The Emergence of Adaptive Decision Making in Children

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How do children become adaptive decision makers in complex environments? Though we know that adult-like abilities are present by age 11 or 12, and that children younger than this often fail to adapt, we know virtually nothing about the mechanisms responsible for this development. In this article, we explore the obstacles that confront young children as they attempt to adapt to complex decision tasks. We focus on the possibility that younger children's failures might be linked to a fairly simple obstacle, such as being insensitive to the cost or effort involved in pursuing alternative strategies for making decisions. This possibility was tested in an experimental setting, with children aged seven to 11 years, in which children's decision-making strategies were monitored as they made choices from increasingly complex information boards in the presence or absence of imposed costs for gathering information from the boards. Our results indicate that age differences in adaptivity can be eliminated with the imposition of search costs, implicating sensitivity to decision-making costs as a major contributor to the development of adaptivity in complex environments.

One of the most important skills we develop as consumers is the ability to adapt to complex decision environments. We know that individuals adapt in several ways, key among them being a shift from exhaustive processing of all available information to simplifying strategies that reduce the amount and type of information to be processed. Individuals process less information and become more selective in their processing using a variety of strategies, including ''satisficing'' rather than optimizing, ''multiphase'' or ''multipass'' information searches instead of exhaustive ones, and noncompensatory choice strategies rather than compensatory ones (see Einhorn and Hogarth 1981). Much evidence to this effect has been gathered by observing individuals making choices from information display boards varying in the number of alternatives and attributes available (e.g., Payne 1976). As the number of alternatives and/or attributes increases, individuals restrict their search to a smaller proportion of the available information, focus their search on more promising alternatives, and switch from highly demanding compensatory choice strategies to less cognitively demanding noncompensatory ones (for a review, see Payne, Bettman, and Johnson [1993]).

We know surprisingly little, however, about when and how these skills develop. The only insight at this point is that, by age 11 or 12, children exhibit the same types of adaptive behavior as those found in adults. Evidence to this effect was first reported in a seminal paper by Klayman (1985), who studied 12-year-olds making decisions from information boards of varying complexity. Children were asked to make choices from sets of alternatives (such as bicycles) represented on information boards, which varied in terms of the number of alternatives and attributes listed. Klayman found that his subjects adapted to increasing complexity by simplifying their search for information and using noncompensatory choice strategies in a manner consistent with adult behavior. Subsequent studies using the same experimental paradigm have yielded corroborating data, indicating that children aged 12 years and older exhibit patterns similar to adolescents and adults (Nakajima and Hotta 1989) and that children younger than 10 or 11 years of age are far less adaptive than their older counterparts (Davidson 1991b).

Unfortunately, none of these studies sheds any light on the way in which adaptive decision making develops as children mature. Though we can be reasonably certain that the ability to adapt to complex decision environments develops during early and middle childhood, we know virtually nothing about what mechanisms are responsible for this development. The only clue, to date, is provided

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by our recent study of children's decision-making skills (Gregan-Paxton and John 1995). Our research, conducted with children four to seven years old, found that the ability to trade off the costs and benefits of collecting information prior to choice develops with age, being present to a limited degree at four to five years of age and developing thereafter. Older children were generally more selective in their search strategies, gathering more information when it was most beneficial in making informed choices and gathering less information when it was more costly to do so. Unless encouraged to do so, younger children ignored the cost and effort involved in exhaustive information searches, often gathering much more information than necessary.

It is quite possible that age differences of this sort contribute to developmental trends in adaptive decision making. Specifically, an increased sensitivity to the cost or effort involved in pursuing decision-making strategies may be a necessary condition for adaptive behaviors to occur, especially in complex decision environments. Effective adaptation requires one to balance the costs and benefits, or effort and accuracy, of using exhaustive versus more simplified decision-making strategies (see Payne et al. 1993). Inherent in this scenario is the ability to recognize and respond to the costs of gathering and processing information, particularly as the task environment becomes more complex and more information becomes available. Absent this type of sensitivity, young children may have little incentive to change their strategies in a manner that would effectively balance the costs and benefits in an adaptive manner.

The purpose of this article is to explore these notions as a way of understanding what factors underlie the development of adaptive decision making in children. Specifically, we examine whether age differences in adapting to complex decision environments, as noted in prior work, are related to younger children's difficulties in attending to and responding to the costs of exhaustive (and inefficient) decision-making approaches. In doing so, we propose that young children's failures to adapt can be linked to simple deficits, such as being insensitive to search costs, and that, if these deficits can be alleviated, young children can perform as well as much older children in complex decision tasks.

Toward these aims, we first present our view of how adaptive decision making develops, which describes the obstacles young children face as they attempt to adapt and identifies several propositions about how adaptive decision making emerges during childhood. Based on this framework, we present hypotheses about how the salience of search costs might affect the types of adaptive behavior exhibited by children of different ages. We then test these hypotheses in an experiment, conducted with children seven to 11 years of age, in which decision-making strategies were monitored as children made choices from information boards of varying complexity. Finally, we discuss the implications of our results in terms of understanding the emergence of children's decision-making skills and suggesting an agenda for future research.

CONCEPTUAL BACKGROUND

Why Do Young Children Fail to Adapt?

The current state of knowledge suggests that children younger than 10 or 11 years of age do not adapt effectively when faced with complex decision environments. The interesting question here is why children often fail to adapt. We propose that the obstacles are similar to those facing young children in most learning and problem-solving situations, generally referred to as knowledge deficits and utilization deficits. Knowledge deficits refer to the lack of basic skills and knowledge needed to perform a task. Utilization deficits, on the other hand, refer to difficulties in using whatever knowledge or skills are available in a particular learning or problem-solving situation. The notion of knowledge and utilization deficits provides a useful framework for exploring several reasons why young children may not adapt effectively in complex decision tasks, as well as for understanding why sensitivity to search costs might be a crucial factor.

Knowledge Deficits. Turning first to knowledge deficits, one possibility is that younger children may lack the basic metacognitive knowledge that flexibility in approaching a decision task is beneficial and that strategies need to be adapted when facing more complex tasks. In other areas of child development, strategy production has long been linked to the development of metacognition during early childhood, especially the understanding of the connection between behaviors and the goal one is trying to achieve (e.g., Alexander and Schwanenflugel 1994; Beuhring and Kee 1987; Bjorklund and Harnishfeger 1990). As children gain experience with problem situations, they become aware of factors affecting their performance on tasks and begin to recognize that different situations require different behaviors or strategies. Without this type of metacognitive knowledge, children are unlikely to adapt their decision-making approach simply because they see few benefits of doing so.

A second possibility is that younger children do possess some base level of metacognitive knowledge necessary for adaptation, but lack knowledge about specific decision-making strategies. Strategies useful for complex decision environments, such as noncompensatory ones, may become part of one's repertoire only after considerable experience and maturity. Though little is known about children's knowledge base in this area, evidence from research on children's problem-solving skills in areas such as mathematics suggests that children discover new strategies as they gain experience with a specific task (see Siegler and Jenkins 1989). Because young children generally have fewer experiences of this nature, they typically possess a smaller repertoire of strategies for learning and problem solving than older children do (for a review, see Siegler [1991]).

A final possibility is that young children may fail to adapt well to complex decision environments due to a lack of knowledge about which strategies work best in different situations. What may be missing is not the basic notion of adaptivity, nor basic knowledge regarding alternative strategies, but the specific links that trigger a particular strategy for a particular task. For example, young children may have a repertoire of simplifying strategies appropriate for a complex decision task, but may lack the production link between the task (complex) and the decision-making strategy (simplifying) that triggers an adaptive response.

Utilization Deficits. Turning to utilization deficits, a number of obstacles may prevent children from using whatever strategies they have available. First, young children may have difficulty attending to and encoding elements of the decision environment that should trigger a particular strategy (for a similar idea, see Payne et al. [1993]). With a complex task, children may not attend to certain cues signaling that too much information is available for an exhaustive search or that, even if a more exhaustive search of information is possible, it would not be beneficial to do so. A case in point, raised earlier, is that young children may not pay attention or be sensitive to the effort or cost involved in gathering and processing large amounts of information. Insensitivity to the cost and effort involved in processing large amounts of information would certainly decrease the probability that simplifying strategies would be triggered by complex decision environments.

A second possibility is that young children, though attending to important cues in the decision environment and selecting an appropriate strategy, nevertheless have difficulty implementing the strategy they have chosen to pursue. One problem may be young children's difficulties in selectively attending to relevant information in the task environment and ignoring irrelevant information. Being selective in what type of information is processed is a key component of most simplifying strategies, especially noncompensatory choice strategies. Even if young children have a sense of what type of simplifying strategy would be appropriate for a complex decision task, they may have difficulty implementing the strategy because they are easily distracted by irrelevant information. In learning or memory tasks, it is not unusual to find that children younger than 10–11 years of age fail to restrict their attention to task-relevant information (see Siegler 1991). Similar evidence has been reported in a decision-making context, with younger children (aged seven to eight years) gathering as much information about irrelevant as relevant attributes (Davidson 1991b).

Implementation problems may also surface as young children find it difficult to perform whatever calculations or operations are required to apply a particular strategy to the problem at hand. Though simplifying strategies are often used for complex decisions, these strategies may still require a series of calculations or comparisons for implementation. Given that young children are still developing skills in basic areas of mathematics, even simple comparisons may prove unwieldy. For example, a weighted adding strategy would be impossible for a child in the early elementary school grades to implement because they lack the skills to do the mathematical operations that are involved.[1]

How Does Adaptive Decision Making Emerge?

The view emerging from our discussion of knowledge and utilization deficits is that adaptivity develops as children mature and different types of obstacles are removed. As their knowledge base about decision making develops and they become more experienced in utilizing the knowledge they possess, children adapt more effectively to all types of decision settings, especially those that are complex and require approaches that produce good choices with reasonable effort.

Basic Propositions. This scenario suggests several propositions about the development of adaptive decision making in complex decision environments. First, given the variety of knowledge and utilization deficits that might be operating in any particular setting, it seems unlikely that adaptive decision making emerges at any one particular age, such as 10 or 11 years of age, as the findings to date would suggest. Rather, it is our view that the knowledge and skills needed for adaptive decision making begin to develop at an early age, as early as the preschool years, but remain unused unless the task is a simple one that provides prompts that trigger the knowledge children possess. Implicit in this view is the notion that many problems faced by young children in adapting to complex decision environments are caused by utilization deficits, not knowledge deficits.

Related to this is a second proposition suggesting that adaptivity to complex task environments does not emerge in an "all-or-none" fashion. Evidence of rather simple forms of adaptivity might be found at relatively young ages, even though knowledge or utilization deficits might preclude a full repertoire of adaptive responses until early adolescence. For example, adults often adapt to more complex information environments by reducing the amount of information they gather, selectively processing more information about some alternatives than others, and using noncompensatory choice strategies. Young children would be unlikely to produce this full range of adaptive responses, but may be able to use a rather basic strategy of simply reducing the amount of information acquired.

Finally, this line of reasoning suggests that even young children can exhibit adaptive decision making in complex decision environments, especially when prompted by cues

[1] We are indebted to a reviewer for suggesting this deficit and the weighted adding strategy example.

or instructions that alleviate whatever deficits they experience. Though prior work has emphasized differences in adaptivity among younger (seven to eight years old) and older children (10–11 years old), this does not rule out the possibility that younger children can be just as adaptive in complex tasks with the provision of appropriate cues. Cues or prompts can facilitate adaptivity by triggering the use of whatever strategies young children have for dealing with complex decision environments.

Empirical Support. Direct support for these propositions has yet to surface. As noted earlier, the few studies that exist on this topic simply document that effective adaptation to complex decision environments emerges by at least 11–12 years of age.

Indirect evidence, however, can be found in several related lines of research. First, studies of learning and problem solving are generally supportive of the idea that cognitive skills develop gradually over time, that evidence of such skills does not emerge on an all-or-none basis, and that young children can exhibit quite sophisticated skills under facilitative conditions (see Siegler 1991). In particular, a good deal of evidence exists that young children have strategies at their disposal that are "hidden" from view by utilization deficits. Children as young as four or five years of age can appear quite strategic in their approach to problems when provided with perceptual cues, explicit instructions, or a meaningful context that facilitates the use of whatever knowledge they have (Alexander and Schwanenflugel 1994; Miller and Harris 1988; Beuhring and Kee 1987). In fact, in some cases, young children perform at levels similar to those of much older children in the presence of cues highlighting the need for a particular strategy (e.g., Woody-Ramsey and Miller 1988).

Second, evidence related to children's decision-making skills provides some promising data. In a study with children ranging in age from seven to 11, Davidson (1991b, experiment 2) reports some limited success with a perceptual cue that clearly identifies the most relevant pieces of information in an information display board. Recalling that attending to relevant and ignoring irrelevant information is a likely type of utilization deficit, one could expect that a relevancy cue would enable younger children to be more adaptive and more selective in the way they approached a complex decision task. Davidson found that the cue was helpful in this regard, but only for the older children (ages 10–11); younger children (ages seven to eight) did not benefit.

More promising is the evidence from our study (Gregan-Paxton and John 1995) on children's ability to trade-off costs and benefits of search. As mentioned earlier, we found that younger children (ages four to five) did not balance the costs and benefits of search in gathering predecisional information unless very salient cues about the costs of gathering data were presented. Imposing search costs encouraged the youngest children to restrict their search activity when the benefits of more exhaustive searches were minimal. Though young children (ages four to five) were still less consistent than older children (ages six to seven) in adapting their search strategies across a variety of different cost-benefit situations, it was equally clear that the cost cue diminished problems that young children had in utilizing an appropriate strategy.

Research Hypotheses. Direct evidence for our propositions was pursued in this study by exploring the role that sensitivity to search costs might play in how children adapt to complex decision environments. Following up on our earlier study (Gregan-Paxton and John 1995), we hypothesized that young children would be largely inattentive or insensitive to the costs of exhaustively processing information in an information-intense environment, constituting a type of utilization deficit that leads to failures to adapt effectively. If this utilization deficit can be alleviated, through the use of prompts or cost cues, young children will exhibit many of the same adaptive behaviors that older children do in complex decision settings.

Two specific hypotheses were advanced. Our first hypothesis was that, without search cost cues, older children would exhibit more adaptive behavior than would younger children. This prediction replicates the general finding of age differences from prior research by Davidson (1991a) and extends it by examining several different indicators of children's ability to adapt to complex decision tasks, including the total amount and proportion of available information processed, the type of search strategy (e.g., exhaustive vs. multipass), and selective processing of information by alternative. Variations of these dimensions, capturing changes in the amount and selectivity of information processed across complex task environments, have been commonly employed by researchers studying the decision-making skills of preadolescents (Klayman 1985; Nakajima and Hotta 1989) and elementary school children (Davidson 1991a, 1991b). Age differences with regard to these dimensions were hypothesized as follows:

H1: In the absence of substantial search costs, older children will exhibit more adaptive behavior in response to increasing task complexity than will younger children. Older children will:

H1a: process a smaller amount and proportion of available information.

H1b: conduct less exhaustive searches, using strategies such as satisficing; and

H1c: exhibit more selectivity in processing information by concentrating on more promising alternatives and ignoring poorer ones.

More important, a second hypothesis was advanced to test the idea that age differences in adaptivity to complex decision environments could be diminished, or perhaps even eliminated, by making search costs more salient using concrete cues. Evidence to this effect would provide support for our first proposition that adaptivity to complex decision tasks does not emerge at any one particular age (e.g., 10 or 11 years) as well as our third proposition that younger children can be encouraged to be more adaptive in these settings with appropriate cues. Support for our second proposition, that adaptivity does not emerge in an all-or-none fashion, was pursued by further predicting that the provision of search cost cues would eliminate the gap between younger and older children for some, but not all, types of adaptive responses. Recalling our prior reasoning, it seemed likely that cues would encourage adaptive responses of a more straightforward nature (e.g., reducing the amount of information processed) rather than those that require more sophisticated strategies (e.g., using a very selective search strategy). Absent prior research to guide more specific hypotheses, we forwarded the more general hypothesis that search cost cues would eliminate age differences for only some forms of adaptive response. Thus:

H2: In the presence of substantial search costs, younger children will exhibit adaptive behavior in response to increasing task complexity that is equal to that of older children in some of the following ways:

H2a: processing a similar amount and proportion of available information

H2b: conducting similar types of searches, favoring less exhaustive ones such as satisficing; and/or

H2c: exhibiting similar selectivity in processing information by concentrating on more promising alternatives and ignoring poorer ones.

METHOD

Overview

Children played a game called "treasure hunt," in which they were allowed to pick a "treasure box" from several depicted on information boards. Information boards varied in complexity, manipulated by the number of treasure boxes (alternatives) and the number of individual prizes (dimensions) included in each treasure box. Information about the prizes in each treasure box could be obtained by uncovering "curtains" hiding the information on the display board. Search costs were made salient for half the subjects by requiring them to pay (i.e., give up a piece of candy) for each piece of information they uncovered on the board.

Children's decision-making strategies in this task were examined in a 2 (age: second graders, fifth graders) × 2 (search cost: low, high) × 2 (alternatives: 3, 6) × 2 (dimensions: 3, 6) experimental design. Age and search cost were varied between subjects, with alternatives and dimensions varied as within-subjects factors.

Subjects

Eighty-nine children were recruited from two parochial schools in a large western city. Forty-five children were second graders (ages seven to eight, 21 males, 24 females) and 44 were fifth graders (ages 10–11, 20 males, 24 females). Parental permission was obtained for each child prior to the start of the study. Each child also signed an assent form before participating.

Experimental Stimuli

Information boards were used to present the various options to children. In doing so, we modified the format of the stimuli typically employed in previous studies (Klayman 1985; Davidson 1991a), where alternatives (e.g., bicycle A, bicycle B) and dimensions (e.g., size, price) were conveyed by verbal labels. Instead, we used visual representations of the alternatives and dimensions to diminish any difficulties due to reading ability or familiarity with the dimensions and prizes being offered. Treasure boxes were placed on the left-hand side of the information board, portrayed visually by different colored boxes with bows. Thus, each row represented a different treasure box. Information about the possible contents of each treasure box was provided across the top of the board, with each column representing a different prize category (e.g., pencils, erasers, money). Here, the actual prizes for each category were mounted on the board, with one prize being less desirable than the other in each category (e.g., a dollar vs. a nickel). Specific prizes for each treasure box were also mounted on the information board in the appropriate columns, hidden from view by a felt curtain.

Four information boards of this type were constructed to manipulate task complexity. As shown in Table 1, the boards featured either three or six alternatives (treasure boxes) and three or six dimensions (prize categories). The prize categories, and specific prizes, were selected with several considerations in mind. First, prize categories were selected to be of interest to a wide range of elementary school students in terms of age and gender. Second, the prizes available in each category were selected in such a way that one prize would be more valuable than another (e.g., a dollar or a nickel; a zebra-striped pencil or a plain yellow one). This was deemed critical for encouraging subjects to search for information, especially in the high search cost condition. Third, the difference in value between prizes was designed to be relatively high in some categories (e.g., dollar vs. nickel) and relatively lower in others (e.g., miniature vs. small plastic frog). This was deemed important to facilitate the use of simplifying strategies by allowing children to concentrate on some (more important) dimensions than others. Finally, the individual treasure boxes were designed to be unique, with none

TABLE 1

EXPERIMENTAL STIMULI

Dimensions/ alternatives	Pencil	Eraser	Money	Stickers	Candy	Toy
3 × 3:						
Yellow box	Zebra-striped	Plain pencil-top	1 dollar	. . .	. . .	. . .
Green box	Plain yellow	Yikes! fun shape	1 nickel	. . .	. . .	. . .
Orange box	Zebra-striped	Yikes! fun shape	1 nickel	. . .	. . .	. . .
3 × 6:						
Yellow box	Thunderbolt design	Plain pencil-top	3 quarters	Skeleton	Miniature Tootsie Roll	Small plastic frog
Green box	Thunderbolt design	Plain pencil-top	3 quarters	Skeleton	Giant Tootsie Roll	Miniature plastic frog
Orange box	Plain yellow	Colorful pencil-top	1 nickel	Flowers (set of 8)	Giant Tootsie Roll	Small plastic frog
6 × 3:						
Yellow box	Prism design	Plain pencil-top	1 penny	. . .	. . .	. . .
Green box	Prism design	Plain pencil-top	3 quarters	. . .	. . .	. . .
Orange box	Plain yellow	Yikes! fun shape	1 penny	. . .	. . .	. . .
Blue box	Plain yellow	Yikes! fun shape	3 quarters	. . .	. . .	. . .
Grey box	Prism design	Yikes! fun shape	1 penny	. . .	. . .	. . .
Red box	Plain yellow	Plain pencil-top	3 quarters	. . .	. . .	. . .
6 × 6:						
Yellow box	Rainbow colored	Yikes! fun shape	1 penny	Skull and crossbones	Large roll of Life Savers	Small square puzzle
Green box	Plain yellow	Yikes! fun shape	1 penny	Flowers	Large roll of Life Savers	Small square puzzle
Orange box	Rainbow colored	Plain pencil-top	1 dollar	Skull and crossbones	Large roll of Life Savers	Small square puzzle
Blue box	Plain yellow	Plain pencil-top	1 dollar	Flowers	Small roll of Life Savers	Large foot-shaped puzzle
Grey box	Rainbow colored	Yikes! fun shape	1 penny	Skull and crossbones	Small roll of Life Savers	Large foot-shaped puzzle
Red box	Plain yellow	Yikes! fun shape	1 penny	Flowers	Small roll of Life Savers	Large foot-shaped puzzle

NOTE.—Actual prizes were mounted on the information boards to provide a full visual display.

being composed of more than two-thirds of the more highly valued prizes. This was deemed necessary to prevent an overly attractive treasure box (a dominant alternative) from restricting the extent of search.

Procedure

Children reported to an interviewing area where they were greeted by the experimenter and an assistant. After engaging in a brief discussion with the child, the experimenter gave the child the assent form to read and sign.

Next, the child was shown the warm-up board consisting of four treasure boxes and three prize categories. This warm-up board, which was not one of the experimental boards of interest, was provided to allow children to practice the task and to allow the experimenter to clarify instructions as needed. Children were informed that there were prizes behind each curtain that went with different treasure boxes, and were told that they could take home all the prizes in the treasure box of their choice. Before choosing their favorite treasure box, they were told they would be given an opportunity to gather information about the contents of the treasure boxes by asking the experimenter to take down the curtains covering the prizes. At this point, children in the high cost condition were given a small plastic bag with 12 pieces of candy in it (one for each curtain on the warm-up board). They received the following instructions:

> To start the game, I will give you some pieces of candy. You can keep all of these pieces of candy for yourself. Or, you can use some of your candy to find out which of the two prizes are behind each curtain to help you decide which treasure box to pick as your favorite. You can look behind as many curtains as you want before you make your choice. But, every time you want to look behind a curtain, you will have to give me a piece of your candy. Once you give me a piece of your candy, I can't give it back to you, okay? When you want to see behind a curtain, tell me which curtain you want and give me one of your pieces of candy. I will take down the curtain for you.

Subjects in the low cost condition were not given any candy. They were simply told that they could take down as many curtains as they wanted before choosing their favorite treasure box. Subjects were assigned randomly to the low and high cost conditions.

Children proceeded to play the warm-up game, removing as many curtains as they wished and selecting their favorite treasure box. While doing so, children were prompted to either pick a curtain or make a choice ("Do you want to take down a curtain or pick your favorite treasure box?"). Upon selection of the favorite treasure box, the experimenter removed any unopened curtains to reveal the contents of the chosen treasure box. The experimenter pointed to each prize, reinforcing the fact that "these are the prizes you would get to keep if we were playing for real." The experimenter also reminded the child that s/he would not get to keep any of the other prizes in the unchosen box. The experimenter then asked if the child had any questions and continued on to the main experimental tasks.

Children continued to play the treasure hunt game, playing one game with each of the four information boards. The order in which subjects saw the four information boards was governed by random assignment to one of four presentation orders. These four orders were designed in such a way that each of the four boards appeared equally often in the first, second, third, and fourth positions. In addition, across orders, each board preceded and followed every other board exactly one time (e.g., the 3 × 3 board preceded and followed the 3 × 6 board exactly once). At the end of the last game, children were thanked for their participation, informed that they would receive their treasure boxes at the completion of the study, and asked not to discuss the games and prizes with their classmates.

Independent Variables

Age. Second graders (ages seven to eight) and fifth graders (ages 10–11) were included in the study. Examination of these age groups allowed us to compare our results directly with those reported in the only published work to date examining decision-making skills in complex tasks with children of different ages (Davidson 1991a, 1991b). Much younger children were excluded from the study based on findings from our earlier study (Gregan-Paxton and John 1995) that suggested that children do not develop elementary notions of cost-benefit trade-offs in decision making until they are at least six to seven years old.

Search Costs. Search costs were manipulated by varying the cost of taking down curtains covering the contents of each treasure box. A low cost condition was created by allowing children in one group to take down as many curtains as they wished, with the only cost being the minimal effort expended in pointing to the curtains and the brief delay in making a choice. Relative to that, the high cost condition was created by requiring children in a second group to give up a piece of candy or gum for each curtain removed. Because children participated in four games, a slightly different type of candy or gum was used for each game to ensure that children would not devalue the currency of exchange. Starburst candies (tropical and regular flavors) and sugarless gum (strawberry Trident and Carefree bubblegum) were used for this purpose due to their popularity with children of all ages.[2] To avoid a confound with decision complexity, candy was always used for the first and third game, while gum was used for the second and fourth game. The type of candy or gum used within each position was determined randomly.

Number of Alternatives and Dimensions. Task complexity was manipulated by varying the number of alternatives (i.e., treasure boxes) and the number of dimensions (i.e., individual prize categories) for each game. To allow direct comparison with previous research (Klayman 1985; Davidson 1991a), information boards were created with three and six alternatives crossed with three or six dimensions. Thus, in total, children saw four boards varying in complexity: 3 × 3 (three alternatives × three dimensions), 3 × 6 (three alternatives × six dimensions), 6 × 3 (six alternatives × three dimensions), 6 × 6 (six alternatives × six dimensions).

Dependent Variables

Predictions regarding adaptivity were tested by examining several aspects of children's information gathering activities prior to choice. First, we examined the total number of curtains taken down from each information board, which could vary between zero (no curtains taken down) and 36 (all curtains taken down on the 6 × 6 board). More important, we also examined the proportion of curtains taken down from each information board, which could range from 0 percent (no curtains taken down) to 100 percent (all curtains taken down). Because the number of curtains varied as a function of the size of the information board, proportions were used to allow direct comparisons between boards varying in the total amount of information available.

A third measure provided more detail on the nature of the search patterns being used by children. Modifying coding schemes used by other researchers (e.g., Klayman 1985), we coded children's search patterns into five categories: exhaustive, multipass, satisficing, single-pass, and none. Exhaustive searches were at one end of the continuum, with children taking down every curtain on the information board; at the other end of the continuum, a category ("no search") was established for children who failed to take down even one curtain from the board. Between these extremes, multipass search was operationally defined as a search in which all alternatives were examined at least once (i.e., one curtain was taken down for each alternative), with some alternatives then examined further in the second or subsequent passes. Single-

[2]To check our assumption that candy and gum would be popular with children participating in the study, we asked 20 second graders and 19 fifth graders to rate each item on a five-point smiley face scale (1 = do not like; 5 = like a lot). As expected, candy was rated highly by both second ($\bar{X}$ = 4.85) and fifth graders ($\bar{X}$ = 4.52), as was gum (for second graders, $\bar{X}$ = 4.50; for fifth graders, $\bar{X}$ =4.42) There were no significant differences between age groups (both p's > .20). These findings indicate that candy and gum are equally popular with children in both age groups and, in addition, that any affect or mood induced by receiving these items should also be equivalent across age groups.

pass searches were identified as those in which the search ended at the first pass (i.e., only one curtain was taken down for each alternative). Finally, satisficing was defined as any search in which a choice was made before at least one curtain had been taken down for each alternative, with the exception of the "no search" category.

A final measure was created to capture how selective children were in their information-gathering activities. Recall that selectivity, defined as gathering more information about some alternatives than others, is a common simplifying strategy and an indicator of noncompensatory processing. In our study, we assessed how selective children were in gathering information from each information board by examining the proportion of curtains opened that focused on the chosen alternative. These proportions were computed by dividing the number of curtains taken down for the chosen treasure box by the total number of curtains taken down for that information board. Higher proportions were viewed in a positive manner, indicating that children were focusing on a more promising alternative (that was ultimately chosen) and gathering information about it to ensure its acceptability on a number of dimensions.

RESULTS

Amount of Information Searched

We hypothesized that age differences would emerge in the amount of information children searched prior to making their choices, but that these age differences would disappear with the imposition of substantial search costs. Specifically, in the low cost condition, fifth graders were expected to gather less information than were second graders (Hypothesis 1a); in the high cost condition, however, second graders were expected to become efficient in gathering information and were expected to perform at a level consistent with that of fifth graders (Hypothesis 2a).

To examine these predictions, data pertaining to the number and proportion of curtains opened were analyzed in a 2 (age) × 2 (search cost) × 2 (number of alternatives) × 2 (number of dimensions) repeated measures ANOVA (see Table 2 for means and standard deviations).[3] Data involving proportions were transformed (arcsin) prior to being entered into the analysis. To test our hypotheses, we analyzed all interactions involving search costs by way of contrasts that allowed us to test whether differences between age, alternatives, or dimensions were significant within the low cost or high cost condition. For example, Hypothesis 1a was tested by comparing age and task complexity levels within the low cost condition. Similarly, Hypothesis 2a was tested by comparing age and task complexity levels within the high cost condition. Evidence supportive of our predictions would be obtained by finding a significant age difference for the low cost but not the high cost condition.

The results were consistent with our predictions (see Fig. 1). First, in the low cost condition, older children were more efficient than were younger children, as noted by a significant difference between age groups in the low cost condition for the total number of curtains opened ($F(1, 84) = 6.56, p < .01$) and the proportion of curtains opened ($F(1, 84) = 6.67, p < .01$). This trend was consistent across task complexity, as older children were more efficient than were their younger counterparts regardless of the number of alternatives or dimensions involved. Accordingly, there was no significant pattern of interactions between age and components of task complexity (alternatives, dimensions) within the low cost condition.[4] Children of all ages did, however, respond to increases in task complexity, opening more curtains in total as the number of alternatives and dimensions increased (for alternatives, $F(1, 84) = 32.61, p < .01$; for dimensions, $F(1, 84) = 31.01, p < .01$; for alternatives × dimensions, $F(1, 84) = 12.62, p < .01$), but opening a lower proportion of available curtains as the number of alternatives and dimensions increased (for alternatives, $F(1, 84) = 18.11, p < .01$; for dimensions, $F(1, 84) = 21.69, p < .01$; for alternatives × dimensions, $F(1, 84) = 6.40, p = .01$).

In the high cost condition, as expected, a different pattern emerged. First, and most important, younger children became more efficient in gathering information and managed to catch up to their older peers, as noted by the lack of significant differences between second and fifth graders within the high cost condition for both the total number and proportion of curtains opened (both p's $> .20$).[5] Once again, this trend was evident across task complexity, with younger children gathering similar amounts of information as older children regardless of the number of alternatives or dimensions involved. There were, accordingly, no significant interactions involving age, alternatives, and dimensions (all p's $> .20$).

[3]Gender was entered as an additional factor in preliminary analyses for all dependent measures. The findings indicate no significant gender effects, including interactions of gender with other factors, for four out of five measures. The only significant gender effect that emerged was a gender × age × dimensions interaction for the proportion of curtains opened. Given that there were 45 possible effects involving gender across the five measures, and that only one reached significance at a .05 level, gender was dropped from further consideration in our analyses.

[4]There were no statistically significant interactions between age and task complexity (alternatives, dimensions) for the proportion of curtains opened (all p's $> .20$). There was, however, a significant age × dimensions interaction for the total number of curtains opened ($F(1, 84) = 5.55, p = .02$), indicating that differences between second and fifth graders were much larger for information boards with six dimension than three dimensions. Given that this effect did not emerge in any other analyses, it was not considered further.

[5]Contrasts between cost conditions provide additional support for the notion that second graders became more efficient in gathering information in the high cost condition. These children opened fewer curtains in the high versus low cost condition ($F(1, 84) = 2.62, p = .05$, one-tailed), as well as opening a smaller proportion of the available curtains in the high versus low cost condition ($F(1, 84) = 2.37, p = .06$, one-tailed).

TABLE 2

MEANS AND STANDARD DEVIATIONS FOR NUMBER AND PROPORTION OF CURTAINS OPENED BY EXPERIMENTAL CONDITION

	Low search cost				High search cost			
Age	3 × 3	3 × 6	6 × 3	6 × 6	3 × 3	3 × 6	6 × 3	6 × 6
Number of curtains opened:								
Second grade	4.70	7.55	7.70	12.76	3.60	5.06	5.47	8.91
	(3.30)	(7.10)	(6.40)	(12.95)	(2.20)	(4.08)	(4.31)	(9.71)
Fifth grade	3.00	4.68	3.57	6.50	2.98	3.48	3.38	6.23
	(2.54)	(4.62)	(3.59)	(8.35)	(1.82)	(2.67)	(2.44)	(3.52)
Proportion of curtains opened:								
Second grade	.55	.49	.45	.40	.41	.29	.32	.25
	(.34)	(.34)	(.33)	(.33)	(.23)	(.22)	(.23)	(.27)
Fifth grade	.37	.28	.25	.21	.36	.22	.20	.17
	(.26)	(.25)	(.18)	(.23)	(.18)	(.14)	(.13)	(.10)
Proportion of curtains opened for chosen alternative:								
Second grade	.36	.21	.35	.27	.41	.34	.39	.33
	(.28)	(.27)	(.32)	(.26)	(.33)	(.32)	(.37)	(.31)
Fifth grade	.34	.32	.41	.22	.40	.42	.66	.27
	(.34)	(.33)	(.36)	(.27)	(.29)	(.30)	(.33)	(.20)

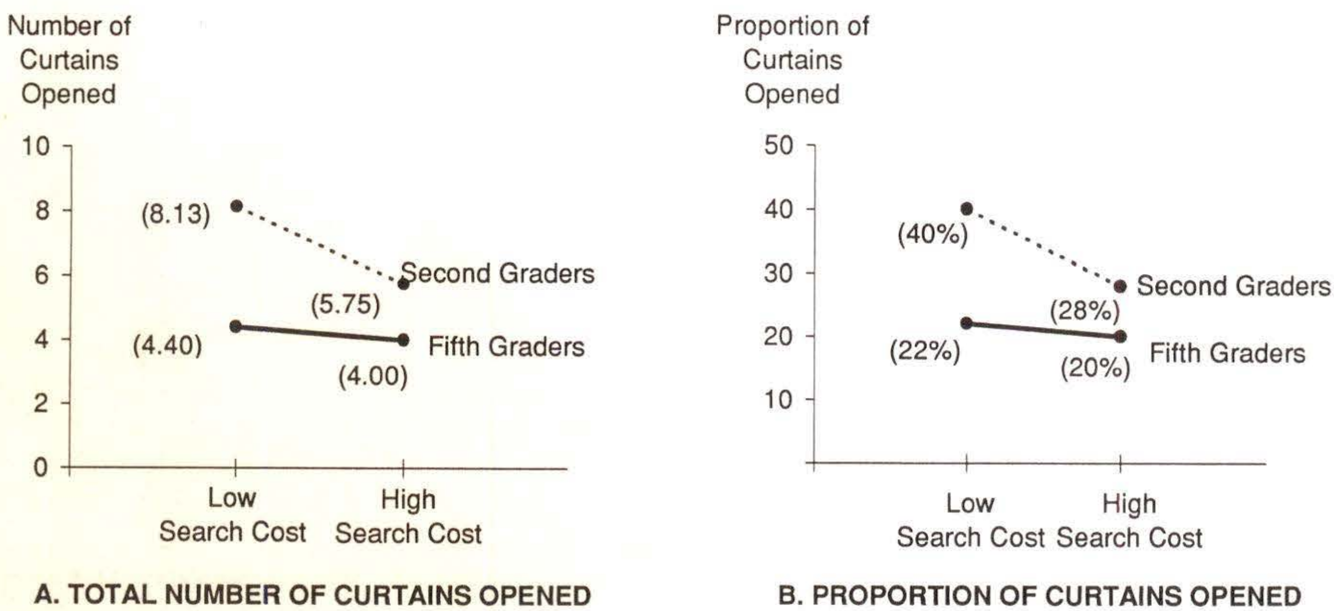
NOTE.—Standard deviations are in parentheses. Cell sizes for the second-grade sample were $n = 21$ (low search cost) and $n = 22$ (high search cost). Cell sizes for the fifth-grade sample were $n = 23$ (low search cost) and $n = 22$ (high search cost).

Information Search Strategies

Our prediction was that older children would use less exhaustive search strategies than would younger children in the low cost condition (Hypothesis 1b), but that these differences would disappear in the high cost condition as younger children became more adaptive (Hypothesis 2b). To test this prediction, chi-square tests for each task condition (3 × 3, 3 × 6, 6 × 3, 6 × 6) were performed to assess whether the distribution of search patterns (exhaustive, satisficing, multi-/single-pass) was significantly different for older versus younger children in the low cost condition (Hypothesis 1b) and in the high cost condition (Hypothesis 2b). Note that the single-pass and multipass

FIGURE 1

NUMBER AND PROPORTION OF CURTAINS OPENED BY AGE AND SEARCH COST



search strategies were combined due to the small number of children using a single-pass strategy; for the same reason, children electing not to search at all were omitted from the analysis.

As expected, the results indicate the existence of age differences (see Table 3). For the low cost condition, age differences in search strategies emerged as the information boards became more complex. Specifically, search patterns for second versus fifth graders were not significantly different for the 3 × 3 board ($\chi^2 = 4.15$, 2 *df*, $p = .14$), were marginally significant for the 6 × 3 board ($\chi^2 = 5.59$, 2 *df*, $p = .09$), and were significantly different for both the 3 × 6 ($\chi^2 = 7.45$, 2 *df*, $p = .02$) and the 6 × 6 boards ($\chi^2 = 6.34$, 2 *df*, $p = .04$). Thus, it appears that older children are more adaptive in the search strategies they employ but that these differences become apparent only when the task becomes sufficiently complex.

Consistent with our predictions, a different pattern emerged for the high cost condition. Search patterns were not significantly different for second and fifth graders for any of the information boards (all p's $> .20$). Given the fact that cell sizes in many of the chi-square tables were small and that insignificant findings might be attributed to a lack of power, we collapsed the data across information boards and used a z-test to explore whether age differences might emerge in a more general pattern. This analysis yielded the same result, with both younger and older children using strategies such as satisficing (62 percent vs. 63 percent) and multi-/single-pass searches (20 percent vs. 23 percent), with virtually no use of exhaustive search strategies (2 percent vs. 2 percent). Thus, age differences that were so evident in the low cost condition disappeared with the imposition of substantial search costs.

Selectivity of Information Search

We hypothesized that age differences would emerge in the way children adapted to increasingly complex tasks, but that many of these differences would dissipate once younger children were given a search cost cue. However, it was felt that age differences would not necessarily be eliminated for all forms of adaptive responses as a result of imposing substantial search costs. The selectivity of children's information search was suggested as one type of response that may not be mutable with a simple change in search costs. Thus, fifth graders were expected to gather proportionately more information related to their final choice than were second graders in both the low cost condition (Hypothesis 1c) and in the high cost condition (Hypothesis 2c).

To examine these predictions, data pertaining to the proportion of curtains opened for the chosen alternative were analyzed in a 2 (age) × 2 (search cost) × 2 (number of alternatives) × 2 (number of attributes) repeated measures ANOVA (see Table 2 for means and standard deviations). Proportions were transformed (arcsin) prior to being entered into the analysis. Hypothesis 1c was tested by contrasting age and task complexity levels within the low cost condition. Similarly, Hypothesis 2c was tested

TABLE 3

FREQUENCY OF SEARCH PATTERNS BY EXPERIMENTAL CONDITION

	Low search cost					High search cost				
Search pattern and age	3 × 3	3 × 6	6 × 3	6 × 6	Overall	3 × 3	3 × 6	6 × 3	6 × 6	Overall
Satisficing:										
Second grade:										
Percentage	33	38	48	52	43	50	86	68	73	69
n	7	8	10	11		11	19	15	16	
Fifth grade:										
Percentage	57	74	48	70	62	45	78	61	65	63
n	13	17	11	16		10	18	14	15	
Multipass and single pass:										
Second grade:										
Percentage	29	14	24	14	20	41	5	23	23	23
n	6	3	5	3		9	1	5	5	
Fifth grade:										
Percentage	22	17	35	22	24	45	9	30	35	30
n	5	4	8	5		10	2	7	8	
Exhaustive:										
Second grade:										
Percentage	29	24	19	24	24	5	5	5	5	5
n	6	5	4	5		1	1	1	1	
Fifth grade:										
Percentage	9	0	0	0	2	0	4	4	0	2
n	2	0	0	0		0	1	1	0	

NOTE.—Percentages within an experimental condition may not add up to 100 percent. A small number of children elected not to search at all and were deleted from the table.

by contrasting age and task complexity levels within the high cost condition. Evidence supporting our predictions would be obtained by a significant difference between age groups in both the low cost and high cost conditions.

The results were counter to our predictions but, nevertheless, interesting. In the low cost condition, the proportion of curtains opened for the chosen alternative did not vary by age ($p > .20$). In the high cost condition, however, evidence of age differences did emerge, albeit in a surprising direction. Specifically, fifth graders became more selective in information gathering than second graders in moderately complex task situations, that is, those involving the 3 × 6 information board (a 20 percent improvement) and the 6 × 3 information board (a 69 percent improvement).[6] These trends are reflected in a significant age × alternatives × dimensions interaction ($F(1, 84) = 8.34$, $p < .01$).[7] Thus, despite the fact that children of all ages were using a similar decision-making strategy (satisficing), and processing similar amounts of information, older children focused more of their effort on more promising alternatives. For example, looking at the search patterns of a sample second and fifth grader as shown in Figure 2, one sees that both children used a satisficing strategy; but, the older child was more focused and gathered more information about his eventual choice than did the younger child (60 percent vs. 22 percent of information).

Summary

Taken as a whole, the results were generally supportive of our hypotheses. The strongest support emerged for our predictions regarding the amount of information children processed in the course of their deliberations. Hypotheses pertaining to the number and proportion of curtains opened (Hypotheses 1a and 2a) were confirmed. Results were also strong for our predictions about the search patterns children would employ in the course of their decision making. Both Hypotheses 1b and 2b were supported, though age differences only emerged for more complex information boards in the absence of search costs. The only significant departure from our expectations occurred with respect to the selectivity of children's information processing, as measured by the proportion of curtains opened for the chosen alternative (Hypotheses 1c and 2c). Here, we found that age differences did not exist in the absence of search costs, contrary to our predictions. Interestingly, though, search costs increased the selectivity of older children, who focused more attention on the promising alternatives as search costs increased.

These findings highlight important differences in adaptivity across age groups and task conditions. We should note, however, that our focus has been on how children adjust their effort in the face of complex decision tasks, putting aside the issue of whether these adjustments result in "good" or "accurate" choices. Though adaptivity can be viewed in terms of effort alone, as it has in much decision-making research, we did attempt to explore the issue of whether children are adapting in ways that result in choices that are as least as good as, or even better, than before.

Judging decision accuracy for any task is a difficult endeavor without detailed information regarding each individual's preferences for different choice alternatives. However, we designed our choice alternatives (treasure boxes) in such a way that one dimension (money) would be the most important to children, which it apparently was as indicated by the amount of information children gathered on this dimension. Assuming for the moment that obtaining the top prize in the money category would be a reasonable indicator of a good choice, we examined the percentage of children in each age and search cost condition that selected a treasure box with the highest money prize (e.g., a dollar for the 3 × 3 board or three quarters for the 3 × 6 board).

Averaging across information boards, the results suggest that children adapted in a way that preserved their ability to make good choices. Even though young children adapted to the imposition of substantial search costs by reducing the proportion of information they selected, they continued to make choices that netted the largest amount of money (70 percent of choices for the low cost condition; 74 percent of choices for the high cost condition). Older children adapted to the imposition of substantial search costs by becoming more selective in gathering information about more favorable alternatives. The result was a slight increase in the percentage of good choices, though the difference was not statistically significant (72 percent for the low cost condition; 85 percent for the high cost condition). Most important, for our purposes, is the indication that children's adaptive responses were truly adaptive in the sense that simplifying the decision process was accompanied by choices that appear to be at least as good as those made with more effort.

DISCUSSION

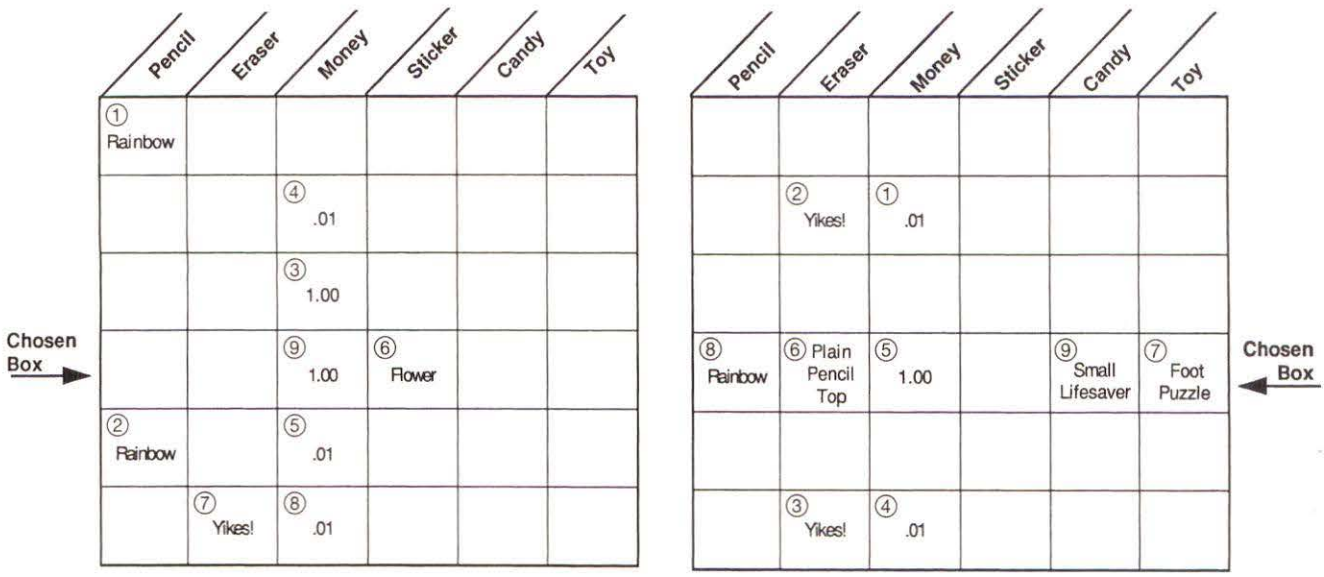
Consistent with prior research, we found that younger children were often less effective in adapting to complex decision environments than were older children. Older children, for example, responded to complex tasks by

[6] A similar age difference was found by examining the variability of search, by alternatives and by dimensions. These two measures, used frequently to assess selectivity in decision settings, were analyzed in a 2 (age) × 2 (search cost) × 2 (number of alternatives) × 2 (number of dimensions) repeated measures ANOVA. Comparing age and task complexity levels within the low cost condition, we found no age differences for either variability measure (p's $> .20$). Within the high cost condition, however, fifth graders became more selective in their search as task complexity increased.

[7] Three additional effects were significant: cost ($F(1, 84) = 3.86$, $p = .05$), alternatives ($F(1, 84) = 21.46$, $p < .01$), and alternatives × dimensions ($F(1, 84) = 4.51$, $p = .04$). These effects were qualified, however, by the significant age × alternatives × dimension interaction within the high cost condition. Thus, these additional factors are not discussed in the text.

FIGURE 2

EXAMPLES OF SEARCH PATTERNS FOR 6 × 6 INFORMATION BOARD



A. Second-Grade Girl B. Fifth-Grade Girl

more drastic reductions in the proportion of information they gathered and by greater use of satisficing strategies in making choices. However, when provided with a cue in the form of substantial search costs, younger children used whatever strategies they possessed in a more effective manner. So effective, in fact, that adaptive behavior on the part of younger children often equaled that of much older children.

These findings have implications for understanding how the ability to adapt to complex decision environments develops throughout childhood. To discuss these implications, we return to the two questions posed earlier in the article.

Why Do Young Children Fail to Adapt?

Prior research has been instrumental in identifying early and middle childhood as the major time frame within which children develop the skills they need to adapt to complex decision environments. Missing, however, was a conceptual framework to identify the mechanisms behind this developmental progression, to explain why young children fail to adapt as effectively as older children do, and to understand under what conditions young children might overcome these obstacles. Further, there was no empirical evidence pointing to any particular mechanism or obstacle as being responsible for children's success, or lack of success, in adapting to more complex decision environments.

Our main contribution in this context has been twofold. One, we have provided a conceptual framework that describes adaptivity emerging in children as they are able to overcome different types of obstacles, referred to here as knowledge deficits and utilization deficits. In particular, we have argued that utilization deficits are particularly important obstacles in middle childhood, with these deficits blocking children from effectively using the decision strategies they have at hand for handling complex tasks.

Two, in support of these ideas, we have identified and empirically examined a major utilization deficit related to adaptive decision making, namely, sensitivity to the cost or effort involved in implementing decision strategies. The idea here was that young children may not pay attention or be sensitive to the substantial cost or effort involved in gathering and processing large amounts of information, decreasing the probability that exhaustive searches would be abandoned in favor of more efficient simplifying strategies. Our study provides evidence, for the first time, that sensitivity to search costs drives many of the age differences in adaptivity to complex decision tasks, as well as demonstrates that younger children can respond as effectively as much older children as long as concrete cues are provided to increase the salience of search costs in their decision-making process.

As described here, our view of utilization deficits emphasizes a cognitive rationale for why young children fail to adapt effectively. For example, we describe insensitivity to search costs as a prime example of younger children's failure to attend to and encode important cues in the decision environment that signal the need to adapt. This view is certainly compatible with our findings, but we note that motivational factors may be operative as well. Young children may be insensitive to search costs because their goals in decision settings may not be geared to making "efficient" or "good" choices. Perhaps goals such as "exploring" are more important, making considerations about the effort involved in different decision-making approaches quite irrelevant. In light of the fact that a clean distinction between cognitive and motivational factors seems impractical at this point, we simply note that utilization deficits may be a mixture of both.

How Does Adaptive Decision Making Emerge?

Our pattern of results, indicating when and how age differences are exhibited as children adapt to increasingly complex decision environments, provides evidence regarding three propositions we outlined earlier in the article.

Considering our first proposition, we now have direct evidence that young children can adapt as effectively as older children do in many respects, dismissing the notion that adaptive decision making emerges at any one particular age. Prior to our study, the limited empirical data seemed to be converging toward a conclusion that "adult-like" adaptivity to more complex decision tasks surfaces around 10 or 11 years of age. The only attempt to encourage this type of adaptivity in younger children, by providing cues to pinpoint the most relevant pieces of information in an information display board, was unsuccessful (Davidson 1991b, experiment 2). Our results, pointing to the success of search cost cues as a way of enhancing younger children's abilities, demonstrate quite well that children as young as seven or eight years of age have many of the basic abilities to adapt to complex tasks, even though these abilities are often hidden from view.

Turning to our second proposition, we now have evidence to support the idea that adaptivity to complex decision environments does not emerge in an all-or-none fashion. As illustrated here, young children's abilities are exhibited in some situations but not others, and emerge for some aspects of adaptivity but not others. For example, in our study, the youngest children responded to the imposition of search costs by becoming more efficient in the amount of information they processed and by using less exhaustive search strategies. However, they did not become more selective in the sense of focusing more attention on the most promising alternatives in the choice set.

Further evidence can be seen in the way older children responded to our experimental conditions. As expected, the imposition of search costs did not influence most of the adaptive behaviors exhibited by these children, such as the amount of information processed or the general search strategy employed. Older children were, however, influenced by the presence of search costs in becoming more selective in their information gathering activities. Thus, even children who appear to have rather well-developed responses for adapting to complex tasks can still be encouraged to improve their performance. The imposition of search costs did not appear to trigger a major shift in decision strategies, but did spur older children to fine-tune their general approach to focus more quickly on an acceptable alternative.

Finally, our third proposition is also supported by the evidence at hand. Clearly, younger children in this study were able to exhibit adaptive behaviors in the face of complex decision environments as long as we provided a cue. This builds on the evidence we reported in our earlier study (Gregan-Paxton and John 1995), which found that preschool children (four to five years in age) were able to make certain types of simple cost-benefit trade-offs in gathering information prior to choice, as long as search costs were imposed. In fact, by combining results across studies, an interesting developmental pattern emerges. It appears that the ability to make elementary trade-offs between the costs and benefits of collecting information prior to choice surfaces sometime between the preschool and early elementary school years, as our earlier findings (Gregan-Paxton and John 1995) would suggest. Preschool children exhibit these abilities, though not consistently, when search costs are made salient. Once children master these elementary trade-offs, around six to eight years of age, they have an important skill that is necessary to adapt to more complex environments, but do not pay as much attention to the costs of using certain decision strategies as they should. Older children (10–11 years old), in contrast, pay attention to the costs or effort involved in making decisions and make appropriate trade-offs as they adapt to more complex environments. As we have seen in the current study, seven- to eight-year-olds can adapt as effectively as older children when search costs are made salient, but do require extra cues to direct their attention to elements in the decision environment (such as large amounts of information) that should trigger simplifying strategies.

Future Research Directions

Our findings open the door to at least three new areas of research. First, further attention needs to be directed toward identifying the extent and nature of utilization deficits that arise in children's decision making. We have proposed general classes of such deficits and have empirically verified at least one in this study. However, further work would be useful in identifying other types of utilization deficits and pinpointing when they arise in the developmental sequence.

Second, further attention could be focused on knowledge deficits, which we did not address empirically in this study. Identifying the nature of such deficits will necessarily require an exploration of what children know about decision-making strategies at different ages. As noted before, there is no prior research on children's knowledge bases to date. Moving forward on this topic would be an important step in understanding what children know about decision making and how experience affects their knowledge base.

Finally, the notion of knowledge deficits and utilization deficits in children raises an interesting issue for researchers who focus on adult decision makers. Could the same types of deficits underlie failures to adapt effectively in adult consumers? Conceptually, many of the same types of deficits have been proposed by Payne and his colleagues (Payne et al. 1993) to describe failures to adapt in adult decision makers. Though they may differ in form, the basic notion of knowledge and utilization deficits seems equally useful across groups. Empirically, we know that certain types of processing deficits are shared by children and certain groups of adults, such as the elderly (John and Cole 1986). It would seem reasonable that parallel deficits in decision making might follow, such as difficulties in encoding or selectively attending to important elements in the decision environment. Research along these lines would not only benefit our understanding of adults but might also provide important links in understanding how adaptive decision making emerges throughout the life span.

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