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ABSTRACT

This paper describes an on-going research program focused on the development of attention in children with specific reference to the strategies and patterns of activities which children use in seeking information and in directing and controlling their own attention. Findings from three earlier studies suggest that older children are better able than younger children to select only relevant information, to remember only potentially relevant information, and to shift quickly from selecting one type of relevant information to another. These findings provided evidence of a developmental trend towards more flexible, efficient strategies of attention. This evidence, together with the conceptualization of attention as the selectivity which characterizes a variety of cognitive activities, suggests general questions regarding the formulation of attention development. More is known of environmental factors which are related to children's attention than is known about the way children control and direct their own attention. Little is known about the ways in which one's own behavior controls what one attends to. At present, attempts are being made to identify developmental trends in search strategies. Instances in which young children are more accurate than adults (as in the Stoop effect) show that adults are not universally more accurate, flexible, and efficient attenders than children. The development of search strategies is being studied by asking children to engage in search activities which simulate search as it occurs ordinarily, by asking about children's discovery and use of redundant information in this search task, and by employing tasks which dictate two distinct search strategies. (GO)

The Development of Strategies of Attention[1]

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Most current study of attention in adults can be described as being in the information processing tradition. Investigators want to find where -- along the path from stimulus intake to response or behavior -- selectivity occurs. A number of ingenious techniques have been devised to aid in this search as is illustrated in the work of Anne Treisman (1969), Michael Posner (1969), and Ulrich Neisser (1967) among others. These investigators use error analyses in shadowing tasks, or patterns of reaction time in choice tasks. They use these tasks in order to specify the locus of attention -- how far along in information processing it occurs -- and they also use these tasks to specify the stimulus characteristics which afford selectivity.

A result of this work has been the identification of a variety of sites of attention. Deutsch and Deutsch (1963), for instance, locate attention at the response end of the path whereas Treisman locates attention much closer to the input end. This variation in the presumed locus has led to a state of affairs in which, for some investigators, the study of attention involves the study of memory processes while for others, it is the study of perceptual processes.

When some students and I began to study the development of attention

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in children a few years ago, we assiduously avoided any apparent concern with the lack of clarity associated with the term attention. We wanted to ask first, whether the locus of attention in the developing child is similar to that in the adult, second, how attention functions in the developing child, and third, what characteristics of stimulus information and of tasks affect children's attention. We set about studying our own variety of attention in spite of a dim realization, even then, that the concept of attention itself was badly in need of clarification.

Subsequently, we reached a point in our investigation when we wanted to specify the relation between our species of attention and those varieties being studied by others. So we undertook a moderate form of that conceptual clarification which we knew from the start was necessary. What I will do today is describe briefly -- as background -- our early studies of the development of attention; and then I will share with you our conclusions about the concept of attention as it is applied currently to the study of cognitive development. These conclusions are not at all profound, but they have helped us to think more clearly about the role of attention in children's cognition.

We began with the observations of parents and teachers that as children get older they become less "distractible," and better able to "pay" attention for a longer period of time. We were also interested in the results of studies of selective listening in which older children are found better able than younger children to report only one of two simultaneously heard messages. And we were also interested in the results of studies of incidental learning in which older children are shown not necessarily to recall more incidental information than younger children. This latter observation of course, is ambiguous with respect to the

question: Where is the locus of attention, since the older children could either be perceiving only the relevant information or they could be only remembering the relevant information. In other words, the older children in an incidental learning situation could be selectively perceiving or they could be selectively remembering. In fact, that is the distinction which interested us initially as we set about our search for the locus of attention -- somewhere in cognitive processing either in perception or in memory.

We constructed two experimental tasks which we hoped would help us in this search. In both tasks, children were asked to view pairs of objects -- colored wooden animals -- and to compare some feature of them -- either their colors or their shapes. In one task, the children, who were second graders and sixth graders, were told which feature to judge just prior to viewing a pair. In the second task, the children viewed a pair for a limited time and then were told which feature to compare. We reasoned that a relative advantage for the older children in one or the other of these tasks would be informative about where the selectivity occurs which leads them to be better attenders. We found, as we expected, that the older children were faster than the younger children in both tasks, but the effect of age on comparison speed was greater for the first task than for the second task. The older children were better able than the younger children to take advantage of knowing what to look for in that task; they could focus on the relevant information to the exclusion of what was irrelevant. The effect seemed to imply that attention was occurring during the initial selection of information (Pick, Christy, & Frankel, 1972).

In a second study (Pick & Frankel, 1973), we added potentially dis-

tracting features to the pairs midway through both tasks. The distraction did not affect the children's comparison speed at all in the task in which they knew what to look for. However, in the second task, that in which the pair is seen prior to knowing what is relevant, the distracting features did affect the children's comparison speed, and the effects were different for the two age groups. Specifically, the effects were temporary for the older children and more general for the younger. The distracting features seemed to affect the efficiency with which the younger children could perform the task. But the distraction, in this case, was affecting the younger children's performance in the task in which memory is involved rather than affecting their performance during the initial selection of information.

Finally, in a third study (Pick & Frankel, 1974), we used the task in which the children are told which feature to judge prior to seeing the pair. This time, however, we compared their judgments in a condition in which the same feature was judged through a series of many trials with their judgments in a condition in which different features or combinations of features were judged in each trial. We found this second condition to be especially detrimental to the comparison speeds of the younger children -- much more so than for the older children. The older children were much more able to adjust what we called their selection strategies than were the younger children.

Thus, in these three studies we found that the older children were better able than the younger children first, to select only relevant information, second to remember only potentially relevant information, and third, to shift quickly from selecting one type of relevant information to another. Together, these findings provided evidence of a developmental

trend toward more flexible, efficient strategies of attention.

We had concluded by now that it is not useful to try to answer the question with which we initially began our study -- the question, Where is the locus of attention? Is it in perception or in memory? We had already seen results in our own studies which were sensibly interpreted in terms of developmental changes in the way children "filter out" irrelevant information as well as results reflecting developmental changes in the way children organize information in memory for quick recall. We had seen selectivity operating at the time of initial selection of information and we had seen selectivity in memory as well. We made the obvious observation that disagreement among various descriptions of attention arises because different researchers and theorists describe different types of selective activities. Common to all conceptualizations of attention, however, is a reference to selectivity -- selectivity of some aspect of cognitive functioning -- selective perception, selective memory, even selective thinking. We concluded that it might be useful to conceive of attention as the selectivity which does characterize a variety of cognitive activities -- perception, memory, thought (cf. Pick, Frankel, & Hess, in press). Viewed in this way, as selectivity which occurs throughout cognitive functioning, there are some obvious general questions to be answered in arriving at a formulation of the development of attention. What factors influence the child's selection of information -- either from the environment or from his memory -- and do these factors affect attention differently depending upon the age of the child? This question focuses on the environmental contribution to attention. But we can also ask about the child who is doing the attending. How does the child go about selecting information, and do his strategies change with the task? Do young children

search differentily, i.e., in different patterns or with different strategies than do older children? When we asked these questions, we found that much more is known about environmental factors which are related to children's attention than we know about how children control and direct their own attention. For instance, we know a good deal about preferences and salience and novelty, and how different physical, spatial, or conceptual arrangements affect what children will notice or remember -- in short, what they will attend to.

We also found that very little is known about the activities engaged in by the attender, i.e., the ways in which one's own behavior controls what one attends to. So we began to try to ask about the types of activities and strategies which children engage in in order to bring about attention to one type of information or another. This is the question we are concentrating on now. We are trying to identify developmental trends in search strategies, i.e., in those activities in which children engage in bringing about attention to one type of information rather than another. On first consideration, it may seem obvious that increasing flexibility, accuracy, and efficiency characterize the development of attention strategies. That is, it may seem self-evident that older children are "better" than younger children -- every day in every way -- and that we may be engaged simply in rediscovering the wheel. However, there are some situations in which accuracy and efficiency are more characteristic of younger children's attending than of adults'. One instance is the well-known Stroop effect in which skilled readers have difficulty naming the print color of words which are color names when the print color and the word are incongruous. For instance, if the word is "yellow" and it is printed in black print, it is difficult to say "black" while looking at the word.

We have previously found (Pick, Pick, & Hales, 1972) that a Stroop-like effect sometimes occurs even when the task requires just a simple comparison -- a judgment of same or different.

Another instance in which children are more accurate and efficient attenders than adults is the case of certain visual illusions which increase in magnitude as children get older. For example one such illusion, the Ponzo illusion, may depend on interpreting representattional information for depth, as in a picture. Adults who have had a long history of successfully interpreting depth information in pictures seem unable to inhibit attending to that information and to attend instead to the lines on the flat surface of the paper. Young children, on the other hand, as well as adults with a history of education, are perfectly able to compare accurately lines on paper without interpreting them as representing depth in a pictorial scene (Leibowitz & Pick, 1972).

Still another instance in which adults are rather inefficient attenders occurs in letter search tasks. Adults require many practice sessions in such a task before they are able to search for target letters by searching for the relevant features instead of by searching for the entire letter shape (Yonas & Gibson, 1967).

In short, adults are not universally more accurate, flexible, and efficient attenders than children and so it seems relevant to ask what tasks and situations elicit different search strategies. We are trying to think about the types of real search activities children engage in. We are constructing tasks which allow us -- on the one hand, to look at the generality of the findings from our earlier reaction time studies and -- on the other hand to observe more directly than we could in the reaction time tasks the patterns or strategies of search children use when seeking

a particular object or type of information. In short, we ask children to engage in search activities in situations which simulate search as it occurs ordinarily.

An instance of the type of task I am referring to is one in which a child is given a large collection of colored plastic three-dimensional letters and is asked to find particular letters in the collection. We are interested in the speed with which children of different ages can accomplish such search -- just as we were in the reaction time studies. But we are also interested in the patterns in which the children move their hands as evidence of the strategies they are using. Differences in strategies as a function of age tell us about whether efficiency and flexibility do accurately describe the direction in which attention develops. And we find such differences. For instance, in one situation the letters are different colors, the target letters are also different colors, and the collection is in a container. When we observe the frequency of the use of different strategies, we find: First, only children as old as 10 or 11 years ever empty out the container and spread out the letters in an attempt to scan quickly the entire collection. Younger children never do this and if a letter spills out, they quickly return it to the container. The typical search of fourth- or fifth-graders consists of moving the letters around in the container into piles so as not to search through letters already searched. Children of early elementary school age also use their hands to sort through the collection, but they tend not to try to avoid searching through letters already searched. They are less efficient than the older group, but their search is still systematic in the sense that they try to search completely through the collection. Preschool children "go through the motions" of a coordinated

search, but their search looks like just motions. They use their hands to push letters around in the container, but there is no clear relation between what they do with their hands and locating targets. If a target happens to appear, these children identify it, but they do not behave as though their hand movements are in the service of search. These descriptively different strategies are reflected in reaction time patterns as well. That is, search time mirrors the apparent sophistication of the strategy with the more efficient strategy resulting in a task completed successfully sooner.

We are not ready to conclude that the youngest children, the preschoolers aren't flexible, though. One 4-year-old who was having difficulty and taking a long time to find all the "G"s or whatever her target letter was, picked up a letter, checked it, found that it was not what she wanted and said, "I'm going to look for all the 'P's instead, and here's the first one!"

Another way in which we are studying the development of search strategies is to ask about children's discovery and use of redundant information in this search task. For instance, if children search in a multicolored collection of letters for all the "A"s, "L"s, and "S"s, and all the instances of those letters are the same color and they are the only letters of those colors, can children discover and use that information? The answer is, that the older children are, the more likely they are to discover and use that redundancy. Such use is reflected in decreases in search times over trials. Also, if children are informed of the redundancy, and they are older than preschool age, they are almost certain to use it. However, young preschool age children are likely not to use the redundancy even if they are informed about it. The adaptability which

characterizes the way older children use the available information is simply not part of the young children's behavior.

Finally, let me describe briefly one example of a third type of task which we are using to help us identify strategies of attention. We think of our reaction time tasks as instances in which we have a high degree of control over the information which is available for children to use -- and also, an instance in which we have to make inferences from search time about the strategies being used. The letter search tasks I have just described are instances in which we have less control (than in the reaction time task) over the information which is available, but we have more opportunity to observe directly strategies instead of only being able to infer them from reaction times. There is a third type of task in which we have all but lost control over the information which is available to be used but which enables us to observe quite directly children's attention to one or another type of information. An example of this type of task is one which we have labelled an "alphabet board" task. The alphabet board is a tray with four rows of indented spaces, each in the shape of a letter and the tray is accompanied by sufficient letters to fill each space. The child is shown the tray and the letters and asked first to put the letters in the tray and then to show a friend how to play the game. There are two obvious ways to play the game: One can pick up the nearest (or most apparent) letter and place it in the tray and then the next nearest, etc. This is an efficient strategy if one knows the alphabet well enough to "string it out in space," i.e., if one knows that "L" goes in the middle, "W" near the end, etc. A second strategy is to look for "A," then for "B," etc. In other words, one can fill the tray in the order of the alphabet. When we look at the frequency with which children

use one or the other strategy, we find that children older than 8 years nearly invariably use the first strategy, that is, they select the letter nearest the tray first, regardless of whether it is at the beginning of the alphabet. Children of 4 and 5 years mostly use the second strategy -- that is, begin with "A," then "B," etc. -- They use this strategy both when they play the game themselves, and when they show a friend how to play it. For children of 6 or 7 years, neither strategy predominates when they fill the tray for the first time; but when they show a friend how to play the game, they usually use the "less mature" strategy, that is, they look first for "A," then for "B," etc. It is as though the requirement of making explicit the rules of the game lead them to revert to the "simpler" strategy. Obviously search time is fairly uninformative in this task, but our confidence in the interpretation of the relative sophistication of these two strategies is increased by the fact that here too, search time mirrors the apparent sophistication of the strategy being used.

In summary we are finding it useful to view attention as the selectivity which characterizes all aspects of cognitive functioning. The goal of this research program (at least as we presently conceive it) is to describe the development of attention with specific reference and emphasis on the strategies and patterns of activities children use in seeking information and in directing and controlling their own attention.

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