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A Developmental Study of Consumer Information-Processing Strategies

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Subjects at four age levels (kindergarten, fourth grade, eighth grade, and college) made preference judgments for a set of consumer products varying on four dimensions. Though product preferences reflected independently assessed dimension ratings, subjects had preferences on more dimensions than they took into account in the product ratings. Not until late adolescence did subjects integrate their preferences on two or more dimensions.

This study investigates how individuals make preference judgments about commonplace, multiattribute objects of the sort they might encounter as consumers. One can assume that the individual has preferences on individual attributes, and that these preferences are in some manner integrated into an overall preference judgment of the object. The attention of consumer researchers to how individuals integrate attribute information in making object evaluations is relatively recent. Existing studies have addressed themselves to defining and testing a number of theoretical models of the information integration process, e.g., linear, nonlinear, additive, subtractive, and multiplicative (Bettman, Capon, and Lutz 1975a; 1975b; 1975c; Haggerty 1978; McElwee and Parsons 1977; Park 1976; 1978; Scott and Wright 1976).

This work is, for the most part, an outgrowth of the research on processes of information integration by Anderson (1973) and his co-workers, primarily in the domain of person perception. In the prototypical study, a subject is asked to rate the likeability of a hypothetical individual who is said to possess some combination of personality traits that have been rated on desirability by previous samples of subjects.

The experimental paradigm used in the present study differs in some important ways from Anderson's. For

better external validity, the task chosen was one in which subjects were asked to indicate their preferences for actual, physically present objects they were permitted to inspect, in addition to indicating preferences regarding individual attributes of the objects. Thus, there was no uncertainty about the object to be rated; it was revealed in its entirety to the subject, in contrast to Anderson's prototypical task in which a subject is asked to judge a hypothetical object based on a set of adjectives.

A related difference between Anderson's experimental paradigm and that used in the present study has to do with what information is being integrated. In Anderson's paradigm, extensive precautions are taken to ensure that the subject takes into account each piece of information (adjective). The information to be integrated is thus regarded as constant, and the objective is to discover the integration strategies that subjects use. In the present situation, no attempt was made to ensure that each of the attributes entered into a subject's judgment. Rather, our interest was in investigating how many attributes subjects spontaneously take into account when evaluating multiattribute objects, as well as examining the strategies by which they integrate information about the relevant attributes.

In addition, again in contrast to Anderson's typical procedure, we obtained separate judgments of a subject's preferences with respect to the multiple levels of each individual attribute. Our interest was whether subjects take into account each of their dimension preferences and integrate these stated preferences in some consistent way.

The other major concern of the present study was a developmental one. If adults do indeed possess complex information-processing strategies, such strategies

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may nevertheless exceed the cognitive capacities of children and, thus, may emerge only gradually, as a function of advances in cognitive development. The possibility of such a developmental evolution is suggested by two distinct theoretical systems within the cognitive development literature. One is the structural developmental theory of Piaget, which holds that children acquire the ability to attend to and coordinate multiple dimensions only gradually, in a series of qualitatively distinct stages. The second is the information-processing theory of Pascual-Leone (1970), which holds that the "mental space" required for information processing increases developmentally and dictates the complexity of cognitive strategy within the individual's competence.

We were particularly interested in the relation between object ratings and dimension ratings as a function of age. Subjects of all ages are likely to possess and be able to express preferences with respect to each of the individual dimensions. It may be only with increasing age and cognitive development, however, that subjects are able to take into account and integrate their various dimension preferences in rating the multidimensional objects.

Accordingly, the experimental procedure was designed to be appropriate over a wide age range. In addition to collecting data for a young adult sample, we repeated the procedure with subjects of three additional age groups: kindergarten, fourth grade, and eighth grade. These age groups were chosen to coincide with major stage levels in Piaget's system: pre-operational, concrete operational, and early formal operational.

EXPERIMENT 1: METHOD

Materials

The objects were a set of pocket-size notebooks of the type that might be purchased in a low-priced variety store. The notebooks varied on four dimensions, with two levels of each dimension represented. The dimensions were color (red or green), surface (dull or shiny), shape (long/thin or short/wide), and fastening (side or top). Each of the 16 possible combinations was represented in two identical notebooks, yielding a total set of 32 notebooks. Subjects were shown each notebook individually, in a random order, and asked to indicate their liking for the notebook on a nine-point scale, using an apparatus to be described later. 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 (also described later).

Subjects

The young adult subjects were students in an introductory psychology course in a large state university.

The kindergarten, fourth, and eighth graders were from a middle-income-level elementary and junior high school in the surrounding community. There were 20 subjects in each of the four age groups, ten of each sex. The university was a commuter school, and students were, therefore, from the local community. The four age groups were, thus, roughly equivalent on the major variables of socioeconomic level and educational background.

Procedure

The procedure consisted of three phases: introduction, object-rating task, and dimension-rating task. Half of the subjects in each age group received the dimension-rating task first; the remainder received the object-rating task first.

Introduction. For both the introductory presentation and the dimension-rating task, stimuli were devised for representing independently each of the four dimensions on which the notebooks varied: color, shape, fastening, and surface. For representing color, two cardboard pieces (12 cm \times 6 cm) were used, of a size and shape intermediate between the two shapes represented in the actual notebooks (15 cm \times 5 cm and 10 cm \times 7.5 cm), one with the green and one with the red covering used in the actual notebooks. Another set of cardboard pieces of the same size were used to represent the dull versus shiny dimension, both surfaces of a neutral (gray) color.

A similar set of cardboard pieces of the same size and color was used to represent the fastening dimension: one had the common type of spiral coil used to fasten notebooks attached across the left side and the other had the coil attached across the top. The shape dimension was represented by two cardboard pieces of the same neutral color and of the two shapes (15 cm \times 5 cm and 10 cm \times 7.5 cm) represented in the actual notebooks. Each of the eight stimuli just described had a felt backing for attachment to a felt board used in the dimension-rating task.

The introductory presentation to the subject was as follows:¹

I have some notebooks here and I'm trying to find out how people like them. I'm going to ask you how much you like each of the notebooks. Will you help me by thinking really carefully, and then telling me how much you like each of the notebooks? Let me tell you about the notebooks first. Some are red and some are green. Some have a dull surface like this, and some have a shiny surface like this. Some are long and thin, like this, and some are short and fat, like this. Some open at the

¹ It was explained to older subjects that the task was being given to young children as well, and that we had, therefore, made up very detailed, explicit instructions to make sure the young children understood.

side, like this, and some open at the top, like this. (Appropriate stimuli were displayed as the experimenter mentioned each dimension.)

Object-Rating Task. The experimenter displayed a three-dimensional formboard of sturdy, colored cardboard. The formboard contained a row of nine equal-sized compartments of adequate size to accommodate one of the notebooks. The back surface of the formboard extended upward above the compartments, enabling a schematic representation of a face to be displayed directly above each compartment. Each face consisted of a circle cut out of white paper and pasted onto the orange cardboard over one of the compartments. Each circle was 5 cm in diameter and contained two dots representing eyes, an angle representing a nose, and a line mouth 2.3 cm in width, all in a standard position on the face. The nine faces differed only with respect to the curvature of the mouth. The mouth of the face above the center compartment was a straight line. The four faces above the compartments to the right of the center face had mouths that were turned upward in a smiling position. The degree of smile was graduated by varying the height of the sides of the mouth—either 0.4, 0.7, 1.0, or 1.3 cm—with the greater heights further from the center compartment. The four faces above the compartments to the left of the center one had mouths that were turned downward, in a frowning position, with the degree of frown similarly graduated. Instructions to the subject were as follows:

For this part, I'd like you to tell me how much you like the different notebooks. We'll use this board for you to tell me. I'll show you the notebooks, one at a time. If you like a notebook a really, really lot, then put it in here (9) by the very happy face. If you like it, but not so much, put it in here by one of these faces that aren't quite as happy (8–6). If you really don't like it, put it in here (1) by the very sad face. If you don't like it very much, put it in one of these (2–4). If you don't like it, but don't not like it—if you sort of feel just in-between—put it here in this middle one (5). Okay?

Let's try some practice ones with the board. (The experimenter displayed three cardboard cut-out pictures of fruits.) If you had to say how much you like lettuce as something to eat, which face would you put the picture of the lettuce by? (Subject responded.) If you had to say how much you like grapes, which face would you put the picture of the grapes by? (Subject responded.) If you had to say how much you like a tomato, which face would you put the picture of the tomato by? (Subject responded.)

The experimenter answered any questions the subject had about the rating procedure before proceeding. He then presented each of the 32 notebooks, one at a time in random order, removing each notebook from view after the subject had placed it in one of the nine compartments and the placement had been recorded.

Dimension-Rating Task. The experimenter presented a felt-covered board divided into nine equal 5-cm sections, with a larger space, 7 cm long, at either end. The same eight stimuli employed in the introductory presentation were used in the dimension ratings. Each pair of stimuli was in turn attached to opposite ends of the board. Instructions were as follows:

For this part, I'd like you to tell me how you feel about each of the different things about the notebooks. We can use this board for you to tell me. Here is a special felt square. I'm going to write your initial on the square, so we know that it tells how *you* feel (this procedure included for two youngest age groups only). I'd like you to put the square somewhere on the board to tell how you feel. Remember, some of the notebooks are *red* and some *green*. (Experimenter attached appropriate stimuli to ends of felt board.) Do you like notebooks better that are *red* or *green*? If you really like *red* much more than *green*, then put your square here (1). If you like *red* a little more than *green*, then put it in one of these (2–4). If you like *green* a little more, put it in one of these (6–8). If you like *green* a really lot more, put it here (9). If you like *red* and *green* just the same, then put it here (5).

Let's try a practice one. If you had to say how much you like an apple or an orange for an afternoon snack, where would you put your square? (Experimenter attached felt-backed pictures of an apple and orange to ends of board.) If you really, really like an apple much more than an orange, then put your square here (1). If you like an apple a little more than an orange, then put it in one of these (2–4). If you like an orange a little more put it in one of these (6–8). If you like an orange a really lot more, put it here (9). If you like an apple and an orange just the same, then put it here (5). Okay, now why don't you put the square where it goes to tell how you feel. (Subject responded.) Here's another one. If you had to say how much you like a baseball or a football to play with, where would you put your square? (Appropriate stimuli displayed, and subject responded.)

After answering questions about the rating procedure, the experimenter continued:

Now let's do the ones about the notebooks. If you had to say how much you like red or green as the color of the notebook, where would you put your sticker? (Appropriate stimuli displayed; repeated for remaining dimensions: plain/shiny; long and thin/short and fat; side/top fastening.)

RESULTS

Adult Data

Each of the subject's object ratings was treated as an independent judgment to be entered into an overall analysis of variance for that subject, following Anderson's tradition. Each ANOVA included four variables (color, shape, fastening, and surface); the two replications of the 16 unique notebooks provided the error term.

Subjects were then categorized in terms of the pattern of effects shown in their individual ANOVAs. Ten of the 20 subjects showed main effects for two dimensions; four subjects showed main effects for three dimensions. Seven of these 14 subjects, in addition, displayed one or two interaction effects, with two of the seven also showing one three-way interaction. One subject showed one main effect and an interaction effect. A majority of subjects, then, 15 of 20, integrated preferences with respect to two or more dimensions. Of the remaining five subjects, four showed a single main effect and one showed no effects.²

Including both main and interaction effects, the modal tendency was for a subject to take two dimensions into account in making the object ratings: one subject took all four into account, five took three into account, nine took two into account, four took only one into account, and one showed no effects. For subjects who took more than one dimension into account, the modal pattern was that of either one or two substantial main effects, with the remaining effects accounting for little of the explained variance. Only a small amount of variance (a mean of five percent) was explained by interaction effects; this finding is similar to previous findings from the human judgment literature (Hoffman, Slovic, and Rorer 1968).

In order to obtain a descriptive index of the consistency with which subjects performed the object ratings, a correlation coefficient between the two replications, i.e., the two identical sets of 16 notebooks, was computed for each subject. The average coefficient was 0.72. Fourteen subjects had coefficients above 0.75, and 16 had coefficients above 0.50. Only two subjects had coefficients below 0.40.

In the dimension ratings, a majority of subjects (95 percent) preferred one value over the other on either three or all four dimensions. Considerable consistency was found between main effects in the object ratings and preferences in the dimension ratings. Almost without exception, main effects in the object ratings were reflected in the dimension ratings: in only two instances did a subject show a main effect in the object ratings while indicating a neutral preference with respect to that dimension, i.e., choice of the center point on the dimension-rating scale. In no instance did a subject show a main effect in the object ratings while indicating a contradicting preference in the dimension ratings. Thus, subjects were able to articulate accurately in the dimension ratings those preferences they were taking into account in making the object ratings.

In addition, there was some tentative indication of a correspondence between subjects' object ratings and the *relative strengths* of their dimension preferences. Ratings at either the end or next-to-end points on the dimension-rating scale were regarded as reflecting

a "strong" preference on a given dimension; ratings at the center point were regarded as reflecting a neutral preference, and ratings at the remaining points were regarded as reflecting a "weak" preference. In general, subjects showed a tendency to attend in the object ratings (as indicated by significant ANOVA effects) to all dimensions for which they indicated a strong preference before attending to any dimensions for which they indicated only a weak preference. Specifically, of the 16 subjects who indicated both weak and strong preferences, only six exhibited an effect in the object ratings for a weak-preference dimension while ignoring, i.e., not showing an effect in the object ratings, a strong-preference dimension. Three of these cases entailed only a single, minor inversion, e.g., a dimension the subject gave a rating of 2 showed an effect in the object ratings, whereas one given a 3 did not.

What is perhaps the most significant finding from the adult data, however, emerges when the relation between object and dimension ratings is viewed in the opposite direction. Though the preferences indicated by subjects' object ratings were reflected as well in their dimension ratings, the reverse was not true. In their dimension ratings, subjects indicated preferences with respect to more dimensions than those for which significant effects emerged in their object ratings.

An example will serve to illustrate the typical pattern. Subject 4 indicated strong preferences on three dimensions, A, B, and C, and no preference with respect to Dimension D, but in the object ratings showed effects only for Dimensions A and B. Despite a strong expressed preference on Dimension C in the dimension ratings, in the object ratings Subject 4 showed a difference score for Dimension C (i.e., the absolute difference between the mean ratings of the two levels of Dimension C) of only 0.13, compared to difference scores of 4.75 and 2.13 for Dimensions A and B, and 0.00 for Dimension D. Thus, Dimension C was given virtually no more weight than Dimension D, on which the subject had a neutral preference.

Despite the sophistication shown by adult subjects, then—in terms of their ability to integrate preferences with respect to multiple dimensions in a systematic manner, and their ability to accurately articulate these preferences in independent dimension ratings—in making object ratings, subjects typically did not take into account all the dimensions on which they had preferences.

Developmental Data

A comparison of the performance of the younger groups with that of the adults revealed both similarities and differences. First, a majority of subjects at all four age levels indicated nonneutral preferences for either three or four of the dimensions. One kindergarten child, five fourth graders, four eighth graders, and one college subject had preferences on only one or two

² The 0.01 level of significance was employed throughout.

dimensions (typically two). Thus, the age groups did not show pronounced differences in expression of preferences on the dimensions themselves. Furthermore, although their accuracy was somewhat reduced, the younger subjects showed a tendency parallel to that of the adults to articulate accurately in their dimension ratings the main effects that emerged in their object ratings. In comparison to 95 percent of main effects among adult subjects: 82 percent of main effects among eighth graders, 71 percent of main effects among fourth graders, and 80 percent of main effects among kindergarten children were accompanied by preferences in the appropriate direction in the dimension ratings.³ For none of the age levels did order of task presentation have a significant effect; performance was unaffected by whether subjects rated the objects first or the dimensions first. This was true both in terms of rating consistency and in terms of the ANOVA patterns to be discussed shortly.

In the object ratings themselves, however, substantial differences among the age groups appear. In terms simply of overall number of significant ANOVA effects, the figures are: adults 49, eighth graders 23, fourth graders 25, and kindergarten children 8. In order to make the desired qualitative comparisons across age groups, subjects were categorized according to the pattern of effects that emerged in their individual ANOVAs. The category system employed and the resulting frequencies are presented in Table 1. At the kindergarten level, the modal pattern was no significant effects. Among the older age groups simple main effects, without interactions, become more frequent, with a single main effect becoming the predominant pattern at the eighth grade level. At the adult level, the predominant pattern is multiple main effects with or without interaction effects.⁴

A problem arises, however, in interpreting the age differences in Table 1. The number of effects to emerge in a subject's ANOVA is, of course, influenced by the error variance, which in the present case was a function of the consistency with which the subject rated the two replications (identical sets) of notebooks. As might be anticipated, this consistency varied with age, the average correlation coefficients between the two replications being: kindergarten children 0.04, fourth graders 0.40, eighth graders 0.50, and adults 0.72.

Accordingly, the ANOVA differences across age groups may be solely a function of these differences in rating consistency. Although such differences are themselves of some interest, they are not surprising; the more important developmental question is whether

TABLE 1
PATTERNS OF PERFORMANCE IN THE OBJECT RATINGS BY AGE GROUP

Pattern	Age group			
	Kinder- garten	Fourth grade	Eighth grade	College
No effects	14	7	2	1
Interaction effects only	1	1	0	0
One main and one or more interaction effects	1	2	0	1
One main effect	4	6	14	4
Two or three main effects	0	3	4	7
Two or three main effects and one or more interaction effects	0	1	0	7
Total	20	20	20	20

or not there are any qualitative differences in the types of information-integration strategies used by subjects of different ages, apart from the differences in the consistency of their ratings. Accordingly, we sought a means of comparing age groups with respect to types of strategies in a manner that would not be influenced by the variability in rating consistency. In particular, our concern was whether more effects would have appeared among younger subjects, had they shown a response consistency comparable to that of the oldest subjects.

To address this issue, we reexamined the data to ascertain what patterns would have emerged had the subject shown complete accuracy (i.e., consistency) in the object ratings. To do this, we considered a subject's ratings of the first replication of the 16 unique notebooks (i.e., first exposure to each notebook) as the "true" rating of each notebook, and analyses were performed of these first-replication data. These analyses were identical to the ones reflected in Table 1, with the exception that the three-way and four-way interactions were pooled to form an error term.⁵ Alternatively, we could have considered the second replication by itself as comprising the "true" ratings. As the results of both are very similar, only the first is presented (Table 2).

A comparison indicates that Tables 1 and 2 are very similar. The major difference is the absence of interaction effects among the college subjects; these tended not to reach statistical significance in the single-replication analyses, due to the larger error term. It is important to note that the younger subjects show no more advanced patterns in the single-replication analyses than they did in the original analyses. We are, thus, safe in concluding that the absence of these advanced patterns among younger subjects in the orig-

³ The meaningfulness of this figure for the kindergarten children is limited by the very small number of significant main effects among this age group.

⁴ We are assuming that the "interaction effects only" pattern shown by two younger subjects is a chance result and does not reflect a true interactive strategy.

⁵ This procedure is justified by the virtual absence of three-way and four-way interaction effects in the original analysis.

TABLE 2

PATTERNS OF PERFORMANCE IN THE OBJECT RATINGS BY AGE GROUP (FIRST REPLICATION ONLY)

Pattern	Age group			
	Kindergarten	Fourth grade	Eighth grade	College
No effects	16	11	8	4
Interaction effects only	2	1	0	0
One main and one or more interaction effects	0	1	0	0
One main effect	2	5	10	11
Two or three main effects	0	1	0	5
Two or three main effects and one or more interaction effects	0	1	2	0
Total	20	20	20	20

inal analyses is not due simply to the low rating consistency among these subjects.

DISCUSSION

The preceding results suggest a number of developmental changes leading to the adulthood capacity to integrate preferences on a number of dimensions into a complex preference judgment of a multidimensional object. Let us consider first the youngest age group, the kindergarten children. There is no evidence to indicate that these subjects based their object ratings on preferences with respect to one or more of the individual dimensions. A number of possible interpretations of their object-rating performance must, therefore, be considered. First, subjects of this age may have been unable to make appropriate use of the object-rating apparatus to express their preferences. In previous studies (Butzin and Anderson 1973; Hendrick, Franz, and Hoving 1975), however, subjects in this age range were found capable of consistent preference judgments regarding two-dimensional stimuli, using a very similar type of rating-scale apparatus.⁶ This would suggest that the difficulty was not with the rating procedure per se.

Another possibility is that kindergarten children may not have had stable preferences with respect to the stimulus dimensions, a possibility that was not assessed by means of repeated measurement of the dimension ratings. Or, if the kindergarten children did have stable preferences with respect to the notebook

dimensions, the relatively large number of different dimensions on which the notebooks varied may have created an information overload that caused these subjects to be unable to process appropriately their dimension preferences in making the object ratings.

If this latter possibility is correct, two alternative subpossibilities must be considered. As a response to this information overload, subjects simply placed the objects randomly. Or, if more information was available than an individual was able to process, s/he may have found a way to reduce that information to an acceptable amount by either systematically simplifying it or ignoring certain of its aspects. This may be a general cognitive processing strategy that becomes especially critical in a developmental context, as has been discussed elsewhere (Angelev and Kuhn 1976). In the present task, a subject may attend to a particular dimension preference in judging a notebook, while ignoring other dimensions on which s/he also has preferences. The dimension that is being attended to, however, may fluctuate after every few, or even every single, notebook that is judged. Such a strategy would result in a placement of notebooks that appeared random, as well as a near-zero consistency across object-rating replications.

EXPERIMENT 2

The object of Experiment 2 was twofold. Because of the indeterminance surrounding interpretation of the kindergarten children's data, we wished first to discount the hypotheses that this age group either lacked stable preferences with respect to the stimulus dimensions or were unable to express these preferences by means of the procedure that was utilized. This objective was accomplished by repeated measurement of dimension preferences among a sample of kindergarten children.

The second objective was to obtain additional evidence on kindergarten children's object-rating performance. It was hypothesized that if the number of dimensions on which the objects varied were reduced, some regularity in the kindergarten children's object ratings should emerge, thus discounting the interpretation that they failed to understand the rating procedure or for some other reason responded randomly.

METHOD

Subjects

Subjects were 12 kindergarten children of the same socioeconomic level and age as those in Experiment 1.

⁶ However, Butzin and Anderson (1973) did not state the exact number of subjects at each age level in their sample, and discarded a few younger subjects due to their "inability to use the response scale."

Procedure

The procedure was identical to that employed in Experiment 1, except for replication of the dimension ratings and the stimuli used in the object-rating task. The notebooks varied on two, rather than four, dimensions, with two levels of each dimension. Each subject, thus, saw four unique notebooks. Six replications of this set were presented, yielding a total of 24 notebooks.

RESULTS

Dimension Ratings

As in Experiment 1, a majority of subjects (92 percent) showed nonneutral preferences on at least three of the four dimensions. Seven of the 12 subjects showed perfect consistency between the two replications of the dimension ratings. Nine discrepancies occurred among the remaining five subjects: one subject showed a discrepancy on three of the four dimensions, two subjects showed a discrepancy on two dimensions, and two subjects showed a discrepancy on only one dimension. There were nine points on the dimension-rating scale and, hence, a discrepancy between replications could be as small as one point or as large as eight points. The average discrepancy was 4.78 points. Thus, kindergarten children showed reasonable reliability in their dimension ratings.

Object Ratings

A consistency index, derived by computing the average correlation coefficient between all replications, was obtained for each subject. Over all subjects, the average was 0.50 (comparable to that of eighth graders in Experiment 1). The index was greater than 0.50 for six subjects, between 0.30 and 0.50 for three subjects, and below 0.30 for three subjects.

Individual analyses of variance comparable to those described in Experiment 1 were carried out. Five subjects showed no effects. Six subjects showed a single main effect. One subject showed two main effects, though the second was much weaker than the first and just reached significance. No subjects showed interaction effects.

The kindergarten children in this study, unlike the subjects in Experiment 1, did not show strong consistency between object ratings and dimension ratings. Of the eight main effects that emerged, three were accompanied by preferences in the dimension ratings that were in a consistent direction (both replications). Three were accompanied by preferences in an inconsistent direction on at least one replication, and two were accompanied by neutral preferences.

DISCUSSION

Experiment 2 indicates that when the number of dimensions is reduced, at least some kindergarten children perform consistent object ratings. The dominant pattern was that of a main effect for one of the two dimensions. Inspection of the trial-by-trial data indicated that subjects tended to settle into a pattern of rating in terms of a single dimension, after a period of instability on the initial six to eight notebooks.

Given that the majority of subjects in Experiment 2 exhibited some consistent strategy, it is likely that many subjects in Experiment 1 also attempted a consistent strategy, and were not simply responding randomly. For some reason, however, the high information load (number of dimensions) prevented subjects from settling into a consistent focus on a single dimension; subjects did so after six to eight trials in Experiment 2, but had not done so after 32 trials in Experiment 1. For the high-information situation, then, the previous interpretation of kindergarten children's object-rating performance remains the most viable one: a subject attends to one particular dimension preference in judging a notebook; the dimension being attended to, however, fluctuates frequently.⁷

From the patterns exhibited by the remaining age groups, as shown in Table 1, it is seen that in the next two age groups the single-main-effect pattern increases in frequency, becoming the predominant pattern by eighth grade. Not until the adult age group is reached, however, do subjects show patterns involving multiple main effects with any significant frequency. In terms of a developmental progression, then, if it is assumed that the youngest subjects tend to use the shifting single-dimension strategy just discussed, it would appear that subsequently the fluctuation in the attended-to dimension disappears; the subject is, thus, making judgments based on a single, constant dimension, and ignoring others on which preferences may exist. Subsequently, this strategy is replaced by one in which subjects take into account two or more dimensions on which they have preferences, and integrate these preferences into a complex judgment, often in terms of a

⁷ In the Piagetian cognitive development literature, there is, in fact, considerable reference to such a mode of stimulus processing in connection with the preoperational mode of reasoning. The most salient example is the classification of multidimensional geometric forms (Inhelder and Piaget 1964). When asked to "put the ones together that go together," a frequent mode of response among preoperational subjects is the creation of a long "train" with each new object added based on a similarity to the immediately preceding one (e.g., shape, color, size), but with a constantly fluctuating criterion of similarity, so that the subject falls far short of the objective of placing the objects in a set of consistent logical classes. Thus, a "shifting single-dimension" strategy has considerable plausibility as an explanation for the performance of the kindergarten children in the present study.

simple linear model, but sometimes with small interaction effects.⁸

It is possible to interpret the progression just described within a Piagetian framework. The decline of the shifting-dimension strategy and the resulting focus on the consistent single dimension can be associated, as discussed, with the decline of the preoperational and development of the concrete operational reasoning structure that takes place during the early school-age years. In addition, there may be some association between the appearance of multiple-dimension strategies and the development of formal operations. These strategies, the present data suggest, begin to appear by early adolescence and are common, but not universal, among adults. Similarly, the existing data within the cognitive development literature suggest that formal operational reasoning strategies emerge at early adolescence, but do not appear or do not become fully consolidated in all individuals, such that some significant proportion of the adult population may continue to reason at less than a formal operational level throughout adulthood (Neimark 1975).⁹

As suggested in the introduction, another theoretical context in which the present results might be interpreted is the information-processing model of Pascual-Leone (1970). In this context, the age differences found in the present study would be interpreted in terms of differences in processing space (*M-space*). The two kinds of explanations, however, are not necessarily contradictory: both cognitive-structural and processing-space factors may impose limitations on subjects' performance.

The processing-space issue brings up the critical question of why adults tended to use a maximum of two or three dimensions in making the object ratings,

when their dimension ratings indicated they frequently had preferences on more than these dimensions. Although cognitive processing limitations of some sort are likely to enter into the explanation for younger subjects, the question cannot be answered definitively for adults until additional parameters are investigated, including the number of dimensions on which the objects vary, their salience to the subject, and the salience of the object class as a whole.¹⁰

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⁸ Related to research on impression formation is the question of the specific manner in which the attribute information is combined. Anderson has marshalled considerable evidence in favor of an averaging model, in which attribute information is averaged with a neutral initial impression to form an overall judgment. The major competing alternative is an adding model, in which attribute information is combined additively (Wyer 1974). In an analysis of variance framework, the finding of simple main effects can be accounted for by either an adding or an averaging model, in which equal weight is given to each item of information. Interaction effects can be explained by an averaging model in which information items are given unequal weights, but not by an unequal-weighted adding model (which would produce only main effects), or they can be explained as true configural effects. The wide differences in explained variance for main effects in the present study suggest that unequal weighting did occur. However, given that true interaction effects occurred only among the adult subjects, an averaging model would have difficulty in accounting for why unequal weighting caused interaction effects for adults, but not for eighth graders (who showed a large number of significant effects, but no interaction effects). An alternative interpretation might be that by adulthood, higher-order configural processing is added to an unequal-weighted adding strategy used at younger age levels.

⁹ A forthcoming study (Capon, Kuhn, and Gurucharri) investigates performance on the present notebook task through middle and late adulthood.

¹⁰ It may be, for example, that although subjects have preferences on a given dimension, the dimension itself is of such limited salience that this preference does not show up in the object ratings. (At issue here is Anderson's distinction between weight and scale value; see Anderson 1970.) This issue also arises in interpretation of the developmental data. Though subjects of each age indicated preferences on the four dimensions to an approximately equivalent extent, the salience of the dimensions themselves (as opposed to preference on the dimension) may conceivably have differed systematically across age groups. This possibility makes it desirable to replicate the developmental data using new dimensions and/or product classes.

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