Information Format and Choice Task Effects in Decision Making

JAMES R. BETTMAN
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The effects of the specific choice task undertaken and the format of information presentation on accuracy, choice time, subjective reactions, and format selection are considered. The notion that the degree of congruence between format and task influences performance is supported for the time data and to some extent for subjective reactions, but not for format selection or accuracy.

Scholars in many disciplines are interested in (a) how to best present information to consumers, (b) how consumers utilize information presented in different formats, and (c) how different types of choice tasks affect consumers’ reactions and performance. This paper presents a series of three studies that examine several issues related to the form of presentation of information and the type of choice task engaged in by consumers, in order to gain insights into how consumers adapt to differing decision problems. After briefly reviewing some relevant research on decision task and format, the specific issues to be examined are considered in more detail.

Research on Choice Tasks

The term choice task is used here to refer to the task the consumer performs in choosing among a set of alternatives. For example, the consumer might be told to choose the alternative from the set presented, that has the lowest price per unit weight (a lexicographic choice task). Wright (1975) has done the major work in examining the impact of choice task on performance. Wright specified four choice tasks for his subjects (averaging with equal weights for all attributes, averaging with differential weights, conjunctive, and lexicographic). He also varied the number of alternatives from which the subject had to choose at three levels: two, six, and ten. Performance was measured by examining the accuracy of the subjects in selecting the “correct” alternative, given the choice task they were to perform, and by examining the subjects’ subjective reactions (e.g., confidence, satisfaction, difficulty). Wright found that accuracy differed over tasks: subjects performed with highest accuracy on the lexicographic task, and decreased accuracy as the number of options increased. There was also a significant interaction, with lexicographic and equal weight averaging more accurate for two options, and all tasks roughly equal in accuracy for ten options. Finally, subjects rated the conjunctive task as being more difficult and as offering more optimizing potential than the linear averaging tasks, contrary to most of the previous theoretical reasoning.

Wright’s work has been discussed here because it shows that specific choice tasks affect consumers’ per-

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1 Each of these tasks specifies how the consumer is to choose an alternative. In averaging with equal weights, the consumer chooses the alternative that has the best average rating over all attributes. For differential weight averaging, different attributes are given different weights, and the alternative with the highest weighted average rating is chosen. In a conjunctive task, each attribute has a cut-off level separating satisfactory and unsatisfactory values for that attribute. An alternative is acceptable only if all its attributes have satisfactory values. Finally, in the lexicographic task, an importance ordering for attributes is specified. Alternatives are compared first on the most important attribute, and if one alternative is best on that attribute, it is chosen. If there are ties for the best rating on this attribute, then the second most important attribute is considered for the tied alternatives, and so on.
Research on Information Format

Several authors have found that the format used to present information affects the processing of that information (Russo and Dosher 1975; van Raaij 1976; Bettman and Kakkar 1977). Three ways of presenting information have been considered: matrix format, brand, and by attribute. In matrix format, a data table is presented, with, for example, each column representing a particular brand and each row a particular attribute. In brand presentation, information on all the attributes of a specific brand is presented together, with, for example, one booklet or sheet for each brand. In attribute presentation, information on each brand for the given attribute (e.g., the prices of all the brands) is presented together, with one booklet or sheet per attribute.

Information presentation format affects the way consumers acquire and process that information. Two typical acquisition and processing strategies used by consumers are brand processing and attribute processing. In brand processing, the consumer examines one brand at a time. That is, the consumer may decide to look at a particular brand, examine several attributes for that brand, then decide to examine several attributes for a second brand, and so on. Other consumers may look at a particular attribute (e.g., price) and then examine values for each of several brands on that one attribute. A second attribute may then be considered, and so on. This strategy is termed attribute processing.

Some studies of information acquisition using matrix presentation formats, which allow subjects to utilize either brand or attribute processing relatively easily, found that subjects tended to use either attribute processing predominantly (Russo and Dosher 1975; Russo and Rosen 1975; Capon and Burke 1977) or brand and attribute processing approximately equally (Bettman and Jacoby 1976). However, other studies showed that different forms of presentation could affect processing (van Raaij 1976; Svenson 1974).

In a direct examination of this impact of format, Bettman and Kakkar (1977) used matrix, brand, and attribute presentation conditions. They found mostly brand processing in the matrix condition, almost exclusively brand processing in the brand presentation condition, and almost exclusively attribute processing in the attribute presentation condition. Thus, consumers appear to process information in ways congruent with the presentation format, processing the information as it is structured, without rearranging it. Strictly speaking, these studies only show how consumers acquire information, since only overt search for information is actually measured. However, there is some suggestive evidence from eye-movement studies (Just and Carpenter 1976) that acquisition and processing patterns are related.

This notion that consumers process information in the form in which it is presented may have important implications for the way in which presentation format and choice task interact. Different choice tasks can be characterized by different forms of processing. For example, a weighted linear task assumes that the consumer evaluates the performance on each attribute of a given alternative, weights these evaluations, and then sums them. This task, is, therefore, characterized by brand processing. A lexicographic task specifies that the consumer first considers the most important attribute and compares the available alternatives on that attribute, choosing the best alternative. If there is a tie, a second attribute is considered, and so forth. The lexicographic task thus uses attribute processing.

Given that different choice tasks can be characterized as using either attribute or brand processing, one can hypothesize about the way in which format and choice task will interact. In particular, performance may be affected by the degree of agreement or congruence between the type of processing encouraged by the presentation format and the type of processing required by the particular task. For example, performance should be best for a lexicographic task if the format is matrix, next best with attribute format, and worst if the format is brand. This follows because the processing required by the lexicographic rule (comparing the alternatives on one or more attributes) is easiest if all the attribute values for each alternative are arranged in a matrix table, next easiest where data for all alternatives are displayed separately for each attribute, and should be hardest when data for all attributes are displayed separately for each alternative, as the subject must search across several displays to compare alternatives on the attribute(s) of interest.

In a similar way, one could argue that the weighted linear task should be easiest with matrix format, next easiest with brand format (as brand processing characterizes this task), and most difficult with attribute format. More detailed specifications of this congruence hypothesis are given after the specific choice tasks used in the study are presented. Wright and Barbour

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The finding of brand processing for the matrix condition may be due to the use of experienced shoppers who would tend to be familiar with various brands and more accustomed to using brand processing.
tasks and formats. Four different tasks, defined in detail later, were utilized: lexicographic, conjunctive, differential weighted adding, and a heuristic version of Tversky's additive difference model (Tversky 1969).\textsuperscript{3} The latter was used because it had been found to be descriptive of subjects' processing in some recent studies (Russo and Dosher 1975; Wright and Barbour 1977). One of these tasks requires attribute processing (lexicographic), two use brand processing (conjunctive and adding), and one requires attribute processing with some integration across attributes (heuristic additive difference).

The tasks were carried out on sets of five hypothetical alternatives. Each alternative was a food product with values on six attributes: unit price, caloric content, and percentages of the recommended daily allowances for protein, vitamin A, vitamin C, and iron. The levels used were typical of those found on breakfast cereal packages.

For the lexicographic task (LEX), subjects were asked to choose the alternative with the highest protein content. If there were ties, they were to choose the alternative with the lowest unit price from among the tied alternatives. The alternatives were constructed so that in half of the sets there would be ties among two of the alternatives on protein content, but never ties on unit price.

For the conjunctive task (CONJ), subjects were given standards that had to be met for each attribute (e.g., unit price of $1.00 per pound or less; protein per serving of 18 percent of the recommended daily allowance or more). An alternative was acceptable if one or more standards were not met. Subjects were asked to list all acceptable alternatives (which could range from none to five).

The additive task (ADD) asked subjects to compute a score for each alternative by taking three times protein plus one times vitamin A plus one times vitamin C. All of these attributes used a percentage of recommended daily allowance scores. Next, the alternative with the highest score was to be selected. The alternatives were selected so that there would be no tied scores.

The heuristic additive difference task (HAD DIF) asked subjects to compare alternatives in pairs. First, the subject compared the first two alternatives, choosing the one that was better on the most attributes (better was defined as lower on price and calories and higher on protein, vitamins A and C, and iron). Then, the chosen alternative was compared to the third alternative, the

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\textsuperscript{3} Tversky's (1969) additive difference model applies to choice between two alternatives. The decision maker is hypothesized to consider differences in the utilities of the two alternatives on each attribute. These differences are then weighted and combined over attributes to yield an overall relative score for the two alternatives. The alternative with the higher relative score is chosen. The heuristic version of this model, discussed here, considers more than two alternatives, however, and does not explicitly consider attribute differences.

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Each subject was assigned to only one cell of the design. The tasks used specify a procedure for the subjects to follow in making a choice. Although one could argue that consumer education efforts might involve specifying rules, such specification may be atypical of consumer choice. However, to test the way in which choice task and format interact in affecting subjects' performance, it is essential to know, unambiguously, the procedure being used by each subject. The current state of the art in identifying the choice rules used by subjects where no specification is made is not encouraging. Thus, it was deemed necessary to specify the procedures to be used, as in Wright's (1975) study.

One might also legitimately ask whether a sample of college students is appropriate for the phenomena studied (Ferber 1977). The use of these students seemed appropriate for several reasons. First, the alternatives were chosen so that the attributes might be reasonably familiar to students (i.e., nutritional information similar to that found on cereal packages). The great majority of these students (90 to 95 percent) lived in their own apartments and thus were buyers of food items. This, of course, does not imply that these students, as consumers, are nutritional experts. Jacoby, Chestnut, and Silberman (1977) argue that both students and other consumers may not fully comprehend nutritional information.

Second, the focus of the study was not on content (which specific brands or attribute levels a subject might prefer) or on a description of the choice rules subjects might use if left to their own devices, but rather on psychological processes in a specific experimental setting. That is, the subjects were given tasks to perform, and the way in which those tasks and the formats used interacted was of interest. Given this focus and the fact that most of the students were food shoppers, the sample seems reasonable.

As several authors have pointed out, however, where prespecified tasks are used and psychological processes are the focus, a major threat to external validity is aptitude-treatment interaction (Cronbach 1975). That is, one must be concerned with whether characteristics of the subjects interact with the treatments. As Cronbach notes, however, characterizing aptitude-treatment interactions is very difficult. In the present study, one major source of such interaction might be intelligence level, and it may not be possible to generalize the results to consumers with levels of intellectual agility different from college students.

Procedure. Subjects were interviewed during class periods, and were self-paced. The twelve versions of the questionnaire instrument (with the various task and format combinations) were randomly arranged before distribution, so that assignment to conditions was random. The questionnaires were in French.

Subjects were told that the study was part of research being done by the Office of Consumer Protection to aid in providing information to consumers. This appeared

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Footnote: This sequential comparison process, called standard revision, has been found in some studies (Svenson 1974; Russo and Rosen 1975).
to obtain high levels of concentration from the subjects. Each subject was then instructed to look at the questionnaire booklet, which contained an example of the particular type of format that would be used in presenting information. The specific task to be undertaken by that subject was then described in detail, and an example given of its application. The subjects were requested to read this description thoroughly and to be sure they understood the task well before starting to make choices. Subjects’ comprehension of the tasks was not measured at this point, leading to potential problems of data interpretation, as discussed later.

After reading the task description, subjects were asked to take their packet of ten sets of alternatives and perform their given task on these ten sets, as accurately and rapidly as possible. For the matrix condition, the ten sets were ten separate sheets of paper with a matrix on each; for the brand condition, there were ten sets of five stapled sheets of paper; and for the attribute condition, there were ten sets of six stapled sheets of paper, as described earlier. Subjects were instructed not to unstack or take apart the sheets describing the alternatives and not to write on these sheets, as they were to be used again. Thus, subjects could not rearrange the sheets to form matrices in this manner. However, subjects could, and some did, write intermediate calculations in the margins of their questionnaires.

Subjects noted their starting time (when they began the first choice) and the time they finished each of the ten choices (in seconds) from a clock at the front of the room.9 After going through all ten sets of alternatives, subjects filled out nine-point scales on task execution difficulty (1 = extremely easy, 9 = extremely difficult), confusion with the task itself (1 = extremely clear, 9 = extremely confusing), confusion with the information presented (1 = extremely clear, 9 = extremely confusing), satisfaction with the way information was presented (1 = not at all satisfied, 9 = extremely satisfied), confidence in the choices made (1 = not at all confident, 9 = extremely confident), and appropriateness of the information for the task (1 = not at all appropriate, 9 = very appropriate).

It should be noted that these subjective state measures were taken after all ten choices were made, not after the first choice or other earlier choices. Thus, these measures might differ from what would have been obtained earlier. The decision to measure after all choices were made was due to concern with potential biases in the subsequent performance measures (time, accuracy) if subjective states were measured more than once or earlier in the experiment. This decision, however, may lead to confounding between reactions to the task-format combination and practice effects. Also, these measures probably are treated by the subjects (e.g., task confusion) as reactions to the total choice experience, not as reactions to the initial presentation of the task, the information, and so on.

Finally, each booklet contained examples of all three types of format, and the subjects were asked to rank the formats in the order they would prefer if they were to perform the task again. Subjects were told the true purpose of the study following completion of the questionnaires.

Hypotheses. The accuracy level for each subject was defined as the percentage of the ten sets of alternatives done correctly, the same accuracy measure used by Wright (1975). In this study accuracy is objective and experimenter-determined, as the prescribed tasks determine the alternative to be chosen from each set. Thus, experimental design is used to gain control over determination of accuracy. Other investigators have used measurement to attempt to control determination of accuracy. For example, Jacoby, Speller, and Kohn (1974a,b) attempt to measure subjectively optimal choices by determining the distance of each alternative from the subject’s ideal brand. Given the design of the current study, objective, experimenter-determined accuracy is most appropriate. However, in other cases, attempting to measure subjective accuracy may be desirable (Jacoby 1977; Wilkie 1974).

Finally, it should be noted that accuracy may change over the course of the experiment. That is, subjects may use the first few choices to familiarize themselves with the task. Thus, accuracy may improve with practice. Such potential practice effects are considered later.

There were, therefore, four types of data available for analysis: an accuracy measure, the time taken to make the choices, six measures of subjective reactions, and format choices. Three basic types of questions could then be considered:

1. How do subjects adapt to the task-format combinations?
2. How do subjects subjectively react to the task-format combination?
3. How is format choice affected by the task and/or format?

Adaptation to the task and format combination given to subjects should depend on the degree of congruence between the task and format, as argued previously. In particular, the lexicographic task should be easiest with matrix format (since the search for the appropriate attribute should be easier if all attributes are in one table), next easiest with attribute format, and most difficult with brand format. The conjunctive and adding tasks should be easiest with matrix, next easiest with brand, and most difficult with attribute. The heuristic additive

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9 This use of subjects’ self-reports of starting and finishing times could potentially be subject to biases. Subjects might round off differently, report that they took less time than they actually did to show they can perform quickly, report that they took longer than they actually did to show they devoted effort to the task, and so on. While such biases may be present, it is not obvious. For example, there are two equally plausible opposing demand characteristics and evaluation apprehension hypotheses noted above. In any case, there is no reason to suspect that such biases, if present, are systematically linked to various treatments.
The difference task seems to require matrix format for ease of processing, as both within-attribute and across-attribute operations are needed. It is not clear whether the attribute or brand format should be next easiest for this task.

These hypothesized orderings should show up in the performance of subjects if the congruence hypothesis is valid. However, there are two ways that performance might be affected: by accuracy and by time. Subjects can make tradeoffs of time and accuracy. Thus, one might find that subjects take a given amount of time and accuracy varies over task and format combinations; or that subjects maintain the highest levels of accuracy they can, but take more time for task-format combinations that are more difficult. We therefore hypothesize that performance varies with the degree of congruence between task and format, and that this effect may appear in either the accuracy or choice time data depending on how subjects adapt.

The subjective-state variable reactions should also vary with degree of congruence. In particular, subjects with more congruence might be expected to be more satisfied, feel less difficulty, and so on.

One might also hypothesize that the format selected would vary with the task faced by subjects, in line with the congruence hypothesis. For example, in the lexicographic condition, subjects should select matrix most often, attribute next, and brand least. However, the format selected might also vary with what the subject actually received.

The data on time, accuracy, and subjective-state variables were analyzed by analysis of variance. The format choice data were examined using contingency tables and chi-squares.

Results

Adaptation to the Task. Treatment means for Study I are shown in Table 1, with the analysis of variance results summarized in Table 2. The accuracy results show an effect due to the task ($p < 0.001$), with no format or interaction effects. The lexicographic and adding tasks were performed most accurately, with the conjunctive and heuristic additive difference tasks performed less accurately. Perhaps the most surprising aspect of the accuracy data is the poor performance of subjects in the matrix-HAD DIF cell. There is no evidence in this study to indicate whether these accuracy differences reflect difficulty in understanding the tasks, difficulty in executing them or both, although subjects were told to be sure they understood the tasks before starting.

There are no obvious impacts of task-format congruence on accuracy. However, subjects could adapt by being as accurate as possible, given the task, and taking more time when there was less congruence. The

<table>
<thead>
<tr>
<th>Choice task/</th>
<th>Percent correct$^a$</th>
<th>Time taken$^b$</th>
<th>Task difficulty</th>
<th>Task confusion</th>
<th>Information confusion</th>
<th>Satisfaction</th>
<th>Confidence</th>
<th>Appropriateness of information</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEX</td>
<td>.86 (.52)</td>
<td>370.1</td>
<td>2.8</td>
<td>3.3</td>
<td>3.7</td>
<td>5.9</td>
<td>7.1</td>
<td>6.3</td>
</tr>
<tr>
<td>Attribute</td>
<td>.82 (.17)</td>
<td>350.9</td>
<td>3.9</td>
<td>4.2</td>
<td>4.5</td>
<td>4.5</td>
<td>6.8</td>
<td>5.5</td>
</tr>
<tr>
<td>Brand</td>
<td>.82 (.16)</td>
<td>448.1</td>
<td>2.3</td>
<td>2.3</td>
<td>3.0</td>
<td>6.8</td>
<td>7.6</td>
<td>6.7</td>
</tr>
<tr>
<td>Matrix</td>
<td>.92 (.19)</td>
<td>321.5</td>
<td>2.4</td>
<td>3.2</td>
<td>3.6</td>
<td>6.4</td>
<td>6.9</td>
<td>6.6</td>
</tr>
<tr>
<td>CONJ</td>
<td>.69 (.40)</td>
<td>650.3</td>
<td>3.3</td>
<td>4.6</td>
<td>4.6</td>
<td>5.5</td>
<td>6.3</td>
<td>5.8</td>
</tr>
<tr>
<td>Attribute</td>
<td>.68 (.14)</td>
<td>796.5</td>
<td>3.6</td>
<td>5.1</td>
<td>4.5</td>
<td>4.9</td>
<td>6.2</td>
<td>5.5</td>
</tr>
<tr>
<td>Brand</td>
<td>.68 (.16)</td>
<td>572.0</td>
<td>3.4</td>
<td>4.1</td>
<td>4.8</td>
<td>5.9</td>
<td>6.3</td>
<td>5.9</td>
</tr>
<tr>
<td>Matrix</td>
<td>.73 (.10)</td>
<td>570.7</td>
<td>2.7</td>
<td>4.4</td>
<td>4.3</td>
<td>5.9</td>
<td>6.5</td>
<td>6.0</td>
</tr>
<tr>
<td>ADD</td>
<td>.85 (.44)</td>
<td>717.9</td>
<td>3.4</td>
<td>3.9</td>
<td>4.6</td>
<td>5.1</td>
<td>6.4</td>
<td>4.3</td>
</tr>
<tr>
<td>Attribute</td>
<td>.86 (.17)</td>
<td>777.4</td>
<td>3.3</td>
<td>3.8</td>
<td>4.9</td>
<td>5.1</td>
<td>6.3</td>
<td>4.4</td>
</tr>
<tr>
<td>Brand</td>
<td>.86 (.14)</td>
<td>771.5</td>
<td>2.9</td>
<td>2.9</td>
<td>4.9</td>
<td>5.4</td>
<td>7.3</td>
<td>4.5</td>
</tr>
<tr>
<td>Matrix</td>
<td>.82 (.13)</td>
<td>582.5</td>
<td>4.1</td>
<td>5.0</td>
<td>6.2</td>
<td>4.9</td>
<td>5.5</td>
<td>4.2</td>
</tr>
<tr>
<td>HAD DIF</td>
<td>.67 (.44)</td>
<td>909.0</td>
<td>4.0</td>
<td>4.0</td>
<td>4.1</td>
<td>5.3</td>
<td>5.6</td>
<td>5.7</td>
</tr>
<tr>
<td>Attribute</td>
<td>.59 (.18)</td>
<td>1098.2</td>
<td>3.9</td>
<td>3.8</td>
<td>3.8</td>
<td>5.2</td>
<td>5.3</td>
<td>5.0</td>
</tr>
<tr>
<td>Brand</td>
<td>.81 (.13)</td>
<td>910.8</td>
<td>4.5</td>
<td>3.5</td>
<td>4.6</td>
<td>5.6</td>
<td>6.9</td>
<td>6.5</td>
</tr>
<tr>
<td>Matrix</td>
<td>.64 (.13)</td>
<td>645.3</td>
<td>4.6</td>
<td>3.9</td>
<td>3.9</td>
<td>5.1</td>
<td>5.4</td>
<td>5.8</td>
</tr>
<tr>
<td>Combined</td>
<td>.74 (.66)</td>
<td>759.1</td>
<td>3.6</td>
<td>4.2</td>
<td>4.4</td>
<td>4.9</td>
<td>6.0</td>
<td>5.1</td>
</tr>
<tr>
<td>Attribute</td>
<td>.79 (.59)</td>
<td>660.4</td>
<td>3.2</td>
<td>3.2</td>
<td>3.8</td>
<td>5.9</td>
<td>7.0</td>
<td>6.2</td>
</tr>
<tr>
<td>Brand</td>
<td>.73 (.55)</td>
<td>505.0</td>
<td>3.3</td>
<td>4.2</td>
<td>4.4</td>
<td>5.6</td>
<td>6.1</td>
<td>5.8</td>
</tr>
<tr>
<td>Total</td>
<td>.77 (180)</td>
<td>649.1</td>
<td>3.4</td>
<td>3.9</td>
<td>4.2</td>
<td>5.5</td>
<td>6.4</td>
<td>5.6</td>
</tr>
</tbody>
</table>

$^a$Number in parenthesis represents sample sizes for each cell. These were the same for all variables except Appropriateness, which had missing data for one subject in the ADD-Attribute condition, ten subjects in the ADD-Brand condition, and one subject in the HAD DIF-Brand condition.

$^b$Total time (in seconds) for all ten choices.

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TABLE 2
ANALYSIS OF VARIANCE RESULTS FOR STUDY I: F VALUES*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Format</th>
<th>Task</th>
<th>Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent correct</td>
<td>0.65</td>
<td>6.89</td>
<td>1.14</td>
</tr>
<tr>
<td>Time taken</td>
<td>6.68†</td>
<td>20.60†</td>
<td>1.59</td>
</tr>
<tr>
<td>Task difficulty</td>
<td>29</td>
<td>1.68</td>
<td>1.38</td>
</tr>
<tr>
<td>Task confusion</td>
<td>3.68‡</td>
<td>2.41‡</td>
<td>0.86</td>
</tr>
<tr>
<td>Information confusion</td>
<td>1.45</td>
<td>1.51</td>
<td>2.23‡</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>3.48‡</td>
<td>0.91</td>
<td>1.01</td>
</tr>
<tr>
<td>Confidence</td>
<td>3.39‡</td>
<td>3.19‡</td>
<td>0.76</td>
</tr>
<tr>
<td>Appropriateness of information</td>
<td>2.17</td>
<td>4.18‡</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Degrees of freedom are (3, 166) for Format, (2, 166) for Task, and (6, 166) for the interaction in all cases except Appropriateness, where the degrees of freedom for the denominator are 156.

*p < 0.01
†p < 0.05
‡p < 0.10

Hypothesized pattern does occur almost perfectly in the time data, where there are significant effects due to task (p < 0.001) and format (p < 0.002). In general, LEX took the least time, followed by CONJ, ADD, and HAD DIF; and matrix formats were characterized by lower times, followed by brand and attribute. The orderings for time are (from least to most time taken): matrix, brand for LEX; matrix, brand, attribute for CONJ; matrix, brand, attribute for ADD; and matrix, brand, attribute for HAD DIF. These orderings were predicted under the congruence notion (although the ordering for HAD DIF was not firmly predicted); clearly the times are very close in many cases, and the differences are not statistically reliable. The overall pattern, however, supports the congruence notion.

Subjective Reactions. Overall, brand format seems to be least confusing and most positively evaluated, with the matrix and attribute formats seen as more confusing and less positive. Also, LEX seems least confusing and most positively evaluated of the tasks, with the ordering for the other tasks not clear. As shown in Table 2, there are no significant effects for task difficulty; format and task effects for task confusion; no significant main effects, but an interaction for information confusion; a format effect for satisfaction; format and task effects for confidence; and a task effect for appropriateness. These subjective reaction results do not agree with the time results or the congruence hypothesis for format. Rather, brand format was reacted to more favorably, perhaps due to subjects' experience with the preponderance of brand formats in the real world. The results for task seem to agree somewhat more, with LEX being viewed more positively. Even if practice effects influenced these measures, as discussed earlier, it is difficult to understand why the matrix format is rated less favorably.

Format Choices. The format choices for Study I were also examined. Matrix was chosen most often (80 percent), with brand chosen 12 percent and attribute 8 percent. Format chosen was not related to the task or to the format actually received.

The major feature is the overwhelming preponderance of matrix format choices, even though the subjective reaction variables were not favorable toward matrix. Relative format preferences after eliminating the matrix format were 56 percent for brand and 44 percent for attribute format. There was still no relationship to task.

Discussion of Study I

The major findings of Study I are the following: Accuracy varied over tasks, with no apparent effect of task/format congruence. Choice time varied over both tasks and formats, with clear support for the congruence notion in this data. The subjective reaction results showed that the LEX task and brand format were viewed most positively, with matrix format viewed unexpectedly negative. Finally, there was no relationship between the task performed and format choices.

The hypothesis that subjects may adapt to tasks in different ways is borne out in Study I, as subjects did not appear to adapt in their format choices or by varying

As noted earlier, these findings might be subject to biases due to inadequate task comprehension by subjects or due to practice effects. Both of these potential biases were examined using additional data analyses. To deal with the problem of task comprehension, the data for Study I were reanalyzed after those subjects getting fewer than half of the ten choices correct were eliminated, leaving 151 subjects. More subjects were eliminated from the CONJ task (15) than for the other tasks. Accuracy was roughly 90 percent for LEX, CONJ, and ADD, with HAD DIF at 74 percent. These accuracy findings again showed no evidence of task-format congruence. The time-taken results were similar to those for the entire sample, with effects due to format and task. There was still support for the congruence hypothesis, with the only difference in results being an ordering from least to most time taken for CONJ of brand, matrix, and attribute. The subjective reaction results remained essentially the same as in the entire sample.

The second potential problem was practice effects. Analyses showed that the last five choices were more accurate and took less time than the first five. Hence, the data were reanalyzed by using only the last five choices for each subject. Again, the results were similar to those for the entire sample, with the congruence notion supported in the time, but not in the accuracy data. Finally, if one examines only the last five choices for the most accurate subjects, the pattern of results remains essentially unchanged. The congruence results for the choice time data, therefore, seem quite robust even after potential problems are taken into account. This lends more confidence to the pattern of results obtained. A more detailed description of these additional analyses is available from James R. Bettman.

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accuracy, but rather by varying time. There were no effects of the congruence between task and format on accuracy measures, but the hypothesized pattern emerged in the time data.

Why was there no congruence effect on accuracy, given the strong format effects shown in prior studies (e.g., Bettman and Kakkar 1977)? First, the format manipulation used in the present study was not as strong as that used by Bettman and Kakkar, where separate booklets placed along a long table were used in the brand and attribute conditions. In the present study, subjects could flip through the pages rapidly, write on the questionnaires, and even redefine some tasks (e.g., the CONJ task), as noted previously. Second, as stressed earlier, subjects could adjust the time taken. Thus, congruence effects might show up on accuracy if time pressure were applied.

Some interesting comparisons can be made between the accuracy results of Study I and those of Wright (1975). In making these comparisons, Wright’s six-option case was used, as that is closest to the number of alternatives used in Study I. There is remarkably good agreement on overall accuracy for LEX (0.86, Study I: 0.83, Wright) and CONJ (0.69, Study I: 0.68, Wright), given differences in procedure and subjects. The other tasks are not the same as Wright’s, although ADD and Wright’s differential weight averages are related. These latter tasks do not agree as well (0.85, Study I: 0.54, Wright), which may be due to the fact that the data Wright gave to subjects were not numerical and had to be transformed by them, making the task more difficult.

The subjective reaction measures do not agree with the time data, but seem more in line with the accuracy measures. The matrix format, interestingly, is not viewed as favorably as the format choices imply. Instead, brand format is reacted to most positively. Perhaps subjects are more familiar with brand formats and less with matrix formats, as most real-world product information is presented by brand. Comparing the results of the subjective measures to those of Wright (1975) for confusion, LEX is seen as less confusing than CONJ in both studies. Wright’s differential weight averaging seems to be rated abnormally low (less confusing than LEX). ADD is rated between LEX and CONJ in the present study. For confidence, LEX was rated highest in both studies, with Study I showing CONJ and ADD about equal, and Wright finding CONJ rated higher than his averaging task. Thus, there is a reasonable amount of similarity, with the differences probably due to different task definitions.

Finally, the format results show no matching of format to the task. Such matching may only occur over time, if at all. However, subjects may adapt the rule they use to the format given, in cases where they are free to use whatever rule they wish (Bettman and Kakkar 1977).

Thus, Study I provided support for the congruence hypothesis in the choice time data, but not in the accuracy, subjective measure, or format data. This again points out that there are many avenues for adaptation, only some of which will be utilized.

**STUDY II**

In Study I subjects were given a particular format and task to perform, and asked to make choices. Subjects could give their preferences for a format after they had made their choices, but not before. One might argue that there was no effect of task on format because subjects had already completed the choice task, and hence there was no real incentive to adapt format to the task. Therefore, Study II was designed to examine whether allowing subjects to choose a format after their task had been described to them, but before making a choice, would yield the hypothesized congruence effect. It was also of some interest to simply examine the pattern of choices, as previous studies presented a given format to subjects, rather than allowing them to choose.

**Method**

**Subjects.** The subjects were a different set of 180 French-speaking business majors, none of whom were the same individuals used in Study I.

**Tasks and Formats.** As the focus in Study II was on format selection and not so much on the tasks to be undertaken, different and somewhat simpler tasks were used: lexicographic (LEX), brand rating (RATING) and preference (PREF). One of these tasks is characterized by attribute processing (lexicographic), one by brand processing (brand rating), and one is indeterminate (preference). The latter task was included to see if format choices in an unstructured preference task might shed light on the kinds of rules being used by subjects. These tasks were also carried out on sets of five hypothetical alternatives, each described by six attributes, as in Study I.

The LEX task was the same as in Study I. The RATING task required the subject to give an overall rating for each of the five alternatives on a nine-point scale (1 = don’t like at all, 9 = like very much). Finally, in the preference task the subject was simply asked to choose the most-preferred alternative. The same three formats used in Study I—matrix, brand, and attribute—were available in Study II.

**Procedure.** Questionnaires were again administered during class periods and were self-paced. The same explanation as in Study I was used. Questionnaire booklets contained examples of each of the three different kinds of format. The order of presentation of the three formats (six different orders) was randomized. After these examples, each subject’s booklet contained

*There were no effects due to order, so the data were collapsed over order for the remaining analyses.*
a description of the task to be performed (one of the three just described). The questionnaires were randomized before distribution. Subjects were told to read the description carefully and to be sure to understand the task well before making a choice; task comprehension was not directly measured at this point.

Subjects were then asked to rank the three formats in order of their preference for the given choice task. They then raised their hands, and assistants came to their desks and handed them information in a particular format. As the matrix format had been so overwhelmingly chosen in Study I, and it was desired that subjects actually use a range of formats in Study II, the assistants randomly gave the subjects either their first choice (96 of 180, or 53 percent) or their second choice (84 of 180, or 47 percent) of format. Each subject then made one “choice” according to his or her assigned task, and timed that task (in seconds) using a clock in the front of the room. Subjects then filled out nine-point scales for satisfaction, task difficulty, confusion with the task, confidence, and appropriateness, as in Study I. Finally, subjects were asked what format they would desire if they repeated the task, and were informed of the true purpose of the study.

**Hypotheses.** The congruence hypothesis can be examined again, as in Study I. Although the major focus is on the format choices, data related to adaptation to the task and subjective reactions are also available.

There were no accuracy measures in Study II, nor was Study II designed to directly examine adaptation to the task, as was Study I. However, the time data can be examined in an ad hoc fashion to see if the Study I results are replicated. Subjects can be placed into a 3 × 3 table based upon the particular task-format combination used, and the time data can be examined for congruence within this 3 × 3 framework. In particular, for LEX, matrix should be fastest, then attribute, then brand. For RATING, matrix should also be fastest, followed by brand and then attribute. Finally, the ordering for PREF is not predictable a priori. Again, let us emphasize that this is an ad hoc analysis, examining only indirectly what Study I examined directly. The subjective reaction measures should also vary with degree of congruence, as hypothesized in Study I.

The major focus of Study II is on the format choices. The congruence hypothesis would predict that the task to be engaged in will affect the format chosen. That is, a task characterized by brand processing (RATING) should lead to matrix and brand format choices, whereas a task characterized by attribute processing (LEX) should lead to matrix and attribute format choices. The PREF task cannot be predicted. The manipulation on whether the first or second choice of format was received also allows comparison of the choice of format after the task, with both the choice prior to the task and the format actually received. The format data were analyzed using contingency tables and chi squares.

**Results**

**Adaptation to the Task.** Treatment means for Study II are presented in Table 3, and the 3 × 3 analysis of variance results are summarized in Table 4. The time results show a pattern of adaptation as predicted by the congruence hypothesis and as found in Study I. There are significant effects due to task (p < 0.001) and format (p < 0.005), with the interaction approaching significance (r = 0.077). In general, LEX took the least time, followed by PREF and RATING, and matrix formats took the least time, followed by brand and attribute. Note also that the orderings for time within task are (from least to most time taken) matrix, attribute, brand for LEX; matrix, brand, attribute for RATING; and matrix, brand, attribute for PREF. These are consistent with the congruence hypothesis for LEX and RATING, while no prior prediction was made for PREF. Thus, the pattern supports the congruence notion.

**Subjective Reactions.** The matrix format seems to be least confusing and most positively evaluated, with attribute second and brand third. Also, LEX is least difficult, least confusing, and most positively rated, with RATING and PREF about equal. As shown in Table 4, there is a task effect and an interaction for task difficulty. There are also effects due to format and task for task confusion: format and task for satisfaction: format, task, and an interaction for confidence; and format for appropriateness. The subjective reaction results seem to agree with the congruence notion and the time results more closely than those in Study I. For example, the rankings within tasks are relatively consistent across variables (descending from more “positive” to less): matrix, attribute, brand for LEX; matrix, brand, attribute for RATING; and matrix first with brand and attribute not consistent for PREF. Thus, Study II provides evidence for congruence in both the time and subjective reaction data.

**Format Choices.** The format choices for Study II closely resembled those in Study I. Matrix was chosen predominantly both prior to and after task completion (77 percent in both cases), with brand second (18 percent prior, 14 percent after) and attribute third (5 percent prior, 9 percent after). Again the format

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9Format received and granting of first choice are not independent. Thus, any effect due to format in the 3 × 3 table may be really due to whether the first choice was received. To examine this more closely, the subjects were arrayed in a 3 × 3 × 2 table (task by format by whether first choice was received), and ANOVAs were run on the time and subjective state variables. In every case where there was an effect due to format in the 3 × 3, there was one in the 3 × 3 × 2. Thus, no “spurious” effects due to format were noted. The only significant effect due to whether the first choice was received in the 3 × 3 × 2 analyses was on satisfaction (which was lower if the first choice was not received).
TABLE 3
TREATMENT MEANS FOR STUDY II

<table>
<thead>
<tr>
<th>Choice task/ format</th>
<th>Time taken</th>
<th>Task difficulty</th>
<th>Task confusion</th>
<th>Satisfaction</th>
<th>Confidence</th>
<th>Appropriateness of information</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEX</td>
<td>96.7(64)</td>
<td>3.2</td>
<td>3.9</td>
<td>6.1</td>
<td>6.8</td>
<td>5.8</td>
</tr>
<tr>
<td>Attribute</td>
<td>91.1(19)</td>
<td>2.9</td>
<td>3.6</td>
<td>5.6</td>
<td>6.9</td>
<td>5.9</td>
</tr>
<tr>
<td>Brand</td>
<td>114.8(21)</td>
<td>4.4</td>
<td>4.9</td>
<td>4.4</td>
<td>5.9</td>
<td>5.1</td>
</tr>
<tr>
<td>Matrix</td>
<td>85.4(24)</td>
<td>2.4</td>
<td>3.2</td>
<td>7.9</td>
<td>7.4</td>
<td>6.3</td>
</tr>
<tr>
<td>RATING</td>
<td>218.6(59)</td>
<td>4.8</td>
<td>4.9</td>
<td>5.9</td>
<td>5.1</td>
<td>5.3</td>
</tr>
<tr>
<td>Attribute</td>
<td>315.6(9)</td>
<td>5.9</td>
<td>6.6</td>
<td>4.2</td>
<td>3.1</td>
<td>3.6</td>
</tr>
<tr>
<td>Brand</td>
<td>237.5(20)</td>
<td>4.6</td>
<td>5.2</td>
<td>4.4</td>
<td>5.0</td>
<td>4.3</td>
</tr>
<tr>
<td>Matrix</td>
<td>177.0(30)</td>
<td>4.7</td>
<td>4.2</td>
<td>7.3</td>
<td>5.8</td>
<td>6.5</td>
</tr>
<tr>
<td>PREF</td>
<td>162.8(57)</td>
<td>4.5</td>
<td>5.0</td>
<td>5.5</td>
<td>6.0</td>
<td>5.2</td>
</tr>
<tr>
<td>Attribute</td>
<td>207.1(17)</td>
<td>4.7</td>
<td>5.5</td>
<td>4.1</td>
<td>6.3</td>
<td>3.9</td>
</tr>
<tr>
<td>Brand</td>
<td>150.0(16)</td>
<td>4.1</td>
<td>5.6</td>
<td>4.6</td>
<td>5.4</td>
<td>4.6</td>
</tr>
<tr>
<td>Matrix</td>
<td>140.0(24)</td>
<td>4.5</td>
<td>4.2</td>
<td>7.0</td>
<td>6.2</td>
<td>6.5</td>
</tr>
<tr>
<td>Combined</td>
<td>179.8(45)</td>
<td>4.2</td>
<td>4.9</td>
<td>4.8</td>
<td>5.9</td>
<td>4.7</td>
</tr>
<tr>
<td>Attribute</td>
<td>167.7(57)</td>
<td>4.4</td>
<td>5.2</td>
<td>4.4</td>
<td>5.4</td>
<td>4.7</td>
</tr>
<tr>
<td>Brand</td>
<td>137.4(78)</td>
<td>3.9</td>
<td>3.9</td>
<td>7.4</td>
<td>6.4</td>
<td>6.4</td>
</tr>
<tr>
<td>Matrix</td>
<td>140.0(24)</td>
<td>4.2</td>
<td>4.2</td>
<td>7.0</td>
<td>6.2</td>
<td>6.5</td>
</tr>
<tr>
<td>Total</td>
<td>157.6(180)</td>
<td>4.1</td>
<td>4.6</td>
<td>5.8</td>
<td>6.0</td>
<td>5.5</td>
</tr>
</tbody>
</table>

* Number in parenthesis represents sample sizes for each cell. These were the same for all variables.

Discussion of Study II

There are two major conclusions from Study II. First, both the time and subjective reaction measures support

STUDY III

In Study II, the predominance of matrix choices may have masked any effect of task on format choice. Hence, Study III replicated Study II with the matrix format eliminated entirely. Only attribute and brand formats were available.

Method

Subjects. Subjects were a third set of 113 French-speaking business majors, taken from the same population described earlier.

Tasks and Formats. The tasks were the same as in Study II, but only two formats were used, brand and attribute.

Procedure. The procedure was essentially the same as for Study II. Subjects had only two formats from which to choose, and subjects were again given either their first (62 percent) or second (38 percent) choice.

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Hypotheses. The congruence hypotheses considered in Studies I and II were again examined for the adaptation, subjective reaction, and format data. The analyses were similar to those in Study II, with the main focus on the format results.\textsuperscript{10}

Results

Adaptation to the Task. The time results (not presented here) show a task effect ($p < 0.02$), but no format effect. There is, thus, no support for the congruence hypothesis; even the direction of the time results within tasks is opposite to that predicted. In general, LEX took least time, then RATING, and then PREF, as in Study II.

Subjective Reactions. In general, there are very few effects of task or format on the subjective reaction measures. There are no format effects and only one task effect on task difficulty. LEX is least difficult, followed by PREF and RATING.

Format Choices. Brand format was chosen most often, both prior to and after the task (62 percent prior and 59 percent after). Despite removing the matrix choice, there is still no relationship between format choice and task either prior to or after the task. The format chosen after the task is more strongly related to the prior choice than to the format actually received.

Discussion of Study III

The format choice results again show no adaptation to the task. Thus, the findings of Study II were not due to the preponderance of matrix choices. Neither the adaptation results nor the subjective reactions show any impact of format.

GENERAL DISCUSSION

Two major topics are treated in this general discussion of the three studies: a comparison of the results across the three studies and a discussion of the implications of the results.

Comparison of the Three Studies

Adaptation to the Task. Subjects adapted by varying the time taken in accordance with the congruence hypothesis in both Studies I and II. The hypothesis was not supported for Study III, perhaps because there was too little variation in the formats.\textsuperscript{11} Thus, there is some evidence that one way consumers adapt to choice tasks is by varying the time they devote, keeping accuracy as high as possible (see also Chestnut and Jacoby 1976). Time pressure might, therefore, lead to adaptation by degrading accuracy. In a setting where there is less encouragement for rationality than in the present studies (with the cover story about consumer policy), adaptation might also be made by trading accuracy for time.

The time results are also interesting in that the average times for the one LEX choice in Studies II and III (96.7 and 159.2 seconds) are longer than what one would expect based on the average total time for 10 LEX choices from Study I (370.1 seconds). This may be due to two factors. First, there was increased speed over the course of the ten choices due to learning. The average time for the first choice was 109.0 seconds across tasks and formats, and 47.6 seconds for the tenth choice; for the LEX choice, the average time for the first choice was 64.4 seconds. Second, Chestnut and Jacoby (1976) have shown that subjects spend less time on any one decision as the number of choices to be made increases, and argue that subjects choose to do this because of the increased time "costs" of search when more decisions are to be made.

Subjective Reactions. The orderings on the subjective reaction variables tend to differ across studies. This may be due to slight variations in the studies or poor measures, among other reasons. The poor measure explanation is less credible than it might be, because the results tend to be consistent within each study. The main anomaly in the subjective reactions data is the poor showing of the matrix format in Study I. Otherwise, matrix is seen most favorably, and LEX is seen as the easiest task.

Format Choices. There is consistently no impact of task on format choice across the studies. The percentage of choices for each format is also close across studies.

Overall Conclusions. The three studies offer mixed support for the format-task congruence hypothesis. There is reasonably good evidence that subjects

\textsuperscript{10}The ad hoc analyses of the time and subjective reaction variables in Study II were also used in Study III. However, due to the fact that the two formats used were relatively close in the time spent and reactions to them in Study II, with the matrix format being different, it was anticipated that more effects of whether the subjects got their first choice would be found. This was true, with effects found for time, satisfaction, task confusion, and appropriateness (less time, more satisfaction, less confusion, and more appropriate if the first choice was received). There were no effects due to format in either the $3 \times 3 \times 2$ (task by format by whether first choice was received) or $3 \times 2$ (task by format) analyses for any variable.

\textsuperscript{11}Another possible reason is that such adaptation may require learning to develop. Study I used ten choices, and Studies II and III used one. If the data for the first choice alone in Study I are considered, the hypothesized congruence effects do not occur, possibly because subjects are using the first few trials as practice, as noted earlier. This finding may not be directly applicable to Studies II and III, as the tasks used and the average time taken per decision differed. However, adaptation effects may, in general, appear more consistently if opportunities for learning are provided. Multiple choices should probably be utilized for studying such adaptation effects in future research.
adapted by varying time taken in accordance with what would be predicted by format-task congruence. There was limited support from the subjective reaction variables, and none from the format choices. Subjects may vary time and, perhaps, the way they feel, but there is no evidence that they consider choosing specific formats. This may not be too surprising because consumers do not normally have a choice of formats, and, therefore, may not even consider such choices. However, if a choice of formats was available, consumers might learn over time to adapt format to task. Providing such opportunities to learn may be necessary for observing adaptation effects.

Implications

Implications for three areas are considered: measuring reactions to choice tasks, use of time as a measure in studying choice, and format implications.

Reactions to Choice Tasks. According to the results presented here, lexicographic tasks are easy, and the heuristic additive difference and conjunctive and adding tasks are somewhat more difficult. However, several authors have found heuristic additive difference rules being used (Russo and Dosher 1975; Wright and Barbour 1977), and have argued that subjects use them because they are easy. The resolution of this seeming contradiction may be that in giving subjects a task, the hardest part of implementing a particular rule may be "given" to the subject. The subject is told which attribute to consider most important (LEX), what the cutoffs or standards are (CONJ), and so on. These may be the most difficult aspects of specifying such rules. Therefore, rules where only ordinal properties are used, like the heuristic additive difference (is A or B better on more attributes?), may be easier to use in practice, as weights and cutoffs need not be developed. Also, conjunctive rules may be easy if used only to eliminate alternatives with obnoxious negatives. Thus, one must be very cautious in making statements about relative task difficulty when some of the hardest parts of a task to determine in actual practice are being given already completed to the subjects.12

Time as a Measure. Choice time was an extremely useful measure in these studies. Without a measure of choice time, there would have been no indication of how consumers were adapting to the degree of task-format congruence. Consumers can adapt to tasks in many ways, only two of which are time and accuracy. It may be very useful to consider further use of choice times in studying consumer choice processes (Johnson and Russo 1978; Wright 1977).

Format Implications. There was no effect of task on choice of format, possibly because consumers do not have to make many format choices in their everyday decision making. However, there were effects of task-format congruence on choice time. This implies that the issue of format may still be important for policy because formats that require longer times for a given task and level of accuracy may result in lower accuracy if time pressure is experienced. In the three studies presented, matrix information was overwhelmingly chosen and took less time to process. Thus, matrix formats may be more conducive to information processing than other formats (Bettman 1975). However, matrix formats are not often available in the real world, except as tables in publications such as Consumer Reports. Several authors (Russo, Krieser, and Miyashita 1975; Wilkie 1975; Bettman 1975) have argued that matrix presentations should be encouraged by policy makers. The present results add empirical support for these arguments.

REFERENCES


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