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# Bruner on Mental Development<sup>1</sup>

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**E**DUCATORS have long had a professional concern for understanding the nature of human cognitive processes. This concern has sustained a continuing interest in the research and theoretical developments transpiring at Harvard's Center for Cognitive Studies under the direction of Jerome S. Bruner. Bruner's work is, for several reasons, of particular interest to persons encountering children in classrooms. First, he has never limited his interests to the psychological phenomena of cognitive development in and of themselves (1960a and 1966a). In addition, Bruner has actively participated in the development of curricular materials (1965; Bruner and Kenney, 1965) and teaching strategies (1961, 1968a, 1969a). Finally, Bruner is interested in the individual's readiness to learn (1957, 1960b) and believes that education has broad social objectives (1964a) as well as the immediate goals of skill development as indices of the development of intelligent behavior (1960c, 1964b).

In his early discussions of discovery learning (1961, 1966b), Bruner emphasized the learner's ability to resolve ambiguity in the stimulus field, which depends upon the ability to perceive the stimuli and to process the informational input from the environment (1963, 1964b). This position has

classified Bruner as a functional information-processing theorist, and is closely related to his most recent research into the cognitive processes of infants (1967, 1968b, 1969b).

In his effort to understand the integration of eye and hand movement in the development of intelligence, Bruner has identified four primary concerns (1969d, p. 224): *intention* (voluntary, self-initiated activity), *skill* (the ability to overcome human awkwardness), *attention* (how the afferent domination of perception and attention alters to become efferently relevant), and *integration* (the "orchestration" of previously separate activities).

### The Eye

In the main, Bruner believes that human vision guides the development of voluntary hand movements (1969d, pp. 224-27) and the eventual development of hand-to-hand relationships, which appear to take approximately two years during childhood. Immediately after birth the infant's vision is diffusely distractible. This phase is followed by a period when human vision is characterized by the obligatory nature of attention, that is, attention seems to be "stuck." This period is in turn followed by the development of anticipatory and predictive vision. During the first two periods, the human's attention is directed *outward* to the environment, searching for an object or person on which to fasten.

<sup>1</sup> The author is grateful to Professor Bruner for his comments and his provision of the necessary papers to obtain an integrated view of his research.

This pattern changes gradually during the development of biphasic attention, which allows the infant to anticipate objects in the environment, that is, the infant moves attention from one object to another without intermediate drifting. Bruner believes this is what Piaget (1952) calls a "visual schema" in which objects are related to other objects in the environment.

In his writings, Bruner places great emphasis on the development of biphasic attention, which he sees as crucial since the human now *processes* information instead of just receiving it. This developmental change involves not only the infant's placement of attention, but also the withdrawing and shifting of attention. The development of biphasic attention comes before precise coordination of the hand and eye, that is, visually guided reaching which involves an *orientative visual matrix*, explaining the individual's appreciation of seen hand movements. This matrix includes an understanding of both vision and line of sight as compensated for by eye and head movements. During the period of the development of the orientative visual matrix, the individual is also developing hand-mouth coordination and vision-mouth coordination. Bruner sees the mouth as the terminus of guided reaching activity.

## The Hand

*Taking possession of objects.* In an early study, Jonckheere (1968c) examined the use of simple tools in early childhood. Using children from 18-24 months old, Jonckheere required the subjects (Ss) to retrieve an object beyond arms' reach with a rake. The Ss in this *gestalt*-like study were unsuccessful in accomplishing the task. Bruner believes they failed because they could not orchestrate the component behaviors into an effective whole; that is, integration of component behaviors appears to be a most difficult requirement in the development of human manual intelligence.

To support his ideas, Bruner and his associates designed a follow-up to the Jonckheere study, which Bruner believes demonstrated a strong relationship between control

of skilled behavior and later problem solving, a relationship which Bruner calls programmatic.

This programmatic relationship is confirmed by the fact that skilled behavior and problem solving share several features. In particular, the two types of behavior share the feature of productivity; that is, a set of component or constituent behaviors with rules for combination are capable of generating a repertory of higher level behaviors. To confirm his interpretation, Bruner used 49 infant Ss from 4-18 months, and presented the Ss with a series of toys. The first presentation was of a single toy which, once dealt with by the S, was followed by a second presentation of another toy, and so on, to the fourth presentation.

The youngest Ss in this study could handle only the initial presentation, but the 6-8 month Ss demonstrated that simple reach and grasp were now embedded in more complex behavior. These Ss took the second toy, sometimes transferring the object to an empty hand, a behavior which was preceded by the infant's bringing and holding the toy at midline. This gradually changed to *anticipatory* hand-over, wherein Ss expected a second presentation, and some Ss crossed the midline to make the transfer either by traversing the midline or by adjusting it by body shift.

The 9-11 month Ss showed another important development. Many could now handle three presentations by depositing one of the toys for a short period of time. At 12 months, many of the children anticipated additional presentations and were adept at storage for this eventuality. In addition, at this age, many had developed to the point where there was a significant enough reserve of prehensibility to allow them to accept another toy in the same hand. These older children also used other people, such as the mother, as storage agents.

For heuristic purposes, Bruner uses an information processing model, and interprets the initial failures of his Ss as uncontrolled activity. He considers the infant's eventual successes with the environment as the first steps toward voluntary and unitary action;

effortless subroutines are developed which are in turn incorporated into more complex acts. Bruner identifies this developmental process as *modularization*, a major process requiring several supporting processes, including the notion of developed behaviors triggering behaviors to-be-developed, a concept sometimes associated with ethology. However, he sees this as the progressive incorporation of behavioral modules into programs.

For explanatory power, Bruner uses Bernstein's model including (a) the individual's *effector activity* regulated according to specific parameters, (b) a *control element* which conveys the value of the parameter, (c) a *receptor* which perceives the factual value of the behavior in relation to the parameter, (d) a *comparator* which perceives discrepancies between the factual and required values, (e) an *encoding device* which corrects behaviors, and (f) a *regulator* which in turn controls the effector activity. Like most IP models, this is an open-energy,

closed-loop system, and learning effects changes in the control, receptor, and comparator mechanisms.

### Acquisition of Complementary Two-Handedness

Success in two-handedness increases with age, and appears to be a function of controlling interfering activities such as clawing and banging. As the Ss' control increased, there was less likelihood that component acts would become autonomous. Early success allows for the perfection and reinforcement of serial ordering of modularized behaviors, which leads to eventual skill mastery. Bruner believes that the first appearance of a constituent activity is *innate*, occurring in a crudely controlled form, and that it is only after the initial appearance that the behavior is consolidated and shaped. He holds that the emergence of a behavioral pattern or strategy seems independent of practice, and does not develop as the result of trial and error; in-



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stead, development appears to be in response to environmental demands and events (operative requirements) which require the *intention* of the learner.

## Development of Detour Reaching

In his study of human manipulator behavior, Bruner manipulated the experimental situation by using both transparent and opaque screens. There were four positions for the object from "open" (no obstruction) to "deep" (5" behind screen). The screen was at the S's midline. One most intriguing observation was the performance differences by age in relation to the type of screen. The youngest Ss were more successful with an opaque screen than with the transparent screen, a result which Bruner interprets as a reduction of interference in the detour reaching of the youngest Ss.

Several behavioral organizations were observed in this study, and Bruner identified a progression of processes: activation of the hand nearest the goal (ipsilateral hand); activation of the appropriate hand; the appreciation of spatial demands; dissociation of line of action from line of sight; ability to shift behavioral program; and the ability to sequence instrumental behaviors in order to reach the goal. As in the other investigations of manual intelligence, Bruner sees in the development of detour reaching a close relationship between initial skill learning and later problem solving; all dependent upon the individual's integration of constituent behaviors with prerequisites of intention, skill, and attention.

In conclusion, Bruner, in his latest research, has evolved several concepts which seem important for educators. First, the development of intelligent behavior seems even more to be a matter of sequence. Second, skilled behavior is not an entity in and of itself; rather, it is the result of integrating constituent behavior. In addition, Bruner seems to have shown that the control of the stimulus field and the amount of the information available to the learner correlate with the development of certain skills. He has

again emphasized the overpowering impact of the environment upon intelligence, and in the school, the educator is largely in control of the environment.

This critical function of the educator as the controller of the child's intentions in the learning process cannot be ignored. The importance of this concept receives incremental explanatory power when it is understood that the intention or purpose of human cognitive functioning is *to know*. Berlyne (1954; 1957; 1962; 1963; 1965) defined this process as *epistemic curiosity*, or the seeking of the learner to resolve ambiguity in the stimulus field. Epistemic curiosity has been defined (Rowland and Frost, in press) as the fundamental or basic cognitive drive, a notion which is directly linked to the *Structure-Process* model for education (Frost and Rowland, 1969). The fullest implications of Bruner's most recent, and perhaps his most difficult research can be appreciated only through this theoretical interpretation in regards to education which begins with the origins of life, called *genetic epistemology* as conceived by Piaget (1947/50). In this context, Bruner's concepts have provided the medium for irrevocably linking developmental psychology and education, a development which Bruner predicted in *Toward a Theory of Instruction* (1966), a small book which has been severely criticized (Ausubel, 1966), but never fully appreciated for its psychological and educational implications.

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