BASIC COGNITIVE PROCESSES IN CHILDREN

Basic Cognitive Processes in Children

Report of the Second Conference Sponsored by the Committee on Intellective Processes Research of the Social Science Research Council

Edited and with a New Introduction by

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INTRODUCTION TO THE PHOENIX EDITION

The five conferences sponsored by the Social Science Research Council's Committee of Intellective Processes Research in the late 50s and early 60s each resulted in a published monograph, and each stimulated considerable research in the subsequent decade. Perhaps the most germinal of these conferences and resulting monographs was the second, held in Minneapolis in the spring of 1961, from which the papers in this volume resulted. The field of cognitive development, and in particular the study of basic cognitive processes in children, though variously stimulated by developments in Piaget's theory, advances in psycholinguistics, and the great outcropping of studies of infant cognitive capacities, has nonetheless followed to a remarkable degree the insights and foresights contributed ten years ago by the authors of the papers in this volume.

The position taken here by E. J. Gibson flowered rapidly into a formal treatment of the development of perception of critical features of stimuli, and has led to a markedly increased concern among investigators of early perception with problems of how children acquire the first discriminations of which they are capable and how the visual apparatus comes to dominate the child's growing apprehension of his environment. The discussion by Herman Witkin is clearly an accurate anticipation of the field's increasing concern with individual differences, and of our current focus on whether individual continuities from earliest experience to adult characteristics have been perhaps overoptimistically cast in our zeal to make early predictions of later functioning.

The article by Tracy Kendler on mediating responses served to raise the language-and-thought problem in a way that stimulated both important theorizing and a large body of research. Reese's mediational deficiency hypothesis and Flavell's production deficiency hypothesis were both partly stimulated by Kendler's paper. Although it soon appeared that the conclusion implied, namely, that preverbal and nonverbal organisms simply lacked the verbal mediation facility that was available to older children and adults, was perhaps an oversimplification, subsequent studies on both inductive reasoning and the dimensional organization of postdiscrimination shift behavior have confirmed that Kendler's views of the mechanisms involved, especially dimen-

sional organization, were an accurate prediction of what would later prove to be important.

In the remarkably productive tradition of the University of Iowa Child Welfare Research Station, the article by Charles Spiker on verbal factors in the discrimination learning and transfer of children signaled at once the coming of age of a carefully developed model of children's learning in relation to their language, and the realization that other behaviors of children, such as selective attention, could serve to transform confusing stimuli into useful information long before formal mediational processes could be identified in their behavior. The extension of the role of the organism in interpreting, adding to, subtracting from, and selecting those stimulus features subsequently utilized as *information* is a dominant theme in the last ten years' research on learning and cognitive development, and the field continues to owe an often unacknowledged debt to the precise work of behavior theorists concerned with the first steps in this progression.

The article by Jerome Kagan, Howard Moss, and Irving Sigel on conceptual styles anticipates a large and rapidly growing body of research on cognitive styles and conceptual tempos in children's information processing that has not yet reached its zenith. In subsequent articles Kagan and others have greatly extended the concept of tempo as a fundamental variable, traced its development and generality, and studied its relation to a variety of key intellectual competencies, such as selective observing and effective scanning behaviors. Readers interested in following the more recent literature stimulated in part by this paper should utilize the term "reflection-impulsivity," which replaced "analytic-descriptive vs. global" as the core variable. The more recent work on reflection-impulsivity as a dimension of cognitive tempo has often utilized the Matching Familiar Figures test (MFF) as criterion, where the work reported here was anchored on the Conceptual Style Test (CST). Style and tempo have been studied with a variety of different subcultural populations, ages, and special groups, such as retardates, and it is too soon to estimate with confidence where the current high rate of such studies will eventually take us. Hopefully recent studies of the trainability of styles and tempos will some day enable educators to teach children to approach different kinds of tasks with the style most appropriate for that task, and such a possibility seems not as remote as it did to the first audience to consider this contribution, thanks largely to the extensive research stemming from this paper.

Yet another germinal paper is that by Jerome Bruner and Rose Olver, which reported for the first time some important advances in understanding how children perceive, cognize, and represent the objects and events in their environment. The paper not only anticipates the distinguished book by

Bruner, Olver, and Greenfield that was to follow, but also lays the groundwork for Bruner's most significant contribution to the theoretical literature previously dominated by Piaget on cognitive development. Particularly compatible with recent thinking in American social science is the sharp divergence from the Piagetian tradition represented in Bruner and Olver's emphasis on linguistic and verbal modes of representation. The paper is also the first of several to employ a research strategy of dual classification of children's performances: once by the logical strategy employed and the basis for grouping, and again by the language frames utilized. Another hallmark of the Bruner group established here is the deliberately continuous variation in level of difficulty contained in the task, which provides a semi-independent confirmation of the developmental ordering derived from cross-age comparisons. When the older children's performance on difficult items is qualitatively similar to that of younger children on easier items, the developmental sequence is confirmed and regression, a phenomenon denied by the Piagetians, becomes a testable hypothesis and a useful research tool. Additional research stimulated in part by this paper has concerned itself with logical and visual search and with question-asking behavior as they develop in children. The distinction between enactive, iconic, and symbolic modes of representation as a developmental sequence also derives its initial importance from this first study of equivalence transformations.

Although Richard Atkinson's paper on mathematical models in research with children did not directly stimulate a new research thrust in the decade following its presentation, it pointed to two concepts that have been represented in subsequent child research. The specific one is the two-stage model which holds that for any reasonably complex learning task some preliminary response is necessary, such as selective observing, deciding what kind of trial type is occurring, or in general assimilating the task to some more or less well defined category for which the child has a more or less well defined strategy. The two-stage model clearly illustrated in Atkinson's model has received direct or indirect confirmation from many studies of dimensional attending, distinctive feature discrimination, and cross-modal transfer. The second point made by Atkinson that has reverberated in child research is that one goal of any integrated developmental theory is to decide whether changes associated with age can best be described by alteration of simple parameters, such as stimulus sampling or conditioning rates, or whether the changes are so thoroughly qualitative that they cannot be fruitfully described in terms of maturational parameter changes. The nature of one's developmental theory will largely depend on how this question is answered, and the use of formal theoretical tools such as mathematical modeling, computer simulation, and

behavior modification have served to sharpen our understanding of the choices implicit in less formal theories.

Finally, the papers by Daniel Berlyne and Herbert Pick served a very important function in bringing to the awareness of American and European psychologists the potential value to us of the many experimental studies made by Soviet psychologists and the ease with which their data can be transposed to answer developmental research questions couched in other than Pavlovian terms. Subsequent translations of Soviet works and numerous international meetings have benefited from the thoughtful interpretations provided in these informal but stimulating papers.

JOHN C. WRIGHT

JEROME KAGAN

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Basic Cognitive Processes in Children

I

INTRODUCTION

In the summer of 1959 the Social Science Research Council established the Committee on Intellective Processes Research. As its first effort the Committee decided to sponsor a series of conferences on various aspects of children's thought. The first conference was held in 1960 at Endicott House and concentrated on the contributions of Piaget, Inhelder, and their colleagues at Geneva. The proceedings of the first conference were reported as the first monograph in this series (Kessen and Kuhlmann, 1962).

The second conference was held in April, 1961, in Minneapolis and devoted itself to a broad range of research issues in the study of cognitive development. In addition to the invited papers and prepared discussions, the editors have summarized the issues raised by the group discussions.

In attendance at the second conference were: Richard C. Atkinson, Stanford University; Alfred L. Baldwin, Cornell University; Daniel Berlyne, University of Toronto; Yvonne Brackbill, University of Denver; Roger W. Brown,* Massachusetts Institute of Technology; Jerome S. Bruner, Harvard University; Susan M. Ervin, University of California; Colin Fraser, Massachusetts Institute of Technology; Riley W. Gardner, The Menninger Foundation; Eleanor J. Gibson, Cornell University; Wendell E. Jeffrey, University of California, Los Angeles; Jerome Kagan,* Fels Research Institute; Tracy S. Kendler, Barnard College; William Kessen,* Yale University; Harry Levin, Cornell University; Eleanor Maccoby, Stanford University; Lloyd N. Morrisett,* Carnegie Corporation of New York; Howard A. Moss, National Institute of Mental Health; Francis H. Palmer,* Social Science Research Council; Herbert Pick, University of Wisconsin; A. Kimball Romney,* Stanford University; Irving E. Sigel, Merrill-Palmer Institute; Charles C. Spiker, State University of Iowa; Harold W. Stevenson,* University of Minnesota; Michael A. Wallach, Massachusetts Institute of Technology; Herman A. Witkin, State University of New York; and John C. Wright, University of Minnesota. Members of the Social Science Research Council Committee on Intellective Processes Research are indicated with an asterisk.

The editors are grateful for the assistance of Harold W. Stevenson, who made the physical arrangements for the conference and advised in the preparation of this report. Without the enthusiasm of Francis H. Palmer and the

support of the Social Science Research Council the research contributions reported here might never have been brought together in such a fertile and stimulating context.

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II

DEVELOPMENT OF PERCEPTION: DISCRIMINATION OF DEPTH COMPARED WITH DISCRIMINATION OF GRAPHIC SYMBOLS

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The invitation to speak to this Conference on my work in the field of perceptual development came at a most welcome moment for me. For the past six years I have worked, with several colleagues, on developmental aspects of two radically different kinds of perception—the perception of *depth* and the perception of outline forms inscribed on a piece of paper—that is, *letters* and *words*. Here was the opportunity to compare the two and, hopefully, to synthesize them.

Interest in the development of perception (especially space perception) goes back as far as the philosophical beginnings of psychology. The empiricism of the British philosophers and the nativism of the Germans have always formed the core of courses in the history of psychology. Everyone takes a position in the controversy, usually on the side of empiricism in this country. Textbooks of child psychology reflect this fact; here is a typical quotation from a well-known one, Goodenough's *Developmental Psychology*: "Very early in life and without being aware that we are doing so, we learn to interpret this (binocular) difference in visual sensations in terms of tactual and muscular sensations we get from handling objects. . . . When we say the tree trunk *looks* rounded we mean only that the visual sensation has the qualities that from infancy on we have learned to associate with objects that *feel rounded*" (1934, p. 138). The current enthusiasm for experiments on "early experience" confirms the continued presence of the empiricist's bias.

On the other hand, we can find statements exhibiting the opposite bias, such as Pastore's that "All the significant aspects of perceiving are unlearned. These include pattern and depth perceptions, the so-called laws of organization, figure-ground relationship, solidity, the illusions, the constancies, the phi phenomenon, figural after-effects, and the perception of the world as upright" (1960, p. 93).

A recent criticism has been that the division of behavior into "innate" and "acquired" is an artificial dichotomy. Hebb, for instance, has said "I

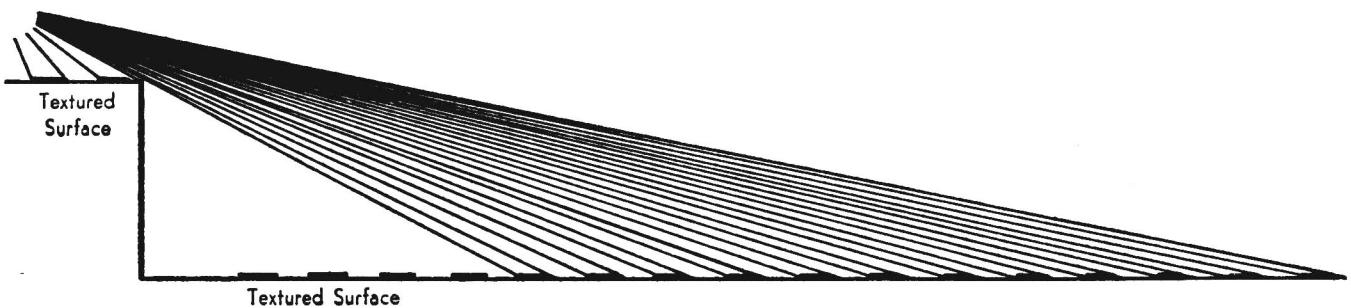

FIGURE 1—Schematic representation of the visual cliff.

urge that there are not two kinds of control of behavior and that the term 'instinct' implying a mechanism or neural process independent of environmental factors, and distinct from the processes into which learning enters, is a misleading term and should be abandoned" (1953, p. 46).

The dismissal of the problem as false is not very satisfying. It is too easy to find cases of behavior which seem primarily learned or primarily unlearned. There may even be mechanisms "different from the processes into which learning enters." A more appealing approach is to study the ontogenetic process, asking how learned and unlearned processes develop and interact.

We have at present many methods available for the study of perceptual development. The developmental testing program that characterized the early stages of child psychology in this country can be supplemented by comparative studies with different animal species and by controlled experiments. Experimental methods include control of early environment (the deprivation experiment and the enrichment technique); perceptual learning experiments such as Kohler's with distorting lenses; or others providing controlled practice under more normal conditions (our own scribble experiment). Besides these, there is the procedure of logical analysis with inference of what "must have" happened, and experimental test of the inference. This latter procedure may seem roundabout, but some very impressive work of this kind can be cited (for instance, that at the Haskins laboratory on "acquired distinctiveness" of phoneme features [Liberman *et al.*, 1957]).

My two cases have been or can be attacked by all these methods. But first they must be described in some detail. The potential information available in the stimuli for the two situations is the logical starting place.

Comparison of Stimuli

A standard situation for the study of depth discrimination was devised by Dr. Richard Walk and myself. We called this situation the "visual cliff." The important element of this situation is a drop-off downward, or depth-at-an-edge. The device consists essentially of a raised center runway with a sheet of strong glass extending outward on either side. Directly under the glass on one side is placed a textured pattern; farther below the glass on the other side, at any desired depth, is the same pattern. The simplest version of the stimulus situation might be conceived of as a platform with a drop-off to a floor below. Figure 1 shows the pattern of light rays projected to the subject's eye from the floor and from the platform on which he stands.

If the elements of the textured pattern are identical above and below, the light rays reaching the eye will differ in *density*, a finer density characterizing the surface farther below the eye. There is thus potential information in the light itself for the detection of the drop-off.