been recognized. Moreover, psychology drew inferences from this concept that seem to be in direct opposition to those that should flow from it. Having established the interdependency of functions (i.e., having established the unity of the activity of conscious awareness) psychology continued to study the activity of the separate functions, ignoring their relationships. It continued to treat consciousness as a collection of functional parts. This tendency of general psychology was transferred to genetic psychology. As a consequence, the development of the child's consciousness was represented as the sum of the changes occurring in the separate functions. Even here, the primacy of the functional parts over consciousness as a whole remained the supreme dogma. To understand how this occurred, we must consider the implicit postulates that provided the foundation for this traditional conception of the interconnection of functions and the unity of consciousness.

Traditional psychology taught that the mental functions always act in unity with one another (perception with memory and attention, etc.) and it is in this that consciousness is unified. However, it implicitly supplemented this idea with three postulates: (1) that these connections among functions are constant, unchanging, and uninfluenced by development; (2) that these connections operate consistently and identically in the activity of each function and that they can, therefore, be removed from the analytic frame (i.e., they do not have to be taken into account in studies of the separate functions); and (3) that these connections are inessential and that the development of consciousness must be understood in terms of the development of its functional parts; though the functions are interconnected, the stability of their connections gives them an entirely autonomous nature, an independence in their development and change. The liberation of psychology from these postulates represents the liberation of psychological thought from the functional forms of analysis that imprison it.

As we have suggested, all three of these postulates are false. These interfunctional connections and relationships are neither constant nor inessential. They cannot be placed outside the analytic frame within which psychological investigations are carried out. Change in these interfunctional connections, – *change in the functional structure of consciousness – is the main and central content of the entire process of mental development.* That which served as a postulate for traditional psychology must become psychology's central problem. Traditional psychology proceeded from the postulate that the mental functions are connected and did not pursue the question further. Neither the nature of these interfunctional connections nor their development became an object of investigation. For the new psychology, this change in interfunctional connections and relationships becomes the central problem. If we fail to resolve this problem, we *will* not be able to understand the changes we observe in the isolated functions. This conception of developmental change in the structure of consciousness must be considered if we are to resolve the question that interests us in the present context, the question of how the school-age child becomes consciously aware of attention and memory, and gains voluntary control over them while his intellect remains outside conscious awareness.

It is a general law of development that conscious awareness and mastery characterize only the higher stages of the development of a given function. It arises comparatively late and must be preceded by a stage where conscious awareness is absent, a stage where there is no volition in the application of a given form of conscious activity. For conscious awareness of a function to be achieved, the individual must first possess what he is to become consciously aware of. If we are to master something, we must have at our disposal what is to be subordinated to our will.

The first stage in the development of consciousness in infancy is characterized by a lack of differentiation in the separate functions. This stage is followed by two others. These are the stage of early childhood and the stage of the preschool age. Early childhood is characterized by the development and differentiation of perception. In this stage, perception is the dominating function of activity and of the development of consciousness as a whole. In the preschool age, the development of memory is dominant. Thus, by the time the transition to school age occurs, perception and memory are comparatively developed, creating a basic prerequisite for mental development during this stage.

If we consider the fact that attention is a function of the structuring that is perceived and represented in memory, it is apparent that when the child reaches school age he has comparatively mature forms of attention and memory at his disposal. He has what he must now gain conscious awareness of and master. This is why conscious awareness and voluntary control are characteristics of memory and attention that advance to the forefront during this phase of the child's development.

This makes it equally clear why the school child's concepts remain involuntary and outside conscious awareness. To become consciously aware of something and master it you must first have it at your disposal. However, concepts, or, more properly, preconcepts (we prefer this designation for these concepts of the school child, since they have not yet attained the higher degree of development), emerge for the first time in the school-age child. They mature only during this period. Prior to this stage, the child thinks in general representations or complexes (a term we have used elsewhere to refer to the structure of generalizations that dominates the preschool period). Since preconcepts emerge only during the school age, it would be odd if the school child attained conscious awareness or mastery of them. This would mean that consciousness is not only capable of becoming consciously aware of its functions (i.e., of mastering them) but of creating them from nothing before they develop.

These are the theoretical considerations that cause us to reject Piaget's explanation of the lack of conscious awareness of concepts. At this point, we must turn to the research data. We must come to understand the nature of conscious awareness to be able to clarify the manner that conscious awareness of attention and memory emerges. We must do this if we are to be able to specify the source of this lack of conscious awareness of concepts, the path by which the child ultimately attains this conscious awareness, and the sense in which conscious awareness and mastery are two aspects of the same process.

Research tells us that conscious awareness is a very special process. We will attempt to identify its general features. At the outset, we must pose the first and the most basic question: What does it mean to become "consciously aware." This phrase has two meanings, and serious confusion has arisen because Claparède and Piaget have confused them. Specifically, Claparède and Piaget have confused Freud's terminology and the terminology more characteristic of general psychology. When Piaget speaks of a lack of conscious awareness in the child's thought, he does not mean to imply that the child is not conscious of what is occurring in his consciousness; he does not mean to imply that the child's thinking is unconscious. Piaget assumes that consciousness plays a role in the child's thought, but not to the end. In the beginning, in the infant's solipsism, we do have unconscious thought. Ultimately, conscious socialized thought is attained. In the interim, we have several stages that are represented by Piaget in terms of the gradual dying out of egocentrism and the gradual growth of social forms of thinking. Each of these middle stages represents a certain compromise between the infant's unconscious autistic thought and the adult's social conscious thought. What then, does it mean to say that the thought of the school child lacks conscious awareness? For Piaget, it means that the child's egocentrism is accompanied by a certain degree of unconsciousness. It means that thought is characterized by conscious awareness but not consistently. Thought contains elements of both the conscious and the unconscious. Piaget himself recognizes that one is on slippery ground with the concept of "unconscious reasoning." If we view the development of consciousness as the gradual transition from the unconscious (in Freud's sense) to full consciousness, this representation of the process is correct. However, Freud's research established that the unconscious – which is carved out from consciousness – emerges comparatively late. In a certain sense, it is a product of the development and differentiation of consciousness itself. Therefore, there is a great difference between the concepts of "unconscious" and "lack of conscious awareness." Lack of conscious awareness is not simply part of the conscious or unconscious. It does not designate a level of consciousness. It designates a different process in the activity of consciousness. I tie a knot. I do it consciously. I cannot, however, say precisely how I have done it. My action, which is conscious, turns out to be lacking in conscious awareness because my attention is directed toward the act of tying, not on how I carry out that act. Consciousness always represents some piece of reality. The object of my consciousness in this example is the tying of the knot, that is, the knot and what I do with it. However, the actions that I carry out in tying the knot – what I am doing – is not the object of my consciousness. However, it can become the object of consciousness when there is conscious awareness. Conscious awareness is an act of consciousness whose object is the activity of consciousness itself.*

Piaget's research has shown that introspection begins to develop significantly only in the school age. Further research has shown that as introspection develops something occurs that is analogous to what occurs in the development of external perception and observation during the transition from infancy to early childhood. It is well known that the most important change in external perception during this period is that the child makes the transition from nonverbal and therefore nonmeaningful perception to meaningful and verbal object perception. The same can be said of introspection at the beginning of the school age. The child makes the transition from nonverbal to verbal introspection. He develops internal meaningful perception of his own mental processes. However, whether it is external or internal, meaningful perception is generalized or abstracted perception. Consequently, *the transition to verbal introspection represents the initial generalization or abstraction of internal mental forms of activity.* This transition to a new type of internal perception represents a transition to a higher form of internal mental activity. To perceive something in a different way means to acquire new potentials for acting with respect to it. At the chess board, to see differently is to play differently. By generalizing the process of activity itself, I acquire the potential for new relationships with it. To speak crudely, it is as if this process has been isolated from the general activity of consciousness. I am conscious of the fact that I remember. I make my own remembering the object of consciousness. An isolation arises here. In a certain sense, any generalization or abstraction isolates its object. This is why conscious awareness – understood as generalization – leads directly to mastery.

Thus, the foundation of conscious awareness is the generalization or abstraction of the mental processes, which leads to their mastery. Instruction has a decisive role in this process. Scientific concepts have a unique relationship to the object. This relationship is mediated through other concepts that themselves have an internal hierarchical system of interrelationships. It is apparently in this domain of the scientific concept that conscious awareness of concepts or the generalization and mastery of concepts emerges for the first time. And once a new structure of generalization has arisen in one sphere of thought, it can – like any structure – be transferred without training to all remaining domains of concepts and thought. Thus, *conscious awareness enters through the gate opened up by the scientific concept.*

Two aspects of Piaget's theory are worth noting in this context. The very nature of spontaneous concepts is defined by the fact that they lack conscious awareness. Children have the capacity to operate spontaneously with spontaneous concepts but lack the capacity for conscious awareness of them. We have seen how this is true of the child's concept "because." The spontaneous concept is characterized by a lack conscious awareness. Attention is always directed toward the object that the spontaneous concept represents rather than on the act of thought that grasps that object. Nowhere in Piaget's work do we find the thought that "spontaneous" is a synonym for "lack of conscious awareness" when we are referring to concepts. This is why Piaget limits the history of the child's thought to the development of spontaneous concepts. This is also why he fails to understand how conscious awareness of concepts can emerge in the child's spontaneous thought other than from the outside.

While conscious awareness is absent in the spontaneous concept, however, it is a basic characteristic of scientific concepts. The second of the two aspects of Piaget's theory that we said were worth noting in this context is related to this fact. All Piaget's research leads to the idea that *the decisive difference between spontaneous and nonspontaneous concepts, and the difference between spontaneous and scientific concepts in particular, is that spontaneous concepts are given outside any system.* Following Piaget's rule, if we want to find the path from the child's nonspontaneous concept to the spontaneous representation that is hidden behind it, we must free that concept from any trace of a system. Isolating the concept from the system in

* In the preschool age, the child is asked: "Do you know what your name is?," and the child answers: "Kolya." He is not consciously aware of the fact that the focus of the question is not what he is called but *whether or not he knows* his name. He knows his name, but is not consciously aware of his capacity in this respect.

which it is included and in which it is connected with all other concepts is the ultimate methodology recommended by Piaget for the liberation of the mental orientation of the child from his nonspontaneous concepts. Piaget demonstrated in practice that this desystematization of the child's concepts is the best means for obtaining the kinds of answers from children that fill his books. It is obvious that the presence of a concept system is significant for the nature and structure of each individual concept. The concept becomes something different – a complete change in its psychological nature occurs – as soon as it is taken in isolated form. Its nature changes as soon as it is torn from the system of concepts and placed in a simpler and more immediate relationship to the object.

On this basis alone, we can state the core of our hypothesis (we will discuss this hypothesis in more detail later in summarizing our experiments): *Only within a system can the concept acquire conscious awareness and a voluntary nature. Conscious awareness and the presence of a system are synonyms when we are speaking of concepts, just as spontaneity, lack of conscious awareness, and the absence of a system are three different words for designating the nature of the child's concept.*

This follows directly from what we said above. If conscious awareness means generalization, it is obvious that generalization, in turn, means nothing other than the formation of a higher concept (*Oberbegriff – ubergeordneter Begriff*) in a system of generalization that includes the given concept as a particular case. However, if a higher concept arises above the given concept, there must be several subordinate concepts that include it. Moreover, the relationships of these other subordinate concepts to the given concept must be defined by the system created by the higher concept. If this were not so, the higher concept would not be higher than the given concept. This higher concept presupposes both a hierarchical system and concepts subordinate and systematically related to the given concept. Thus, the generalization of the concept leads to its localization within a definite system of relationships of generality. These relationships are the foundation and the most natural and important connections among concepts. Thus, at one and the same time, generalization implies the conscious awareness and the systematization of concepts.

What Piaget himself has to say makes it clear that a system is significant for the internal nature of the child's concepts. Piaget notes that the child manifests little systematicity, connectedness, or deduction in his thought. The need to avoid contradiction is foreign to him. He places assertions alongside one another rather than synthesizing them. He is satisfied with synthetic schemes rather than submitting problems to analysis. In other words, the child's thought is closer to a collection of theses flowing simultaneously from actions and dreams than to adult thought, thought which is conscious of itself and has a system.

We will try to show somewhat later that all the empirical laws and regularities established by Piaget in connection with the child's logic apply only within the domain of the child's unsystematized thought. They apply only to concepts taken outside any system. This is the common cause of all the phenomena Piaget describes. To be sensitive to contradiction, one must do more than simply place judgments in a sequence. These judgments must be logically synthesized. The capacity for deduction is possible only within a definite system of relationships among concepts. The phenomena described by Piaget follow from the absence of such as system as inevitably as a shot follows pressure on the trigger of a gun.

However, only one issue is of interest to us at this point. We are interested in demonstrating that the system – and the conscious awareness that is associated with it – is not brought into the domain of the child's concepts from without; it does not simply replace the child's own mode of forming and using concepts. Rather, the system itself presupposes a rich and mature form of concept in the child. This form of concept is necessary so that it may become the object of conscious awareness and systematization. We are interested in demonstrating that the first system – a system that emerges in the sphere of scientific concepts – is transferred structurally to the domain of everyday concepts, restructuring the everyday concept and changing its internal nature from above. The dependence of scientific concepts on spontaneous concepts and their influence on them stems from the unique relationship that exists between the scientific concept and its object. As we said, this relationship is characterized by the fact that it *is mediated through other concepts. Consequently, in its relationship to the object, the scientific* *concept includes a relationship to another concept,* that is, it includes the most basic element of a concept system.

Thus, because it is scientific in nature, the scientific concept assumes some position within a system of concepts. This system defines the relationship of scientific concepts to other concepts, The essence of any scientific concept was defined in a profound manner by Marx:

> If the form in which a thing is manifested and its essence were in direct correspondence, science would be unnecessary (Marx and Engels, *Collected Works,* v. 25, chap. 2, p. 384).

In this statement, Marx touches on the essence of the scientific concept. The scientific concept would be superfluous if it reflected the object in its external manifestation as an empirical concept. The scientific concept necessarily presupposes a different relationship to the object, one which is possible only for a concept. However, as we have shown above, the relationship to the object that is characteristic of the scientific concept presupposes the presence of relationships of concepts to one another. It presupposes a system of concepts. From this vantage point, we can say that the concept must be seen as part of the entire system of the relationships of generality that define its level of generality, just as a stitch must be seen as part of the fibers that tie it to the common fabric. At the same time, it becomes apparent that the distinction between spontaneous and nonspontaneous concepts in the child coincides logically with the distinction between empirical and scientific concepts.

We will return to this problem again. In this context, we will limit ourselves to a single illustration. It is well known that more general concepts arise in the child earlier than more specific ones. Thus, the child usually learns the word "flower" earlier than the word "rose." In this context, however, the concept of "flower" is not actually more general that the concept of "rose"; it is merely broader, When the child has mastered only a single concept, its relationship to the object is different than it is after he masters a second. However, even after he masters a second concept, there is a long period during which the concept of "flower" continues to stand alongside, rather than above, the concept of "rose." The former does not include the latter. The narrower concept is not subordinated. Rather, the broader concept acts as a substitute for the narrower one. It stands alongside it in a single series. When the concept of "flower" is generalized, the relationship between it and the concept of "rose" changes as well. Indeed, there is a change in its relationship with all subordinate concepts. This marks the emergence a concept system.

We return again, then, to the point where we began our discussion, that is, to the initial question posed by Piaget: How does conscious reflection arise? We have attempted to clarify why the school child's concept lacks conscious awareness and how it acquires conscious awareness and a volitional nature. We found the source of the lack of conscious awareness of concepts not in egocentrism but in the absence of system in the child's spontaneous concepts. This is why spontaneous concepts lack conscious awareness and volitional control. We found that conscious awareness is realized through the formation of such a system, a system which is based on specific relations of generality among concepts. We also found that conscious awareness of concepts leads to their volitional control. By its nature, the scientific concept presupposes a system. Scientific concepts are the gate through which conscious awareness enters the domain of the child's concepts.

It has become clear to us why Piaget's theory is powerless to answer the question of how conscious awareness is realized. Piaget's theory bypasses the scientific concept. All that is reflected in his theory are the laws and regularities characteristic of concepts as they exist outside any system. In Piaget's view, the child's concept can become the object of psychological investigation only when any trace of systematicity is removed from it. This makes it impossible to explain how conscious awareness is realized. As a consequence, Piaget's theory is relevant only within the narrow limits of nonsystemic concepts. To resolve the problem that Piaget posed, the *system* that Piaget tossed out along the roadside must become the focus of our work.

3

The previous sections illustrate the extraordinary importance of scientific concepts for the development of the child's thinking. It is in this domain that thinking first crosses the threshold that separates preconcepts from true concepts. This is a critical point in the development of the child's concepts and is the focus of our research. We have seen, however, that this issue is merely one aspect of a more general problem, a problem that we will consider briefly in this section.

In essence, *the problem of nonspontaneous concepts – of scientific concepts in particular – is the problem of instruction and development.* Spontaneous concepts create the potential for the emergence of nonspontaneous concepts in the process of instruction. Instruction is the source of the development of this new type of concept. Thus, the problem of spontaneous and nonspontaneous concepts is a special case of the more general problem of instruction and development. Isolated from this more general context, the problem of spontaneous and nonspontaneous concepts cannot be correctly stated. At the same time, a comparative analysis of the development of scientific and everyday concepts provides an empirical foundation for addressing the more general problem of the relationship between instruction and development. It provides data on a limited and specific manifestation of the relationship between instruction and development that allow us to evaluate our general conception of this relationship. In this sense, our working hypothesis and the experimental research that it has produced have implications that extend beyond the boundaries of the narrow issue of concept development to the more general problem of the relationship between instruction and development.

We will not outline the problem of instruction and development in any extended form nor attempt even a tentative resolution of it in the present context. We have addressed this issue elsewhere. However, since this problem constitutes the framework for the focus of the present investigation and is in a certain sense its object, several basic issues must be addressed. Without attempting to outline all the attempts to resolve this question that have emerged in the history of our science, we will consider three that are currently of significance for Soviet psychology.

The first perspective on the relationship between instruction and development that we will consider is probably the most widely accepted. It is based on the assumption that *instruction and development are two distinct and essentially independent processes*. Within this framework, the child's development is conceptualized as a process that is subordinate to natural laws. The child develops in accordance with a maturational model. Instruction is understood as an external utilization of the potentials that emerge in development. The typical expression of this perspective in the analysis of the child's mental development is the attempt to isolate that which is a function of development from that which is a function of instruction. The fact that not a single investigator has succeeded in this task is generally attributed to limitations in research method. The attempt is made to compensate for these inadequacies of method through the power of abstraction. It is on this basis that the child's intellectual characteristics are differentiated into those which: (1) arise from development, and (2) owe their origin to instruction. It is generally assumed that a normal and high level of development can be attained without instruction. It is assumed that children will develop all the higher forms of thinking attainable by man without school instruction, that they *will* manifest all the intellectual potentials manifested by children who have received school instruction.

This theory more often takes a somewhat different form which begins with the recognition of an indisputable dependency that exists between instruction and development. Development creates the potentials while instruction realizes them. The relationship between these processes is represented in much the same way that preformism represents the relationship between dispositions and development. Dispositions contain the potentials that are realized in development. Here again, we find the notion that it is development itself that creates potentials that are then realized in instruction. Instruction is *constructed over a framework provided by maturation*. As it is conceptualized within this framework, the relationship between instruction and development can be compared to the relationship between production and consumption.

Instruction consumes the products of development. It uses them and applies them to life. There is a one-sided dependency between development and instruction. Instruction depends on development while development is not influenced by instruction.

In accordance with this theory, then, it is sufficient to recognize that a certain level of maturation in certain mental functions is a prerequisite for instruction. It is impossible to teach a one year old to read or a three year old to write. Consequently, analysis of the mental processes involved in instruction is reduced to the clarification of the types of functions and the degree of maturation necessary for instruction to occur. Instruction in writing can begin if the child's memory has reached a level of development that makes it possible for him to remember the letters of the alphabet, if his attention has developed to the extent that it can be maintained on matters of little interest to him for a given period of time, and if his thinking has matured to the point that makes it possible for him understand the relationships between sounds and the written signs that symbolize them.

Though this perspective recognizes a one-sided dependency of instruction on development, this dependency is conceptualized in purely external terms. Any internal interpenetration or interconnection between these processes is excluded. Though it approximates reality more closely than other members of this class, this is why we group this theory with those which begin with the postulate of the independence of instruction and development. To the extent that this is the case, the kernel of truth that is contained in this theory becomes lost in the mass of falsehoods that lie at the core of this entire group of theories.

Fundamental to this conception of the independence of the processes of instruction and development is a notion that has received little attention until recently. This notion concerns the issue of sequence as it relates to the processes of instruction and development. This theory resolves this basic issue of sequence with its assumption that *instruction rides on the tail of development,* that development must complete certain cycles or stages or bear certain fruits before instruction is possible.

Of course, this notion contains a certain element of truth. There are certain developmental prerequisites that must be met before successful instruction can begin. New forms of instruction are without question dependent on the completion of certain cycles in the child's development. There is a lower threshold prior to which instruction is not possible. However, this dependency is not the most important characteristic of the relationship between instruction and development, It is of secondary importance. The attempt to represent it as the central issue, or, indeed, as the whole issue, leads to several misunderstandings and mistakes. Specifically, it has been assumed that instruction reaps the fruit of the child's maturation while it has no significance for development. The child's memory, attention, and thinking develop to the level where the child can be instructed in writing and arithmetic. In response to the question of whether instructing the child in writing or arithmetic affects his memory, attention, or thinking, however, traditional psychology suggested that these processes always change when they are exercised whatever form that exercise may take. The course of development itself, however, does not change as a consequence of instruction. Nothing new emerges in the child's mental development when we teach him to write. The child we have when we finish is identical to the one we had when we began, with the sole exception that he is literate.

This perspective completely dominated traditional educational psychology, including Meumann's well-known work. Piaget pushes this perspective to its logical limit. He assumes that *the child's thinking inherently passes through certain stages and phases of whether or not he receives instruction.* That the child receives instruction has no direct impact on the developmental process. It is not in any way unified with the processes of the child's own thinking. It is external to them. The teacher must view the autonomous characteristics of the child's thinking as a lower threshold that determines the possibilities which exist for instruction. When the child develops new potentials for thinking, new types of instruction will be possible. For Piaget, the index of the level of the child's thinking is to be found not in what the child knows or what he is able to learn but in his capacity for thinking in a domain where he has no knowledge. Here, instruction and development or knowledge and thinking are placed in the sharpest possible opposition. Proceeding from this thesis, Piaget presents the child with problems from domains where his lack of knowledge can be assumed. The underlying premise is that if we ask the child about things that he may know, the results we receive may represent not the child's thinking but his knowledge. Spontaneous concepts which arise in the child's development are therefore considered the proper indices of his thinking. Scientific concepts, which have their source in instruction, cannot be used as indices in this way. In this opposition of instruction and development we are brought once again to Piaget's basic premise: Scientific concepts do not emerge from spontaneous concepts or transform them; they force them out and replace them.

The *second* perspective on this issue is diametrically opposed to that we have just outlined. Here, *instruction and development are merged. The two processes are identified.* This perspective first developed in the educational psychology of William James. James attempted to demonstrate that the formation of associations and habits lies at the foundation of both instruction and mental development. Of course, when these processes are identified, there is no foundation on which to differentiate them. This thesis inevitably leads to the declaration that instruction is development, that instruction and development are synonymous.

The foundation for this theory is provided by associationism, the concept that provided the basis for the whole of traditional psychology. The rebirth of this concept in educational psychology is now represented by the "last of the Mohicans," that is, by Thorndike and the reflexologists who have translated the concept of association into the language of physiology. This theory represents the development of the child's intellect as a sequential and gradual accumulation of conditioned reflexes. It represents instruction in precisely the same way. The result is the conception that instruction and development are synonymous. The child develops to the extent that he is taught. Development is instruction; instruction is development. Rather than untying the knot which represents the relationship between instruction and development, the first theory cuts it. This theory recognizes no relationship between the two processes. This second theory eliminates or avoids this knot entirely. Since they are one and the same thing, the issue of the relationship between instruction and development or the nature of this relationship cannot arise.

There is a *third* group of theories that have been particularly influential in European child psychology. These theories attempt to rise above the extremes inherent in the two perspectives outlined above, they attempt to sail between the Scylla and Charybdis. The result, however, is typical of theories that attempt to occupy a middle ground between two extreme perspectives. This third group of theories fails to gain a position *above* the other two and assumes a position *between* them. To the extent that it overcomes the extremes of one perspective, it assumes the extremes of the other. It rises above the first false theory by yielding to some extent to a second which is equally false. It overcomes the extremes of the second by yielding to the first. This type of theory has an inherent duality. By occupying a position between two contradictory perspectives, it leads to a certain *unification of these points of view.*

This type of position is taken by Koffka. From the outset, he makes it clear that *development always has a dual character* and that it is necessary to distinguish development as maturation and development as instruction. Of course, this implies that we must recognize each of the two extreme positions in turn, that we must unify them. The first perspective is based on the concept that the processes of development and instruction are independent of one another. Koffka reiterates this position, arguing that development is maturation which has it own internal laws independent of instruction. The second perspective is based on the concept that instruction is development. Koffka literally reiterates this position.

If the first theory cuts the knot rather than untying it and the second eliminates or avoids it entirely, Koffka's theory tightens the knot further. Koffka's position not only fails to resolve the issue but confuses it. It lifts itself upward to the level of the principle which underlies the mistake that is common to both the first two groups of theories, to the level of the principle that produced their shared misstatement of the problem. Koffka's theory proceeds from a fundamentally dualistic understanding of development. Development is not represented as a unified process. There is development as maturation and development as instruction. In three respects, however, Koffka's thinking moves us beyond the other two theories.

1. The unification of these two contradictory perspectives requires the assumption that there is a mutual dependency between the two types of development, that is, between maturation and instruction. This assumption is included within Koffka's theory. Koffka establishes that maturation depends on the functioning of the organ and consequently on the development of its function in instruction. In turn, maturation moves instruction forward by opening up new potentials. Thus, instruction has some influence on maturation and maturation has some influence on instruction. This "some" is, however, left entirely uninterpreted in Koffka's theory. His theory does not go beyond a general recognition of this mutual influence. Rather than

making it an object of investigation, Koffka is satisfied with merely postulating the mutual dependency between these two processes.

2. This third theory also leads to a new understanding of instruction. For Thorndike, instruction is a meaningless mechanical process which produces its results through trial and error. For structural psychology, *instruction represents the emergence of new structures and the development of old ones.* Since the process of structural development is recognized as primary – recognized as an independent prerequisite for instruction – this theory suggests from the outset that instruction has a meaningful structural character. The fundamental characteristic of any structure is that it is independent of the elements that form it, of the concrete material that provides its basis. Its fundamental characteristic is its potential for being transferred to other material. Thus, if the child forms a structure or learns an operation in the course of instruction, he has acquired more than the potential of reproducing that structure or operation.

He has acquired much greater potentials that extend to the domains of other structures. We have given the child a penny's worth of instruction and the consequence has been a dollar's worth of development. A single step in instruction can represent a hundred steps in development. This constitutes the most positive feature of this new theory. This theory teaches us to see the difference between instruction which provides only what it provides directly and instruction which provides more. Learning to type may not change the general structure of consciousness. Learning a new method of thinking or a new type of structure produces a great deal more than the capacity to perform the narrow activity that was the object of instruction.

3. The third positive feature of this new theory is a direct function of the second and is related to the issue of the sequence of instruction and development. This issue fundamentally distinguishes this third theory from the first two.

We have seen that the first theory takes the position that instruction follows on the tail of development. First there is development and only then instruction. The second theory cannot even state this question because the two processes are identified or merged with one another. In practical terms, however, the second theory proceeds from the presupposition that instruction and development proceed synchronically as two parallel processes, that development follows instruction step for step just as a shadow follows the object which casts it. To the extent that it unites these two perspectives and differentiates maturation and instruction, the third theory preserves both these representations of the temporal connections between instruction and development. However, it supplements them with something fundamentally new which stems from its conception of instruction as a structural and meaningful process. We have seen that within this framework instruction can give more to development than is present in its direct results. Applied to one point in the child's thought, it alters and restructures many others. Its developmental consequences may be distal as well as proximal. *Instruction is not limited to trailing after development or moving stride for stride along with it. It can move ahead of development, pushing it further and eliciting new formations.* This insight has immeasurable importance and value. It atones for many of the inadequacies of Koffka's eclectic theory, a theory which accepts all three of the logically conceivable temporal relationships between instruction and development as equally plausible and significant. In spite of their differences, the first and second theories lead to the conclusion that instruction changes nothing in development. Thus, this third theory leads to an entirely new problem, a problem that is extremely important for the hypothesis that we are developing.

Though in many respects entirely new, this problem also represents a return to a very old issue in psychology and education, an issue that has almost been forgotten. This return does not represent the rebirth of the conceptions associated with the original expression of the problem, conceptions whose inadequacy has long since been demonstrated. However, as is frequently the case in the history of scientific thought, the reanalysis of a theory from the new perspectives which science has achieved leads to the restoration of several correct positions that were found not only in the older theory that is being reanalyzed but in theories that preceded it.

We are referring here to the theory of formal discipline, a theory usually associated with the name of Herbart. Fundamental to the concept of formal discipline is the notion that there are educational subjects which provide something more than the knowledge and skills that constitute the subject itself. These subjects contribute to the development of the child's general mental capacities. Proponents of this theory distinguished educational subjects in terms of their relative significance as formal disciplines. Though itself progressive, this perspective led educational practice to reactionary forms of teaching, the most direct instantiation of which were the German and Russian classical gymnasiums. In the gymnasium, a great deal of attention was focused on the study of the Latin and Greek languages. This was done not because it was thought to be important for life, but because it was thought that the study of these subjects facilitated the child's general mental development. In the *Realschule,* this same significance was attributed to the teaching of mathematics. Just as ancient languages were thought to provide for the development of the mental capacities required in the humanitarian sciences, mathematics was thought to provide for the development of the mental capacities needed in the practical [scientific and technical] disciplines.

The total demise of the theory of formal discipline was partially a function of the undeveloped state of the theory. The primary factor in its demise, however, was its failure to correspond with the practical tasks of the new bourgeois pedagogy. It was Thorndike who emerged as the major ideologist here. In a series of studies, he attempted to show that the concept of formal discipline was a myth or legend, that instruction does not have any long term influences on development. In this research, Thorndike completely rejected the concept that there is any dependency between instruction and development. The theory of formal discipline had a correct premonition of this dependency but depicted it largely in caricature. Thorndike's position, however, is convincing only to the extent that it deals with the caricatured exaggerations and distortions of this dependency that were developed within the theory of formal discipline. He does not even address the core of the idea, much less destroy it.

Thorndike's conclusions are not convincing primarily because he failed to overcome the false statement of the problem that is contained in the teachings of Herbart's followers. He attempts to refute these ideas by assuming the same position and using the same tools they did. The result is that he refutes not the ideas that lie at the core of this old teaching but only those which constitute the husk that covers it.

In theoretical terms, Thorndike approaches the problem of formal discipline within a framework which assumes that everything in instruction influences everything else. Thorndike raises the question of whether studying the multiplication tables will influence the capacities to chose a mate or understand anecdotes. In answering this kind of question in the negative, Thorndike demonstrates only what we knew from the outset. In neither instruction nor development does everything influence everything else. Influences cannot have a universal range. They cannot link points of instruction and development that have nothing of a mental nature in common. He is absolutely wrong, however, when he extends this perfectly correct thesis and concludes that nothing influences anything. Thorndike merely demonstrated that instruction which influences functions that have nothing in common with the functions that underlie other forms of activity or with the functions of thinking will not have any influence on these other forms of activity. This thesis is beyond dispute. It does not, however, clarify the question of whether instruction might have some influence on functions whose mental natures are similar (i.e., either identical or closely related). Thorndike has not resolved the question of whether instruction can facilitate the development of a certain system of functions or the study of subjects that depend on related mental processes. Thorndike's rejection of the concept of formal discipline is valid only where we are dealing with functions that are combined in a meaningless way.

Thus, Thorndike's conclusions are valid only if we are concerned with meaningless combinations of functions. On what basis does he extend these conclusions to the child's instruction and development as a whole? Why does his finding that everything does not influence everything convince him that nothing influences anything? The answer to these questions lies in the general theoretical conception that underlies all Thorndike's work. In accordance with this conception, there are no combinations in the activity of consciousness other than meaningless ones. Within this framework, all instruction and development are reduced to the mechanical formation of associative connections. That is, all the activities of consciousness are connected in a single manner. The learning of the multiplication tables is connected with the understanding of anecdotes in the same way that the formation of algebraic concepts is connected with the understanding of the laws of physics. We know, however, that this is not the case. In the activity of consciousness, structured and meaningful connections and relations dominate. The presence of meaningless connections is more the exception than the rule. This view is fundamental to contemporary psychology. If we accept it, all the thunder and lightning that Thorndike attempts to bring down on the teaching of formal disciple strikes his own theory. Thus, though he does not recognize it, Koffka must to some degree return to the concept of formal discipline. Koffka represents structural psychology, and structural psychology rejects the very core of the associative conception of the child's instruction and mental development.

Even Koffka, however, overlooked a second mistake in Thorndike's critique of the theory of formal discipline. In his attempt to refute Herbart's conception, Thorndike resorted to experimentation on extremely narrow, specialized, and, therefore, elementary functions. He provided subjects with practice in discriminating the lengths of line segments and then studied how this form of instruction influenced their capacity to discriminate the size of angles. Of course, no influence was found. This was a function of two factors. First, Thorndike did not teach his subjects material of the type typical of school instruction. No one has ever argued that teaching someone to ride a bicycle, to swim, or play golf (forms of activity that are much more complex than the discrimination of the magnitude of angles) has any significant influence on the general development of the child's mind. Such an argument has been made only with respect to the study of subjects such as arithmetic or the child's native language, only with respect to complex subjects that are linked to the entire system of mental functions. That the discrimination of line lengths has no direct influence on the discrimination of angles provides no basis for the assumption that the study of the native language – and the general development of the meaningful aspect of speech that is associated with it – is not linked in some way to the study of arithmetic. Thorndike has demonstrated only that there are two kinds of instruction. One is epitomized by the formation of specialized, narrow skills. This form of instruction is often encountered in the professional adult instruction. The other form of instruction is typical of childhood and incorporates whole complexes of mental functions. It leads to the development of entire domains of the child's thinking. This form of instruction clearly influences similar, related, or even identical mental processes. For the first form of instruction, formal discipline is more the exception than the rule. It is a fundamental law of the second form of instruction.

Moreover, as we have seen, the activity that Thorndike used in his experiments is associated with what is structurally among the lowest, most elementary, and simplest functions. In contrast, school instruction is associated with the higher mental functions. Their complex structure distinguishes these mental functions from those studied by Thorndike. More importantly, however, they are distinguished by the fact that they are entirely new formations and by the fact that they are complex functional systems. Given what we know of the higher mental functions, it is apparent that the potential for formal discipline in the domain of the higher processes which arise in the course of the child's cultural development is fundamentally different from its potential in the domain of elementary processes. The homogeneity of the structure of the higher mental functions and the unity of their origin convinces us of this. We have noted that all the higher functions have a homogeneous basis. They become higher functions because the subject attains conscious awareness and mastery of them. As we said earlier, logical memory can be called voluntary memory just as voluntary attention can be called logical attention. We would add here that both these functions can be called abstract as opposed to concrete, paralleling the way we generally distinguish abstract and concrete forms of thought. Thorndike's conception, however, rejects the notion of a qualitative difference between the higher and lower processes. It is the assumption that these processes are identical in nature that convinces Thorndike that he is justified in using studies of instruction that deal exclusively with the elementary processes in his attempt to resolve the question of formal discipline in the domain of school instruction.

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Having prepared the necessary theoretical foundation and analyzed the question from a critical perspective, we can now attempt to outline our own perspective on it. We will rely on four groups of studies that lead us to a unified conception of the problem of instruction and development. Basic to our approach is the concept that instruction and development are neither two entirely independent processes nor a single process. In our view, they are two processes with complex interrelationships. We conducted a series of studies to explore these relationships and these studies provide the empirical foundation for our hypothesis.

As we said, this research is unified in its concern with the general problem of the relationship between instruction and development. Its basic task was to explore the complex relationships between instruction and development by focusing on the work that the child does in school, that is, by focusing on reading and writing, grammar, arithmetic, the natural sciences, and the social sciences. A variety of specific issues were explored. We looked at the child's mastery of the decimal system in association with the development of the number concept, at the development of conscious awareness of mathematical operations in solving problems, and at the construction and resolution of problems by primary school children. This research increased our understanding of the development of oral and written speech in the first school age, helped us to identify stages in the development of the understanding of transferred word meaning, provided data on the influence that the learning of grammatical structures has on the course of mental development, and clarified the relationship between the nature of the social and the natural sciences in school. Thus, some aspect of the general issue of the relationship between instruction and development was addressed in each of these studies.

The most important issues that we were able to address through this research concerned: (1) the maturity of specific mental functions when instruction begins; (2) the influence of instruction on their development, the temporal relationship between instruction and development, and; (3) the nature and significance of instruction as a formal discipline.*

1. The first series of studies dealt with the issue of the maturity of the mental functions that provide the foundation for instruction in basic school subjects such as reading, writing, arithmetic, and natural science. Though the first group of theories discussed above maintain that these functions must mature before instruction can begin, this first series of studies consistently indicated that they do not, even though instruction may be proceeding smoothly. We will clarify this point using the example of written speech.

Why is written speech so difficult for the school child? Why, at several stages, is there a difference of six to eight years in the speech age for written and oral speech? The most common explanation for this is based on the assumption that because written speech is a new function it must repeat the basic developmental stages that oral speech has already passed through. Thus, the eight year old's written speech will be similar to the two year old's oral speech. It has even been proposed that the age level for written speech should be measured from the point when instruction begins in order to establish this correspondence between written and oral speech.

This explanation is clearly unsatisfactory. The two year old uses comparatively few words and a primitive syntax because his vocabulary is still poor and because he has not mastered complex sentence structures. The vocabulary of the school child's written speech, however, is not poorer than that of his oral speech. They are one and the same vocabulary. The syntax and the grammatical forms of written and oral speech are also the same. The child has already mastered them by the time he reaches school. Thus, the poverty of vocabulary and the undeveloped syntax that explain the primitive nature of oral speech in the two year old cannot explain the primitive nature of the school child's written speech. This analogy does not adequately explain the large disparity in the school child's written and oral speech.

Research indicates that the development of written speech does not reproduce that of oral speech. Any similarity that exists between the two processes is external and symptomatic rather than essential. Written speech is more than the translation of oral speech into the written sign. Mastering written speech requires more than learning the techniques of writing. Otherwise, we would expect that once these mechanisms of written speech were learned, written speech would be as rich and developed as oral speech; the two would be as similar as the translation is to the original. This is not the case however.

Written speech is an entirely unique speech function. Its structure and mode of functioning are as different from those of oral speech as those of inner speech are from external speech. Even the most minimal level of development of written speech requires a high degree of abstraction. Written speech lacks intonation and expression. It lacks all the aspects of speech that are reflected in sound. Written speech is speech in thought, in representations. It lacks the most basic feature of oral speech; it lacks material sound.

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* Vygotsky used the thesis research of his students at the Leningrad pedagogical institute here. – Editor's note.

The result is that the psychological conditions characteristic of written speech are very different from those of oral speech. Through oral speech, the child has achieved a rather high level of abstraction with respect to the object world. With written speech, the child is presented with a new task. He must abstract from the sensual aspect of speech itself. He must move to abstracted speech, to speech that uses representations of words rather than words themselves. In this respect, written speech differs from oral speech in the same way that abstract thinking differs from graphic thinking. This means that written speech cannot repeat the developmental stages of oral speech. The abstract nature of written speech – the fact that it is thought rather than pronounced – represents one of the greatest difficulties encountered by the child in his mastery of writing. Those who continue to assume that the critical problems are factors such as the underdevelopment of the small musculature and factors associated with the techniques of writing fail to see the root of the problem.

Written speech is more abstract than oral speech in other respects as well. It is speech without an interlocutor. This creates a situation completely foreign to the conversational speech the child is accustomed to. In written speech, those to whom the speech is directed are either absent or out of contact with the writer. Written speech is speech-monologue. It is a conversation with a white sheet of paper, with an imaginary or conceptualized interlocutor. Still, like oral speech, it is a conversational situation. Written speech requires a dual abstraction from the child. It requires an abstraction from the auditory aspects of speech and an abstraction from the interlocutor. This is the second of the basic difficulties the school child encounters in his mastery of written speech. Speech that lacks real sound (speech that is only represented or thought and therefore requires the symbolization of sound – a second order symbolization) will be more difficult than oral speech to the same degree that algebra is more difficult for the child than arithmetic. Written speech is the algebra of speech. The process of learning algebra does not repeat that of arithmetic. It is a new and higher plane in the development of abstract mathematical thought that is constructed over and rises above arithmetic thinking. In the same way, the algebra of speech (i.e., written speech) introduces the child to an abstract plane of speech that is constructed over the developed system of oral speech.

Moreover, *the motives that would cause one to resort to written speech are even less accessible to the child when he begins to learn to write.* As is true of any new form of activity, the motivation for speech and the need for it is fundamental to its development. The need for oral communication develops throughout infancy. It is a basic prerequisite for the first meaningful word. To the extent that this need has not matured, we find delays in speech development. When school instruction begins, however, the need for written speech is comparatively undeveloped. When he begins to write, the school child does not sense the need for this new speech function.

The relevance of the notion that motivation generally precedes activity to the special difficulties that the child encounters in the mastery of written speech is not limited to the ontogenetic domain. Every conversation and phrase is preceded by a speech motive. This motive is the source of the affective inducements and needs that feed the activity. With every moment, the situation that is inherent in oral speech creates the motivation for each turn of speech; it creates the motivation for each segment of conversation or dialogue. The need for something produces the request. The question creates the answer. The expression brings the retort and the failure to understand the clarification. A multitude of similar relationships between speech and motive are fully determined by the situation inherent in real oral speech. Thus, oral speech is regulated by the dynamics of the situation. It flows entirely from the situation in accordance with this type of situational-motivational and situational-conditioning process. With written speech, on the other hand, we are forced to create the situation or – more accurately – to represent it in thought. The use of written speech presupposes a fundamentally different relationship to the situation, one that is freer, more independent, and more voluntary.

The child must act with more volition with written speech than with oral speech. This is a general thread that links the distinguishing characteristics of written speech. Even the sound form of the word must be differentiated in written speech, while with oral speech it is pronounced automatically and without any differentiation into separate sounds. In saying a word, the child is not conscious of how he pronounces the sound. He does not intentionally pronounce each separate sound. With written speech, however, he must become consciously aware of the word's structure. He must partition it and voluntarily recreate it in written signs.

We find an analogous situation with the child's activity in forming phrases. In writing, he constructs the phrase in the same voluntary and intentional way as he creates the word from separate letters. That is, the child's syntax is as voluntary as his phonetics. The semantic aspect of written speech also requires voluntary work on word meanings. It requires that they be arranged in a particular syntactic and phonetic sequence. This reflects the fact that written speech stands in a different relationship to inner speech than does oral speech. While the development of external speech precedes the development of inner speech, written speech emerges only after the development of the latter. Written speech presupposes the existence of inner speech. According to Jackson and Head, written speech is the key to inner speech. The transition from inner to written speech requires what we have called voluntary semantics, which is associated with the voluntary phonetics of written speech. The grammar of thought characteristic of inner and written speech do not coincide; the meaningful syntax of inner speech is completely different from that of either oral or written speech. Entirely different laws govern the construction of the whole and of meaningful units. In a certain sense, the syntax of inner speech is the polar opposite of that of written speech. The syntax of oral speech stands somewhere between these two poles.

Inner speech is maximally contracted, abbreviated, and telegraphic. Written speech is maximally expanded and formal, even more so than oral speech. Written speech does not contain ellipses while inner speech is filled with them. Syntactically, inner speech is almost entirely predicative. In oral (audible) speech, syntax becomes predicative where the subject and related parts of the sentence are known to the interlocutors. This is consistent with the nature and structure of inner speech. With inner speech, the subject – indeed the whole conversational situation – is known to the individual who is thinking. Here, speech consists almost entirely of predicates. We do not have to tell ourselves what this speech is about. That is always implied, forming the background of consciousness. This explains the predicative nature of inner speech. Even if inner speech were made audible to the outsider, only the speaker would understand it. No one else would know the mental field in which it flows. Inner speech is, therefore, completely idiomatic.

In contrast, written speech requires the situation to be established in full detail so it can be understood by the interlocutor. Written speech is the most expanded form of speech. Even things that can be omitted in oral speech must be made explicit in written speech. Written speech must be maximally comprehensible to the other. Everything must be laid out fully. This transition from a maximally contracted inner speech (i.e., from speech for oneself) to a maximally expanded written speech (i.e., to speech for the other) requires a child who is capable of extremely complex operations in the voluntary construction of the fabric of meaning.

The second basic characteristic of written speech (i.e., its greater *consciousness*) is closely linked with its *volitional nature.* Wundt noted that the intentional and conscious nature of written speech is among the most important features that distinguishes it from oral speech. In his view, the difference between the development of language and of writing is that the latter is directed by consciousness and intention almost from the outset. This is why change in sign systems can be voluntary (as in the development of cuneiform writing systems for example) while the processes involved in language change are always unconscious.

In our research, we were able to establish that this is as true of the ontogenesis of written speech as it is of its phylogenesis. From the very beginning, consciousness and intention direct the child's written speech. The child learns the signs of written speech and the use of these signs consciously and volitionally. In contrast, oral speech is learned and used unconsciously. Written speech forces the child to act more intellectually. It requires conscious awareness of the very process of speaking. The motives of written speech are more abstract, intellectualistic, and separated from need.

In summarizing this brief discussion of our study of the psychology of written speech, we can say that the mental functions which form written speech are fundamentally different from those which form oral speech. Written speech is the algebra of speech. It is a more difficult and a more complex form of intentional and conscious speech activity. Two conclusions follow: (1) this explains the radical difference between the child's oral and written speech (this difference is a function of differences in the level of development required by activities that are spontaneous, involuntary, and without conscious awareness and those that are abstract, voluntary, and characterized by conscious awareness); and (2) *when instruction in written speech begins, the basic mental functions that underlie it are not fully developed; indeed, their development has not yet begun.* Instruction depends on processes that have not yet matured, processes that have just entered the first phases of their development.

This latter point is supported by research in other areas. Instruction in arithmetic, grammar, and natural science do not begin when the appropriate functions are mature. On the contrary, the immaturity of the required mental functions at the beginning of the instructional process is a general and basic law in all domains of school instruction. Since this emerges most clearly in the analysis of instruction in grammar, we will limit our discussion to this single issue in the present section. Our analysis of the acquisition of scientific concepts will be deferred to subsequent sections.

Since grammar would seem the least necessary or useful school subject for the child, the issue of the value of instruction in grammar is methodologically and psychologically complex. Arithmetic provides the child with new abilities. By acquiring knowledge of arithmetic, a child who once lacked the ability to add or divide now has this ability. Instruction in grammar does not seem to provide the child with new capacities in this sense. The child has the capacity to decline and conjugate before he comes to school. What does he learn from instruction in grammar? This is the argument that underlies the "agrammatical" movement which suggests that grammar should be removed from the list of school subjects because it is unnecessary, because it provides no new speech capacities. If we analyze instruction in grammar and written speech, however, we find that it has tremendous significance for the general development of the child's thought.

Of course, the child is able to decline and conjugate long before he arrives at school. For all practical purposes, he has already acquired the entire grammar of his native language. Nonetheless, while he declines and he conjugates, he does not know that he declines and conjugates. This activity has been acquired in a purely structural manner, in much the same way he has learned the phonetic constituents of the word. If you ask the young child to pronounce a specific combination of sounds such as "sk," he will not be able to do it. This kind of voluntary articulation is difficult for him. In the word "Moscow," however, he pronounces these same sounds freely and nonvolitionally. Within a defined structure, the sounds emerge spontaneously in the child's speech. Outside speech, however, these same sounds are not available to the child. *The child is able to pronounce a given sound, but he is not able to pronounce it volitionally*. This is the common characteristic of all the speech operations of the child who is on the threshold of school age.

This means that the child has certain speech capacities, but he does not know that he has them. These operations lack conscious awareness. This is reflected in the fact that the child possesses them only when they are used spontaneously or automatically, when they are used in situations where they are elicited by the structure of the situation. Outside this structure, the child is not able to do what he can within it. That is, he is not able to do volitionally, consciously, and intentionally what he is able to do without voluntary control. As a consequence, he has limited use of his capacities.

Once again, lack of conscious awareness and the nonvolitional nature of the child's capacities turn out to be two sides of a single phenomenon. This is characteristic of the child's grammatical skills such as his capacities to decline and conjugate. The child uses the correct case and the correct verb form in the structure of a particular phrase. He does not, however, consider the fact that such forms exist. He cannot, therefore, decline or conjugate a verb fully. The preschool child possesses all the basic grammatical and syntactic forms. He does not acquire fundamentally new grammatical or syntactic structures in school instruction. From this perspective, instruction in grammar is indeed a useless undertaking. What the child does learn in school, however, is conscious awareness of what he does. He learns to operate on the foundation of his capacities in a volitional manner. His capacity moves from an unconscious, automatic plane to a voluntary, intentional, and conscious plane. Instruction in written speech and grammar play a fundamental role in this process.

Given what we already know of the character of written speech, no elaboration is required to see the importance of this conscious awareness of speech – this mastery of it – for the mastery of written speech. The development of conscious awareness and mastery are both necessary for written speech. When learning to spell words that are spelled phonetically, the child gains conscious awareness that a word such as "fast" contains the sounds F – A – S – T, that is, he gains conscious awareness of his own activity in the production of sound; he learns to pronounce each separate element of the sound structure voluntarily. In the same way, when the child learns to write, he begins to do with volition what he has previously done without volition in the domain of oral speech. Thus, both grammar and writing provide the child with the potential of moving to a higher level in speech development.

Only two school subjects, writing and grammar, have been considered here. However, research on any of the basic school subjects would show the same thing: Thought has not fully matured when instruction begins. We can now make an even more interesting conclusion on the basis of our studies. If we consider the psychological aspects of school instruction, we will see that it constantly revolves around what are the basic new formations of the school age – conscious awareness and mastery. We can show that the most varied subjects of instruction have a common foundation in the child's mind. Moreover, this common foundation is a basic new formation of the school age, a formation that develops and matures in the process of instruction itself. Its developmental cycle is not completed before this age. *The development of the psychological bases of school instruction do not predate instruction; they develop in an unbroken internal connection with it.*

2. Our second group of studies were concerned with the issue of the temporal relationship between the processes of instruction and development. Research has shown that instruction always moves ahead of development. The child becomes proficient in certain skills before he learns to apply them consciously and volitionally. There is always a divergence between school instruction and the development of the corresponding functions. These processes never run in parallel.

The educational process has its own sequence, logic, and complex organization. It progresses through lectures and excursions. In today's class there will be one lesson, in tomorrow's another. This process is regulated by programs and schedules. It would be a tremendous error to assume that there is a complete correspondence between the external structure of the educational process and the internal structure of the developmental processes that it brings to life. It would be a mistake to think that the pupil's failure in arithmetic in a given semester necessarily corresponds with the progress in his internal developmental semester. If we represent both the educational process and the development of the mental functions that are directly involved in that process as curves (as we have attempted to do in our experiments), we find that these curves never coincide. Their relationship is extremely complex.

We usually begin the teaching of arithmetic with addition and end with division. There is an internal sequence in the statement of all arithmetic knowledge and information. From the developmental perspective, however, the various features and components of this process may have an entirely different significance. It may be that the first, second, third, and fourth components of arithmetic instruction are inconsequential for the development of arithmetic thinking. Some fifth component may be decisive. At this point, the developmental curve may rise sharply and begin to run ahead of the instructional process. What is learned thereafter may be learned in a entirely different way. Here, there is a sudden shift in the role of instruction in development. The child has finally understood something, finally learned something essential; a general principle has been clarified in this "aha experience." Of course, the child must learn the subsequent components of the program. In an important sense, however, they may already be contained in what he has learned. In each subject, there are essential, constituting concepts. If the course of development coincided completely with that of instruction, every point in the instructional process would have equal significance for development. The curves that represent instruction and development would coincide. Every point in the curve representing instruction would have a mirror image in the curve representing development. Research indicates that this is not the case. In both instruction and development, there are critical moments. These moments govern those which precede and follow it. These points of transition on the two curves do not coincide but display complex interrelationships. Indeed, as we said before, there could be no relationship between instruction and development if the two curves were to fuse.

Development has a different tempo than instruction. What we have here is a situation inherent in any scientific attempt to establish a relationship between two related processes that must be measured in accordance with different units of measurement.

The development of conscious awareness and volition cannot coincide with the school's program in grammar. The period required by the educational program for learning to decline substantive nouns will not necessarily coincide with that required for the internal development of the conscious awareness or mastery of speech. Development is not subordinated to the school program. It has its own internal logic. A given lesson in arithmetic will not correspond with a given stage of development, with the development of voluntary attention for example. Still, instruction in arithmetic may have a fundamental influence on the movement of attention from the domain of the lower mental functions to that of the higher. In the literal meaning of the word, instruction and development are incommensurable. In school, the child does not learn the decimal system as such. He learns to write numbers, add, multiply, and solve problems. Nonetheless, some general concept of the decimal system does develop.

The general implications of our second group of studies can be summarized in the following way: At the moment a given arithmetic operation or scientific concept is acquired, the development of this operation or concept is not completed. The curve representing its development does not correspond with that representing the school program. Instruction moves ahead of development.

3. The third group of studies dealt with an issue similar to that addressed by Thorndike in his experiments on the theory of formal discipline. However, our experiments were carried out with higher rather than elementary mental functions. Our experiments dealt with school instruction rather than with the discrimination of line segments or the magnitude of angles. In other words, we transferred the experiment to a domain where a meaningful connection might be expected between the subjects of instruction and the mental functions that play a role in them.

These studies have shown that the various subjects of school instruction interact with each other in the course of the child's development. Development is a much more unified process than would be indicated by Thorndike's experiments, where development takes on an atomistic character. Thorndike's experiments indicated that the development of each bit of knowledge and each skill consists in the formation of independent chains of associations that cannot facilitate the development of other associative chains. Each process of development is independent and isolated. Each occurs in an identical manner in accordance with the law of associations. Our research has shown that the child's mental development does not occur in accordance with the system of school subjects in this way. Arithmetic does not result in the development of certain functions while written speech leads to the development of others. There is a common mental foundation to various aspects of these subjects. Conscious awareness and mastery emerge in the same way with instruction in grammar or written speech. They play a significant role in arithmetic instruction and will take a central position in our analysis of scientific concepts. *The child's abstract thinking develops in all his lessons.* Its development does not move in separate channels corresponding to the school subjects.

There is a process of instruction which has its own internal structure, its own sequence, and its own emerging logic. At the same time, in the head of each pupil, there is an internal network of processes which are called to life and motivated in school instruction. These have their own logic of development however. Among the basic tasks of the psychology of school instruction is to clarify this internal logic, the internal course of development that is called to life by a particular course of instruction. Three facts have been solidly established in our experiments: (1) there is significant commonality in the mental foundations underlying instruction in the various school subjects that is alone sufficient to insure the potential for the influence of one subject on the other (i.e., there is a formal aspect to each school subject); (2) instruction influences the development of the higher mental functions in a manner that exceeds the limits of the specific content and material of each subject. Once again, this provides support for the idea of a formal discipline which is different for each subject but common to all. In attaining conscious awareness of cases, the child masters a structure that is transferred to other domains that are not directly linked with cases or grammar; and (3) the mental functions are interdependent and interconnected. Because of the foundation which is common to all the higher mental functions, the development of voluntary attention and logical memory, of abstract thinking and scientific imagination, occurs as a complex unified process. The common foundation of all the higher mental functions is conscious awareness and mastery. The development of this foundation is the primary new formation of the school age.

4. Our fourth group of studies dealt with an issue that is new for contemporary psychology but fundamental to the problem of instruction and development in the school-age child.

Psychological research on the problem of instruction is usually limited to establishing the level of the child's mental development. The sole basis for determining this level of development are tasks that the child solves independently. This means that we focus on what the child has and knows today. Using this approach, we can establish only what has already matured. That is, we can determine only the level of the child's *actual* development. To determine the state of the child's development on this basis alone, however, is inadequate. The state of development is never defined only by what has matured. If the gardener decides only to evaluate the matured or harvested fruits of the apple tree, he cannot determine the state of his orchard. Maturing trees must also be taken into consideration. The psychologist must not limit his analysis to functions that have matured. He must consider those that are in the process of maturing. If he is to fully evaluate the state of the child's development, the psychologist must consider not only the actual level of development but *the zone of proximal development.* How can this be accomplished?

When we determine the level of actual development, we use tasks that require independent resolution. These tasks function as indices of fully formed or fully matured functions. How, then, do we apply this new method? Assume that we have determined the mental age of two children to be eight years. We do not stop with this however. Rather, we attempt to determine how each of these children will solve tasks that were meant for older children. We assist each child through demonstration, leading questions, and by introducing the initial elements of the task's solution. With this help or collaboration from the adult, one of these children solves problems characteristic of a twelve year old, while the other solves problems only at a level typical of a nine year old. This difference between the child's mental ages, this difference between the child's actual level of development and the level of performance that he achieves in collaboration with the adult, defines the zone of proximal development. In this example, the zone can be expressed by the number "4" for one child and by the number "1", for the other. These children are not at the same level of mental development. The difference between these two children reflected in our measurement of the zone of proximal development is more significant than their similarity as reflected in their actual development. Research indicates that *the zone of proximal development has more significance for the dynamics of intellectual development and for the success of instruction than does the actual level of development.*

To explain this, we cite the well known fact that with collaboration, direction, or some kind of help the child is always able to do more and solve more difficult tasks that he can independently. What we have here is only an example of this general rule. An explanation, however, must go further. It must identify the causes that underlie this phenomenon. Rooted in traditional psychology, as well as in the everyday consciousness, is a view of imitation that assumes it is a purely mechanical activity. From this perspective, a solution that is not reached independently is not considered an index or symptom of the development of the child's intellect. It is assumed that the child can imitate anything. What I can do by imitation says nothing about my own mind. It cannot be used in assessing development. This view is false.

It is well established that the child can imitate only what lies within the zone of his own intellectual potential. If I am not able to play chess, I will not be able to play a match even if a chess master shows me how. If I know arithmetic, but run into difficulty with the solution of a complex problem, a demonstration will immediately lead to my own resolution of the problem. On the other hand, if I do not know higher mathematics, a demonstration of the resolution of a differential equation will not move my own thought in that direction by a single step. To imitate, there must be some possibility of moving from what I can do to what I cannot.

This allows us to introduce an addendum to what we said earlier concerning collaborative work and imitation. We said that in collaboration the child can always do more than he can independently. We must add the stipulation that he cannot do infinitely more. What collaboration contributes to the child's performance is restricted to limits which are determined by the state of his development and his intellectual potential. In collaboration, the child turns out to be stronger and more able than in independent work. He advances in terms of the level of intellectual difficulties he is able face. However, there always exists a definite, strictly lawful distance that determines the differential between his performance in independent and collaborative work.

Our research demonstrates that the child does not solve all unresolved problems with the help of imitation. He advances only up to a certain limit, a limit which differs for different children. As our example indicated, this ceiling may be very low for one child and significantly higher for another. If an individual could imitate anything irrespective of the state of his development, both these children would have solved all the problems with equal facility. Of course, this was not the case. In collaboration, the child solves problems that are proximal to his level of development with relative ease. Further on, however, the difficulty grows. Ultimately, problems become too difficult to resolve even in collaboration. The child's potential for moving from what he can do to what he can do only in collaboration is the most sensitive index of the dynamics of development and the degree of success that will come to characterize the child's mental activity.

Kohler encountered this problem in his well known experiments on the chimpanzee where he asked whether animals have the ability to imitate the intellectual actions of other animals. Kohler considered the question of whether the rational, goal-oriented operations of the apes are not simply resolutions of problems that they have learned through imitation, resolutions completely inaccessible to the animals themselves. His experiments demonstrated that an animal's imitative potential is strictly limited by his intellectual potential. In other words, the ape (i.e., the chimpanzee) can meaningfully carry out through imitation only what he can carry out independently. Imitation does not move the chimpanzee further along in the domain of intellectual operations. Of course, through training, the ape can learn to carry out much more complex operations than would have been accessible to its own mind. Here, however, the operation is carried out automatically and mechanically as a meaningless habit. It does not constitute a rational and meaningful solution of a problem. Comparative psychology has established several indices that allow us to distinguish intellectual, meaningful imitation from automatic copying. In the first case, the resolution of a problem is learned suddenly – once and forever. It does not require repetition. The error curve falls steeply and suddenly from one hundred percent to zero. Every indication of an independent, intellectual solution is manifested. This solution is attained as a consequence of grasping the structure of the field, of grasping the relationships among objects. With training, however, learning proceeds by trial and error. The learning curve representing mistaken solutions falls slowly and steadily. Learning requires frequent repetition. The training process manifests no meaningfulness and no understanding of structural relations. It is realized blindly and without structure.

This fact is of fundamental significance for the psychology of instruction. It is significant that in none of the three theories of instruction that we have reviewed in this chapter is any fundamental distinction made between the instruction of animals and the instruction of people. The same explanatory principle is applied to training and instruction. Even on the basis of what we have said here, however, it is clear that there is a fundamental difference between these processes. Not even the most intelligent animal can develop his intellectual capacities through imitation or instruction. He cannot learn anything that is fundamentally new. He can learn only through training.

If we consider instruction in this specifically human sense, animals cannot be instructed.

In contrast, development based on collaboration and imitation is the source of all the specifically human characteristics of consciousness that develop in the child. Development based on instruction is a fundamental fact. Therefore, a central feature for the psychological study of instruction is the analysis of the child's potential to raise himself to a higher intellectual level of development through collaboration, to move from what he has to what he does not have through imitation. This is the significance of instruction for development. It is also is the content of the concept of the zone of proximal development. Understood in a broad sense, imitation is the source of instruction's influence on development. The child's instruction in speech, and school instruction generally, is largely a function of imitation. In school, the child receives instruction not in what he can do independently but in what he cannot yet do. He receives instruction in what is accessible to him in collaboration with, or under the guidance of, a teacher. This is a fundamental characteristic of instruction. Therefore, the zone of proximal development – which determines the domain of transitions that are accessible to the child – is a defining feature of the relationship between instruction and development.

What lies in the zone of proximal development at one stage is realized and moves to the level of actual development at a second. In other words, what the child is able to do in collaboration today he will be able to do independently tomorrow. Instruction and development seem to be related in the same way that the zone of proximal development and the level of actual development are related. The only instruction which is useful in childhood is that which moves ahead of development, that which leads it. However, it is only possible to teach a child when he is able to learn. Instruction is possible only where there is a potential for imitation. This means that instruction must be oriented to the lower threshold of the developmental cycle which has already occurred. Still, development depends not so much on matured as maturing functions, since it always begins with what has not yet matured in the child. The potentials for instruction are determined by the zone of proximal development. Returning to our example, we can say that the potentials for instruction will be different with these two children even though their mental ages are identical. Their potentials for instruction will be different because the zones of their proximal development are so different. As the research cited above has shown, any subject of school instruction always builds on a foundation that has not yet fully matured.

It could be argued that if written speech requires volition, abstraction, and other functions that have not yet matured in the school child, we need to delay instruction until these functions begin to mature. Practical experience demonstrates, however, that instruction in writing is among the most important subjects in the child's early school career and that it elicits the development of functions that have not yet matured. Thus, when we say that instruction should rely on the zone of proximal development rather than on mature functions, we are not prescribing anything new for the school. We are simply freeing ourselves from an old delusion that implies that development must complete its cycles for instruction to move forward. This perspective requires a fundamental change in the kinds of pedagogical conclusions that should be drawn from psychological research. Psychologists have focused on the question of whether a child is sufficiently mature for instruction in reading or arithmetic. Of course, this question retains its validity. It is important to determine the lower threshold of instruction. The issue is not exhausted by this question however. It is equally important to determine the upper threshold of instruction. Productive instruction can occur only within the limits of these two thresholds. Only between these thresholds do we find the optimal period for instruction in a given subject. *The teacher must orient his work not on yesterday's development in the child but on tomorrow's.* Only then will he be able to use instruction to bring out those processes of development that now lie in the zone of proximal development.

It is well known that when the complex system dominated school instruction it was said to be based on "pedagogical foundations." It was argued that this system corresponded to the characteristics of the child's thinking. The statement of the issue here was false in that it was based on the assumption that instruction must be oriented on yesterday's development, on the characteristics of the child's thinking that have already matured. The complex system led to the reinforcement of that which the child must leave behind with his arrival at school. The orientation was towards the thinking that the child is able to do independently, No consideration was given to the child's potential to move from what he is able to do to what he is not. The state of development was evaluated in the tradition of the foolish gardener, the gardener who considers only the fruit that has ripened. No consideration was given to the fact that instruction must carry development forward. No consideration was given to the zone of proximal development. The orientation was toward the path of least resistance, toward the child's weakness rather than his strength.

It is important to recognize that the forms of thinking which correspond to the complex system are those of the child who comes to school with functions that matured during the preschool age. In introducing the complex system into the school, we are introducing' a system of instruction compatible with the intellect of the preschooler. For the first four years of school instruction, we are reinforcing the weakest aspects of the preschooler's thinking. This system of instruction does not lead the child's development forward but rides its tail.

Having concluded this account of our research, we can now attempt to outline the perspective on the relationship between instruction and development that emerges from it.

We have seen that instruction and development do not coincide. They are two different processes with very complex interrelationships. *Instruction is only useful when it moves ahead of development.* When it does, it *impels or wakens a whole series of functions that are in a stage of maturation lying in the zone of proximal development.* This is the major role of instruction in development. This is what distinguishes the instruction of the child from the training of animals. This is also what distinguishes instruction of the child which is directed toward his full development from instruction in specialized, technical skills such as typing or riding a bicycle. The formal aspect of each school subject is that in which the influence of instruction on development is realized, Instruction would be completely unnecessary if it merely utilized what had already matured in the developmental process, if it were not itself a source of development.

Therefore, instruction is maximally productive only when it occurs at a certain point in the zone of proximal development. Many modern educators (i.e., Fortune, Montessori, and others) refer to this as a sensitive period. The eminent biologist, de Vries, used the phrase "sensitive period" to designate a period of ontogenetic development he identified in his studies. During these periods, he found that the organism is particularly sensitive to particular types of influences. At a critical point, the influence may elicit profound changes that have an impact on the whole of development. At another point in the developmental process, these same conditions may have no influence on development or they may even have an effect that is the opposite of what they would have had during the sensitive period. This concept of sensitive periods largely coincides with we have in mind when we speak of optimal periods for instruction. There are, however, two differences between these concepts: (1) We have attempted to determine the nature of these periods not only empirically but experimentally and theoretically and have found the explanation for sensitivity to a specific type of instruction in the concept of the zone of proximal development (this has provided us with the potential to identify these periods). (2) Montessori and others tend rely on a direct biological analogy between their concepts of sensitive periods; they tend to equate the sensitive periods identified by de Vries in his studies of the lower animals and those that we find in complex human developmental processes such as those involved in the development of written speech.

In contrast, our research demonstrates that these sensitive periods are associated with the social processes involved in the development of the higher mental functions. These mental functions are an aspect of the child's cultural development and have their source in collaboration and instruction. Montessori's findings are valid. She demonstrated, for example, that with instruction in writing involving children as young as four-and-a-half and five years of age we find a fruitful, rich, and spontaneous usage of written speech that is not found when instruction begins later. Montessori refers to the abundant, explosive display of written speech that is observed at this age as "explosive writing." This is the basis for her conclusion that this is an optimal or sensitive period for writing instruction.

We find similar situations with any subject of instruction that has a sensitive period. The critical question concerns the nature of these sensitive periods however. During a sensitive period, certain conditions – particularly certain types of instruction – can influence development. This is because the corresponding cycle of development is not yet complete. When this cycle of development is complete, these same conditions may have no significant effect on development. For a given period to be sensitive to specific conditions, the corresponding processes of development must not have been completed. This coincides with the empirical data found in our research.

When we observe the child's development and instruction in school, it becomes apparent that each *subject demands* more than the child is capable of, leading the child to carry out activities that force him to rise above himself. This is always the case with healthy school instruction. The child begins to learn to write when he does not yet have the mental functions that are required for written speech. It is for precisely this reason that instruction in written speech calls these functions to life and leads their development. This is true of all productive instruction. The incompetent child in a group of competent children will be delayed in his development and in the relative success of his mental activity. So will the competent child in a group of incompetent children. For one of these children the problem lies in the fact that instruction is too difficult –

for the other in the fact that it is too easy. These opposing conditions lead to the same result. In both cases, instruction occurs outside the zone of proximal development, below it in one case and above it in the other. It is as fruitless to teach the child what he is not able to learn as it is to teach him what he can already do independently.

We can identify characteristics of instruction and development that are unique to the school age, since instruction and development do not begin when the child comes to school. Instruction occurs on all levels of the child's development. As we shall see in the following section, however, instruction takes on forms that are specific to each age level. Further, at each of these levels, instruction has a unique relationship to development.

At this point, we will limit ourselves to a review of the general implications of what we have said. In our discussion of written speech and grammar, we have seen that there is a common foundation to the mental aspect of instruction in the basic school subjects. All the major mental functions that actively participate in school instruction are associated with the important new formations of this age, that is, with conscious awareness and volition. These are the features that distinguish all the higher mental functions that develop during this period. Thus, the school age is the optimal period for instruction. It is a sensitive period for those subjects that depend on conscious awareness or volition in the mental functions. Consequently, instruction in these subjects provides the ideal conditions for the development of the higher mental functions which are in the zone of proximal development during this period. Instruction has a decisive influence on the course of development because these functions have not yet matured at the beginning of the school age and because instruction organizes their further development and partially determines their fate.

It is important to stress, however. that the same can be said of the development of scientific concepts. The basic characteristic of their development is that they have their source in school instruction. Therefore, the general problem of instruction and development is fundamental to the analysis of the emergence and formation of scientific concepts.

5

We will begin with the analysis of a basic fact which has been established through the comparative study of the school child's scientific and everyday concepts. A natural first step in any attempt to clarify the unique characteristics of scientific concepts would be to compare them with the child's everyday concepts. In taking this approach, we take the path from the known to the unknown. The child's everyday concepts have been extensively studied. The desire to see how they compare with scientific concepts is natural. To do this, we need to construct what are structurally identical experimental tasks that can be based on either scientific or everyday concepts. As we anticipated, this type of research leads to the finding that these two kinds of concepts do not manifest identical levels of development. Depending on whether the operation is carried out on the basis of scientific or everyday concepts, the child will manifest different capacities to grasp relationships of causation and dependency or relationships of implication. Comparative analysis of scientific and everyday concepts within a single age group indicates that – with an appropriate educational program – the development of scientific concepts outstrips that of spontaneous concepts. In scientific concepts, we encounter higher levels of thinking than in everyday concepts. In a task involving the completion of a sentence cut off at the word "because" or "although," the rate of success for scientific concepts is consistently higher than it is in tasks based on everyday concepts (Figure 2 omitted).

This finding requires clarification. How do we explain the increased levels of successful task performance characteristic of problems based on scientific concepts?

First, it might be argued that establishing causal dependencies in the domain of scientific concepts is easier for child because of his school knowledge; that is, it might be argued that his difficulty with similar problems based on everyday concepts is a function of inadequate knowledge. This explanation must be rejected immediately. Research methods excluded any potential for influence from this factor. Piaget had selected materials that excluded inadequacy of knowledge as a factor in the child's resolution of the problem. There is no question that the objects and relationships in Piaget's experiments (and in our own) are familiar to the child. The task with which the child is faced is that of completing phrases that are taken from his own everyday speech. The phrases in the experiments have simply been broken off in the middle and therefore require supplementation. Similar phrases, that are properly constructed, are encountered constantly in the child's spontaneous speech, The inadequacy of this explanation becomes particularly apparent when one considers that performance improves when scientific concepts are incorporated into the task. The child performs better on tasks based on scientific concepts (i.e., tasks that require the establishment of causal dependencies between facts and concepts from the social sciences) than on tasks that require the establishment of similar relationships between concepts and facts from his everyday experience. It seems unlikely that this is a function of the child's familiarity with the material involved, that he is less familiar with falling off a bicycle or the destruction of a ship than with class struggle, exploitation, or the Paris Commune. Clearly, the child has greater experience and knowledge of the objects and events represented by everyday concepts.

To explain this phenomenon, we must clarify the nature of the difficulty the child has in finishing a phrase such as that mentioned above. There is only one answer to this question. This task requires the child to do with conscious awareness and volition what he does spontaneously and without volition many times each day. The child uses the conjunction "because" correctly. If a child of eight or nine years saw a bicyclist fall in the street, he would never say that the bicyclist fell and broke his leg because they took him to the hospital. However, this is precisely the kind of thing that was said in the experiments. We have discussed the differences between volitional and nonvolitional modes of carrying out an operation. The child who uses the conjunction "because" irreproachably in his spontaneous speech may still lack conscious awareness of the concept. He uses this relationship in speech earlier than he acquires conscious awareness of it. The voluntary use of structures that he has mastered in appropriate situations of use is still inaccessible to him. The child lacks something that is critical for the correct resolution of these problems; he lacks conscious awareness and volition in the use of his concepts.

We must now ask what kinds of operations the problems which include materials that were taken from the social sciences demand from the child. Here, the child tends to complete the phases in the following way: "In the USSR it is possible to have a planned economy because there is no private property; all the land, factories, and power stations are in the hands of the workers and peasants." Assuming this question has been addressed in the educational program, the child knows the appropriate causal relationship. Of course, he also knows why the ship sinks and why the bicyclist falls. What is it that he does when he answers this question taken from the social sciences?

We think that the operation that the school child carries out in solving this problem can be explained in the following way. First, the operation has a history. It was not constructed during the experiment. The experiment can be seen as a final stage in a long process that can only be understood in connection with those that precede it. The teacher, working with the school child on a given question, explains, informs, inquires, corrects, and forces the child himself to explain. All this work on concepts, the entire process of their formation, is worked out by the child in collaboration with the adult in instruction. Now, when the child solves a problem, what does it requires of him? It requires the ability to imitate and solve the problem with the help of teacher even though we do not have an actual situation of collaboration at this moment. The situation lies in the past. Here, the child must make independent use of the result of that earlier collaboration.

The fundamental difference between the problem which involves everyday concepts and that which involves scientific concepts is that the child solves the latter with the teacher's help. When we say that the child acts on the basis of imitation, we do not mean that he looks another person in the eye and imitates him. If today I see something and tomorrow do it, I do it on the basis of imitation. When the school child solves a problem at home on the basis of a model that he has been shown in class, he continues to act in collaboration, though at the moment the teacher is not standing near him. From a psychological perspective, the solution of the second problem is similar to this solution of a problem at home. It is a solution accomplished with the teacher's help. This help – this aspect of collaboration – is invisibly present. It is contained in what looks from the outside like the child's independent solution of the problem.

We find, then, that two fundamentally different operations are demanded of the child in his performance on these problems. In a problem involving everyday concepts he must do with volition something that he does with ease spontaneously. In a problem involving scientific concepts, he must be able to do in collaboration with the teacher something that he has never done spontaneously. This is the only explanation of the differences in the performance levels on these two types of problems. We know that the child can do more in collaboration than he can independently. If it is true that the solution of social science problems is a covert form of collaboration, it becomes apparent why successful performance on these problems outstrips performance on problems that are based on everyday concepts.

We can now discuss a second important finding: The problems involving the conjunction "although" produce an entirely different pattern of performance in children in this same school grade. Here, the curves representing the successful resolution of problems based on scientific concepts and everyday concepts merge. This can be explained by the fact that the category of adversative relationships matures later in the child's spontaneous thinking than that of causal relationships. Spontaneous concepts in this domain have not yet matured enough for scientific concepts to rise above them. As we have noted, one can gain conscious awareness only of what one has; one can subordinate only those functions that are active. Since at this age the child has worked out the spontaneous application of the concept "because," he can become consciously aware of it and use it voluntarily in collaboration. However, if he has not mastered the relationships expressed by the conjunction "although" in his spontaneous thinking, he cannot gain conscious awareness of it in his scientific thinking. He cannot gain conscious awareness of what he does not have. He cannot master functions that are absent. In this situation, the curve representing successful solution of problems based on scientific concepts will be as low as that representing everyday concepts.

A third important finding is that the curve representing correct performance on tasks involving everyday concepts rises rapidly and eventually approaches the level representing problems based on scientific concepts. Ultimately, the two curves merge. Everyday concepts overtake scientific concepts, attaining the same level of development. The possibility that the mastery of scientific concepts influences this development in the child's spontaneous concepts is obvious. Everyday concepts are restructured under the influence of the child's mastery of scientific concepts. This becomes more convincing when we realize that the process involved in the formation and development of concepts must be structural in nature. This means that when the child masters the structure that is associated with conscious awareness and mastery in one domain of concepts, his efforts will not have to be carried out anew with each of the spontaneous concepts that were formed prior to the development of this structure. Rather, in accordance with basic structural laws, the structure is transferred to the concepts which developed earlier.

This assertion is supported by a fourth research finding: The relationship between everyday and scientific concepts with which we are familiar from our data on causal relationships is found in the category of adversative relationships with fourth grade children. There is a sharp difference between the curves representing successful performance on the two types of problems. Performance levels on problems based on scientific concepts again outstrip those associated with everyday concepts. Somewhat later, we again find rapid improvement in the level of performance on problems based on everyday concepts. This level quickly approaches that characteristic of performance associated with scientific concepts. Again, the two curves ultimately fuse.

Thus, performance levels on tasks based on scientific and everyday concepts manifest the same regularities and relationships when the operations involve the conjunction "although" as they did when the operations involved the conjunction "because." There is, however, a two year delay. This supports our contention that these regularities – though based on the description of particular concepts – are general laws. They are not dependent on the year in which they occur or the type of operations with which they are connected.

These findings seem to allow us to clarify the most important aspects of a question of great interest to us, namely, the question of the relationship between scientific and everyday concepts in the first moments of the development of a given system of knowledge. They allow us to clarify the key point in the development of the various kinds of concepts with a certain degree of certainty. Relying on what we know about the natures of these kinds of concepts, we can hypothetically represent the curve of development of spontaneous and nonspontaneous concepts by moving from this key point.

These findings lead to the conclusion that *the development of scientific and spontaneous concepts take opposite paths.* We can now answer the question we raised earlier concerning how concepts such as "brother" and "exploitation" develop by saying that they develop in reverse directions.

This is a key point of our hypothesis.

The child gains conscious awareness of spontaneous concepts at a comparatively late point in the developmental process. His abilities for the verbal formulation and definition of concepts and his volitional use of the concept in establishing complex logical relationships with other concepts are not present in the initial stages of the developmental process. The child knows things. He has a concept of the object. What the concept itself represents remains vague for the child however. He has a concept of the object and is consciously aware of the object that is represented in the concept. He is not, however, consciously aware of the concept itself. He does not have conscious awareness of the act of thought that allows him to represent the object. In contrast, the development of scientific concepts begins with that which remains most underdeveloped in the spontaneous concept over the whole of the school age. It begins with work on the concept itself. It begins with work on the concept's verbal definition, with operations that presuppose the nonspontaneous application of this concept.

Scientific concepts begin their life at a level that the development of the child's spontaneous concepts has not yet reached. Work on the new scientific concept in instruction requires the very operations and relationships that are impossible for the child of this age. (Piaget has shown that even a concept such as "brother" manifests this limitation up to the age of eleven or twelve years).

The strengths and the weaknesses of everyday and scientific concepts differ. The strength of the school child's concept of "brother" is that it has undergone a long path of development and that his concept exhausts the greater part of the empirical content of the concept. This is precisely the weakness of his scientific concept. The strength of the scientific concept (i.e., concepts such as "Archimedes' law" or "exploitation") also turns out to be the weakest aspect of the everyday concept. The child has outstanding knowledge of what a brother is and this knowledge is saturated with experience. However, when he must solve an abstract problem such as those we find in Piaget's experiments (e.g., the problem about "the brother of a brother"), the child becomes confused. He is powerless to operate with this concept in a nonconcrete situation. This was demonstrated clearly in Piaget's work.

When the child learns a scientific concept, he quickly begins to master the operations that are the fundamental weakness of the everyday concept. He easily defines the concept, applies it in various logical operations, and identifies its relationships to other concepts. We find the weakness of the scientific concept where we find the strength of the everyday concept, that is, in its spontaneous usage, in its application to various concrete situations, in the relative richness of its empirical content, and in its connections with personal experience. Analysis of the child's spontaneous concept indicates that he has more conscious awareness of the object than of the concept itself. Analysis of his scientific concept indicates that he has more conscious awareness of the concept than of the object that is represented by it. Therefore, the threat to satisfactory concept development differs fundamentally for scientific and everyday concepts.

Examples can easily be found that support this assertion. In answer to the question of what a revolution is, third grade students who had just covered the period from 1905 to 1917 answered that: "Revolution is where the oppressed class wages war with the oppressing class. It is called a civil war. The citizens of a single country wage war against each other." The development of the child's consciousness is reflected in these answers. We find class criteria in them. However, the depth and fullness of the student's *conscious awareness* of this material is qualitatively different than that of adults.

This assertion can be clarified by the following example:

[Student] "Serfs were peasants who were the property of the landowners."

[Adult] "What was the life of the landowners like under serfdom?"

[Student] “Very good. They were all rich. They had ten story houses, many rooms, and were all well-dressed. They had electricity.”

Here we can see the child’s unique though simplified understanding of serfdom. It is more a representation or image than a scientific concept in the true sense of the word. The situation is completely different with a concept such as “brother.” The child’s incapacity to rise above the situational meaning of this word, his inability to approach the concept “brother” as an abstract concept, and his incapacity to avoid logical contradictions while operating with it, are the dangers present in the development of everyday concepts.

The developmental paths taken by the child’s spontaneous and scientific concepts can be schematically represented as two lines moving in opposite directions. One moves from above to below while the other rises from below to above. If we designate the earlier developing, simpler, and more elementary characteristics as lower and the later developing, more complex characteristics (those connected with conscious awareness and volition) as higher, we can say that *the child’s spontaneous concepts develop from below to above, from the more elementary and lower characteristics to the higher, while his scientific concepts develop from above to below, from the more complex and higher characteristics to the more elementary.* This difference in the development of scientific and everyday concepts is closely associated with their different relationships to the object, an issue we discussed earlier.

The birth of the spontaneous concept is usually associated with the child’s immediate encounter with things, things that are often explained by adults but are nonetheless real things. Only through a long developmental process does the child attain conscious awareness of the object, of the concept itself, and the capacity to operate abstractly with the concept. In contrast, the birth of the scientific concept begins not with an immediate encounter with things but with a mediated relationship to the object. With the spontaneous concept, the child moves from the thing to the concept. With the scientific concept, he is forced to follow the opposite path – from the concept to the thing. It is no surprise, then, that the strength of one type of concept is the weakness of the other. In his earliest school lessons, the child learns to establish logical relationships between concepts. The movement of this concept is inward. It clears a path to the object and connects itself to the child’s experience, absorbing it. Both types of concepts are located in one and the same child and at more or less the same level of development. In the thinking of the child, one cannot separate the concepts that he acquires in school from those that he acquires at home. Nonetheless, these concepts have entirely different histories. One concept reaches the level it has attained while having undergone a certain portion of its development from above. The other reaches this level having completed the lower portion of its developmental path.

Thus, while scientific and everyday concepts move in opposite directions in development, *these processes are internally and profoundly connected with one another.* The development of everyday concepts must reach a certain level for the child to learn scientific concepts and gain conscious awareness of them. The child must reach a threshold in the development of spontaneous concepts, a threshold beyond which conscious awareness becomes possible.

The child’s concepts of history, for example, begin their development only when his everyday concept of the past is sufficiently differentiated, only when his life and the life of those near to him are placed in the framework of an initial abstraction of the “before and now” in his consciousness.

However, as is indicated by the experiments discussed above, everyday concepts are also dependent on scientific concepts. The scientific concept has undergone that part of development which still faces the everyday concept. It is with the scientific concept that a series of operations that are beyond the child when he is operating with concepts such as “brother” begin to emerge. This cannot remain without significance for the portion of the developmental path that remains for the everyday concept. Having already traveled the long path of development from below to above, everyday concepts have blazed the trail for the continued downward growth of scientific concepts; they have created the structures required for the emergence of the lower or more elementary characteristics of the scientific concept. In the same way, having covered a certain portion of the path from above to below, scientific concepts have blazed the trail for the development of everyday concepts. They have prepared the structural formations necessary for the mastery of the higher characteristics of the everyday concept.

The scientific concept grows downward through the everyday concept and the everyday concept moves upward through the scientific. In this assertion, we are only stating our experimental findings in more general terms. Let us review these findings. The everyday concept must reach a certain level of spontaneous development for the superior scientific concept to emerge. As we have seen, this potential is present for the concept "because" by the second grade while for the concept "although" it only emerges in the fourth grade. Everyday concepts, however, move quickly along the upper section of the path which was blazed by scientific concepts. In this process, they are restructured in accordance with the structures prepared by the scientific concept. This is reflected in the sharp upward movement in the curve representing everyday concepts to the level of that representing scientific concepts.

We can now state our findings in more general terms. *The strength of the scientific concept lies in the higher characteristics of concepts, in conscious awareness and volition.* In contrast, this is the weakness of the child's everyday concept. The strength of the everyday concept lies in spontaneous, situationally meaningful, concrete applications, that is, in the sphere of experience and the empirical. The development of scientific concepts begins in the domain of conscious awareness and volition. It grows downward into the domain of the concrete, into the domain of personal experience. In contrast, the development of spontaneous concepts begins in the domain of the concrete and empirical. It moves toward the higher characteristics of concepts, toward conscious awareness and volition. The link between these two lines of development reflects their true nature. This is *the link of the zone of proximal and actual development.*

It is indisputable that conscious awareness and the volitional use of concepts (i.e., the characteristics of the school child's spontaneous concepts that remain underdeveloped) lie entirely within the school child's zone of proximal development. They emerge or become actual in his collaboration with adults. This is why the development of scientific concepts presupposes a certain level in the development in spontaneous concepts, in connection with which conscious awareness and volition emerge in the zone of proximal development. Scientific concepts restructure and raise spontaneous concepts to a higher level, forming their zone of proximal development. What the child is able to do in collaboration today, he will be able to do independently tomorrow.

Thus, the development of scientific concepts does not coincide with that of spontaneous concepts. Precisely because of this, there exist extremely complex relationships between them. If scientific concepts simply repeated the developmental history of spontaneous concepts, these relationships would not be possible. The links between the two processes and the tremendous influence they have on one another is possible because their development takes such different paths.

If the development of scientific concepts repeated that of spontaneous concepts, the acquisition of a system of scientific concepts would contribute only an increase or broadening of the circle of concepts, only an enrichment of the child's vocabulary. However, our theory and research indicate that scientific concepts provide a segment of development which the child has not yet passed through; they indicate that the scientific concept moves ahead into a zone where the corresponding potentials have not yet matured in the child. This allows us to begin to understand that instruction in scientific concepts plays a decisive role in the child's mental development.

Before we discuss the influence of scientific concepts on the child's general mental development, we will reconsider the analogy between this process and that of learning a foreign language. As this analogy indicates, the developmental path we have outlined for scientific concepts is only a single instantiation of a much broader group of developmental processes that have their source in systematic instruction.

The child learns a foreign language in school differently than he learns his native language. He does not begin learning his native language with the study of the alphabet, with reading and writing, with the conscious and intentional construction of phrases, with the definition of words, or with the study of grammar. Generally, however, this is all characteristic of the child's first steps in learning a foreign language. The child learns his native language without conscious awareness or intention; he learns a foreign language with conscious awareness and intention. The development of the native language moves from below to above; the development of the foreign language moves from above to below. With the native language, the lower, more elementary characteristics of speech arise first. Its more complex forms develop later in connection with conscious awareness of its phonetic structure, its grammatical forms, and its volitional use. With a foreign language, it is the higher, more complex characteristics of speech that develop first, those that are associated with conscious awareness and intention. The more elementary characteristics of speech, those associated with the spontaneous and free use of speech, development later.

Thus, intellectualistic theories of speech development such as Stern's, theories which assume that the development of speech begins with the mastery of language principles or the relationship between sign and meaning, apply only to the learning of foreign languages. Further, *the strength of the child's foreign language is the weakness of his native language.* Moreover, where the native language is strong, the foreign language is weak. The child's use of the grammatical forms of his native language is impeccable. He does not, however, have conscious awareness of his use of these forms. He declines and conjugates but is not consciously aware that he does this. He is generally not able to determine the gender, case, or grammatical form that he applies correctly in a given phrase. In the foreign language, however, the child is able to distinguish words of masculine and feminine genders. From the outset, he has conscious awareness of the proper declinations and grammatical modifications.

The same is true of phonetics. The child's use of the auditory aspect of his native language is beyond reproach, but he does not consider the kinds of sounds he is pronouncing. As a consequence, it is extremely difficult for him to sound out the word, to partition it into its component sounds. With the foreign language, however, he does this with ease. In his native language, his written speech lags significantly behind his verbal speech. In the foreign language, however, this is generally not the case. Indeed, the child's written language is often more advanced than his verbal language. Once again, the weaker aspects of the native language are the stronger aspects of the foreign and vice versa. The spontaneous use of phonetics (what is called pronunciation) is a extremely difficult for the school child who is learning a foreign language. Free, lively, spontaneous speech characterized by the rapid and correct application of grammatical structures is attained only with extreme difficulty and only near the end of the developmental process. The development of the native language begins with the free and spontaneous use of speech and ends with conscious awareness and mastery of the speech forms. In contrast, the development of the foreign language begins with conscious awareness and volitional mastery of language and culminates in free, spontaneous speech. The two developmental processes move in opposite directions.

As is true of the development of scientific and spontaneous concepts, however, there is *a mutual dependence* between these two paths of development. The conscious and intentional learning of a foreign language is obviously dependent on a certain level of development in the native language. The child already possesses a system of meanings in the native language when he begins to learn a foreign language. This system of meanings is transferred to the foreign language. Once again, however, the process of learning a foreign language clears the path for the acquisition of higher forms of the native language. Learning a foreign language allows the child to understand his native language as a single instantiation of a linguistic system. As a consequence, *the child acquires a potential for generalizing the phenomena of his native language* and for gaining conscious awareness of his speech operations and mastering them. In the same sense that algebra represents the generalization, conscious awareness, and mastery of arithmetic operations, the development of a foreign language represents an abstraction of linguistic phenomena and the conscious awareness of speech operations. It represents the translation of speech operations to the higher plane of conscious awareness and volitional speech. This is what Goethe meant when he said that he who does not know at least one other language does not fully know his own.

Our discussion of this analogy was motivated by three considerations. First, this discussion has helped us clarify and support the notion that the dynamics of the development of what seem to be identical structures at different ages and under different conditions may – indeed must – differ radically in functional-psychological terms. In essence, there are only two possibilities for explaining the relationship between the development of verbal and written speech, between native and foreign languages, between the logic of action and the logic of thought, and between graphic logic and the logic of verbal thinking. These two possibilities are mutually exclusive.

The first type of explanation relies on *the law of displacement.* Here it is assumed that processes of development that have occurred at earlier stages are repeated or reproduced with the development of more advanced functions; the basic difficulties encountered in earlier processes of development are manifested once again at the higher level. This approach has been applied frequently by psychologists in resolving the problems mentioned above. Recently, Piaget has renovated this approach and used it as his ace in the hole. The second type of explanation provides the basis for our hypothesis of *the zone of proximal development.* This form of explanation is based on the notion that analogous systems in higher and lower domains develop in contrasting directions. This is the law of interconnections between higher and lower systems in development. This law was discovered, and has been supported, through our studies of the development of spontaneous and scientific concepts, native and foreign languages, and verbal and written speech. Later, we will attempt to apply it to Piaget's analysis of the development of graphic logic and the logic of verbal thinking as well as to his theory of verbal syncretism.

On this level, our experiment on the development of scientific and spontaneous concepts is an "experimentum crucis" in the full sense of the phrase. It permits a final resolution of the dispute between these two mutually exclusive explanations. Two things must be demonstrated. First, we must *show that the learning of a scientific concept differs from the learning of an everyday concept in much the same way that foreign language learning in school differs from learning a native language.* Second, we must *show that relationship between the development of the two types of concepts are much the same as the relationships between the processes of foreign and native language development.* It also important for us to show that scientific concepts are as inadequate in some contexts as everyday concepts are in scientific contexts, and that this pattern corresponds with the fact that the strengths and weaknesses of native and foreign languages are manifested in different contexts.

The second reason we have used this analogy is that there is more than an accidental correspondence between these two developmental processes. Their similarity is not merely a formal one. These two processes have a profound internal kinship which kinship explains the remarkable correspondence between the dynamics of their development. If we focus on the mental nature of the development of these two processes, we find that they represent the development of two aspects of a single process, the development of two aspects of the process of verbal thinking. In foreign language learning, the external, sound, and phasal aspects of verbal thinking are the most prominent. In the development of scientific concepts, the semantic aspects of this process come to the fore. To a limited extent, learning a foreign language also requires mastering the semantic aspect of foreign speech, just as the development of scientific concepts requires the mastery of the scientific language (i.e., the mastery of scientific symbolism). This is particularly important in learning terminology and symbolic systems, as in arithmetic for example. The analogy we have developed should have led us to expect this from the outset. However, the development of these two aspects of speech, the phasal and the semantic, do not simply parallel one another; each process has its unique dynamics. Like any analogy, ours has its limits. The learning of the foreign and native language have certain similarities to the development of scientific and everyday concepts, but the two sets of processes also differ profoundly in many respects.

This leads directly to the third consideration that brought us to explore this analogy. As is known, the learning of a foreign language in school presupposes a developed system of meanings in the native language. In learning the foreign language, the child does not develop the semantic aspect of speech anew. He does not form new word meanings or learn new concepts of objects. He learns new words which correspond point for point with the system of concepts that he has already acquired. As a consequence, an entirely *new* relationship of word to object emerges, a relationship which is different from that which we find in the native language. When the child learns the foreign word, it is not related to the object in a direct or immediate way. This relationship is mediated by the words of the native language. Our analogy remains in force here because this occurs in the development of scientific concepts as well. The scientific concept is not related to its object directly. Once again, this relationship is *mediated* by existing concepts.

We can extend this analogy further. The mediating role played by the words of the native language in establishing the relationship between the foreign word and the object results in *significant developments in the semantic aspect* of the native language. Because it can now be expressed in two different words from different languages, the meaning of the word or concept is torn from its immediate connection with the phonological form of the word in the native language. Word meaning is thus differentiated from the sound aspect of speech and acquires a degree of independence. As a consequence, the child gains conscious awareness of the meaning as such. The mediation of the relationship between the scientific concept and the object by the everyday concept has similar results. As we will see in more detail later, *the everyday concept acquires a whole series of new relationships with other concepts as it comes to stand between the scientific concept and its object.* Its relationship with the object is also transformed in this process.

Problems arise, however, if we attempt to extend this analogy further. In learning a foreign language, a system of developed meanings is given from the outset in the native language. This existing system is a prerequisite for the development of the new system. In the development of scientific concepts, on the other hand, *the system emerges only with the development of the scientific concept and it is this new system that transforms the child's everyday concepts.* This difference is more critical than the kinship between these processes because it identifies what distinguishes the development of scientific concepts from the development of other new forms of speech such as foreign languages or writing. This system which emerges with the scientific concept is fundamental to the entire history of the development of the child's real concepts. It is a chapter of that history that is inaccessible to research based on the analysis of artificially or experimentally formed concepts.

6

We turn now to the central problem of our research, the problem of system.

There is no question that any concept is a generalization. Up to this point, however, we have been dealing with separate, isolated concepts. We must now ask *what kinds of relations there are between concepts.* How is the individual concept – this stitch that we tear away from a living integral fabric – intertwined and interwoven with the system of concepts present in the child? Only within such a system can the concept arise, live, and develop. The concept does not emerge in the child's mind like a pea in a sack. Concepts do not lie alongside one another or on top of one another with no connections or relationships. If this were the case, thought operations requiring the co-relation of concepts would be impossible, as would the child's world view and the entire complex life of his thought. Moreover, without well-defined relationships to other concepts, the concept's existence would be impossible. In contrast to what is taught by formal logic, the essence of the concept or generalization lies not in the impoverishment but in the enrichment of the reality that it represents, in the enrichment of what is given in immediate sensual perception and contemplation. However, this enrichment of the immediate perception of reality by generalization can only occur if complex connections, dependencies, and relationships are established between the objects that are represented in concepts and the rest of reality. By its very nature, each concept presupposes the presence of a certain system of concepts. Outside such a system, it cannot exist.

The study of concept systems at each stage of childhood shows that relationships of generality (i.e., differences and relationships of generality: for example, plant, flower, and rose) are the most basic, natural, and common type of relationship among meanings or concepts. It is in this relationship that the nature of the concept is most clearly reflected. Each concept is a generalization. Therefore, the relationships between concepts are *relationships of generality.* The study of these relationships has long been among the central problems of logic and the logical aspect of this issue has been adequately developed. The genetic and psychological problems associated with it have not been adequately developed however. It is generally the logical relationship of the general to the particular that has been studied. What needs to be studied is the genetic and psychological relationships among these types of concepts. This opens up the grandest and most complete problem of our research.

In the development of concepts, the child does not follow the logical path from the more specific to the more general. The child learns the word "flower" earlier than he learns the word "rose"; he learns the more general before the more specific. What are the laws that govern this movement of concepts from the general to the specific and from the specific to the general?

What laws govern this movement which occurs as concepts develop and function in the child's actual living thought? Until recently, this question has remained unanswered. In our research on the child's actual concepts, we have attempted to identify the most basic laws in this domain.

First of all, we were able to show that *generality* (i.e., the difference of generality) *does not coincide with the levels of structural generalization* that we identified in our experimental studies of concept formation (i.e., the levels associated with syncretic concepts, complexes, preconcepts, and true concepts).

First, concepts of different levels of generality are possible within any given structure of generalization. For example, concepts with different levels of generality (e.g., "flower" and "rose") may be present at the stage of complexes. It must be stipulated, of course, that each relationship of generality such as "flower–rose" will have a different nature for each structure of generalization (for the structures characteristic of complexes and preconcepts for example).

Second, concepts with the same level of generality may be present within different structures of generalization. For example, the concept of "flower" may have a general meaning that allows it to represent all species of flowers whether the structure is that of complexes or concepts. Of course, we must stipulate again that the identity of this generality is only a logical or object identity, not a psychological one. The relationship of generality that links "flower" and "rose" will differ depending on whether the structure is that characteristic of complexes or concepts. This relationship will be more concrete for the two-year-old. Here, it is as though the more general concept stands alongside the more specific and acts as a substitute for it. For the eight year old, one concept stands over the other; the more general concept includes the more specific.

Thus, there is no direct correspondence between relationships of generality and the structure of generalization. The two are not entirely foreign to each other nor entirely unconnected with one another. There is a complex mutual dependency between them. This dependency becomes accessible to research only when we recognize the absence of any direct correspondence between them, since no such relationship would be possible if such a correspondence existed. Concepts that are identical with respect to generality may exist in different structures of generalization. Similarly, concepts that differ in their generality may exist within a single structure of generalization. Nonetheless, for each structure of generalization, there will be different relationships of generality. This will be the case both when the concepts appear to be identical in logical terms and when they appear to be different.

The basic finding of our research is that relationships of generality between concepts are closely associated with the structure of generalization (i.e., they are closely associated with the stages of concept development that we studied in our experimental research). *Each structure of generalization* (*i.e., syncretic, complexes, preconcepts, and concepts*) *corresponds with a specific system of generality and specific types of relationships of generality between general and specific concepts.* Each structure of generalization has a characteristic degree of unity, a characteristic degree of abstractness or concreteness, and characteristic thought operations associated with a given level of development of word meaning.

An example may help clarify this point. In our experiments, a child who rarely spoke learned the meanings of five words (i.e., chair, table, cabinet, couch, bookcase) with no particular difficulty. He clearly would have been able to extend the series. However, he could not learn the word "furniture." Though the child could easily learn any word from the series of subordinate concepts, this more general word was impossible for him. Learning the word "furniture" represented something more than the addition of a sixth word to the five that the child had already mastered. It represented the mastery of the relationship of generality. The mastery of the word "furniture" represented the mastery of the child's first higher concept, a concept that would include a series of more specific subordinate concepts. This meant that the child would have to master a new type of relationship between concepts, a vertical rather than horizontal relationship.

This child was able to learn a new series of words (i.e., shirt, cap, fur coat, boots, and pants) but not to go beyond this by learning the word "clothes." *At a certain stage in the development of word meaning in the child, this kind of vertical movement involving these kinds of relationships of generality between concepts is generally inaccessible to the child.* Concepts lie in a single series that lacks hierarchical relationships. The relationship of these concepts to the object is immediate. They are differentiated entirely in terms of their image. The objects represented in them are differentiated in much the same way. This can be seen in the child's autonomous speech, a transitional stage of speech development between the child's preintellectual babbling and the mastery of adult language.

With a concept system which has a structure where the only relationships possible are those that exist between the objects that are reflected in the concepts, the child's verbal thinking will clearly be governed by the logic of graphic thinking. Since the only possible relationships between these concepts are object relationships, it would be more accurate to say that no verbal thinking is possible. At this stage, verbal thinking is dependent on graphic object thinking. This clearly identifiable structure of the concept system, and the limitations of the thought operations associated with it, allows us to isolate this as a special, pre-syncretic stage in the development of word meaning. This is why the appearance of the first higher concept (e.g., a concept such as "furniture" or "clothes" that subordinates a series of existing words) is such an important symptom of the development of the meaningful aspect of the child's speech. It is no less important in this respect than the appearance of the first meaningful word. With subsequent stages of concept development, relationships of generality begin to be formed. With each level of development, we find a unique system of relationships.

This is a general law. It provides the key to studying the genetic and psychological relationships between the general and the specific in the child's concepts. For each stage of generalization, there is a corresponding system of relationships and generality. General and specific concepts are ordered in a genetic series in correspondence with this system. Thus, in concept development, the movement from the general to the specific or from the specific to the general is different for each stage in the development of meaning depending on the structure of generalization dominant at that stage. With the transition from one stage to another, there is a change in the system of generality and the genetic order of the development of higher and lower concepts.

With the higher stages in the development of word meaning – the higher stages in the development of relationships of generality – a phenomenon of fundamental significance for all our thinking emerges. This phenomenon is defined by the law of concept equivalence. The law of concept equivalence says that *any concept can be represented through other concepts in an infinite number of ways.* This law requires some explanation.

Imagine that all concepts are distributed at certain longitudes like the points of the earth's surface between the North and South Poles. Concepts are distributed between poles ranging from an immediate, sensual, graphic grasping of the object to the ultimate generalization (i.e., the most abstract concept). The *longitude of a concept* designates the place it occupies between the poles of extremely graphic and extremely abstract thought about an object. Concepts would then be differentiated in longitudinal terms depending on the degree to which the unity of concrete and abstract is represented in each concept. Imagine further that the globe symbolizes for us all reality which is represented in concepts. We can then use *the concept's latitude* to designate the place it occupies among other concepts of the same longitude – concepts that correspond to other points of reality – just as the geographical latitude designates a point on the earth's surface in the degrees of the earth's parallels.

The concept's <u>longitude</u> represents the nature of the act of thought itself; it represents the way that the object is grasped in the concept in terms of the way that the concrete and the abstract are united in it. The concept's <u>latitude</u> represents its relationship to the object, the link between the concept and a particular point in reality. Together, its longitude and latitude represent both the act of thought and the object with which it is associated, that is, they represent the nature of the concept itself. Thus, they include all the relationships of generality in the domain of a given concept. They include relationships along the horizontal and along the vertical, that is, relationships to subordinated concepts and to higher and lower concepts in correspondence with a particular stage of generality. We will refer to the concept's place in the system of concepts, as defined by its longitude and latitude, as its *measure of generality.*

The use of this metaphor requires one stipulation if a fundamental misunderstanding is to be avoided. In geography, the relationships between longitude and latitude are lineal. Two lines cross at only a single point, with the meridian and parallel determining their position. This language of lineal relationships is not adequate to express the more complex relationships characteristic of the concept system. The content of the concept that is higher in its longitude is also broader. It incorporates a whole section of the lines of latitude of its subordinate concepts which require a whole series of points to designate it.

The measure of generality is the foundation for the relationship of the concept to all other concepts. It determines the potential for transitions from one concept to another and permits the establishment of an infinite number of relationships between them. This is the foundation of concept equivalence.

To clarify this idea, we will consider two extreme cases. On the one hand, we have the child's autonomous speech. Here relationships of generality among concepts are impossible. On the other, we have the developed scientific concept – the concept of number as it develops through arithmetic instruction for example. In the first case, concept equivalence is not possible. The concept cannot be expressed through other concepts. It can be expressed only by itself. The concept of any number in any system of calculation, on the other hand, can be expressed in an infinite number of ways. This reflects both the infinite nature of the number series itself and the fact that all of a number's possible relationships to other numbers are given in its concept. Thus, the number one can be expressed as 1,000,000 minus 999,999 or, more generally, as the difference between any two adjacent numbers. It can also be expressed as any number divided by itself or in an infinite number of other ways. This is a pure example of the law of concept equivalence.

In the child's autonomous speech, the concept does not have equivalents. This is because it does not have relationships of generality with other concepts. There are no relationships of longitude and latitude among them. There are no differing measures of generality which allow movement from one concept to another.

The law of equivalence is unique for each stage in the development of generalization. Concept equivalence is directly dependent on the relationships of generality between concepts and, as we have seen, the later are different for each structure of generalization. *Each structure of generalization, then, determines the potential for concept equivalence within its domain.*

The measure of generality determines the way that any concept functions. As phenomenological research shows, this is also true of the experience of concepts. When we name a particular concept (e.g., "mammal"), the networks of latitude and longitude place us at a specific point. In our thought, we have, in effect, occupied a definite position. We have received an initial point of orientation and we experience a readiness to move in any direction from this point. Any concept arising in isolation in consciousness forms a group of predispositions toward particular movements of thought. Therefore, a concept is represented in consciousness as a figure against the ground that is provided by the relationships of generality that correspond to it. From this ground, we select the required path for the movement of thought. In functional terms, then, the measure of generality *determines the set of possible operations of thought available for a given concept.* As is shown by research on children's concept definitions, these definitions are the direct expression of the laws of concept equivalence governing a given stage of the development of word meaning. In precisely the same way, any operation (i.e., any attempt to compare or establish identity or difference between two thoughts), judgment, or deduction presupposes a definite structural movement along the network of lines of longitudinal and relationships of latitude between concepts.

Where there is a pathological disintegration of concepts, there is a disturbance in the measure of generality and a disintegration of the unity of abstract and concrete in word meaning. Concepts lose their measure of generality and their relationship to other concepts (i.e., those that are higher, lower, and within their own series). The movement of thought begins to occur in a broken, incorrect, and inconsistent line. Thought becomes alogical and unrealistic to the extent that neither the act through which the concept grasps the object nor the relationship of the concept to the object any longer form a unity.

As the relationships of generality change with each new structure of generalization in the process of development, they elicit changes in all the operations of thinking accessible to the child. In particular, the long established independence of the word from the remembered thought increases with the development of relationships of generality and concept equivalence. The young child is completely reliant on the literal expression of the meaning that he learns. To a great extent, the school child already reproduces complex meaningful content independently of the particular verbal expression where he learned it. As relationships of generality develop, there is an increase in the concept's independence from the word. Meaning becomes increasingly independent of the form in which it is expressed. In general terms, there is an increasing freedom of the operations of meaning from their verbal expression.

We have long searched for a reliable way to identify the structures of generalization that characterize the meanings of the child's actual words, for a bridge that would allow us to move from the study of experimental concepts to the analysis of actual concepts. By establishing this connection *between the structure of generalization and relationships of generality,* we have found the key to this critical problem. By studying a concept's relationships of generality, by studying its measure of generality, we obtain the most reliable index of the structure of generalization of actual concepts. There is a meaning which stands in definite relationships of generality with other meanings. it has a specific measure of generality. The nature of the concept (i.e., whether it is syncretic, complexive, or preconceptual) is most fully revealed in the concept's relationships to other concepts. By studying the child's actual concepts (i.e., concepts such as "bourgeois," "capitalist," "landowner," or "kulak"), we can establish the specific relationships of generality that govern each stage of development from syncretic concepts to true concepts. This not only allows us to rebuild the bridge between the study of experimental and actual concepts but allows us to investigate characteristics of the structure of generalization that cannot be studied in an artificial experiment.

The most that the artificial experiment can provide is a general genetic scheme of the basic stages of concept development. The analysis of the child's actual concepts made it possible for us to study little known characteristics of syncretic concepts, complexes, and preconcepts; it made it possible to establish that in each of these spheres of thinking there is a different relationship between the concept and the object. The object is also grasped by a different act of thought. Thus, the two basic features that characterize the concept manifest their differences in the transition from one stage to the next. This implies that the nature of these concepts and all their characteristics differ. A different relationship to the object implies differences in the connections and relationships that are possible among the objects in thought. A different act of grasping the object in thought implies different connections among thoughts, that is, different kinds of mental operations. In each of these spheres, we find characteristics that are a function of the nature of the concept: (1) there is a different relationship to the object and to the meaning of the word; (2) there are different relationships of generality; and (3) there is a different set of possible operations.

However, this investigation of the child's actual concepts represents more than a bridge between the study of experimental and actual word meaning, more than a way of identifying new characteristics of concepts. This research has filled a fundamental gap in previous research. As a consequence, it allowed us to reevaluate the theoretical significance of that research.

In our earlier research, the relationship of the word to the object was analyzed anew with each stage in concept development (i.e., with the stages characterized by syncretic concepts, complexes, and true concepts). We ignored the fact that *each new stage in the development of generalization depends on the generalizations found in the preceding stages.* A new stage of generalization arises on the foundation provided by the previous stages. It does not emerge from a direct generalization of objects by thought, but from the generalization that was generalized in the previous structure of objects. It arises as a generalization of generalizations, not as a new mode of generalizing isolated objects. The results of previous efforts of thought which are expressed in the generalizations that dominate previous stages do not come to naught. They are included in the new work of thought. They are prerequisites for it.*

As a consequence, our earlier research could not establish either the self-movement inherent in the development of concepts or the *internal connections* among the various stages of development. In retrospect, it is clear that we should be criticized because we provided for the self-development of concepts while simultaneously deriving each new stage from a new external cause. The fundamental weakness of our previous research lies in the absence of any

* This idea is illustrated by the gradual development of concepts of history from the initial generalizations of "before" and "now" and the gradual development of sociological concepts from the initial generalizations of "among them" and "among us."

real self-development, in the absence of any real connection between the stages of development. This shortcoming was a function of the very nature of the experiment. It excluded any possibility of identifying the connections between the stages of concept development (i.e., of clarifying the nature of the transitions from one stage to the next) or of discovering the relationships of generality. This is reflected the fact that: (1) the experimental method required the subject to do away with the work he had done after each incorrect resolution – (destroying the previously formed generalization and beginning work anew with the generalization of distinct objects) and; (2) isolated from the experimental context, the concepts stood at the level of development characteristic of the child's autonomous speech; that is, they could be co-related along the horizontal plane but they could not be differentiated along lines of longitude. As a consequence, we inherently saw these stages as moving along on a single plane rather than as forming a spiral based on a series of connected and ascending circles.

By studying the development of actual concepts, however, we were immediately provided with a possibility of filling this gap. An analysis of the development of the preschooler's general representations (which correspond to the experimental concepts that we call complexes) indicated that general representations – as a higher stage in the development of word meaning – emerge not from the generalization of isolated representations but from generalized perceptions. That is, they emerge from the generalizations that dominated the previous stage. This conclusion, which we were able to make on the basis of our experimental research, solved the whole problem. In our study of arithmetic and algebraic concepts, we established an analogous relationship between new generalizations and those that precede them. Here, in studying the transition from the school child's preconcepts to the adolescent's concepts, we were able to establish what is in essence the same thing that we established in previous research on the transition from generalized perception to general representations (i.e., from syncretic concepts to complexes).

A new stage in the development of generalization is achieved only through the reformation – not the nullification – of the previous stage. The new stage is achieved through the generalization of the system of objects already generalized in the previous stage, not through a new generalization of isolated objects. The transition from preconcepts (e.g., the school child's arithmetic concept) to true concepts (e.g., the adolescent's algebraic concept) occurs through the generalization of previously generalized objects.

The preconcept is an abstraction of the number from the object and, based on this, a generalization of the object's numerical characteristics. The concept is an abstraction from the number and, based on this, a generalization of the relationships between numbers. The abstraction and generalization of one's own thought differs fundamentally from the abstraction and generalization of things. It does not constitute further movement in the same direction. It is not the completion of the initial process of abstraction and generalization. It is the beginning of a new direction in the movement of thought, a transition to a new and higher plane of thought. The generalization of one's own arithmetic operations and arithmetic thought is something different and something more advanced than the generalization of the numerical characteristics of objects that underlies the arithmetic concept. Nonetheless, the new concept or generalization arises on the foundation provided by the earlier one. This difference emerges clearly in the fact that the growth of algebraic generalizations is accompanied by a growth in the freedom of operations. The process involved in the liberation from links with the numerical field occurs differently than the process involved in the liberation from links with the visual field. The growth in freedom that occurs with the emergence of the algebraic generalization is explained by the potential for reverse movement from the higher stage to the lower that is inherent in the higher generalization; *the lower operation is already viewed as a special case of the higher.*

Arithmetic operations are preserved even after algebra is learned. This naturally leads to the question of what differentiates the arithmetic concept of the adolescent who has mastered algebra from that of the school child who has not. Research indicates that the adolescent views the arithmetic concept as a special case of the more general algebraic concept. Research also indicates that operations with the arithmetic concept become freer. Because of its independence from particular arithmetic expressions, it is applied in accordance with a more general formula.

With the young school child, the arithmetic concept is the final level. There is nothing beyond it. Therefore, movement within these concepts is always linked to the conditions of a specific arithmetic situation. The young school child cannot rise above this situation. The adolescent can. The adolescent's superior ability in this respect is a function of his mastery of the higher order algebraic concept. We observed a similar phenomenon in studies of the transition from the decimal system to other systems of numeration. The child learns to act with the decimal system before he becomes consciously aware of it. At this stage, the child has not mastered the system; he is bound to it.

Conscious awareness of the decimal system (i.e., the generalization that leads to an understanding of the decimal system as a particular kind of numerical system) leads to a potential for voluntary action in it or in any other numerical system. The criteria of consciousness lies in the potential for moving freely to another system. This represents the generalization of the decimal system, the formation of a general concept of numerical systems. Therefore, the transition to another system is a direct index of the generalization of the decimal system. The child moves from the decimal system to a base five system differently before he has a general formula for doing this than after he has such a formula. In this way, research consistently indicates the existence of connections between higher and lower forms of generalization and of connections to the object through these lower forms.

We must add that this research on the child's actual concepts led to the identification of the final link in the chain of transitions from one stage to another which we are concerned with here. Earlier, we spoke of the link between syncretic concepts and complexes in the transition from early childhood to the preschool age. We also discussed the link between preconcepts and concepts in the transition from the school child to the adolescent. Our research on scientific and everyday concepts casts light on a middle link that we have been unable to make up to this point. As we shall see, it permits us to identify the same type of dependency in the transition from the preschooler's general representations to the school child's preconcepts. Thus, the issue of the links and transitions between the various stages of concept development is completely resolved. We have resolved the question of the self-movement of developing concepts. This question was beyond our grasp in our earlier research.

The study of the child's actual concepts, however, has contributed still more. it not only allowed us to clarify the nature of *inter-stage* movements in concept development, but permitted us to address the issue of *intra-stage* movements (i.e., transitions within a single stage). For example, it allowed us to study the transitions from one type of complexive generalization to another more advanced type. Even here, the principle of the generalization of generalizations remains in force, though it is expressed differently. With transitions from one phase to the next within a single stage, the relationship to the object characteristic of the previous phase is preserved. The entire system of relationships of generality is not radically reconstructed in the way it is with the transition from one stage to the next. In the transition from one stage to another, there is a sharp restructuring of the relationship between the concept and the object as well as a restructuring of the relationships of generality between concepts.

These studies also led us to reconsider the issue of how the transition from one stage to another occurs in the development of meaning. The first study led to the assumption that the new structure of generalization simply nullified or displaced that which preceded it. The previous work of thought was reduced to naught. This implied that the transition to a new stage requires the re-formation of all word meanings that existed with the previous structure. This, of course, would be a truly Sisyphean labor!

This new research, however, indicates that this transition occurs in another way. The new structure of generalization is first formed by the child on the basis of only a few concepts. These concepts are usually newly acquired, through instruction for example. When this new structure has been mastered, the child can reconstruct or reform the structure of all previously existing concepts on this foundation. The previous labor of thought does not just drop away. The concept is not recreated with each new stage. Each meaning is not itself required do all the work involved in the rebuilding of the structure. As is true of all structural operations in thinking, new principles are mastered on the basis of several concepts. These are then transferred through structural laws to the entire domain of concepts.

We have seen that the new structure of generalization to which the child is led through instruction creates the potential for his thought to move to new and higher planes of logical operations. Since the existing concepts are drawn into these operations of thinking, their structure is also changed.

Finally, this *investigation* of the child's actual concepts helped us to resolve an additional significant question that was posed for the theory of thinking long ago. It has been known since the work of the Wurzburg school that the *connections* which determine the movement and flow of concepts are nonassociative. For example, Buhler demonstrated that remembering a thought or reproducing it occurs in accordance with meaningful connections rather than in accordance with the laws of association. However, we have still not resolved the question of how it is that connections determine the flow of thought. These *connections* have been described phenomenologically and extrapsychologically (e.g., as the connection of the goal and the means). In structural psychology, an attempt was made to define these connections structurally, but this definition has two fundamental deficiencies:

> 1. Given this definition, the connections of thinking are fully analogous to those of perception, memory, and all other functions. All are subordinated to structural laws. There is nothing new, higher, or unique to the connections of thinking when they are compared with the connections of perception and memory. The movement and coupling of concepts in thinking becomes incomprehensible. We cannot say how they differ from the structural coupling characteristic of perception and memory. Structural psychology repeats the mistake made by associative psychology. It too begins with the identification of the connections characteristic of perception, memory, and thinking. It fails to see what is specific to thinking. Traditional psychology began with the same two principles. With structural psychology, the principle of association is merely replaced by the principle of structure. The mode of explanation remains the same. In this respect, structural psychology took a step backward from the positions of the Wurzburg school. The Wurzburg school had established that the laws of thinking are not identical to those of memory, that thinking is a special type of activity governed by unique laws. For structural psychology, thinking does not have its own special laws. Structural psychology attempts to explain thinking on the basis of the same laws that govern the domains of perception and memory.
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> 2. The reduction of the connections in thinking to structural connections and their identification with the connections characteristic of perception and memory excludes any possibility for the development of thinking or for understanding thinking as a higher and unique form of activity. This identification of the laws of thought with the laws of memory directly contradicts our findings concerning the emergence of new and higher types of connections between thoughts with each new stage of concept development.

As we have seen, there are no relationships of generality among concepts in the child's autonomous speech (i.e., in the first stage of concept development). As a consequence, the only connections between concepts that are possible are those that can be established in perception. At this stage, thinking as an activity independent of perception is impossible. Thinking as such becomes possible only with the development of structures of generalization and with the emergence of increasingly complex relationships of generality among concepts. With the development of this structure of generalization, there is also a gradual spreading of the connections and relationships that form it. Finally, there is a transition to new and higher types of connections and movements among concepts. This fact cannot be explained on the basis of structural theory and its itself an adequate foundation for rejecting it.

We must ask, then, how these connections that are specific to thinking determine the movement and coupling of concepts. What is the nature of this "connection in accordance with meaning?" To answer these questions, we must move beyond the study of isolated concepts; we must move beyond the study of the single stitch to the investigation of the fabric of thought. With this, it becomes apparent that concepts are connected not by associative threads or in accordance with the structural principles of perceived or represented images but in accordance with their essential nature, *in accordance with relationships of generality.*

The definition of concepts, their comparison and differentiation, the establishment of logical relationships among them – all these operations of thought occur through the lines that connect concepts by relationships of generality, through the lines that determine the potential paths of movement from one concept to the next. The act of defining a concept is based on the law of concept equivalence which presupposes the possibility of this kind of movement from one concept to another. In this process, the longitude and latitude inherent in the concept to be defined – the measure of generality that determines the act of thought contained in the concept and its relationship to the object – is expressed through its connection with other concepts. In turn, these concepts have their own longitudes and latitudes, their own measures of generality that contain acts of thought and relationships to the object. Taken as a whole, however, the longitude and latitude of these concepts are the equivalent of the concept that has been defined. The comparison or differentiation of concepts also presupposes their generalization and movement along the lines representing relationships of generality to a higher concept that subordinates the concepts which are being compared. In the same way, the establishment of logical relationships among concepts which we find in the processes of judgment or deduction requires movement in accordance with these relationships of generality along the horizontal and vertical axes of the concept system.

An example of productive thinking may clarify this point. Wertheimer demonstrated that the common syllogism – as represented in textbooks of formal logic – does not belong to the domain of productive thought. With the syllogism, we ultimately arrive at what was known from the outset. Nothing is contained in the conclusion that was not contained in the premises. For the emergence of the truly productive act, for the emergence of thought that leads to something entirely new, that which constitutes our analytic problem and is part of structure "A" must unexpectedly enter structure "B". The destruction of the structure where the problematic point originally emerged and the transfer of this point to a completely different structure is the basic requirement for productive thinking. How is it possible that "X" (i.e., the problem that was an element in structure "A") can simultaneously enter structure "B"? Obviously, it becomes necessary to go beyond the limits of the existing structural dependencies. The problematic point must be torn from the structure where it is given in our thought. It must then be included in the new structure. Research indicates that this is realized through movement along the lines of the relationships of generality. it is realized through movement to a higher measure of generality, to a higher concept that stands above the subordinate structures "A" and "B". It is as if we are raised above concept "X" and then lowered to concept "B". This unique mode of overcoming structural dependencies is possible only as a consequence of the presence of definite relationships of generality among concepts.

We know, however, that to each structure of generalization there corresponds a specific system of relationships of generality. This is because generalizations of a given structure must exist in a given system of relationships of generality. Consequently, to each structure of generalization, there corresponds a specific system of logical operations of thinking that are possible for that structure. This is among the most important laws of the psychology of concepts. It indicates the unity of the structure and function of thinking, the unity of the concept and the operations which are possible for it.

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We can now attempt to clarify the differences between scientific and everyday concepts in light of our findings. The key difference in the psychological nature of _these two kinds of concepts is a function of the presence or absence of a system. Concepts stand in a different relationship to the object when they exist outside a system than when they enter one. The relationship of the word "flower" to the object is completely different for the child who does not yet know the words rose, violet, or lily than it is for the child who does. Outside a system, the only possible connections between concepts are those that exist between the objects themselves, that is, empirical connections. This is the source of the dominance of the logic of action and of syncretic connections of impressions in early childhood. Within a system, relationships between concepts begin to emerge. These relationships mediate the concept's relationship to the object through its relationship to other concepts. A different relationship between the concept and the object develops. *Supra – empirical connections between concepts become possible.*

It could be demonstrated that all the characteristics of the child's thought identified by Piaget, characteristics such as syncretism, insensitivity to contradiction, and the tendency to place things alongside one another, stem from the extrasystemic nature of the child's concepts. As we have seen, Piaget himself understands that the essential difference between the child's spontaneous concept and the concept of the adult is the extrasystemic nature of the first and the systemic nature of the second. This is why Piaget argues that to discover the child's spontaneous concepts, his statements must be freed from any trace of a system. The principle on which Piaget bases this argument is valid. Spontaneous concepts are by nature extrasystemic. The child, says Piaget, is not systematic. His thought is insufficiently connected or deductive and the need to avoid contradiction is generally absent. He tends to place judgments together in a series rather than synthesizing them. He is satisfied with syncretic schemes instead of analysis. In other words, the child's thought is more similar to a collection of lines flowing from the action or day – dream than it is to the adult's thought (thought which is systematic and characterized by conscious awareness). Thus, in Piaget's view, the absence of a system is an essential feature of the spontaneous concept. Piaget, however, does not understand that the nonsystemic nature of these concepts is not simply one of many features of the child's thought, but the root that gives rise to all the characteristics of the child's thinking that Piaget identifies.

All these characteristics stem from the extrasystemic nature of spontaneous concepts. Each of these characteristics – and the group as a whole – can be explained in terms of the relationships of generality characteristic of the complexive system of spontaneous concepts. The system of relationships of generality inherent in the complexive structure of the preschooler's concepts is the key to the entire phenomenon described and studied by Piaget.

We have begun work on a study devoted to precisely this issue. In the present context, however, we will address it only schematically. First, the inadequacy of the connectedness of the child's thought is a direct expression of an inadequate development of the relationships of generality among concepts. The inadequate nature of the child's deductions, in particular, stems from an underdevelopment of the connections among concepts along the longitudinal axis representing the relationships of generality.

We can also show that the absence of need to avoid contradiction inherently appears where individual concepts are not subordinated to a single superordinate concept. For contradiction to be sensed, the two contradictory judgments must be viewed as particular cases of a single, more general concept. As we have seen, this type of relationship among concepts is absent where concepts are not included in some system. It is, indeed, impossible.

In Piaget's experiments, the child maintains that a bead sinks because it is small at one point, while he claims it sinks because it is large at another. If we consider what occurs in our own thinking when we sense a clear contradiction between these two judgments, we can identify the source of the child's inability to sense this contradiction. The contradiction is noticed when the concepts expressed in the contradictory judgments are included in the structure of a single superordinate concept. It is at this point that we sense that we have expressed two contradictory judgments about o ne and the same thing. Due to the underdevelopment of the relationships of generality in the child, however, the two concepts cannot possibly be unified within the single structure of a higher concept. The result is that the child expresses two mutually exclusive judgments. From his perspective, however, these judgments relate to two different things. In the logic of the child's thought, the only relationships among concepts that are possible are those that exist among the objects themselves. Thus, the child's judgment is purely empirical in nature. This logic of perception does not know contradiction. Within this framework, the child is expressing two equally correct judgments. They are contradictory from the perspective of the adult but not from that of the child. The contradiction exists for the logic of thought but not for the logic of perception. The child can support his statements by citing obvious and irrefutable observations. In our own experiments, when we attempted to make children aware of this contradiction, they often responded by saying: "I saw it myself." Of course, the child actually did see the small bead sink at one point while he saw the large bead sink at another. The thoughts that underlie his judgments can be reduced to the following: "I saw that the small bead sank." "I saw that the large bead sank." The "because" that appears in the child's answer to the experimenter's question does not represent the establishment of a causal dependency. Such a causal dependency is incomprehensible to the child. It is, rather, related to the use of "because" that we encountered in our experiments based on the phrases that required completion, a use of the term characterized by a lack of conscious awareness or the capacity for volitional use.

The child's tendency to place concepts alongside one another is the inevitable expression of the absence of the movement of thought between concepts of higher and lower measures of generality. Likewise, the child's syncretic schemes are a characteristic expression of the dominance of empirical connections and the logic of perception in his thinking. The child takes the connections between his impressions for the connections between things.

Our research indicates that these phenomena are not characteristic of the child's scientific concepts. His scientific concepts are not subordinated to these laws. They restructure these phenomena. The structure of generalization governing each stage of concept development determines the corresponding system of relationships of generality among concepts. As a consequence, it also determines the operations of thinking that are possible at a given stage. This discovery of the common source of all the characteristics of the child's thought described by Piaget leads to a fundamental reassessment of Piaget's explanation of them. The source of these characteristics is not the egocentrism of the child's thought (i.e., what Piaget saw as a compromise between the logic of dreams and the logic of action). Their source lies in the unique relationships of generality among concepts that are characteristic of thought that has been woven from spontaneous concepts. It is not that the child's concepts stand further from real objects than the adult's. It is not that they are saturated with an autonomous autistic thinking. The key is that they stand in a different relationship to the object than the adult's – a closer and more immediate relationship.

As a consequence, the laws that govern this unique form of thought pertain only to the domain of spontaneous concepts. Even as they emerge, the scientific concepts of one and the same child will have different characteristics, characteristics which bear witness to their different natures. Arising from above, from the womb of other concepts, they are born through relationships of generality among concepts that are established in the process of instruction. By their very nature, scientific concepts include something of these relationships, some aspect of a system of concepts. The formal discipline of these scientific concepts is manifested in the complete restructuring of the child's spontaneous concepts. This is why the scientific concept is of such extraordinary importance for the history of the child's mental development.

AN this is contained in covert form within Piaget's own theory. By accepting these positions, we not only eliminate our confusion concerning his findings but are able to provide an adequate explanation for them. As a consequence, Piaget's whole system is exploded from within by the great force of the data that are packed within it, by data which were bound by the chains of erroneous thought. As we have seen, Piaget cites Claparède's law of conscious awareness. This law says that the more spontaneous the use of a concept, the less it will be characterized by conscious awareness. Consequently, spontaneous concepts – because they are spontaneous – will be characterized by a lack of conscious awareness and be unsuitable for voluntary use, Further, we have seen that the lack of conscious awareness means that generalization will also be absent. It means that the system of relationships of generality is underdeveloped. *Thus, spontaneity and a lack of conscious awareness of concepts, spontaneity and the extrasystemic nature of concepts, are synonymous.* Correspondingly, nonspontaneous scientific concepts, because of what makes them nonspontaneous, will be characterized from the outset by conscious awareness. From the outset, they will be characterized by the presence of a system. Our entire dispute with Piaget on this issue can be reduced to a single question: Do systemic concepts force out extrasystemic concepts, taking their place in accordance with the principle of substitution, or do they develop on the foundation provided by extra – systemic concepts by creating a definite system within the existing domain of concepts? The system is the cardinal point around which the whole history of concept development in the school age revolves. It is the new formation that arises in the child's thinking as part of the development of his scientific concepts. It raises his mental development to a higher stage.

The existence of this system that is introduced into the child's thinking with the development of scientific concepts helps to clarify the general theoretical issue of the nature of the relationships that exist between the development of thinking and the acquisition of knowledge (i.e., the relationships that exist between instruction and development). As we have said, Piaget divorces the two processes. In his view, the concepts that the child learns in school have no significance for research on the child's thought. The characteristics of the child's thought are lost in the characteristics of adult thinking with this concept. Therefore, Piaget pursues the study of thinking outside the context of instruction. He proceeds from the assumption that what develops in the child in the process of instruction is of no interest for those who are concerned with the development of the child's thought. For Piaget, instruction and development are incommensurable processes. They are entirely independent and unrelated.

Underlying this perspective is a rupture between the analysis of structure and function in the study of thought which has a long history in psychology.

In psychology, the earliest studies of thinking dealt only with its content. It was assumed that those who are more advanced in their mental development differed from those who are less advanced primarily in the quantity and quality of representations and the number of connections among these representations. The operations involved in thinking were assumed to be identical at different developmental stages.

Thorndike's book on the measurement of intellect is a recent attempt to defend this thesis on a grand scale. Thorndike argues that the development of thinking consists primarily of the formation of new connections between isolated representations. He assumes that a single, unbroken curve can be used to represent the entire process of mental development, a process that begins with the earthworm and culminates in the thinking of the contemporary American student. There are few psychologists today who would want to defend such a thesis.

As is often the case, the reaction against this perspective led to an exaggerated movement in the other direction. It was argued that representations are merely the material of thought, that they play no decisive role in it. Research was focused on the operations of thinking – on its functions. The process that occurs in a man's mind when he thinks became the central concern. This perspective was taken to its logical extreme by the Wurzburg school with their conclusion that objects that represent external reality (including the word) play no role in thinking. From this perspective, thinking is a purely spiritual act which consists of a purely abstract, nonsensual grasping of abstract relationships. On the basis of their experimental work, researchers who have pursued these ideas have proposed many practical ideas. They have also enriched our conception of the unique nature of intellectual operations. The question of how reality is reflected or generalized in thinking, however, has simply been ignored.

The one-sidedness and fruitlessness of this perspective has become increasingly apparent. There is now renewed interest in the material of thought (once the sole object of investigation). It is becoming clear that functions depend on the structure of that which is thought. Any act of thought must somehow establish a connection between the various aspects of reality which are represented in consciousness. The way that this reality is represented in consciousness cannot be without some significance in determining the operations of thinking that will be possible. In other words, the various functions of thinking are inevitably dependent on that which functions, is moved, and is the foundation of this process.

Stated yet more simply, the functions of thinking depend on the structure of thought itself. The character of the operations accessible for a given intellect depend on the structure of the thought that functions. Piaget's work is an extreme expression of this renewed interest in the structure of thought. Piaget, however, takes this interest in structure to an extreme. Like contemporary structural psychologists, he maintains that the functions themselves do not change in the course of development. it is the structures that change. It is this change in the structure that leads to the acquisition of new characteristics by the functions. This return to the analysis of the internal structure of the child's thought, to the analysis of its content, is fundamental to Piaget's work.

However, even Piaget does not resolve the basic problem, since he fails to eliminate the rupture between structure and function in thought. This is why he divorces instruction from development. When either the structural or the functional aspect of thought is excluded from analysis in favor of the other, psychological research on the problem of school instruction is no longer possible. If it is assumed that knowledge and thinking are incommensurable, any attempt to find a link between instruction and development will be doomed to failure. In contrast, if we attempt to unite the structural and functional aspects in the study of thinking, that is, if we begin with the idea that what functions influences the process of functioning, the problem not only becomes accessible but is solved.

Since the meaning of a word belongs to a certain type of structure, only a certain range of operations will be possible within this structure. A different range of operations requires a different structure. In the development of thinking we must deal with several very complex internal processes that change the internal structure of the fabric of thought. There are two aspects that we will always encounter in the concrete study of thinking. Both are of fundamental importance.

The first is the growth and development of the child's concepts, the development of word meaning in particular. The meaning of the word is a generalization. The unique structure of these generalizations represents a unique mode of reflecting reality in thought. This already implies that there will be different relationships of generality among concepts. Finally, different relationships of generality determine the different types of operations that are possible for a given form of thinking. The mode and character of functioning is determined by the structure of that which functions. This is the second critical aspect of any research on thinking. These two aspects of the problem are internally connected with one another. Where one is excluded in favor of the other, this is done to the detriment of the investigation as a whole.

Unifying both these aspects in a single investigation makes it possible to see connection, dependence, and unity where an exclusive, one-sided study sees metaphysical contradiction, antagonism, and permanent conflict, or (in the best case) a possibility for compromise between two incommensurable extremes. Our research indicates that spontaneous and scientific concepts have complex internal connections. In fact, if we fully extend this line of analysis, we find that we will at some point be able to study both spontaneous and scientific concepts within a single research framework. Instruction does not begin at school. It is present in the preschool age as well. We would anticipate that future research will show that the child's spontaneous concepts are the product of preschool forms of instruction, just as scientific concepts are the product of formal instruction in school. We know that the relationship between instruction and development differs with each developmental stage. With each stage, the character of development changes and the organization of instruction takes on a new form. Even more significant, however, is the fact that the relationship between instruction and development changes with each stage. We have developed this idea in more detail elsewhere. In this context, we will merely assert that future researchers must remember that the unique nature of the child's spontaneous concepts is entirely dependent on the relationship between instruction and development in the preschool age. We will refer to this as a transitional spontaneous-reactive form of instruction since it constitutes a bridge between the spontaneous instruction characteristic of early childhood and the reactive instruction common to the school age.

We will not speculate further on the findings of this future research. We have made only the first step in this new direction. While this new approach may seem to needlessly complicate what sometimes seems to be the simple questions of instruction and development – or of spontaneous and scientific concepts – future research will show that it is simply a crude simplification of the real complexities of the situation.

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In light of what we have said, the comparative study of everyday and scientific (i.e., social science) concepts and their development in the school age child carried out by Shif has a twofold significance. The first and the most immediate task of this research was to provide an experimental assessment of our working hypothesis concerning the unique developmental path of the scientific concept. Its second task was to resolve the more general problem of the relationship between instruction and development. We have outlined how this research resolved these two issues. A more complete discussion can be found in the research report itself. In this context, we will only say that these two issues have been satisfactorily resolved on the experimental plane for the first time in this research.

In dealing with these two issues, however, we must raise two additional issues that provide the necessary background for developing research on the first two.

First, we have the issue of the nature of the child's spontaneous concepts, concepts that have until now been considered the only legitimate object of psychological research on concepts and their development. Second, we have the issue of the school child's general psychological development, an issue that must be resolved in some manner before the narrower issues associated with the child's concepts and their development can be investigated. Of course, these latter two issues cannot occupy the same position in our research as the first two. They are not at the center of our attention. Therefore, our research provides only indirect evidence relating to them. Nonetheless, this evidence supports the relevant assumptions we have made in developing our hypothesis.

The most significant aspect of this research, however, is that it leads us to a new statement of the problem of concept development in the school-age child. It provides a working hypothesis which explains the findings of previous studies and is supported by the findings of the present study. Further, this research resulted in the development of methods for studying the child's actual concepts. As a consequence, it reestablished a bridge between the study of experimental concepts and the study of the child's actual living concepts. Moreover, it opened up a new and tremendously important field of investigation that is central to the whole history of the child's mental development. It demonstrated how the development of scientific concepts can be studied scientifically.

The practical significance of this research is that it created the potential for real psychological analysis of issues associated with instruction in the system of scientific concepts (this analysis was consistently guided by the principle and perspective of development). In this respect, this research is directly relevant to education. Though crudely and schematically, the findings of this study have clarified the nature of the processes that occur in the head of the pupil in the course of social science instruction.

We see three fundamental limitations in this research. First, our analysis focused on the general features of the child's social science concepts, not on the features specific to them. That is, in this research, social science concepts were treated more as a prototype for scientific concepts generally than as a particular or unique form of scientific concept. In these first research efforts in this new domain of investigation, we necessarily began by differentiating scientific and everyday concepts. We attempted to discover the unique characteristics of scientific concepts by studying a single form of scientific concept (i.e., the social science concept). Until we had established the line of demarcation between scientific and everyday concepts, the differences between the various types of scientific concepts (e.g., arithmetic, natural science, and social science concepts) could not become the focus of our work. This is inherent in the logic of scientific research. We must first identify the general features of a given domain of phenomena. Only then can begin to look at the differences which exist within each domain.

This explains why the concepts analyzed in this research are not the system of basic, core concepts that form the foundation of the social sciences, but several individual concepts that are not directly connected with one another. These concepts were selected in a simple empirical manner from the material that constitutes the educational program. This also explains why this research tells us more about the general nature of the development of scientific concepts than about the specific characteristics of social science concepts. Finally, this explains why these social science concepts were not compared with everyday concepts taken from comparable domains of social life.

'Me second obvious limitation of this work is that it is too general and insufficiently differentiated in its approach to concept structure, the relationships of generality inherent in a given structure, and the functions that determine a particular structure or particular relationships of generality. As we have seen, the first major limitation of this research made it impossible to address the internal connections in the system of social science concepts, although this is a fundamental issue concerning the development of the concept system. The second major limitation of this research had equally serious consequences. Specifically, we were not able to adequately develop the entire problem of the concept system, that is, the problem of the relationships of generality. As we have seen, this problem is fundamental to child development during the school years. Further, its resolution is basic to the construction of a bridge between the study of experimental concepts (with their structure) and the study of actual concepts (with their unity of structure and function of generalization of thought operations). This simplification was introduced with our statement of the research problem. We were forced to frame the problem more narrowly than we would have preferred. The result was what, under other conditions, would have been an unacceptable oversimplification in our analysis of the intellectual operations that were considered in the experiments. For example, we did not differentiate among various types of causal relationships or among the empirical, psychological, and logical meanings of the word "because." Piaget's work was much better than our own in this respect. One consequence of this was that phases of development within the school age could not be identified. We consciously sacrificed our capacity to make these distinctions in order to gain precision and certainty in our attempt to answer the more basic issue, the issue of the unique characteristics of the development of scientific concepts.

Finally, the third deficiency of this research lies in its inadequate experimental development of the two issues mentioned above, that is, the issue of the nature of everyday concepts and the issue of the general structure of psychological development in the school-age child. The issue of the relationship between the structure of the child's thinking (as described by Piaget) and the basic features of everyday concepts (i.e., their extrasystemic and nonvolitional nature) and the issue of the development of conscious awareness and volition with the emerging system of concepts is fundamental to the general problem of the school child's mental development. Neither of these problems has be resolved experimentally. They have not even been stated in a manner that will allow them to be subjected to experimental resolution. A separate study is needed for the full development of these issues. Consequently, our critique of Piaget's basic positions has inadequate experimental support.

We have outlined these limitations in our work because they allow us to point to the new lines of research that emerge beyond the final pages of our reports. In this way, we also identify this work as a first, modest effort in a new and extremely fruitful domain of psychological research.

We would also like to acknowledge that this working hypothesis and experimental research emerged somewhat differently in the research process than they are presented here. The dynamic process of research is always different from the way it is described and formulated in the scientific literature. Our working hypothesis was not fully constructed before we began our experimental research. Research never begins with a fully developed hypothesis. In Levine's words, the hypothesis and the experiment are two poles of a single dynamic whole. They are constructed, develop, and grow as a single unit. They fertilize one another and move one another forward.

In our view, among the most important indices of the plausibility and fruitfulness of our hypothesis is the fact that the experimental research and theoretical hypothesis – though developed simultaneously – led not only to consonant but to fully unified findings. They provided an illustration of the central point – the main thought – of our entire work. They illustrate the notion that the development of the corresponding concept is not completed but only beginning at the moment a new word is learned. The new word is not the culmination but the beginning of the development of a concept. The gradual, internal development of the word's meaning leads to the maturation of the word itself. Here, as everywhere, the development of the meaningful aspect of speech turns out to be the basic and decisive process in the development of the child's thinking and speech, While it has usually been assumed that the concept is ready when the word is ready, Tolstoy correctly states that "the word is almost always ready when the concept is."