Basic Cognitive Ability Measures as Predictors of Consumer Information Processing Strategies

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The performance of adult females on information acquisition tasks is shown to be related to their performance on information integration tasks; both are shown to be related to basic measures of cognitive ability derived from formal operations theory.

The focus of much recent research in consumer information processing has been on strategies employed by consumers in two aspects of making brand choice or evaluation decisions: information acquisition and information integration. Researchers have investigated information acquisition strategies across a wide range of product classes and by means of three different methodologies: *eye movements* (Russo and Dosher 1976; Russo and Rosen 1975), *protocols* (Bettman and Park 1980; Biehal and Chakravarti 1982; Lussier and Olshavsky 1979; Payne 1976; Svenson 1974), and *information boards* (Bettman and Jacoby 1976; Capon and Burke 1980; Green, Mitchell, and Staelin 1977; Jacoby, Chestnut, and Fisher 1978; Jacoby et al. 1976; Jacoby, Szybillo, and Busato-Schach 1977; Moore and Lehmann 1980; Payne 1976; Staelin and Payne 1976). Very few studies, however, have been concerned with the relationship between acquisition strategy variables and individual characteristics of the consumer.

In one study that did address such characteristics, Capon and Burke (1980) presented data to support their proposition (1) that individual consumers have characteristic information acquisition strategies related to enduring individual characteristics, and (2) that any observed acquisition strategy results from an interaction of the characteristic strategy with task-related factors such as numbers of brands and attributes, format and time pressure, and individual/product class factors (e.g., perceived risk, specific purchase experience, and product importance).[1] Capon and Burke suggested that certain elements of acquisition strategy may be highly influenced by task-related and individual/product class factors, whereas others may be more related to enduring individual characteristics. For example, depth of search (quantity of information acquired) has been shown to be influenced by the individual/product class factors of product importance and product class experience (Jacoby et al. 1978), product class experience (Green et al. 1977; Moore and Lehmann 1980), and perceived risk (Capon and Burke 1980). On the other hand, Capon and Burke (1980) found that sequence of search (attribute, brand, mixed, and random) and level of search (whether or not at least one information item on each available brand was chosen, high and low level) were significantly related to an enduring individual characteristic—socioeconomic status (SES): mid/high SES subjects were more accomplished information processors and were more likely to employ attribute processing and high level strategies, whereas low SES subjects were less accomplished processors and were more likely to process by brand or randomly, and to use low level strategies.

In the case of information integration strategies, too, there has been little work focused on individual differences, but there is some indication that the picture may be similar. Two paradigms have developed for studying how consumers integrate product attribute information. One paradigm, related to Anderson's (1970, 1973) work in person perception, is focused on defining and testing a number of theoretical models of the information integration process (Bettman, Capon, and Lutz 1975a, 1975b, 1975c; Hagerty 1978; McElwee and Parsons 1977; Park 1976, 1978; Scott and Wright 1976). In these studies precautions are taken to ensure that each information item is taken into account (the information to be integrated is thus regarded as constant), and the objective is to discover the integration strategies

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[1]See Bettman and Kakkar (1977) for support of an alternative task format hypothesis.

that subjects use. By contrast, a second paradigm, engendered by the clinical judgment literature (Hoffman, Slovic, and Rorer 1968), makes no effort to ensure that all available information is used. Instead, attention focuses on how many attributes subjects spontaneously take into account when evaluating multiattribute objects, as well as on the strategies by which subjects integrate information about the relevant attributes. It can be argued that this second paradigm more closely resembles the information processing done by consumers.

In their first study employing this paradigm, Capon and Kuhn (1980) found major differences in integration strategies among subject groups ranging in age from kindergarten to college. The youngest subjects did not for the most part show consistent preferences. Older children and adolescents often took only a single dimension preference into account in evaluating objects, and not until college age did the majority of subjects consistently take into account two or three dimensions on which they had preferences and integrate these preferences in their object evaluations. Capon, Kuhn, and Gurucharri (1981) examined adult subjects of different ages across the life span. Performance overall was not inferior to that of the college students. However, wide individual variation was found, suggesting that—as in the case of information acquisition strategies—characteristic information integration strategies may exist that are related to enduring individual characteristics within adult populations.

In the Capon and Burke (1980) study, the individual characteristic found to be related to consumer information processing strategies was SES. Such a finding does not lend itself to immediate or straightforward interpretation. Clearly, socioeconomic status itself does not cause individuals to use different information processing strategies. Rather, SES is a surrogate for other variables in terms of which individuals of different SES levels are likely to differ, and it is among these variables that causal interconnections might be sought. The object of the present research was to investigate one such variable in an effort to enhance our understanding both of the individual variation that has been observed in consumer information processing and of the possible causes that underlie it.

COGNITIVE FUNCTIONING

The variable that seemed the most promising candidate was cognitive functioning. Differences in cognitive functioning across SES levels might well have been responsible for the SES-related differences in consumer information acquisition observed by Capon and Burke (1980). We therefore attempted to relate measures of cognitive functioning to performance on the information acquisition (Capon and Burke 1980) and information integration (Capon and Kuhn 1980) tasks.

One approach to fulfilling this objective is to employ a broad global measure of cognitive functioning, such as IQ. This approach has a serious disadvantage, however: an IQ score is influenced by a very broad range of cognitive abilities. Furthermore, despite the widespread use of IQ tests for various practical purposes, the cognitive strategies that underlie performance on typical psychometric or IQ tests are in general not well understood (Sternberg 1982). Even if a significant relationship were obtained between a global cognitive measure such as IQ and performance on consumer information processing tasks, such a relationship would be difficult to interpret because it would remain unclear exactly what cognitive processes were relevant to performance on the consumer tasks. Thus we chose to employ cognitive measures that (1) assessed a specific cognitive skill or ability, and (2) had been theoretically derived and empirically validated such that the cognitive processes involved in performance on the task were well understood. Within the category of cognitive measures fulfilling these criteria, our selection was further dictated by a rational analysis of the kinds of cognitive skills that appear to be required for execution of the two consumer tasks that are the focus of our interest.

A major feature common to the information acquisition and information integration tasks is the requirement that the individual deal with a large body of complex bits of information. The information acquisition task requires the consumer to make a choice among a limited number of alternatives. Conceptually, it consists of two mutually dependent—and possibly simultaneous—segments: information acquisition and choice. In the prototypical information board study, branded alternatives are represented by verbal attribute descriptions in a large data matrix. Information is acquired by the consumer in a goal-directed, sequential manner (Arch, Bettman, and Kakkar 1978) and is presumably encoded and added to the memory store derived from prior knowledge. In the choice segment, the memory stock is processed according to some decision rule or rules. This task is performed most effectively to the extent that, ceteris paribus, the consumer can streamline information acquisition and minimize the load on memory. Complex choice rules that involve elimination of alternatives via attribute processing meet this criterion, while simple rules that involve making and storing global judgments of a number of alternatives via brand processing do not.

In the information integration task, the consumer must make a global judgment regarding each of a set of objects varying on multiple dimensions. For effective performance on this task, the defining information for each object must be identified, encoded, and represented in the individual's memory structure, and then integrated into a single judgment. Over the series of judgments, each information bit should be treated in a consistent manner. Less than optimal performance occurs to the extent that relevant information is not encoded, not integrated, and/or is treated inconsistently from one judgment to the next.

In both the information acquisition and information integration tasks, then, the information to be processed reflects a matrix of multiple attributes characterizing a set of multiple objects. In both tasks, the individual must (1) attend to and encode information in memory, and (2) perform a set of cognitive operations on these representations. The two cognitive tasks we selected which involve processing like that entailed in the consumer tasks are isolation of variables and systematic combination. Both derive from the theoretical model of formal operational reasoning developed by Piaget. Although Piaget is more widely known for his stage theories of children's cognitive development, the final level in his system—the level of formal operations—may have the most far-reaching implications. Inhelder and Piaget (1958) originally claimed that formal operational cognitive strategies develop universally at adolescence, yet a great deal of subsequent research evidence has accumulated indicating that (1) many adults fail to exhibit a formal operational level of reasoning on the measures Inhelder and Piaget (1958) developed to assess formal operations, and (2) there is considerable variability within adult populations in level of reasoning (see Neimark 1982 for a review).

Inhelder and Piaget (1958) hypothesize the formal operational reasoning structure, which they describe in formal logical terms, as a unified "structured whole" that manifests itself in a set of interrelated cognitive competencies. The two basic cognitive strategies of which the individual operating at a formal operational level is capable are isolation of variables and systematic combination:

- *In the systematic combination task,* the individual must generate all of the possible sets of all sizes that can be constructed from a set of underlying dimensions or elements (e.g., the letters a, b, c, d, and e), a task that can be performed effectively only by the use of some systematic procedure for combining individual elements into multi-element sets.
- *In the isolation of variables task,* the individual encounters an existing multivariable data base and, on the basis of systematic experimentation and observation, must isolate the particular variable that is causally connected to a dependent variable of interest.

Other reasoning strategies linked to the formal operational structure, such as proportion and correlation, are less clearly relevant to performance on the consumer tasks.

Despite Inhelder and Piaget's (1958) hypothesis that the various formal operational reasoning strategies form a "structured whole," a considerable body of research investigating performance in numerous adolescent and adult populations has shown that the various abilities are not tightly connected in the strong sense that Inhelder and Piaget originally implied. While the individual strategies have been found to be moderately intercorrelated in most of the populations studied, showing some support for Inhelder and Piaget's "structured whole" hypothesis (Neimark 1982), an individual who possesses one reasoning strategy identified as formal operational will not necessarily possess any or all of the others.

In the present work, we chose to assess four major formal operational reasoning strategies: isolation of variables, systematic combination, proportion, and correlation. Satisfactory reliabilities have been reported in the literature for the instruments used to assess these strategies (Neimark 1982). Assuming that significant relations between consumer and cognitive tasks are found, use of all four cognitive measures will enable us to distinguish whether (1) it is the formal operational reasoning structure in general that is predictive of performance on the consumer tasks, or (2) only the particular formal operational strategies of isolation of variables and systematic combination that we hypothesized as relevant to the consumer tasks are so predictive.

As indicated previously, there is a substantial range of performance on all of the formal operational tasks among adult populations. For our purposes, use of these developmentally based measures of cognitive functioning is advantageous because the different cognitive strategies or levels of cognitive functioning that are likely to be observed among an adult population can be classified on an ordinal scale from more primitive to more advanced. Thus, the *general working hypothesis guiding this study was that* those subjects who exhibited more advanced strategies in some or all of the cognitive tasks would show more complex or sophisticated strategies, while subjects who exhibited less advanced strategies in some or all of the cognitive tasks would show less complex strategies in the information acquisition and information integration tasks.

Should established measures of cognitive abilities prove to be related to consumer information processing strategies, the implications would be very significant. In the discussion of their research on information acquisition, Capon and Burke (1980) put forward the notion of "preferred" consumer strategies, implying that the consumer makes a conscious choice of one strategy over another. However, if consumer information processing strategies were found to be linked to measures of cognitive ability, a not unreasonable interpretation might be that these strategies are less "preferred" than "constrained." In other words, the information processing performed by individuals in consumer contexts may be constrained by general limitations in individuals' information processing abilities. If so, this would be an extremely important issue to investigate more fully, as it has far-reaching implications for consumer education and for our understanding of consumer behavior in general.

METHOD

Subjects

The 60 female subjects, members of a church group located in the Boston conurbation, were all English-speaking and literate. Their median age was 44 years and ranged from 20–76 years. The modal educational level was high school graduate (31 subjects). Three subjects had less than a high school degree. Thirteen subjects reported some college education, five a college degree, three some graduate training, and five a graduate degree.

Consumer Information Processing Tasks

Information Acquisition Task. The procedure for the information acquisition task was the one used by Capon and Burke (1980). The information environments were simulated by two separate boards—one for each product class studied (steam iron and microwave oven)—on which information was arranged in a matrix fashion. Each board contained six rows representing brands and 27 columns representing attributes. At each brand/attribute intersection, the appropriate information was contained on 20 identical pieces of paper hung face downwards on a hook screwed into the board. The process by which the attributes were selected and the specific attributes employed for each product class are noted in Capon and Burke (1980).

Subjects were told to imagine that they were shopping for a new steam iron and a microwave oven (presented in counterbalanced order across subjects), that they had to choose one brand of each, and that they should behave as they would for an actual purchase. The information boards were explained, and for each product subjects were told to take any information they liked, in any order, as much or as little as they liked, and to stop only when they had made a choice. Once viewed, each information item selected was spindled, could not be seen again, and if information was required a second time, it had to be selected again. After each choice, a short questionnaire relating to the decision was completed. Questionnaire data confirmed that all subjects understood the tasks and completed them in a conscientious manner.

Information Integration Task. The procedure for the information integration task was that used by Capon and Kuhn (1980) and Capon et al. (1981). The objects employed were a set of pocket-sized notebooks of the type that might be purchased in a low-priced variety store. Each of the four notebook dimensions had two levels—color (red or green), surface (dull or shiny), shape (long/thin or short/wide), and fastening (side or top)—yielding 16 different notebooks. Two sets of notebooks were employed and subjects were shown each of the 32 notebooks individually, in a random order, and were asked to indicate their liking for the notebooks on a nine-point scale. In a separate task, subjects were asked to indicate their preferences with respect to the two levels of each of the four dimensions, using a separate apparatus. The procedure is described in detail in Capon and Kuhn (1980).

Cognitive Tasks

Isolation of Variables. Two different measures were employed to assess the isolation of variables strategy: the pendulum problem, adapted from Inhelder and Piaget (1958), and the plant problem, developed by Kuhn and Brannock (1977) and Kuhn and Ho (1977). The pendulum problem requires the subject to manipulate the apparatus to assess the effects of different variables on the pendulum's speed. In the plant problem the results of existing "natural experiments" are displayed, and the subject must draw inferences regarding the effects of several variables on the plant's growth.

Pendulum. The subject was presented with a simple pendulum, a weight suspended from a string. The string length was adjustable and four different weights were provided. The interviewer demonstrated the apparatus and asked the subject to experiment with the pendulum and find out "what makes a difference in how fast it goes." The subject could proceed as long as she wished and state her conclusions when ready. If only verbal statements were made, without manipulating the apparatus, the subject was asked how she could demonstrate what she said. Four variables could have been manipulated: length (the only causal factor), weight, force, and release point. For any variable not considered in stating her conclusions the subject was asked, "does the weight have anything to do with it?"

Plant. The subject was shown two tables each containing sketches of eight plants of the same type, differing only in height (Kuhn and Ho 1977). The interviewer explained that he had similar plants at home and had been trying different foods (a, b, and c) on them. The foods were shown by packets labeled and colored a (orange), b (brown), or c (yellow), sketched adjacent to each plant. Food and plant heights for "Table 1" (leafy plants) were: no food—3 inches, a—3 inches, b—6 inches, c—6 inches, ab—6 inches, ac—6 inches, bc—6 inches, and abc—6 inches. For "Table 2" (flowery plants) they were: no food—3 inches, a—3 inches, b—6 inches, c—6 inches, ab—6 inches, ac—6 inches, bc—9 inches, and abc—9 inches. The subject was told that the interviewer had to decide which food(s) to use for a new plant of each type, but that no more foods than necessary should be used as each was expensive. She was asked to judge which food(s) should be used for each plant type, whether it was different for the two types, and finally, what each food "has to do with it," for each plant type. Justification was solicited for each of the subject's responses. Free inspection of the tables was permitted throughout questioning.

Systematic Combination. The subject was shown a large table on which were placed two sets of materials: a stack of white cards 4½ inches in diameter, and five plastic bowls, each of which contained 30 or more 1-inch-diameter cards. A colored xerox of a food item—a different item for each bowl—was affixed to each small card. The five food items were pepperoni, anchovies, mushrooms, green peppers, and sausage.

The interviewer told the subject that he was thinking of opening a pizza parlor and that he was trying to figure out how many different types of pizza he could put on his menu. The subject was asked to imagine that the large white cards represented plain pizza crusts and that the interviewer was thinking of including pepperoni (points to pepperoni bowl), anchovies (points to anchovy bowl), mushrooms, green peppers, and sausage as possible toppings for the pizzas. The subject was then asked to make up as many different pizzas as possible, using the white cards as pizza crusts and the small food cards as the food items.

Correlation. This measure assesses the individual's ability to reason about relations between variables when there are multiple elements in an individual class. The subject was presented with a set of cards, each of which had the face of "a man from Mars" sketched on it. The sketches were of four types: yellow eyes and blue hair, pink eyes and blue hair, yellow eyes and purple hair, and pink eyes and purple hair. The subject was asked to determine whether there was a relationship between hair color and eye color among people on Mars. In the initial problem, the following frequencies (adapted from Inhelder and Piaget 1958) were presented: yellow/blue = 6, pink/blue = 2, yellow/purple = 1, pink/purple = 6. The subject was then given additional problems involving two sets of cards and asked to determine which of the two sets represented a stronger relationship between the two attributes and how much stronger the relationship was in that set. The series consisted of a positive correlation versus a zero correlation (7, 4, 2, 4 vs. 4, 4, 4, 4), two positive correlations of varying strengths (5, 2, 1, 4 vs. 5, 1, 3, 3), and a positive correlation contrasted to a negative correlation of slightly greater strength (4, 3, 3, 3 vs. 3, 4, 4, 1).

Proportion. This measure assesses the individual's ability to use proportional reasoning. The procedure is based on that used by Capon and Kuhn (1979, 1982). The subject was shown two cans of Arrid XX aerosol deodorant, identical except in size. The larger can was clearly marked 12 ozs., while the smaller can was clearly marked 8 ozs. The larger can bore a label identifying the price as $2.11, while the price marking on the smaller can was $1.36. The interviewer commented to the subject, "you may want to use paper and pencil for these questions, so I'll just leave them here for you to use whenever you want." Referring to the aerosol deodorant, he then continued, "suppose this were a product you used a lot of. When you went to the store to buy some, you found you had a choice between these two sizes. How could you tell which one is the better buy?" If the subject responded in the vein that "you would have to figure it out," the interviewer asked the subject to do that, using the pencil and paper if she wished. If the subject said that "the bigger one" was a better buy, the interviewer asked, "how could you check to make sure the bigger one is actually the better buy?" The intent was to elicit the most advanced level of reasoning of which the subject was capable. If necessary, the interviewer asked, "could you explain to me how you got that answer?" The interviewer recorded the subject's verbal responses and retained any written calculations performed by the subject.

Interview Procedure

A room in the church hall was employed for administration of the tasks. Each subject was interviewed individually. The order of administration of all tasks (consumer and cognitive) was randomized across subjects, with the exception that the information board tasks were completed in sequence. The median completion time of the tasks was approximately 90 minutes; after roughly 45 minutes, the subject was given a break and coffee.

RESULTS

Information Acquisition

The category system for information acquisition was developed by a two-stage process. First, subjects' performance on each acquisition task (steam iron and microwave oven) was assessed, and then performance on the two tasks was combined.

The basic system employed to analyze information acquisition strategies was that developed by Capon and Burke (1980) and consists of two major elements. The first is a master category measure of acquisition sequence—attribute, mixed brand/attribute, brand, and random—which is based on the relative proportions of four transition types: (1) same brand, same attribute, (2) same brand, different attribute, (3) different brand, same attribute, and (4) different brand, different attribute. The second element is a measure of acquisition level (numbers of brands searched), which together with the sequence element forms a nine-category system, as described in detail in Capon and Burke (1980, pp. 321–323). Each subject's performance on each of the two tasks was categorized using this system.

Performance on the two tasks was combined to produce a final three-category system:

- *Consolidated attribute processors* were those who acquired information by means of conceptually complex attribute processing strategies and search of each brand at least once (classified as category 9 sequences by Capon and Burke) on both tasks. This most accomplished processing contrasted with acquisition sequences in which either each brand was not searched at least once (low level strategies) or conceptually simpler brand processing was used.
- *Basic processors* were those who performed at a low level in at least one task (categories 1, 2, 3, 5, 7 or 8), or who were brand processors (category 4) on both tasks.
- *Transitional processors* were high level processors on both tasks, mixed brand/attribute processors (category 6) on one task, and either attribute, mixed brand/attribute, or brand processors (categories 9, 6 or 4) on the other task.

Inspection of part A of Table 1 reveals an extremely close correspondence between the results for the steam iron and microwave oven. Furthermore, these results are highly similar to Capon and Burke (1980), although the present subjects were somewhat more accomplished than those in the Capon and Burke study (1980).

Part B of Table 1 shows the results of subject classification into the final three-category system. Of the 60 subjects, 21 (35 percent) were consolidated attribute processors, searching all brands by attribute (category 9) for both tasks. Twenty subjects (33 percent) who searched all brands were transitional processors, 12 (60 percent) were mixed and attribute processors, five (25 percent) were dual mixed processors, and those remaining were mixed and brand processors. Nineteen subjects (32 percent) were basic processors; they comprised a number of basic types. Six subjects

TABLE 1

INFORMATION ACQUISITION

A. Primary sequence analysis

Category	Steam iron: Subcategory	Steam iron: Category	Steam iron: Total	Microwave oven: Subcategory	Microwave oven: Category	Microwave oven: Total
Random processing			1			1
Category 1		1			1	
Brand processing			17			13
Category 2		2			1	
Category 3		6			4	
Category 4		9			8	
Mixed brand/attribute processing			14			16
Category 5		2			0	
Category 6		12			16	
Subcategory 6a	8			8		
Subcategory 6b	4			8		
Attribute processing			28			30
Category 7		0			0	
Category 8		0			1	
Category 9		28			29	
Subcategory 9a	2			7		
Subcateogry 9b	16			10		
Subcateogry 9c	8			9		
Subcategory 9d	2			3		
High-level processing (Categories 4,6,9)			49			53
Low-level processing (Categories 1,2,3,5,7,8)			11			7

B. Consolidated sequence analysis

	Subtotal	Total	
All brands searched for both tasks		47	
2 attribute sequences	21		→ 21 Consolidated attribute processors
1 mixed, 1 attribute sequence	12		→ 20 Transitional processors (12 + 5 + 3)
2 mixed sequences	5		
1 mixed, 1 brand sequence	3		
2 brand sequences	6		→ 19 Basic processors (6 through final 1)
All brands searched for one task		8	
2 attribute sequences	1		
1 attribute, 1 brand[a] sequence	1		
1 mixed, 1 brand[a] sequence	4		
2 brand sequences	2		
All brands searched in neither task		5	
2 mixed sequences	1		
1 mixed, 1 brand sequence	1		
2 brand sequences	2		
2 random sequences	1		

[a]All brands not searched.

TABLE 2

INFORMATION INTEGRATION PATTERNS OF OBJECT RATING PERFORMANCE

No effects	5	Nonintegrators	37
Interaction effects only	4		
One main effect	22		
One main effect and one or more interaction effects	6		
Two main effects	11		
Two main effects and one or more interaction effects	9	Integrators	23
Three main effects	—		
Three main effects and one or more interaction effects	3		
TOTAL	60		

searched all brands with brand processing, eight searched all brands for one task only, and five did not search all brands in either task in a variety of configurations.

Information Integration

Each object rating by a subject was treated as an independent judgment to be entered into an overall analysis of variance for that individual following the procedure used by Anderson (1970, 1973), Capon and Kuhn (1980), and Capon et al. (1981). Each ANOVA included four factors (color, shape, fastening, and surface), and two levels on each factor; the two replications of the 16 unique notebooks provided the error term. Subjects were categorized according to the pattern of effects shown in their individual ANOVAs. The category scheme and the resulting frequencies are presented in Table 2.

Of the 60 subjects, 29 took into account two or more dimensions in their evaluations, and 23 of these showed two or more main effects. Twenty-eight subjects displayed one main effect, 20 subjects two main effects, and three subjects three main effects. Twenty-two subjects in all displayed interaction effects, 18 of which were associated with main effects. More detailed analysis revealed that 18 of the 22 subjects displayed a single interaction effect, 16 of which were two-way interactions, while of the remaining four subjects, two displayed two interaction effects, one displayed four, and one displayed five. Including both main and interaction effects, the modal tendency was for a subject to take into account two dimensions in her object ratings: two subjects took all four dimensions into account, seven took three into account, 24 took two into account, 22 took one into account, and five subjects displayed no effects. These results are roughly equivalent to the adult data presented by Capon et al. (1981). For purposes of this study, the categories shown in Table 2 were collapsed into two major categories: predominantly nonintegrators (37 subjects), and predominantly integrators (23 subjects).

TABLE 3

INFORMATION ACQUISITION AND INTEGRATION

		Information acquisition		
		Consolidated attribute processors	Transitional processors	Basic processors
Information integration	Nonintegrators	8	15	14
	Integrators	13	5	5

Information Acquisition and Integration

A positive relationship was found between performance on the information acquisition and information integration tasks (Table 3). Subjects classified as consolidated attribute processors on the acquisition task were more likely to be integrators (62 percent) than nonintegrators (38 percent). Conversely, subjects classified as transitional and basic processors were more likely to be nonintegrators (75 and 74 percent) than integrators (25 and 26 percent; chi-square $= 7.65$, $df = 2$, $p < 0.05$).

Cognitive Tasks

The scoring systems used for each of the cognitive tasks are summarized in Tables 4 and 5. Scoring systems for the pendulum, combination, and correlation problems were adapted from Inhelder and Piaget (1958), for the plant problem from Kuhn and Ho (1977), and for the proportion problem from Capon and Kuhn (1982). Four basic levels were differentiated: concrete operational (least advanced of the four), transitional (between concrete and formal operational), beginning formal operational, and consolidated formal operational (most advanced). (Differentiation between the latter two levels was not made in the plant problem, and a transitional level was not identified in the proportion problem, leaving a three- rather than a four-category system for these two problems.) Each subject's performance on each problem was scored by two independent scorers. Percentage agreement reliability estimates were over 90 percent for each of the problems. Differences were resolved through discussion. Subjects' performance in the cognitive tasks is summarized in Table 6. As reflected in this table, levels of performance differed markedly across tasks.

Cognitive Level and Information Acquisition

Nonparametric analyses were used to relate performance on the cognitive tasks to performance on the consumer tasks because the categories used to classify performance in both kinds of tasks reflect ordinal rather than interval scales.

TABLE 4

PERFORMANCE CHARACTERISTICS FOR BASIC COGNITIVE TASKS

	Isolation of variables		Systematic combination
Level	Pendulum problem	Plant problem	Pizza problem
Concrete operational	Fails to isolate variables in manipulations of the apparatus; fails to use "all other things equal" method (i.e., to hold constant those variables not being manipulated); makes false inferences based on invalid experimentation.	Reasons on the basis of isolated instances; makes logical errors of false inclusion (i.e., fails to exclude inoperative variables).	Fails to show any discernible pattern or system in generating combinations.
Transitional	Shows a mixed pattern of behaviors characteristic of the concrete operational level and behaviors characteristic of the beginning formal operational level.	Spontaneously shows exclusion of inoperative variables and inclusion of operative ones. Comprehends either alternative or additive variables, but not both.	Forms at least one two-way sequence, e.g., AB, AC, AD, AE.
Beginning formal operational	Isolates variables on some occasions; isolates variables when specifically suggested; makes no false inferences based on invalid experimentation.	———	Forms all 10 two-way combinations within a sequence of no more than 12 combinations.
Consolidated formal operational	Spontaneously isolates variables using an "all other things equal" method.	Comprehends and differentiates between alternative and additive operative variables; excludes inoperative variables.	Forms all 10 two-way and all 10 three-way combinations.

TABLE 5

PERFORMANCE CHARACTERISTICS FOR DERIVED COGNITIVE TASKS

	Correlation	Proportion
Level	Men from Mars problem	Deodorant problem
Concrete operational	Most advanced reasoning involves forming a concrete ratio (e.g., "six with blue hair have yellow eyes and two have pink eyes"); other reasoning is more general (e.g., "most blue haired men have yellow eyes") or no inferences are made at all.	Fails to construct or complete a calculation, or completes a conceptually incorrect calculation, frequently based on subtraction.
Transitional	Shows a mixed pattern of responses characteristic of the concrete operational level and responses characteristic of the beginning formal operational level.	———
Beginning formal operational	Forms a concept of probability as the ratio of positive confirming cases to the cases possible relative to a given characteristic (i.e., the probability of yellow eyes given blue hair).	Completes a correct calculation based on diagnosis of the ratio of the two weights, e.g., multiply the price of the 8 oz. can by 3/2 and compare the price of the 12 oz. can.
Consolidated formal operational	Reasons by comparing the class of positive (confirming) cases and the class of negative (disconfirming) cases.	Completes a correct calculation of a direct ratio, price per unit weight or weight per unit price.

Table 7 presents contingency tables showing the cross-tabulations of performance on the information acquisition task with performance on each of the cognitive tasks. In each case, performance categories on the cognitive task have been collapsed into two categories. As shown by the varying labels for these two categories in Table 7, the four (or three) initial categories were collapsed differently for different cognitive tasks, reflecting our finding that subjects' performance was distributed across the levels quite differently in different tasks.

TABLE 6

PERFORMANCE ON COGNITIVE TASKS

	Isolation of variables				
	Pendulum	Plant	Systematic combination	Correlation	Proportion
Concrete operational	3	4	26	36	8
Transitional	11	11	15	19	—
Beginning formal operational	13	—	16	4	21
Consolidated formal operational	33	45	3	1	31

TABLE 7

PERFORMANCE ON COGNITIVE AND INFORMATION ACQUISITION TASKS

	Isolation of variables									
	Pendulum		*Plant*		Systematic *combination*		*Correlation*		*Proportion*	
	Nonformal[a]	Formal[b]	Nonformal	Formal	Concrete	Some formal[c]	Concrete	Some formal	Concrete	Formal
Basic processors	4	15	6	13	13	6	12	7	3	16
Transitional processors	7	13	6	14	7	13	15	5	4	16
Consolidated attribute processors	3	18	3	18	6	15	9	12	1	20

[a]The Concrete operational and Transitional categories were collapsed to form the Nonformal category.
[b]The Formal category was formed by collapsing the Beginning formal operational and the Consolidated formal operational categories.
[c]The Some formal category was formed by collapsing the Transitional, the Beginning formal operational, and the Consolidated formal operational categories.

Isolation of Variables. Performing 2 × 3 chi-square analyses of the relation of each of the individual isolation-of-variables measures to major strategy type on the information acquisition task yielded chi-square values that did not reach statistical significance, although the association was in the anticipated direction (chi-square values were: pendulum, 2.53; plant, 1.99; 2 *df*). In each case, the major difference appeared between those subjects who were classified as consolidated attribute processors and those who were not. Subjects classified as consolidated attribute processors were unlikely not to exhibit a formal operational level of reasoning on the pendulum problem (three subjects are the exception) or on the plant problem (again, three subjects are the exception). Of the 25 subjects classified as nonformal on either the plant problem or the pendulum problem, four were classified as nonformal on both problems. None of these totally nonformal subjects was a consolidated attribute processor in the information acquisition tasks.

Combination. In contrast to the weak directional effects found for the isolation of variables tasks, the ability of the systematic combination task to predict performance on the information acquisition task was both in the theoretically expected direction and significant (chi-square = 7.31, $df = 2$, $p < 0.05$). As is evident from Table 7, this relationship is attributable to differential performance on the combination task by subjects classified as consolidated attribute and transitional processors on the one hand and subjects classified as basic processors on the other. Subjects were unlikely to be classified as either consolidated attribute or transitional processors if they did not show at least formal operational reasoning on the combination task. In contrast, subjects classified as basic processors showed a concrete operational level of reasoning in 13 of 19 (68 percent) cases.

Correlation. The chi-square value did not reach statistical significance in this task, though the association was

TABLE 8

PERFORMANCE ON COGNITIVE AND INFORMATION INTEGRATION TASKS

	Isolation of variables									
	Pendulum		Plant		Systematic combination		Correlation		Proportion	
	Nonformal[a]	Formal[b]	Nonformal	Formal	Concrete	Some formal[c]	Concrete	Some formal	Concrete	Formal
Nonintegrators	9	28	13	24	21	16	22	15	7	30
Integrators	5	18	2	21	5	18	14	9	1	22

[a]The Concrete operational and Transitional categories were collapsed to form the Nonformal category.
[b]The Formal category was formed by collapsing the Beginning formal operational and the Consolidated formal operational categories.
[c]The Some formal category was formed by collapsing the Transitional, the Beginning formal operational, and the Consolidated formal operational categories.

in the expected direction (chi-square = 4.53, df = 2, NS). In contrast to the combination task (but not to the isolation of variables tasks), transitional processors on the information acquisition task more closely resemble basic processors than they do consolidated attribute processors. Attribute processors were more likely to show at least some formal reasoning on the correlation task; transitional and basic processors were more likely to show a concrete operational level of reasoning.

Proportion. The theoretically interesting result for this task was that, of the 21 subjects classified as consolidated attribute processors, only one failed to show a formal operational level of reasoning. But due to the relatively few subjects overall who did not show at least some formal operational reasoning on this task, statistical analysis was based on the more even distribution of those subjects who showed consolidated formal operational reasoning (n = 31) and those who did not (n = 29). Association between this dichotomy and information acquisition strategy type was not statistically significant (chi-square = 5.07, df = 2, NS).

Cognitive Level and Information Integration

Isolation of Variables. Association between the pendulum task and the information integration task was not statistically significant, nor was there any directional effect whatsoever. In contrast, association between the plant task and the information integration task was statistically significant (chi-square = 4.55, df = 1, $p < 0.05$) and in the theoretically expected direction: subjects using integrative processing strategies were much more likely to show formal operational reasoning (21 of 23, or 91 percent) than concrete operational or transitional reasoning (2 of 23, or 9 percent; see Table 8).

Combination. Results for this task were statistically significant and in the right direction (chi-square = 7.09, df = 1, $p < 0.01$). Integrative processors were much more likely to show at least some formal operational reasoning (18 of 23, or 78 percent), while nonintegrative processors were more likely to show concrete operational reasoning (21 of 37, or 57 percent).

Correlation. Results were statistically nonsignificant and there were no directional tendencies: integrative and nonintegrative processors were equally likely to show formal operational reasoning (40 percent in both cases).

Proportion. Statistical comparison of subjects who showed consolidated formal operational reasoning (n = 31) versus those who did not (n = 29) yielded nonsignificant results. However, a theoretically interesting pattern was apparent which is parallel to that found for information acquisition strategies: of the 23 subjects who were integrative processors, only one failed to show formal operational reasoning.

DISCUSSION

Our results corroborate earlier results obtained for information acquisition (Capon and Burke 1980) and information integration (Capon et al. 1981) in that they demonstrate range and variety in the information processing strategies employed among populations of adult females in their role as consumers. For both information acquisition and information integration, the range of strategies observed can be ordered roughly on an ordinal scale from simple to complex. Furthermore, performance on the two consumer tasks is significantly related: subjects using more complex information integration strategies were more likely to use more complex information acquisition strategies and vice versa, a result in accordance with an a priori task analysis of the two tasks.

Furthermore, the present results suggest that variations in consumer information processing strategies may be at least in part a reflection of variability in more general information processing abilities. Particularly noteworthy, we believe, is the fact that the cognitive abilities we selected for assessment did not show a uniform relationship to performance on the consumer tasks; rather, certain cognitive abilities were implicated while others were not.

This outcome is both compatible with recent basic research findings on the cognitive skills that were investigated and significant in its implications for our understanding of consumer information processing strategies. As indicated previously, a considerable body of research indicates that the formal operational reasoning abilities described by Inhelder and Piaget (1958) do not form the unified "structured whole" in the strong sense that they implied in their original work. Thus it is not surprising to find that it is particular individual formal operational strategies—rather than the whole set of cognitive strategies labeled formal operational—that are predictive of performance in more applied domains.

The two cognitive strategies that were related to consumer information processing strategies in the present work—one strongly and the other more weakly and less clearly—were the two strategies hypothesized by Inhelder and Piaget (1958) to form the basic structure of formal operations: systematic combination and isolation of variables. The remaining two strategies that we assessed—correlation and proportion—are alleged to be "derived" strategies stemming from the basic structure; neither of these was found to be related significantly to performance on either of the consumer tasks.

Piagetian theory holds that both systematic combination and isolation of variables rely on a mental structure termed a "combinatorial structure." Possession of such a mental structure allegedly permits an individual both to generate systematically all possible combinations of elements (systematic combination) and to isolate relations that obtain among them (isolation of variables) when operating within a multivariable system. The cognitive strategy that showed a clear relation to both information acquisition and information integration consumer tasks was systematic combination. This outcome is theoretically plausible in light of the nature of both consumer tasks. As indicated earlier, both tasks necessitate the consumer's processing of a complex set of information that can be represented by a matrix of attribute × object entries. This information must be encoded, organized, and represented in the individual's memory structure, and subjected to further processing, including—for at least some processors—integrative processing. Possession of a mental scheme that enables multivariable information to be generated and organized in a systematic manner, as assessed by the systematic combination task, would more likely allow the more complex forms of consumer information acquisition and information integration strategies observed in the present study.

The ability to infer intervariable relationships that hold among the elements of a multivariable data base, as assessed in the isolation of variables task, is less clearly a requisite part of either the consumer information acquisition or information integration tasks. However, one might make the same argument for the connection between the two kinds of strategies in the consumer realm, as Inhelder and Piaget (1958) did more generally: the individual who systematically organizes multivariable information sets is more likely to have both the ability and the inclination to infer intervariable relationships based on this information.

In the isolation of variables task and both consumer tasks, the individual must apply cognitive operations to a multivariable data base. The complexity of these operations and the skill with which they are executed are influenced by the individual's ability to impose some organization on the data base itself, and it is this common element that may unite the two kinds of tasks, despite the fact that the specific nature of the operations to be applied to the data base differs. Our results also suggest, at least for the information integration task, that particular forms of isolation-of-variables reasoning may be more relevant in consumer information processing than others. In this case, inferring intervariable relationships based on a presented data display (plant problem) was related to information integration in the consumer task, while the ability to conduct controlled experiments to isolate such relationships (pendulum problem) was not.

Our results provide support for Capon and Burke's (1980) proposition that individuals possess characteristic information processing strategies within the consumer domain. The present work extends this proposition to include information integration as well as information acquisition facets of consumer information processing. Yet our work also suggests the possibility that such characteristic strategies might be regarded most appropriately not as preferred, but as constrained. In other words, the characteristic processing strategies that individuals display in consumer tasks may, at least to some extent, be a function of more general limitations in their information processing abilities. From a methodological perspective, such a finding underscores the importance of conducting consumer research on heterogeneous samples which represent the broad range of individuals that make up the population of consumers.

To refer to processing strategies as constrained is not, however, to conclude that they are fixed, immutable, or impervious to modification. Formal operational strategies such as isolation of variables and systematic combination have been elicited in a number of studies among adolescent or adult subjects who did not display them at an initial assessment, following a period of controlled experience with tasks in which these strategies are required for effective solution (Neimark 1982). This might prove a worthwhile literature to draw on in formulating consumer education objectives and techniques among populations in which consumer information processing strategies appear to be constrained by processing limitations.

A major caveat about our findings has to do with the nature of the two consumer tasks, which themselves imposed constraints on subjects' performance. Although the information integration task employed real objects, as opposed to symbolic representations of them, the objects were relatively inconsequential as consumer products. In the information acquisition task, even though the product class was of importance, consumers received all information in the form of symbolic (written) representations in a matrix format; the task thus differed significantly from the context in which consumers acquire information in natural circumstances. Furthermore, the task itself was highly structured by the task requirements conveyed in the instructions to the subject. Examining performance in contexts in which the artificial constraints imposed on the task cause it to depart significantly from the more natural activity the task is intended to represent is arguably a necessary phase in the research process. In current work, we are exploring the individual difference variables associated with consumer information processing under less constrained conditions that more closely replicate the conditions under which consumer information processing normally occurs.

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