Tool and Symbol in Child Development

The primary purpose of this book is to characterize the uniquely human aspects of behavior, and to offer hypotheses about the way these traits have been formed in the course of human history and the way they develop over an individual's lifetime.

This analysis will be concerned with three fundamental issues: (1) What is the relation between human beings and their environment, both physical and social? (2) What new forms of activity were responsible for establishing labor as the fundamental means of relating humans to nature and what are the psychological consequences of these forms of activity? (3) What is the nature of the relationship between the use of tools and the development of speech? None of these questions has been fully treated by scholars concerned with understanding animal and human psychology.

Karl Stumpf, a prominent German psychologist in the early years of the twentieth century, based his studies on a set of premises completely different from those I will employ here.[1] He compared the study of children to the study of botany, and stressed the botanical character of development, which he associated with maturation of the whole organism.

The fact is that maturation per se is a secondary factor in the development of the most complex, unique forms of human behavior. The development of these behaviors is characterized by complicated, qualitative transformations of one form of behavior into another (or, as Hegel would phrase it, a transformation of quantity into quality). The conception of maturation as a passive process cannot adequately describe these complex phenomena. Nevertheless, as A. Gesell has aptly

pointed out, in our approaches to development we continue to use the botanical analogy in our description of child development (for example, we say that the early education of children takes place in a "kindergarten").[2] Recently several psychologists have suggested that this botanical model must be abandoned.

In response to this kind of criticism, modern psychology has ascended the ladder of science by adopting zoological models as the basis for a new general approach to understanding the development of children. Once the captive of botany, child psychology is now mesmerized by zoology. The observations on which these newer models draw come almost entirely from the animal kingdom, and answers to questions about children are sought in experiments carried out on animals. Both the results of experiments with animals and the procedures used to obtain these results are finding their way from the animal laboratory into the nursery.

This convergence of child and animal psychology has contributed significantly to the study of the biological basis of human behavior. Many links between child and animal behavior, particularly in the study of elementary psychological processes, have been established. But a paradox has now emerged. When the botanical model was fashionable, psychologists emphasized the unique character of higher psychological functions and the difficulty of studying them by experimental means. But this zoological approach to the higher intellectual processes—those processes that are uniquely human—has led psychologists to interpret the higher intellectual functions as a direct continuation of corresponding processes in animals. This style of theorizing is particularly apparent in the analysis of practical intelligence in children, the most important aspect of which concerns the child's use of tools.

PRACTICAL INTELLIGENCE IN ANIMALS AND CHILDREN

The work of Wolfgang Köhler is particularly significant in the study of practical intelligence.[3] He conducted many experiments with apes during World War I, and occasionally compared some of his observations of chimpanzees' behavior with particular kinds of responses in children. This direct analogy between practical intelligence in the child and similar response by apes became the guiding principle of experimental work in the field.

K. Buhler's research also sought to establish similarities between child and ape.[4] He studied the way in which young children grasp objects, their ability to make detours while pursuing a goal, and the manner in which they use primitive tools. These observations, as well as his experiment in which a young child is asked to remove a ring from a stick, illustrate an approach akin to Köhler's. Buhler interpreted the manifestations of practical intelligence in children as being of exactly the same type as those we are familiar with in chimpanzees. Indeed, there is a phase in the life of the child that Buhler designated the "chimpanzee age" (p. 48). One ten-month-old infant whom he studied was able to pull a string to obtain a cookie that was attached to it. The ability to remove a ring from a post by lifting it rather than trying to pull it sideways did not appear until the middle of the second year.[5] Although these experiments were interpreted as support for the analogy between the child and apes, they also led Buhler to the important discovery, which will be explicated in later sections, that the beginnings of practical intelligence in the child (he termed it "technical thinking"), as well as the actions of the chimpanzee, are independent of speech.

Charlotte Buhler's detailed observations of infants during their first year of life gave further support to this conclusion.[6] She found the first manifestations of practical intelligence took place at the very young age of six months. However, it is not only tool use that develops at this point in a child's history but also systematic movement and perception, the brain and hands—in fact, the child's entire organism. Consequently, the child's system of activity is determined at each specific stage *both by the child's degree of organic development and by his or her degree of mastery in the use of tools.*

K. Buhler established the developmentally important principle that the beginnings of intelligent speech are preceded by technical thinking, and technical thinking comprises the initial phase of cognitive development. His lead in emphasizing the chimpanzee-like features of children's behavior has been followed by many others. It is in extrapolating this idea that the dangers of zoological models and analogies between human and animal behaviors find their clearest expression. The pitfalls are slight in research that focuses on the preverbal period in the child's development, as Buhler's did. However, he drew a questionable conclusion from his work with very young children when he stated, "The achievements of the chimpanzee are quite independent of language and in the case of man, even in later life, technical thinking, or thinking in terms of tools, is far less closely bound up with language and concepts than other forms of thinking."[7]

Buhler proceeded from the assumption that the relationship between practical intelligence and speech that characterizes the ten-

month-old child remains intact throughout her lifetime. This analysis postulating the independence of intelligent action from speech runs contrary to our own findings, which reveal the integration of speech and practical thinking in the course of development.

Shapiro and Gerke offer an important analysis of the development of practical thinking in children based upon experiments modeled after Köhler's problem-solving studies with chimpanzees.[8] They theorize that children's practical thinking is similar to adult thought in certain respects and different in others, and emphasize the dominant role of social experience in human development. In their view, social experience exerts its effect through imitation. when the child imitates the way adults use tools and objects, she masters the very principle involved in a particular activity. They suggest that repeated actions pile up, one upon another, as in a multi-exposure photograph; the common traits become clear and the differences become blurred. The result is a crystalized scheme, a definite principle of activity. The child, as she becomes more experienced, acquires a greater number of models that she understands. These models represent, as it were, a refined cumulative design of all similar actions; at the same time, they are also a rough blueprint for possible types of action in the future.

However, Shapiro and Gerke's notion of adaptation is too firmly linked to a mechanical conception of repetition. For them, social experience serves only to furnish the child with motor schemas; they do not take into account the changes occurring in the internal structure of the child's intellectual operations. In their descriptions of children's problem solving, the authors are forced to note the "specific role fulfilled by speech" in the practical and adaptive efforts of the growing child. But their description of this role is a strange one. "Speech," they say, "replaces and compensates for real adaptation, it does not serve as a bridge leading to past experience but to a purely social adaptation which is achieved via the experimenter." This analysis does not allow for the contribution speech makes to the development of a new structural organization of practical activity.

Guillaume and Meyerson offer a different conclusion regarding the role of speech in the inception of uniquely human forms of behavior.[9] From their extremely interesting experiments on tool use among apes, they concluded that the methods used by apes to accomplish a given task are similar in principle and coincide on certain essential points to those used by people suffering from aphasia (that is, individuals who are deprived of speech). Their findings support my assumption that speech plays an essential role in the organization of higher psychological functions.[10]

These experimental examples bring us full circle to the beginning of our review of psychological theories regarding child development. Buhler's experiments indicate that the practical activity of the young child prior to speech development is identical to that of the ape, and Guillaume and Meyerson suggest that the ape's behavior is akin to that observed in people who are deprived of speech. Both of these lines of work focus our attention on the importance of understanding the practical activity of children at the age when they are just beginning to speak. My own work as well as that of my collaborators is directed at these same problems. But our premises differ from those of previous investigators. Our primary concern is to describe and specify the development of those forms of practical intelligence that are specifically human.

RELATION BETWEEN SPEECH AND TOOL USE

In his classic experiments with apes Köhler demonstrated the futility of attempting to develop even the most elementary sign and symbolic operations in animals. He concluded that tool use among apes is independent of symbolic activity. Further attempts to cultivate productive speech in the ape have also produced negative results. These experiments showed once more that the purposive behavior of the animal is independent of any speech or sign-using activity.

The study of tool use in isolation from sign use is common in research work on the natural history of practical intellect and psychologists who studied the development of symbolic processes in the child have followed the same procedure. Consequently, the origin and development of speech, as well as all other sign-using activity, were treated as independent of the organization of the child's practical activity. Psychologists preferred to study the development of sign use as an example of pure intellect and not as the product of the child's developmental history. They often attributed sign use to the child's spontaneous discovery of the relation between signs and their meanings. As W. Stern stated, recognition of the fact that verbal signs have meaning constitutes "the greatest discovery in the child's life."[11] A number of authors fix this happy "moment" at the juncture of the child's first and second year, regarding it as the product of the child's mental activity. Detailed examination of the *development of* speech and other forms of sign use was assumed to be unnecessary. Instead, it has routinely been as-

sumed that the child's mind contains all stages of future intellectual development; they exist in complete form, awaiting the proper moment to emerge.

Not only were speech and practical intelligence assumed to have different origins, but their joint participation in common operations was considered to be of no basic psychological importance (as in the work of Shapiro and Gerke). Even when speech and the use of tools were closely linked in one operation, they were still studied as separate processes belonging to two completely different classes of phenomena. At best, their simultaneous occurrence was considered a consequence of accidental, external factors.

The students of practical intelligence as well as those who study speech development often fail to recognize the interweaving of these two functions. Consequently, the children's adaptive behavior and sign-using activity are treated as parallel phenomena—a view that leads to Piaget's concept of "egocentric" speech.[12] He did not attribute an important role to speech in the organization of the child's activities, nor did he stress its communicative functions, although he was obliged to admit its practical importance.

Although practical intelligence and sign use can operate independently of each other in young children, the dialectical unity of these systems in the human adult is the very essence of complex human behavior. Our analysis accords symbolic activity a specific *organizing* function that penetrates the process of tool use and produces fundamentally new forms of behavior.

SOCIAL INTERACTION AND THE TRANSFORMATION OF PRACTICAL ACTIVITY

Based on the discussion in the previous section, and illustrated by experimental work to be described later, the following conclusion may be made: *the most significant moment in the course of intellectual development, which gives birth to the purely human forms of practical and abstract intelligence, occurs when speech and practical activity, two previously completely independent lines of development, converge.* Although children's use of tools during their preverbal period is comparable to that of apes, as soon as speech and the use of signs are incorporated into any action, the action becomes transformed and organized along entirely new lines. The specifically human use of tools is thus realized, going beyond the more limited use of tools possible among

Prior to mastering his own behavior, the child begins to master his surroundings with the help of speech. This produces new relations with the environment in addition to the new organization of behavior itself. The creation of these uniquely human forms of behavior later produce the intellect and become the basis of productive work: the specifically human form of the use of tools.

Observations of children in an experimental situation similar to that of Köhler's apes show that the children not only *act* in attempting to achieve a goal but also *speak*. As a rule this speech arises spontaneously and continues almost without interruption throughout the experiment. It increases and is more persistent every time the situation becomes more complicated and the goal more difficult to attain. Attempts to block it (as the experiments of my collaborator R. E. Levina have shown) are either futile or lead the child to "freeze up."

Levina posed practical problems for four- and five-year-old children such as obtaining a piece of candy from a cupboard. The candy was placed out of reach so the child could not obtain it directly. As the child got more and more involved in trying to obtain the candy, "egocentric" speech began to manifest itself as part of her active striving. At first this speech consisted of a description and analysis of the situation, but it gradually took on a "planful" character, reflecting possible paths to solution of the problem. Finally, it was included as part of the solution.

For example, a four-and-a-half-year-old girl was asked to get candy from a cupboard with a stool and a stick as possible tools. Levina's description reads as follows: (Stands on a stool, quietly looking, feeling along a shelf with stick.) "On the stool." (Glances at experimenter. Puts stick in other hand.) "Is that really the candy?" (Hesitates.) "I can get it from that other stool, stand and get it." (Gets second stool.) "No, that doesn't get it. I could use the stick." (Takes stick, knocks at the candy.) "It will move now." (Knocks candy.) "It moved. I couldn't get it with the stool, but the, but the stick worked."[13]

In such circumstances it seems both natural and necessary for children to speak while they act; in our research we have found that speech not only accompanies practical activity but also plays a specific role in carrying it out. Our experiments demonstrate two important facts:

(1) A child's speech is as important as the role of action in attaining the goal. Children not only speak about what they are doing; their speech and action are part of *one and the same complex psychological function*, directed toward the solution of the problem at hand.

(2) The more complex the action demanded by the situation and

the less direct its solution, the greater the importance played by speech in the operation as a whole. Sometimes speech becomes of such vital importance that, if not permitted to use it, young children cannot accomplish the given task.

These observations lead me to the conclusion that *children solve practical tasks with the help of their speech, as well as their eyes and hands.* This unity of perception, speech, and action, which ultimately produces internalization of the visual field, constitutes the central subject matter for any analysis of the origin of uniquely human forms of behavior.

To develop the first of these two points, we must ask: What is it that really distinguishes the actions of the speaking child from the actions of an ape when solving practical problems?

The first thing that strikes the experimenter is the incomparably greater *freedom* of children's operations, their greater independence from the structure of the concrete, visual situation. Children, with the aid of speech, create greater possibilities than apes can accomplish through action. One important manifestation of this greater flexibility is that the child is able to ignore the direct line between actor and goal. Instead, he engages in a number of preliminary acts, using what we speak of as instrumental, or mediated (indirect), methods. In the process of solving a task the child is able to include stimuli that do not lie within the immediate visual field. Using words (one class of such stimuli) to create a specific plan, the child achieves a much broader range of activity, applying as *tools* not only those objects that lie near at hand, *but searching for and preparing such stimuli as can be useful in the solution of the task, and planning future actions.*

Second, the practical operations of a child who can speak become much less impulsive and spontaneous than those of the ape. The ape typically makes a series of uncontrolled attempts to solve the given problem. In contrast, the child who uses speech divides the activity into two consecutive parts. She plans how to solve the problem through speech and then carries out the prepared solution through overt activity. Direct manipulation is replaced by a complex psychological process through which inner motivation and intentions, postponed in time, stimulate their own development and realization. This new kind of psychological structure is absent in apes, even in rudimentary forms.

Finally, it is decisively important that speech not only facilitates the child's effective manipulation of objects but also controls *the child's own behavior.* Thus, with the help of speech children, unlike apes, acquire the capacity to be both the subjects and objects of their own behavior.

Experimental investigation of the egocentric speech of children engaged in various activities such as that illustrated by Levina produced the second fact of great importance demonstrated by our experiments: *the relative amount of egocentric speech,* as measured by Piaget's methods, increases in relation to the difficulty of the child's task.[14] On the basis of these experiments my collaborators and I developed the hypothesis that children's egocentric speech should be regarded as the transitional form between external and internal speech. Functionally, egocentric speech is the basis for inner speech, while in its external form it is embedded in communicative speech.

One way to increase the production of egocentric speech is to complicate a task in such a way that the child cannot make direct use of tools for its solution. When faced with such a challenge, the children's emotional use of language increases as well as their efforts to achieve a less automatic, more intelligent solution. They search verbally for a new plan, and their utterances reveal the close connection between egocentric and socialized speech. This is best seen when the experimenter leaves the room or fails to answer the children's appeals for help. Upon being deprived of the opportunity to engage in social speech, children immediately switch over to egocentric speech.

While the interrelationship of these two functions of language is apparent in this setting, it is important to remember that egocentric speech is linked to children's social speech by many transitional forms. The first significant illustration of the link between these two language functions occurs when children find that they are unable to solve a problem by themselves. They then turn to an adult, and verbally describe the method that they cannot carry out by themselves. The greatest change in children's capacity to use language as a problem-solving tool takes place somewhat later in their development, when socialized speech (which has previously been used to address an adult) *is turned inward.* Instead of appealing to the adult, children appeal to themselves, language thus takes on an *intrapersonal function* in addition to its *interpersonal use.* When children develop a method of behavior for guiding themselves that had previously been used in relation to another person, when they organize their own activities according to a social form of behavior, they succeed in applying a social attitude to themselves. The history of the process of *the internalization of social speech* is also the history of the socialization of children's practical intellect.

The relation between speech and action is a dynamic one in the course of children's development. The structural relation can shift even during an experiment. The crucial change occurs as follows: At an

early stage speech *accompanies* the child's actions and reflects the vicissitudes of problem solving in a disrupted and chaotic form. At a later stage speech moves more and more toward the starting point of the process, so that it comes to *precede* action. It functions then as an aid to a plan that has been conceived but not yet realized in behavior. An interesting analogy can be found in children's speech while drawing (see also chapter 8). Young children name their drawings only after they have completed them; they need to see them before they can decide what they are. As children get older they can decide in advance what they are going to draw. This displacement of the naming process signifies a change in the function of speech. Initially speech follows actions, is provoked by and dominated by activity. At a later stage, however, when speech is moved to the starting point of an activity, a new relation between word and action emerges. Now speech guides, determines, and dominates the course of action; *the planning function of speech* comes into being in addition to the already existing function of language to reflect the external world.[15]

Just as a mold gives shape to a substance, words can shape an activity into a structure. However, that structure may be changed or reshaped when children learn to use language in ways that allow them to go beyond previous experiences when planning future action. In contrast to the notion of sudden discovery popularized by Stern, we envisage verbal, intellectual activity as a series of stages in which the emotional and communicative functions of speech are expanded by the addition of the planning function. As a result the child acquires the ability to engage in complex operations extending over time.

Unlike the ape, which Köhler tells us is "the slave of its own visual field," children acquire an independence with respect to their concrete surroundings, they cease to act in the immediately given and evident *space*. Once children learn how to use the planning function of their language effectively, their psychological field changes radically. A view of the future is now an integral part of their approaches to their surroundings. In subsequent chapters, I will describe the developmental course of some of these central psychological functions in greater detail.

To summarize what has been said thus far in this section: The specifically human capacity for language enables children to provide for auxiliary tools in the solution of difficult tasks, to overcome impulsive action, to plan a solution to a problem prior to its execution, and to master their own behavior. Signs and words serve children first and foremost as a means of social contact with other people. The cognitive and communicative functions of language then become the basis of a

new and superior form of activity in children, distinguishing them from animals.

The changes I have described do not occur in a one-dimensional even fashion. Our research has shown that very small children solve problems using unique mixtures of processes. In contrast with adults, who react differently to objects and to people, young children are likely to fuse action and speech when responding to both objects and social beings. This fusion of activity is analagous to syncretism in perception which has been described by many developmental psychologists.

The unevenness I am speaking of is seen quite clearly in a situation where small children, when unable to solve the task before them easily, combine direct attempts to obtain the desired end with a reliance upon emotional speech. At times speech expresses the children's desires, while at other times it serves as a substitute for actually achieving the goal. The child may attempt to solve the task through verbal formulations *and* by appeals to the experimenter for help. This mixture of diverse forms of activity was at first bewildering; but further observations drew our attention to a sequence of actions that clarify the meaning of the children's behavior in such circumstances. For example, after completing a number of intelligent and interrelated actions that should help him solve a particular problem successfully, the child suddenly, upon meeting a difficulty, ceases all attempts and turns for help to the experimenter. Any obstacle to the child's efforts at solving the problem may interrupt his activity. The child's verbal appeal to another person is an effort to fill the hiatus his activity has revealed. By asking a question, the child indicates that he has, in fact, formulated a plan to solve the task before him, but is unable to perform all the necessary operations.

Through repeated experiences of this type, children learn covertly (mentally) to plan their activities. At the same time they enlist the assistance of another person in accordance with the requirements of the problem posed for them. The child's ability to control another person's behavior becomes a necessary part of the child's practical activity.

Initially this problem solving in conjunction with another person is not differentiated with respect to the roles played by the child and his helper; it is a general, syncretic whole. We have more than once observed that in the course of solving a task, children get confused because they begin to merge the logic of what they are doing with the logic of the same problem as it has to be solved with the cooperation of another person. Sometimes syncretic action manifests itself when children realize the hopelessness of their direct efforts to solve a problem. As in the example from Levina's work, children address the objects of their atten-

tion equally with words and sticks, demonstrating the fundamental and inseparable tie between speech and action in the child's activity; this unity becomes particularly clear when compared with the separation of these processes in adults.

In summary, children confronted with a problem that is slightly too complicated for them exhibit a complex variety of responses including direct attempts at attaining the goal, the use of tools, speech directed toward the person conducting the experiment or speech that simply accompanies the action, and direct, verbal appeals to the object of attention itself.

If analyzed dynamically, this alloy of speech and action has a very specific function in the history of the child's development; it also demonstrates the logic of its own genesis. From the very first days of the child's development his activities acquire a meaning of their own in a system of social behavior and, being directed towards a definite purpose, are refracted through the prism of the child's environment. The path from object to child and from child to object passes through another person. This complex human structure is the product of a developmental process deeply rooted in the links between individual and social history.

2

The Development of Perception and Attention

The linkage between tool use and speech affects several psychological functions, in particular perception, sensory-motor operations, and attention, each of which is part of a dynamic system of behavior. Experimental-developmental research indicates that the connections and relations among functions constitute systems that change as radically in the course of a child's development as do the individual functions themselves. Considering each function in turn, I will examine how speech introduces qualitative changes in both its form and its relation to other functions.

Köhler's work emphasized the importance of the structure of the visual field in organizing the ape's practical behavior. The entire process of problem solving is essentially determined by perception. In this respect Köhler had ample grounds for believing that these animals are bound by their sensory field to a much greater extent than adult humans. They are incapable of modifying their sensory field by means of voluntary effort. Indeed, it would probably be useful to view as a general law the dependence of all natural forms of perception on the structure of the sensory field.

However, a child's perception, because it is *human*, does not develop as a direct continuation and further perfection of the forms of animal perception, not even of those animals that stand nearest to humankind. Experiments conducted to clarify this problem led us to discover some basic laws that characterize the higher human forms of perception.

The first set of experiments concerned developmental stages of picture perception in children. Similar experiments describing specific aspects of young children's perception and its dependence on higher