COGNITIVE DEVELOPMENT

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INTRODUCTION

A number of trends are discernible in the recent literature on cognitive development. The thought processes of the adolescent are no longer ignored: Falmagne (38), Osherson (109, 110), and Neimark (105) have done much to rejuvenate interest in the nature of formal operational thought focusing attention on the question of whether Piaget's account of logical thought is correct. The elderly have emerged as an important research population (e.g. 124, 133) with the recognition that the phenomena that emerge during the loss of intellectual function are very bit as central to our understanding of cognitive development as are the phenomena that emerge during the acquisition of intellectual function. There has been an explosion of research on the acquisition of reading skills (54, 123), and the development of memory (e.g. 16, 41, 62, 125). The last 2 years have also witnessed the emergence of research on the relation between the development of hemispheric lateralization of function and cognitive development (154). Cognitive styles are now being considered in terms of the information-processing demands therein (157). And attention has focused on the role of early cognitive development and communication skill in relation to language acquisition (5, 7, 20, 21, 60, 136). To report carefully on these diverse trends one needs to know a fair amount of logic, linguistics, philosophy, and physiology. So one might characterize the last 2 years as the years that forced the cognitive developmentalist to master a number of other disciplines in order to keep up with the literature. A particularly salient case in point is the journal of Human Development where one finds many a paper on the dialectical theory of development. The reader who has studied Hegel and Marx is at a decided advantage.

The need to know much about other disciplines led me to think of reneging on my agreement to write this review. Were it not for yet one further trend that has taken hold in cognitive development, I might have done so. I refer to a shift in emphasis away from the view that the preschooler is cognitively incompetent to one that grants the preschooler at least some competence. This shift comes about in part because of the emergence of researchers committed to the view that cognitive development is not an all-or-none process (147) and in part from the argument that the preschooler simply must have more competence than earlier research has re-
Focus on the Preschooler

Preschoolers are in a unique role as they acquire the basic skills of reading and writing. The focus is on developing an understanding of the fundamental concepts of reading and writing, such as letters, words, and sentences. This involves recognizing and understanding the form and structure of language, as well as the phonemic and phonological aspects of speech.

When teaching young children, it is important to create a supportive and engaging environment that encourages exploratory learning. This includes providing opportunities for children to engage in hands-on activities and to practice reading and writing in meaningful contexts. It is also important to emphasize the importance of reading and writing as a means of communication and expression.

In addition to developing language skills, preschoolers also need to develop fine and gross motor skills, as well as the ability to concentrate and follow directions. These skills are important for later academic success, as they provide a foundation for learning more complex concepts.

Overall, the focus on preschoolers is on promoting holistic development, from language and literacy skills to fine and gross motor skills, in a supportive and engaging environment.
Quantitative Invariance Concepts

Many investigators of the young child’s understanding of quantity have conducted conservation training studies in order to test hypotheses about what the young child must learn before he can be granted a concept of number, length, etc. See Belkin (8) for an excellent review. I suggest that those studies that have yielded positive training effects can be viewed as studies in support of the claim that the young child who participated in the training knew something about quantity to begin with—this despite the fact that he failed a host of conservation pretests. More generally, I advance the thesis that in many cases training studies can be viewed as procedures for uncovering a capacity, as opposed to procedures for establishing a capacity from scratch.

The view that training makes manifest a preexisting understanding of quantity seems inescapable when one considers a particular class of conservation training studies, those that involve modeling techniques. Botvin & Murray (13) provided black children in the first grade who failed to conserve mass, weight, amount, and number one of two kinds of modeling conditions. In the first condition, two nonconservers and three conservers participated in a roundtable discussion. The discussion opened with the experimenter asking each child to answer mass- and weight-conservation questions. The experimenter then left as the group proceeded to discuss their different answers and reach an agreement. A second group of nonconservers watched the opening proceedings of the roundtable, thereby having an opportunity to hear conflicting answers, but did not participate in a discussion. There was no differential effect of the two experimental conditions. Both groups showed a dramatic amount of specific (weight and mass) and nonspecific (number and amount) transfer. And Miller & Brownell (102) allow us to rule out the possibility that conservers are, in general, better at winning arguments. Further, Botvin & Murray’s comparison of explanations given by the original conservers and the newly trained conservers makes it clear that the latter did not simply mimic what they had heard. The original conservers were inclined to give more compensation and reversibility explanations than were the trained conservers. The latter focused on the fact that nothing had been added or subtracted or that a particular transformation was irrelevant. Botvin & Murray take this result to mean that the initial understanding of conservation is different from a later understanding of conservation. The idea is that the conservers first recognize the role of relevant (addition-subtraction) and irrelevant transformations (e.g., displacement) in conservation, an hypothesis which I agree with and to which I will return. But first, I highlight the ease with which Botvin & Murray trained conservation. A brief discussion, or actually an opportunity to hear conservers and nonconservers giving conflicting answers, suffices to make the nonconservers a conservers.

How could this be unless the nonconservers already knew something about the rules regarding quantitative invariance? Parenthetically I note a similar argument has been made regarding Hornblum & Overton’s (69) study of the conservation skills of the elderly. The elderly seem to fail on tests of conservation. But a small amount of feedback alters the behavior and does so very rapidly. Hornblum & Overton appeal to the competence-performance distinction to interpret their elderly subjects’ erratic behavior.

We turn now to the question of whether the evidence supports the idea that despite a failure on a conservation task, the young child does have some understanding of quantitative invariance. Experiments employing modifications of the Piagetian number conservation task and concluding that the young child does in fact have a number invariance scheme (23, 96) have been subject to strong criticism. Hunt (71) shows that the Mehler & Bever (96) results are very susceptible to experimenter bias. The experimenter who is told that the 2-year-old will do well is the one who comes closest to replicating the finding regarding the 2-year-old as a precocious conservers. Katz & Belin (77) quarrel with Bryant’s (23) evidence regarding the young child’s ability to judge equivalence on the basis of one-one correspondence and then conserve—although it must be noted that they did not run the very condition upon which Bryant bases much of his argument, this being one where there were no perceptual cues in conflict with the cue of one-one correspondence.

It seems reasonable to conclude that efforts to show that the young child has an invariance scheme for number as revealed by procedures that closely resemble the Piagetian paradigm are on shaky ground. But it is not clear that the Piagetian task or variants of it are the only tests of the young child’s invariance scheme for number. Work from my laboratory employing a quite different paradigm shows that young children do possess a number invariance scheme. Children between the ages of 2½ and 5 years treat unexpected changes in the numerosity of a set—changes that are produced by the surreptitious addition or subtraction of one or more items—as changes that are relevant to number. They not only recognize the resulting change; they tell us what must have happened, i.e., that somehow an item was either removed or added. On the other hand, when the experimenter surreptitiously lengthens or shortens a row or changes the color or identity of items in a row, the children notice the changes but say that they are irrelevant to number. They correctly insist that the number has remained unchanged even though perceptual properties of the expected set have not. See Gelman (49) for a review of these “magic” studies. Such findings lead to the conclusion that preschoolers possess an invariance scheme for number, a scheme which organizes the real world manipulations that can be performed on a set of objects into ones that are relevant to number and ones that are not. Recall the Botvin & Murray results showing that trained conservers appealed to addition/subtraction and irrelevant transformations in their explanations. I suggest this is as it should be. The nonconservers organize transformations into those that are relevant and those that are irrelevant to number, and this conceptual organization is appealed to when the nonconservers is first converted to a conservers.

I should make clear that I am not claiming the exact same abilities for the young child as for the older child, the child who immediately passes the conservation test. The young child’s knowledge is certainly not as complex as the older child’s. For one thing, the young child’s ability to negotiate numerical tasks seems limited to those that employ small sets (n = 2–5 items). Research by a variety of investigators supports the view that the young child’s skill with small sets is much advanced over
The initial steps of the child's development are crucial in laying the foundation for their future learning. Children who experience a stimulating environment in their early years are more likely to develop strong cognitive, emotional, and social skills. A safe and nurturing home environment is essential for a child's development. While parents play a significant role in a child's education, the role of teachers and caregivers is equally important. Effective teaching strategies include active engagement, providing feedback, and encouraging children to think critically. It's also important to create a supportive and inclusive classroom environment where all students feel valued and respected. By fostering a positive learning atmosphere, teachers can help children overcome challenges and build confidence in their abilities. This approach not only benefits the child's current education but also sets a strong foundation for future learning.
to sort objects on the basis of superordinates. In one experiment, subjects were kindergartners, first-graders, third-graders, and fifth-graders. Stimulus materials were color photographs of clothing (shoes, socks, shirts, pants), furniture (tables, chairs, beds, dressers), people's faces (men, women, young girls, infants), and vehicles (cars, trains, motorcycles, airplanes). (Underlined items were superordinates, items in parentheses were basic.) Subjects in the superordinate condition were given one picture each of the four different objects representing each of the four categories. Subjects in the basic sorting condition received four pictorial examples of one basic object in each of the four superordinate categories.

The results are straightforward. Only half of the kindergartners could sort the superordinate categories. As in previous studies, it was the older children who consistently used such criteria. In contrast, there were no developmental differences in the ability to use basic categories, this because almost all subjects sorted consistently on the basis of basic categories. A second experiment suggests that 3-year-olds would do about as well (i.e. nearly perfectly) on the basic sorting task. Using a simplified (i.e. oddity) sorting task, Rosch was unable to detect any developmental trend from 3 years of age up to adulthood when subjects were required to identify the odd one at the basic level.

These results call into question the widely held assumption that preschoolers have unusual difficulty sorting complex materials on the basis of consistent criteria. Some criteria are readily available, others are not. The question focuses attention on the problem of the superordinate and leads us to consider why it is elusive to the young child. Part of the study is told by Markman & Siebert (9). Markman draws a distinction between classes and collections and the types of concepts they characterize. Several criteria are used to highlight the difference between classes and collections. These are: (a) the way in which membership is determined; (b) the nature of the part-whole relationship involved; (c) the internal organization of concepts; and (d) the nature of the whole that is represented by classes and collections. Before proceeding it is necessary to point out that much of the work on the development of classification skills deals with the kinds of concepts that can be described by a class model. Here concepts are defined in terms of intentional and extensional aspects. The intentional aspect involves the defining criteria of a class; the extensional aspect involves the instances that meet the defining criteria. The typical classification study might present a child with, say, a picture of a robin, a turkey, a sparrow; a bicycle, a car, a bus; a tulip, a rose, and a petunia. The child's job is to place all birds in one pile, all vehicles in another, and all flowers in yet another. In other words, he is to determine that there are three different intentional definitions and that each of these contain three instances, i.e. extensions.

Indeed the foregoing set of stimuli represent classes. It is possible to consider each object independently and determine its class membership by considering it in terms of its defining properties. But to determine whether an object is a member of a collection, one needs to know something about its relationship to other objects. Consider the concept of family and consider a child. Is a child a member of the collection we call a family? That depends on whether the child has a parent (or some other relative). Likewise husband and wife do not constitute a family unless they have children or other relations. The example of family serves to highlight the general determining characteristic of collections: the relationship between objects is crucial. A bunch of stones is a bunch of stones only if there is close spatial proximity between the stones; likewise a bunch of grapes. In short, an object by itself cannot be judged to be a member of a collection; it can, in contrast, be judged to be a member of a class.

Part-whole relations are not the same for classes and collections. In the case of classes the subordinate is included in the superordinate. Thus roses are flowers. But in the case of collections, it makes little sense to say that a subclass of members are also members of the superordinate. Children are not flowers. Once this distinction is pointed out, it is easy to move to the last two distinctions between classes and collections. Collections seem to have a tighter internal organization and their members adhere together to form a whole more readily than do the members of a class. The organization of members of classes is imposed more by the formal structure of a class and the whole is an abstraction. The parts of an object, e.g. foot, hand, eyes, and head of a body must be organized in a certain way if there is to be a percept of a particular object; in a similar way the part of a collection must be organized in a certain way.

These considerations about the nature of collections led Markman & Seibert to suggest a continuum of part-whole relationships; with objects the part-whole relation is tighter than with collections, and collections in turn involve a stronger relation of parts to whole than do classes. In one test of this hypothesis, kindergartners and first-grade children were given different versions of the class-inclusion problems described in the introduction. Children included in the study failed the Piagetian task. Half of these children were asked collection questions; half class questions. The same materials were used in both conditions. As an illustration consider the collection versus class questions regarding red and blue blocks arranged in a pile. Children in the collection condition were asked whether the one who owned the blue blocks or the one who owned the pile of blocks would have more blocks to play with. Children in the control (class) condition were asked whether someone who owned the blue blocks or someone who owned the blocks would have more blocks to play with; i.e. they were given the standard class-inclusion question. Children tested with the modified (collection) questions did much better than those tested with standard (class) questions. A subsequent experiment rules out the possibility that the advantage derived from the fact that the nouns used to describe collections were singular collective nouns. A third experiment failed to show an advantage of objects over collections with regard to part-whole questions. Children did as well on the collection questions as they did on the object questions, a result which led Markman & Seibert to suggest that collections form "psychological units which are as coherent as objects." Whether or not this is the case, we now have some insight into the child's difficulty with standard class-inclusion tasks; the stimuli that are typically used are organized in the mind of the adult who can impose abstract formal rules on the
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designed can influence the quality of observed behavior. Worden (135) suggests that her subjects were better able to show an ability to organize material because they were given an opportunity to do the organizing. And they were required to meet a criterion of two consistent sorts. Odom et al (107) gave their subjects repeated trials and found a significant decrease in matrix classification errors over trials. "This strongly suggests that repeated presentations may be required to obtain a valid assessment of a young child's cognitive ability to classify multiplicatively" (p. 762). Indeed, ponder the fact that many of the early studies of classification behavior involved but one or two trials.

Finally, it seems that in some cases the young child brings to the task a strategy that will interfere with his being able to do what the experimenter wants him to do. Wilkinson's (153) work on class-inclusion provides an excellent case in point. Wilkinson asks whether it might not be that the young child compares the number of items in different groups by counting (see above for supporting evidence). Counting involves tagging each object in an array once and only once. This in turn necessitates a step-by-step partitioning of the counted items from the to-be-counted items. Once counted an item cannot be returned to the to-be-counted category. But this is precisely what the young child who compares quantities by counting would be forced to do in the class-inclusion task. He is asked: "Which is more, the flowers or the roses?" If roses, having already been counted, cannot be recounted without violating a principle of enumeration—count each item once and only once. What to do? Count the other subset. Wilkinson presents excellent evidence in support of this argument and ends up focusing on the need for detailed analyses of the component skills involved in tests of cognitive development.

We take it to be obvious by now that the young child can hardly be characterized as entirely incapable of sorting materials by consistent criteria, or of using class-inclusion rules, or of combining classes, etc. We have suggested a number of variables that have conspired together to mask what classification capacities might be given to the young child. What is called for is just what Wilkinson suggests—a very careful analysis of the component skills that go together to make up flexible classification abilities (cf. 2, 83).

The Young Child's Sensitivity to Order and Causal Relationships

ORDER The traditional view of the young child is of a child who cannot keep straight the order of events let alone be able to order more than two events in temporal succession (118); he cannot impose order on a set of stimuli even when the stimuli dictate an order as in the case of a series of sticks of graded lengths (73); he cannot repeat a story in a way that honors the way it was told, and he seems perfectly satisfied with the idea that causes and effects can take place in such a way as to allow a reversal of their order (46, 118), etc. Perhaps the most striking result of the last 2 years is how far from true this traditional view is. Research resulting from projects on a variety of different topics done in a variety of different ways converge on one very clear theme: order in events and arrays is a very salient feature for the preschool-aged child.

Perhaps the simplest case of an order is that which defines a more-less relationship between two stimuli, be they different in length, numerosity, etc. A variety of investigators (14, 23, 25, 36, 141) have demonstrated preschoolers' success in discrimination tasks that correlate the presence of reward with the stimulus that represents more or less. Siegel (141) shows children as young as 3 being able to choose which of two arrays is more or less numerous when the arrays represent the number combinations of two through nine. Bullock & Gelman (25) report children as young as 2½ transferring an initial order comparison to their choice of winner when shown two new sets representing novel numerocities. Thus children trained that a three-item set is the "winner" and a one-item set is the "loser" choose a four-item set over a three-item set when they first encounter the new sets. Thus, young children can do more than recognize an order relation that holds between two sets; they can compare two ordered sets and make judgments about a common order relation.

Those familiar with the Piagetian literature might choose to be unimpressed with the above findings. After all, for Piaget the question is whether young children can seriate a set of stimuli and what's more whether they can make transitivity judgments. Again the answer is clearly, yes. The reader is probably familiar with the Bryant & Trabasso (24) study wherein the subjects were children (aged 4 to 6 years) who typically fail Piaget's test of transitive inference. In this task the child is shown two of the possible pairings of three sticks of different lengths, e.g., AB (with A > B), and BC (with B > C). He is then asked to determine which of the pair AC is longer without the opportunity to do so by inspection. For Piaget, failure on such tasks reflects the young child's inability to logically add the relations A > B and B > C to come up with the inference that A > C. Bryant & Trabasso wondered if the child's difficulty might not be more of a problem in memory than logical inference. Accordingly, they put their subjects through a memory training phase—a procedure we review here because it is used extensively in the elegant series of studies conducted subsequently by Trabasso and his colleagues (147).

In the Bryant & Trabasso study, children were shown pairs from a set of five sticks (A, B, C, D, E) and taught by means of a discrimination-learning technique which of a pair was the "longer" (or "shorter"). To start, the child was trained on the AB pair, then the BC, CD, and DE pairs. Subsequently, they were shown random pairs of the sticks and required to relern a series of discriminations. There are two features of the training that are noteworthy. First, the children never saw the actual length of the sticks; the bottoms of each pair of sticks were hidden in a box and their tops protruded to the same height. Thus the children had to learn to associate the different colors with different relative lengths. Second, training required children to respond to "which is longer" and "which is shorter" questions—a feature which it now seems served to highlight the comparative relations (127). Following training, the children were tested without feedback on all 10 possible pairs of the training stimuli. And, as in training, the children had to rely on the color of the sticks when choosing one as longer or shorter. The test of the child's ability is best illustrated by the way he responded on the BD comparison and the critical adjacent pairs of
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to construct order—provided the task demands are limited and/or the child has had some suitable training.

Why do increases in task demands, especially ones that require the child to retrieve information in a way that deviates from the way it is stored, impair performance? Brown argues that it is because the young child has yet to achieve a level of thought that is characterized by operational reversibility. And this may very well be the case. A related interpretation is that the young child's competence is fragile and not well enough established to permit him to cope with unfamiliar stimuli or the demands imposed by complex tasks. Whatever the ultimate theoretical account, one thing cannot be denied; the young child's ability to deal with ordered events is less than trivial. It cannot be explained away. I used the discovery of a sensitivity to order makes some of the cases with which the young child approaches the learning of sequenced materials such as count words (53) or language.

CAUSALITY. Since young children are able to keep track of ordered events and remember them in order, it seems odd to think of them as being insensitive to the order rule regarding cause and effect. Yet Shultz & Mendelson (139) conclude that 3-year-olds think to attribute causality to an event that follows a particular effect. By contrast, children 6 years of age or more behave as if they assume that causes precede effects. Kuhn & Phelps (82) likewise report young children indifferent to the order of cause and effect. The results reported by Shultz & Mendelson seem consistent with Piaget's (116) account of the young child's conception of physical causality. The young child is said to associate phenomena on the basis of contiguity without a concern about a possible mechanism and whether the inferred association is reasonable or complete. Such a child might very well believe that causes can follow effects. But is this characterization correct? Is it true that young children are precausal? Or might there be alternative accounts of the evidence advanced in support of this view? I think so.

Consider what Piaget had children talk about—what causes the wind and rain, why rivers flow, how bicycles and other machines work, etc. It is the rare preschooler who has had an opportunity to learn about such events and the workings of machines. And perhaps in the absence of a knowledge base the child cannot help but give answers that are animistic and lacking reference to a potential mechanism. In the case of machines, the child might not realize that the experimenter wants the child to posit a mechanism. Koslowski (unpublished communication) makes such a point in his discussion of the young child's account of the workings of a bicycle. The child might say he thinks the pedals are responsible for the bicycle's movement because he has the question to be one about causal agents and not one about force. It should be possible to show that young children can be reasonable about their choice of possible causes, that they do assume that a mechanism of some kind relates cause to effect, but they do recognize that causes precede effects, etc, provided care is taken to the events the child might know about. Should such evidence be forthcoming, there can conclude that the child's account of things he does not know about is more a result of an effort to cope with the situation than a basic precausal attitude.

Berzonsky (9) showed that the child's familiarity with a topic does influence the quality of his causal accounts. Explanations similar to ones Piaget classified as precausal were forthcoming when the child was questioned about remote events, e.g., why does the moon change shape. But children responded to questions about familiar events—e.g., the flying of kites and the malfunctioning of familiar objects such as the flattening of a tire—with physical mechanical explanations. My own work on the child's understanding of number provides a clear case in point. Almost all children who were confronted with an unexpected change in number were able to provide adequate explanations, i.e., ones involving an assumption that there must have been an addition or subtraction. These children behaved as if they assumed unexpected changes derive from an antecedent cause—even if they did not witness one. Koslowski reaches a similar conclusion in her work. She showed preschoolers an apparatus that involved a bolt passing through a closed box and ringing a bell. Using a series of indirect questions, she observes that the vast majority of children behave as if they recognize that the connecting mechanism was contained in the box. Mendelson & Shultz (98) report a shift in response type depending on whether children (aged 4 1/2 to 7 years) saw how the dropping of a marble into one box could produce a bell ringing inside another box. The model of how this could happen consisted of running a tube from the base of the marble box to the top of the bell box. The children never witnessed the marble going through the tube. Children who saw the tubing tended to use a potential cause an event that occurred consistently but nevertheless in close temporal proximity to the bell's ringing. In contrast children who did not see the model indicated that the event which was closest in time to the bell's ringing was the cause—despite the fact that this event did not occur consistently. Clearly, when the child could imagine a reason for the delay between the cause and effect, he behaved reasonably. Otherwise, he did not.

Merry Bullock and I have just completed a study which shows 4- and 5-year-olds choosing a "reasonable" versus an "unreasonable" event as potential cause. The children were first shown a box with a Plexiglass front. At the left of the box were two handles: one could start a ball rolling down an incline; the other switched on flashing lights at a rate designed to give the appearance that a single light was moving down an incline (phi phenomena). After an initial play period with this box, the children encountered what was, from our point of view, the events of interest. The child watched the light and ball each traverse a path to the end of the box and appear to disappear into another box. The light and ball events were coterminous. Three seconds later a jack jumped out of this second box. The child was given the opportunity to "make jack jump" and questioned as to what happened. Despite no initial tendency to choose to play with the ball-handle more than the light-handle, children behaved as if the ball had to be responsible for jack's jumping. I see this as evidence for their ability to choose a reasonable as opposed to an unreasonable cause. A mechanical jack-in-the-box is likely to work by some impact mechanism. A rolling ball can obviously cause an impact; a moving light is a less obvious candidate.

Mendelson & Shultz obtain evidence like ours when they provide children with information that can be used to make inferences about the events that intervene
Communicating is more than just speaking words. It involves understanding the non-verbal cues, body language, and emotional expressions that accompany verbal communication. Effective communication requires both parties to actively listen and respond in a way that is clear and respectful.

In a conversation, it's important to maintain eye contact, avoid interrupting, and use open-ended questions to encourage the other person to share their thoughts. Active listening involves paraphrasing what the other person has said to ensure understanding and showing empathy through your body language and tone.

Improving communication skills can have a significant impact on personal and professional relationships. It helps to build trust, reduce misunderstandings, and enhance collaboration. Whether you're speaking with family, friends, or colleagues, practicing effective communication can lead to stronger connections and more positive outcomes.

In summary, communication is a critical aspect of any relationship. By focusing on active listening, clear expression, and empathy, we can improve our ability to connect with others and build stronger, more meaningful relationships.
representations of others—representations that involve such variables as cognitive capacity, age, linguistic level, and attentional constraints. And it appears that these representations help to guide the child's choice of responses. But do we grant too much? After all, our subjects talked in the presence of their listeners who may have provided subtle feedback cues. And it is possible that the child's ability to take his listeners' capacities into account is confined to the syntactic domain. The questions then are: Can preschoolers represent individuals other than themselves when those individuals are not present? Do such representations control response selection along dimensions other than syntactic ones? How readily can one demonstrate that preschoolers can take the needs of others into account?

As regards the role of the presence or absence of the listener, Sacks & Devin (131) had preschool children talk to dolls who were identified as babies, 2-year-olds, etc. They report results much like Shatz & Gelman obtained. So the child's ability to adjust his messages is not tied to feedback that is given by a listener. Two unpublished studies, one by Shatz (135) and one by Markman (90), show young children dealing with and/or representing the capacities of others who are not physically present. These studies also provide evidence regarding the generality of nonecentric abilities.

Shatz (135) asked 4- and 5-year-old children to help her make decisions about toys that were to be given to either a 2-year-old or someone their age. Depending on which condition they were in, they were shown a picture of either a 2-year-old or a 4-year-old boy in order to test whether they could make appropriate choices for others when they had no direct feedback from the recipient. The stimuli consisted of four toys, one that was deemed appropriate for 2-year-olds and two deemed appropriate for 4-year-olds. Subjects who chose presents for 2-year-olds picked significantly more 2-year-old toys than expected by chance. Likewise “peer condition” subjects chose 4-year-old toys. An analysis of the toy-choice justifications showed that the children rarely gave inappropriate or egocentric ones such as “I like it.” Instead children tended to refer to the cognitive and/or affective predispositions of the recipient, illustrated by the following explanation: “I didn’t pick this (the number-letter-board) because he (the 2-year-old) can’t read.”

Markman (90) had 5-year-olds make predictions about their own capacity to remember or to perform motor tasks. The memory monitoring task—adopted from Flavell, Frederick’s & Hoyt (42)—required a child to indicate whether or not he would be able to remember a given number of pictures. At first the child saw one picture and was asked if he could remember it; then two pictures and asked if he could remember them, and so on until ten pictures had been shown. Having completed the self-prediction task, the child was asked to make predictions as to how well a 2-year-old and a teenager would do on the same task. There were also motor-skill prediction tasks. In one the child had to predict how far he, a 2-year-old, or a teenager could jump. As the experimenter moved stepwise away from the child, the child had to answer his (or someone else’s) capacity to jump that far. A child’s predictions about his own abilities tended to fall between predictions about abilities of 2-year-olds and teenagers. But it was not just that the child knew that 2-year-olds were worse off and teenagers better off than he. The children made differential predictions about the memorial and motoric skills of 2-year-olds. Most 2-year-olds were judged to be able to handle the motor tasks at some level, but 2-year-olds were usually viewed as creatures who generally could not remember a thing. A kindergarten child is unlikely to have read developmental texts on the normative capacities of 2-year-olds. Yet he correctly judges the subject to be more advanced motorically than cognitively.

Markman and Shatz provide some clues as to what preschoolers know about those younger than they. Further studies provide additional support for the position that preschoolers are not completely egocentric. Borkot (11) presented 3- and 4-year-old children with tasks that were modeled after Piaget & Inhelder’s (120) mountain experiment but designed to include stimuli that young children could readily discriminate to make it easier for the child to respond. It has been shown that older children do better on perspective-taking tasks if they can rotate a display to illustrate their perspective judgments rather than having to match the perspective with one of several shown in pictures (67, 72). Borkot reasoned that the same should hold for still younger children and therefore had them rotate a copy of the test display. The test displays varied in terms of how much one might expect a young child to know about the stimuli. One display consisted of a lake with a sailboat on it, a house and miniature animals. Another display contained eight different groupings of people or animals in natural settings, e.g. a dog and a doghouse. The third display was a replica of Piaget and Inhelder’s mountain task. The experiment involved having a dog named Grover move around the test display. The child indicated what Grover could see by rotating a replica of the test display. All subjects did well at predicting Grover’s perspective. Although they made more errors on the mountain display, they did better than might be expected: 42% and 67% of the 3- and 4-year-olds’ respective responses were accurate. Here again we see the effect of varying task complexity both in terms of stimuli and response demands. Similar results obtain for the young child’s ability to provide nonecentric referents. Systematic variations in stimulus complexity (79) and process demands (47, 122) produce systematic differences in the child’s ability to do well at selecting a nonecentric referent.

When simple tasks are used it appears that young children can make inferences about what another individual might or might not know depending on the circumstances. Marvin, Greenberg & Mosier (93) show children as young as 4 able to recognize that a secret is shared by others who saw the event in question but not by one who had his eyes closed and could not see the event. The same investigators (104) involved preschool children in a task that required them to recognize that information available to them was not available to their mothers so as to be able to answer questions on what their mothers might know. The child first watched a movie of a boy sitting at a table, the sound track revealed the boy’s actions for cookies. Then the child’s mother entered the room and watched the same movie but the sound track was turned off. Finally the experimenter asked the child whether his mother knew that a boy was sitting at a table and that the boy wanted cookies. Since the mother did not hear the sound track, the noncentric child should answer “yes” to the table question and “no” to the cookie question. For one am impressed
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toward being as much concerned for what the young child can do as what he cannot do. A variety of investigators have been concerned with abilities that seem to stand at the interface of perceptual and cognitive skills. Perhaps it is because of the traditional view that the preschooler has many perceptual abilities that these investigators include preschoolers in their designs and, what’s more, give the impression of being open to the possibility that these younger subjects will do well, at least under some conditions. Here are further examples of their abilities: Kindergarten children can detect symmetry in patterns (12). Children as young as 5 can do more than recognize differences in orientation (23, 144). If orientation is represented in a meaningful display, they can store such information (87). Likewise, the same-aged children can recall the spatial location of a particular picture (149). Although preschoolers may in some cases fail to respond to depth cues in a picture (63), there are conditions under which even 2-year-olds are capable of detecting depth in a two-dimensional picture (108). And when care is taken to provide children with a task they can negotiate, 5-year-olds do seem quite capable of mentally rotating their images of a teddy-bear (92).

Several teams of investigators are pursuing an in-depth study of the child’s developing concept of space (1, 140). The focus is on what the preschooler can do as well as what he cannot. Acredolo, Pick & Olsen (1) took children of different ages on a walk through familiar and unfamiliar halls of buildings. During the walk the experimenter would drop a keyring and at the end of the walk ask the child to return to the place of the lost object. If the space in question had a landmark (a chair), young children did as well as older children at finding their way back to the position in question. Likewise, they were able to locate a lost object in a playground that was both familiar and well-dotted with objects that could serve as landmarks. The young child’s ability to locate an object in an undifferentiated space was not particularly good — although it did improve when the child was told in advance to try and remember a particular sight so as to be able to return to it. Such findings are consistent with the Siegel & White (140) hypothesis that young children are able to learn landmarks. And as Acredolo et al note, they lend support to Piaget & Inhelder’s (120) hypothesis about the shift from a reliance on topological relations to the inclusion of Euclidean relations in the establishment of spatial representations. That young children are able to deal with specific landmarks is of particular interest in view of Nelson’s (106) hypothesis about the nature of the preschooler’s knowledge of his world. The idea is that the young child organizes events in his life into scripts that spell out the order in which events occur and the way objects enter into the staging of the events. Since these are events that take place in space, the script analysis would be implausible if children could not notice and remember landmarks.

The script analysis of preschool behavior has a special quality that is seldom encountered in writings about the preschooler. It deals directly with the abilities of the young child rather than treating the preschooler only in comparison to older children. Whether the notion of script proves to be useful remains to be seen. But I find it refreshing to see an effort to capture what it is the young child must know and to deal with the child at his own level. There are other signs in the literature of a developing interest in the need to know more about preschoolers. Fein (39) studies the pretend behavior of 2-year-olds under conditions which maximize its occurrence. Doing this allows her to learn about the objects that serve as acceptable substitutes. Goodson & Greenfield (59) consider play behavior in a somewhat different vein. The question is whether young children assemble toys in a rule-governed fashion. The answer is yes. A variety of studies are converging on the conclusion that young children do well at recalling and understanding stories that are well structured (e.g. 64, 88). And Perlmutter & Myers (114) thought it reasonable to assume that preschoolers would know that certain objects are color-specific and that others are not. And indeed, when young children were shown black and white drawings of a variety of objects they could match the color of color-specific objects, e.g. bananas. In contrast, their color matches for objects that are not color specific, e.g. socks, were random; the children apparently knew that such objects have no particular color.

I assume that there are some readers who remain unimpressed with the preschooler’s cognitive abilities. Perhaps it is well to end this review with a summary of the few studies that have considered the boldest hypothesis to date — i.e. that preschoolers can make inferences. Macnamara, Baker & Olson (86) addressed the question of whether 4-year-olds are able to draw inferences by focusing on the way children answered questions involving the verbs pretend, forget, and know. The children were first told stories, each of which ended with a sentence containing one of the target verbs. For example, one story began with a description of the two toys with which Mary-Jane and Dick usually played. It continued with the children deciding to play with just one of the toys at their next encounter. There is no mention of which toy was selected for their next play session. The story ends with a statement that Mary-Jane forgot to bring the ball. The subject is then asked a series of questions. In order to answer the questions correctly, and which they often did, the child had to deal with the presuppositions and implications given by the story as in “Was Mary-Jane supposed to bring the ball?” and “Was Dick disappointed?” respectively.

Pea (113) has succeeded at assessing the extent to which children between the ages of 1½ and 3 years assign the correct truth-functional value to a variety of sentence types, including true-affirmatives, false-affirmatives, false-negatives, and true-negatives. This involves comparing a child’s responses to each of these types of utterances. For example, children typically say “yes” in response to a true-affirmative (e.g. “That is a ball,” about a ball). In contrast, they couple an oppositional “yes” with the stimulus word in question in a false-negative and thus say “yes, ball” in response to “That is not a ball.” The ability to agree with true-affirmatives and oppose false-negatives begins to show at 24 months of age and is clearly noted by 30 months of age.

These studies on the young child’s use of presuppositions, implications, and truth-functional definitions are in some ways the most startling of all the ongoing research on the preschooler’s cognitive capacities. It is certainly too early to accept Macnamara’s suggestion that the account of such abilities will require an appeal to something akin to formal operations. Although 5-year-olds are able to make some
inferences as to where they did not lose an object, they are unable to limit their search to that area in which they must have lost the object (33). Further, the ability to deal with context-free logical statements is a relatively late development (111). And then the tendency of even 6- and 7-year-old children to store relationships that are implied in a sentence appears to be rather limited (112). They gain almost no recall advantage from cues that are implicit words in the original sentence. Thus the child who lacks to recall "his mother baked a birthday cake" does not seem to benefit from the cue even. This is true despite the fact that even younger children can state the implied agent when explicitly asked to do so. So once again we see a case where the child might have the ability in question but fail to use it in a related task. This is hardly the kind of behavior that characterizes the formal-operational child who generates hypotheses on his own.

But if one hesitates to grant formal-operational thought to the child who can on some occasions think inferentially there is the problem of how to characterize such abilities. Further, there is the question of why such abilities surface at one time and not at another. In the next section, I suggest that part of the young child’s problem is centered in his failure to understand the rules of the experimenter’s game. The effect of this is a child who cannot help but “fail” even if he has the requisite ability to “pass.”

THE RULES OF THE EXPERIMENTER’S GAME

When we ask researchers design a task, we have in mind a set of assumptions as to how one should approach the task in order to succeed. In the case of the Paris & Lindauer experiment (112), the child who can infer the unstated agent should do so at the time he commits a sentence to memory. Otherwise he runs the danger of not being able to benefit from cue words that are the implicit agents. But consider the young child’s viewpoint. Why should he be concerned with the unstated? He is unlikely to have had any comparable tests, and he is probably just beginning his history as a observer. Consequently, he is unlikely to have learned to try to figure out what it is the experimenter is after. Paris & Lindauer advance a similar account and provide supporting evidence. On the assumption that young children who participated in their earlier studies failed to realize that they should pay attention to the nature of unstated agents, they developed an ingenious sentence presentation procedure that forced children to note these agents. This involved having the children act out the actions described in sentences. Consider the sentences “The man shot the robber in the leg” versus “The man shot the robber in the leg with a gun.” The former leaves the agent gun unstated, the latter makes explicit reference to it. Yet the child who can infer the instrument cannot help but invent a pretend gun to carry out the task of acting out. Thus, if a child executes actions that use the implied instrument, the experimenter has succeeded in getting the child to note the variable of interest. What is impressive about the Paris & Lindauer manipulation is that it accomplished more than having the child represent implicit instruments. Children did as well at recalling implicitly cued sentences as they did at recalling explicitly cued ones. The authors conclude that participants in the initial studies did not understand the task demands.

The idea that failure on a task may flow from a misunderstanding of what the experimenter is up to can be applied to a wide variety of studies. And the last 2 years have witnessed the publication of a number of variations on this theme. Girgus, Coran & Fraenkel (56) show that the well-known developmental function for the Müller-Lyer illusion disappears after 2 1/2 minutes of testing and viewing. Why? They conclude that young children start out with different strategies. In particular they start out thinking that they should include the arrows when judging relative length.

Estes (37) suggests that young children are not likely to assume on a priori grounds that the same stimulus will produce reward trial after trial. Indeed, she suggests that they probably assume the contrary. Her example of a child who finishes one bowl of ice cream and looks to another for more ice cream is both charming and compelling. The child who comes to a simple discrimination experiment with such a view can be expected to have difficulty at the start of an experiment. To test this hypothesis, Estes compared learning under two conditions of reinforcement. In one, the reward and the stimulus cueing reward were physically inseparable as when the “reward” was a happy face drawn on the underside of the card on which the to-be-learned +SA was drawn. In the other, a token was placed under the positive stimulus. As predicted, 4- to 6-year-old children made considerably fewer errors when the reward was physically inseparable from the +SA.

Several researchers have suggested that children who participate in transfer experiments may not realize that they are to apply information gained in the training phase to their transfer decisions. Cole (28) has shown that preschoolers treat the initial phase of learning differently than they treat the transfer. Bullock & Gelman (25) report on two problems they encountered in interpreting transfer data. Children between the ages of 2 1/2 and 4 were first given a one-item versus two-item discrimination task. Half the children were told that the one-term array was the “winner” and half were told that the two-item array was the “winner.” From the experimenter’s point of view this constituted a more-less comparison. To determine whether children could transfer the more-less distinction to another set they gave children a three-versus four-item transfer task. They note that apparently many of their “older” children were confused by the question of which array was then the winner. These children often said that neither was the winner, an observation which in point of fact was correct. The children hesitated to choose the best possible choice until asked to do so. When asked to do this, they went on to choose the one that honored the relation they were reinforced for during training. The variation in the question served to tell the children that they were to make a judgment of similarity and not identity. A somewhat different problem arose regarding the interpretation of the transfer responses of the 2-year-olds. These youngest subjects responded at random, a result which could be taken to reveal an inability to use a numerical ordering relation. But it turns out that the 2-year-old’s problem was knowing to apply the knowledge gained during training to the new stimuli. On the hunch that this might be the case, Bullock & Gelman ran a subsequent study where they left the training arrays on the testing table. The arrays were covered, thus a positive transfer result could not be taken as evidence favoring a memory-deficit account of the original study. Apparently, the presence of the old, covered arrays was enough to clue the
CONCLUSION: WHY STUDY EARLY COGNITIVE DEVELOPMENT?

I began with the suggestion that it is a good thing that many in the field of cognitive development have moved to investigate what the preschooler can do as well as what he cannot do. Why? Recall that the traditional account of how the younger child differed from his older cohort was given in terms of capacity the younger child lacked. My objection to this is based on many considerations. First, the characterization of the child's cognitive structure in terms of what it lacks derives in most cases from a very limited experimental investigation of a particular ability. The characterization, for example, of the child as lacking number-invariance rules rested on the child's ability to perform satisfactorily on a single task, the number-conservation task. This task is certainly a test for the presence of number-invariance rules. It is difficult to imagine how a child could pass without such rules. But a failure to pass this test cannot by itself be taken as proof that the child lacks number-invariance rules. Failure on a single test should not be accepted as proof of the null hypothesis. Any nontrivial cognitive structure will by definition play a role in a variety of contents. Thus our first misgiving about the traditional view is methodological in nature. The child is said to lack cognitive principles of broad significance simply because he fails a particular task involving these principles.

Our second concern is with the nature of theorizing that flows from inadequately supported assumptions about what the child lacks. Let us for the moment accept the view that the preschooler is cognitively inept. Such a view makes life difficult for the theorist who is interested in describing the process of cognitive growth from the preschool years through to middle childhood. For we are forced to work with all-or-none descriptive statements about cognitive development. This in effect means we could be caught up in a never-ending guessing game of whence came a particular ability.

Then there is the fact that the focus on deficiencies belies the commitment to a developmental approach. Among those who call themselves developmentalists, I doubt there is anyone who has not been asked to defend the developmental approach. The typical answers involve the view that we will not understand the end product unless we watch its evolution. Indeed, some argue, our understanding of the end product might be altered if we knew its developmental course. It seems inconsistent to argue on these grounds for research comparing children and adults while ignoring the need to compare preschoolers and school-aged children.

Finally, I contend that the decision as to which of the many potential relationships holds between the development of a particular capacity from one point in time to another rests ultimately with the data. Above I summarize the evidence against the view that the disappearance of egocentrism is yoked to the emergence of logico-mathematical abilities. The account of the acquisition of number concepts may very well require a stage theoretic framework. But it begins to look as if the account of communication skills will not. Indeed, as I see the recent findings on what preschoolers can do, it becomes difficult to hold to any theory that links all of the cognitive advances of middle childhood to one grand theory.

I end with one caution about interpreting the evidence summarized in this review. Yes, there are conditions under which young children reveal some capacities they were thought to lack. Yet it still is true that they fail the many traditional tasks we use. The question is, why do they succeed in some cases but not others? Why is a particular capacity so fragile? To answer this most important question we will need to make more extensive use of research designs that compare and contrast rather than merely compare or contrast.

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