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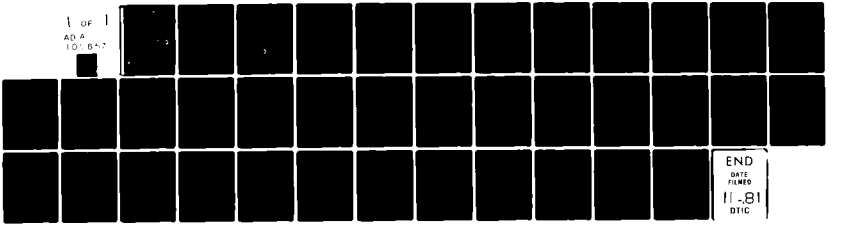

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Text-Based Decisions: Changes in the Availability of Facts Over Time

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Real life decisions and judgments are typically made partly on the basis of memory for information presented at an earlier time but no longer available in memory. For example, while it may be of no special significance, a deeply processed fact could have a greater influence on delayed judgment than another poorly processed fact. In this experiment, certain facts were distinguished during incidental encoding either by repetition or by presentation in concrete (as opposed to abstract) form. These facts were shown to have a disproportionate impact on later judgments in three domains (stock market, medical

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diagnosis and criminal trial). This judgmental bias appeared to be directly connected to better memory for concrete or repeated facts and independent of any difference in weight or importance of retained facts. The results of this study are interpreted in terms of a theoretical control schema that operates on input (text) so as to fill pre-established slots with decision-specific information. Repetitions and concrete statements provide representations that are more available for retrieval at time of judgment.

ABSTRACT

Real life decisions and judgments are typically made partly on the basis of memory for information presented at an earlier time but no longer available for examination. Variables affecting the encoding of information can have a significant effect on later judgment by making certain facts more or less accessible or available in memory. For example, while it may be of no special significance, a deeply processed fact could have a greater influence on delayed judgment than anotner poorly processed fact. In this experiment, certain facts were distinguished during incidental encoding either by repetition or by presentation in concrete (as opposed to abstract) form. These facts were shown to have a disproportionate impact on later judgments in three domains (stock market, medical diagnosis and criminal trial). This judgmental bias appeared to be directly connected to better memory for concrete or repeated facts and independent of any difference in weight or importance of retained facts. The results of this study are interpreted in terms of a theoretical control schema that operates on input (text) so as to fill pre-established slots with decision-specific information. Repetitions and concrete statements provide representations that are more available for retrieval at time of judgment.

Text-based Decisions: Changes in the Availability of Facts over Time

L. E. Bourne, Jr., Steven Antos, & Walter Kintsch

Real life decisions are commonly made on the basis of less than complete information. One reason for this state of affairs is that people must almost always rely on memory for some of the information pertinent to a proper judgment. Regardless of the model that might govern the decision making process, some of the relevant data are entered not directly, but rather from a fallible memory store. A stock broker, for example, might be asked for advice by a client on the possible purchase of a certain company's stock. The broker presumably has some relevant information about that company, which he or she has gleaned from reading various reports. When the request for advice is received, the broker can either consult all the available previously-read sources of information (assuming he can find them and has the time) or can calculate a judgment on the basis of what he or she can remember. Clearly in normal circumstances the later is more typical than the former (Kozminsky, Kintsch, & Bourne, in press).

The broker's decision-making process can be characterized as follows. The inquiry, say from a client, serves as a retrieval cue for the broker. Using this cue, the broker searches memory and retrieves or activates (a certain sample of) relevant facts. On the basis of facts retrieved, their category, their valence, and their weight or diagnostic value, the broker calculates a response. The response is influenced clearly by what comes most readily to mind. Easy to recall facts should, on the average, have more impact on decision than difficult to recall facts. Indeed, by this memory mechanism, extraneous, but highly memorable facts can have an undue influence on the decision. In the context of social judgment, the outcome has been referred to by Tversky and Kahneman (1973) as the availability heuristic.

On the foregoing logic, we should be able to influence decisions and judgments indirectly by manipulating the memorability of data on which those judgments are to be made. We know, for example, that more deeply processed facts, more concrete facts, more familiar (or frequent) facts, more important facts, and more vivid facts (e.g., Craik & Tulving, 1975; Glass, Eddy & Schwanenflagel, 1980; Postman, 1975), are likely to be remembered better and longer than other facts. If we require a judgment to be made later on the basis of memory, we ought to be able to enhance the likelihood, relative to an immediate response baseline, that a subject's judgment will be biased in accord with those facts. In other words, the subject's judgment after a retention interval should be significantly different from what it would have been if made immediately after the presentation of all the facts or if no differential treatment of facts had been used.

We characterize the general decision making process in terms of schema building and schema use. Subjects address any text containing pertinent information with a general knowledge schema that consists of a set of empty slots and an operative set of procedures for filling those slots from text. The slots correspond to predefined categories of information, e.g., capitalization, sales, dividends of a target company whose stock is of interest to the decision maker (broker). Empty slots act as requests for information during reading. A variety of types of information can fill the slots including evaluations (how positive or negative), weight (how important), repetitions, details, etc. Procedures for filling the slots include processes by which categories are identified and evaluations are made. Reading a text as input into decisions then is characterized as building a problem (stock)-specific schema containing all the information that can be abstracted and fit into the general control schema. Decisions are generated on the basis of information retained in the stock-specific schema and available at the time (usually later) of the decision. Access to the evaluative components of each category, which is of course particularly

important in a decision task, can be achieved in a number of ways, including most importantly for this experiment repetitions of certain facts (providing multiple paths to the same category) and details (more likely for categories expressed in concrete examples).

The purpose of the present experiment is to examine the operation of the availability heuristic within a complex, naturalistic judgmental task. Subjects are presented with an array of factual data in textual form. The text is mixed in the sense that, with respect to a particular entity, for example, a stock issue, some of the information is positive (buy the stock) while other information is negative (don't buy). Facts differ as to category, e.g., dividends history, current sales, capitalization, but are relatively homogeneous as to normative weight. By sheer numbers, however, these facts suggest one decision or another. There is both a majority fact set, that should control the subjects decision, other things being equal, and a minority fact set intermingled in the text. To influence fact availability, for some subjects, items in the minority fact set are presented in the form of concrete examples while majority items are stated more or less abstractly. For other subjects, minority items are repeated in slightly different wording while facts in the majority set are presented only once. If concreteness and frequency affect item availability, we can expect, in time, that decisions will be increasingly influenced by the minority fact set.

Subjects participate in an incidental learning paradigm. They perform two overt operations on each item of information. They are asked first to classify the fact according to a pre-established scheme, e.g., dividends, capitalization, sales, etc. Second, they evaluate the fact, i.e., how positive, how negative. The general idea is to induce subjects to engage in processes they might naturally employ if they were reading to make a decision, but without actually preparing to make a decision. These experimental procedures were designed to fill the slots of a problem-

specific schema with essentially the same information as would be represented if decisions were required.

We argue that, in a most general sense, natural decision making depends on two main cognitive components. There are first the logical and inferential processes that compute the decision on the basis of available data. This is the component of primary interest in the vast majority of decision making studies in the literature (e.g., Dawes & Corrigan, 1974). About the second component--mechanisms by which data are made available for computation--far less is known. The second component is of primary interest in this study. We are concerned with delayed judgments, after the factors that influence the memorability of previously input data have had a chance to operate. We have tried to design experimental procedures so that subjects will have sufficient information to make a delayed decision without preparing explicitly to make a decision at input. On the basis of availability heuristic, we expect that subject's decision probabilities will move in the direction of more concrete and the more repetitious information as the time interval between fact presentation and judgment is increased.

Method

Subjects. Sixty subjects, 30 males and 30 females, each participated in two experimental sessions, fulfilling requirements of an introductory psychology class.

Materials. Sentences were constructed that contained positive or negative information pertaining to one of several fact categories for one of three content areas: Stock market, medical diagnosis, and criminal trial. A total of twenty-eight statements, representing seven fact categories (Sales, Earnings, Dividends, Capitalization, General Factors, Growth, and Stock Activity) made up the stock market material. Some of the statements used in the present study were adapted from earlier experiments (Kozminsky, Bourne, Kintsch, in press). Four statements were selected for

each category. Each statement was either a positive or negative statement that was to be understood as providing information about the worth of stock in a fictitious company.

Stock market texts were created in the following manner. For each subject a different random ordering of fact categories was generated. Three fact categories were selected to represent the minority fact set. For "buy" texts the minority fact set contained negative or "not buy" statements. For "not buy" texts "buy" statements were used for the minority fact set and "not buy" for the majority set. The three minority set categories were selected randomly with the constraint that across subjects all fact categories had an approximately equal representation in the minority set. For texts in which fact availability was manipulated by concreteness or specificity, statements in the minority fact set were couched in concrete examples while sentences in the majority fact set were stated more abstractly. Texts in which availability was manipulated by frequency or repetition, all statements were concrete, but statements in the minority fact set were repeated, using different phraseology, after information on the seven basic categories had been presented.

For medical diagnosis, there were eleven fact categories (symptoms): Vomiting, Fever/chills, Tonsillitis, Numbness, Abdominal cramps, Headache/vision, Cough/cold, Muscular ache, Diarrhea, Shortness of breath, Fatigue/insomnia. Twenty-two basic statements, one positive and one negative, were constructed for each of the eleven fact categories. Positive statements indicated presence of the symptom, negative statements indicated absence of the symptom. These basic statements were made by a fictitious doctor (Doctor 1) about a fictitious patient to another conferring doctor (Doctor 2). A second set of twenty-two statements was generated and represented the same kind of information in the basic set except that they were brief dialogues between the doctors, initiated by Doctor 2 asking for clarification on

earlier statements made by Doctor 1. For example, Doctor 2 might ask, "Did you say the patient HAS (HAS NOT) been vomiting for 24 hours?" Doctor 1 would confirm this request for clarification. This second set of statements was used for repetition of certain facts.

Individual texts were prepared for each subject in the same way as described for the stock market texts. However, the minority fact set for the medical texts contained five fact categories instead of three and the majority fact set contained the remaining six. Also, frequency was the only availability manipulation in the medical texts. The repetition of a fact in the texts always occurred with one intervening fact statement, that is, never immediately followed its initial presentation.

The third content area, Criminal Trial, contained brief testimony that fell into one of the seven following fact categories: Eyewitness identification, Possession of stolen property, Motive, Prior criminal convictions, Association with criminals, Knowledge of the crime, Alibi. Fourteen basic testimonies were constructed, a positive and negative one for each of the above seven fact categories. Statements labeled positive made a fictitious, accused defendent look guilty, and negative testimony made him look innocent. Fourteen extra testimonies were devised that represented corroborative testimony on the fourteen basic testimonies. Corroborative testimony was used to repeat certain facts in the texts.

Texts for each subject were prepared as explained for the stock market and medical texts. As in the stock market texts, there were seven fact categories and as in the medical texts; frequency was the only method by which availability was manipulated.

In all of the content areas, texts were presented in much the same fashion. Booklets were constructed such that a statement about one fact category together with a randomized listing of words or labels denoting all possible fact categories

appeared on each page. All statements were written so that subjects could easily identify the fact category being represented. Texts were also prepared for a control condition in which no availability manipulation was made.

Procedure. In the first session each subject read first a stock market text, then a medical text and finally a criminal text. A majority of statements within each text could lead either to a positive (Buy, Hospitalize, or Guilty) or to a negative (Don't buy, Don't hospitalize, Not guilty) decision. Order and number of positive decisions were counterbalanced across subjects. Subjects, however, were not asked to make a decision in the first session. Rather they were lead to believe that their task was to categorize and evaluate (how positive?) each statement, providing the experimenter with normative data for subsequent research. Therefore, subjects read each text one statement at a time and circled the label below each statement that represented the fact category for the information in the statement. They also placed a number next to the circled fact category label (an integer one through six) which represented how positive (or negative) they felt the statement was with respect to: Worth of the stock, sickness of the patient, or guilt of the accused. The integers one through three were considered to be negative statements, and four through six to represent positive information. Subjects did not know they would have to recall and to make a decision on the basis of recalled information later. The first session lasted about half an hour.

In Session two, 48 hours later, all subjects were asked to make three decisions, after reflecting on their memories of the texts they read in the previous session. They were told that some of the facts regarding each decision had been repeated (but not which ones), and were to disregard those repetitions. Each decision was to be based on the majority of the facts in the relevant text (seven for stocks and trial and eleven for medical diagnosis). After making decisions, subjects either free recalled or took a recognition test over stock market facts. The recognition test

was merely a newly randomized presentation of all the statements they had originally seen presented all on one sheet of paper with no foils. Subjects checked "yes" or "no," indicating whether or not they thought they had seen an individual statement in the original text and made a confidence response, using a scale from one to six (higher numbers indicating greater degrees of confidence). Subsequently and successively, the medical diagnosis and criminal trial texts were free recalled. After the memory phase, all subjects were given a list of the fact category labels and asked to indicate, for each label, whether the statement pertaining to that category in the Session 1 text was positive or negative. Then they gave confidence ratings for these responses. Finally, they were asked to evaluate the importance of each category of information from each text, relative to the decision required, using a six point scale. The second session lasted about one hour.

Results

The results of this experiment are consistent across materials, availability manipulations and retention measures. Emphasis in the following sections is placed upon these regularities, although specific variations of significance will be noted.

Decision. Correct decisions, which texts were biased against, were made by 36.6%, 33.4%, and 34.4% of subjects in experimental conditions on stock related, medical and criminal trial materials, respectively. These figures compare with 59.8%, 64.1%, and 64.5% correct decisions on the same materials by subjects in the control conditions (see Table 1). Each difference between experimental and control is highly significant, $\chi^2(1) = 3.25, 5.90, 6.90$, respectively. There are, in these

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Insert Table 1

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data, distinct differences between Yes and No decisions. Subjects in both the experimental and control conditions exhibit an overwhelming tendency to respond negatively, an effect noted in other decision making tasks (e.g., Dreben, Fiske, & Hastie, 1979). Thus, the effect of availability manipulations are more pronounced

in absolute magnitude on negative decisions (53.3% vs. 83.0% correct for experimental and control, respectively) than on positive decisions (16.5% vs. 39.3% correct for experimental and control). The effects of frequency and concreteness in stock-related materials were virtually identical, yielding 36.7% and 36.5% correct decisions, respectively (see Table 2).

Insert Table 2

Retention. Does this judgmental bias in any way reflect a difference in memory for pertinent facts? Evidence suggests that availability manipulations did make the corresponding facts more available in the judgmental session. Over all materials, 34.45% and 35.97% of facts were correctly recalled by the experimental and the control groups respectively from the majority or low available fact set. For comparison, 44.5% and 36.0% were recalled by experimental and control subjects from the high availability or minority fact set. On the recognition test, administered over the stock market materials only, 77.1% of the low availability material and 91.7% of the high availability material was retained by subjects in the experimental group. No recognition data were taken from control subjects.

Differences in retention should be particularly marked for individuals who make a judgmental error, that is, individuals who appear to be influenced by their biased memory of facts presented. Thus, the overall percentage of correct recalls for only those subjects who made a judgmental error are 29.5% versus 29.8% of low available facts as opposed to 47.0% versus 29.7% of high available facts by experimental and control subjects, respectively, the later difference being statistically reliable, $t(84) = 2.31$. Consistent with that possibility is the tendency for these subjects to recall a lower percentage of facts when later tested for retention. As against that background, it is interesting that error prone subjects recall even

more of the minority of high available fact set under the experimental manipulation. Free recall data for the various sets of materials are presented in Table 3.

Insert Table 3

We determined whether each subject recalled a greater number of facts from the minority and majority sets, correcting for differential numbers. In the control group, 34.4% of subjects recall more facts from the minority set. In contrast, 54.1% of experimental subjects recall more facts from the minority set. For the recognition measure, the corresponding percentage was 75%.

One final analysis was performed on free recall data. We determined percentage of facts recalled which were consistent with the subject's decision. These data are presented in Table 4. In both experimental and the control group, subjects were able to recall more consistent facts, 40.9%, than inconsistent facts, 33.7%, as

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Insert Table 4

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would be expected if the subjects based their judgment on those facts which were most recallable, $t(59) = 2.47$.

Importance Rating. A wide range of ratings were given to the various categories that comprised the stock market, medical diagnosis, and criminal trial materials. For the stock market, average ratings ranged from 3.10 (general factors) to 4.63 (earnings), on medical diagnosis from 2.78 (muscle ache) to 3.97 (vomiting), and on the criminal trial from 3.17 (knowledge of the scene of the crime) through 4.68 (possession of stolen property). Since entry of facts into either the minority or majority set was a random affair across subjects, these differences should contribute minimally to any differences in decisions or recall overall. There appears to be no significant difference in the ratings attached to these categories by subjects assigned to the experimental and the control group, mean ratings = 4.0 and 3.8,

respectively. Furthermore, importance ratings remain relatively constant for low and high available category, 3.94 and 4.06 for experimental subjects and 3.77 and 3.74 for control subjects. Finally, there was no difference in ratings between categories presenting positive vs. negative information, means = 3.83 and 3.80, respectively. Subjects did, however, tend to rate higher those categories which matched their judgmental response, as shown in Table 5. The effect, while small, was consistent for both experimental and control subjects and across subjects who

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Insert Table 5

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did and did not make judgment errors, as is shown in Table 6.

Insert Table 6

Decision, Memory and Importance. Conviction regarding a particular judgment has been conceptualized as the ratio of evidence for that judgment to all evidence available, pro and con (Luce, 1959):

$$J_+ = \frac{E_+}{E_+ + E_-}$$

In the present experiment, this model suggests that conviction will depend on the ratio of remembered pro statements to all remembered statements.

$$J_+ = \frac{R_+}{R_+ + R_-}$$

Such an expectation is a simplification in a variety of ways, but particularly because it excludes any influence of vague recollections of valence which do not result in scorable recall. Nonetheless the model does imply a stable relationship between judgment and overt recall. Most models of judgment not only count items of informa-

tion but also incorporate some measure of item strength or weight. Thus

$$J_+ = \frac{\sum_i W_i R_i}{\sum_j W_j R_j},$$

where the i are positive items and the j are all items available. Because we were at pains in the present experiment to select facts of roughly equal importance and because importance ratings tended not to vary with other manipulations, we might expect relatively little contribution of item weight, as an independent factor, to judgment.

These models suggest two measures, an unweighted and a weighted memory score, that can be computed on all subjects. To be consistent with other analyses, these scores should correlate with judgments made. Unfortunately, we have no measure of conviction or commitment in judgment in this study. Thus, our best estimate of the true relation between judgment and memory is a point biserial correlation. The obtained values, over all subjects, were .264 for the unweighted memory score and .266 for the weighted memory score. Neither correlation is impressive, though both are statistically significant. There is no reliable difference between the weighted and unweighted correlations, suggesting that importance differences contribute minimally to the data of this study.

Discussion

Decision making in natural circumstances often relies on the dynamically changing and incomplete data base provided by memory. Decisions are based typically on those facts that are most readily available (Tversky & Kahneman, 1973). Information available in memory is subject to the wide variety of variables known to influence encoding and retrieval. In the present study, we have shown that two manipulations known to influence recall, frequency and concreteness of items, affect judgments in a parallel manner. Thus, it is possible to influence judgments through memory of the judgmental data base.

Exactly how the supposedly independent memory and judgment systems interact is an open empirical question. Subjects in these experiments presumably use a clearcut decision schema that sorts the information obtained from the texts into fundamental categories and provides an easy means of integration for the decision task: they are to decide positively or negatively if the majority of the informational categories are positive or negative, respectively. Suppose that the likelihood of remembering the value of each informational category has some value p. Repeated categories are more likely to be remembered, either because of multiple representations in memory, or because of an increase in strength. Likewise, concrete statements are remembered better than abstract statements, because they are more likely to have dual representation. Hence, when a decision is made from memory, the likelihood that repeated and concrete information will be available in influence it is greater than that for non-repeated, abstract information, leading to the kind of bias effects in the decision task observed here as well as to an enhancement in recall.

Of course the two operative variables in the present study are not the only two that could have been used. There is a variety of other characteristics of input material and encoding operations that might have been examined. Given the robustness of the present results, however, we are optimistic that a similar outcome would have been obtained through other manipulations. Any variation which results in a certain set of facts being more available in memory at decision time will cause those facts to have a disproportionate impact on the decision reached.

There is, obviously, further empirical work to be done. For one thing, the present study used what amounts to an incidental encoding paradigm, giving no instruction to subjects about future possible uses of encoded information. The procedure was designed to induce schematic encoding resembling the procedures subjects theoretically use in naturalistic decision environments, without explicitly preparing them for a decision. Two considerations led to the use of this method. First,

in natural circumstances it is likely that fact-encoding is an ongoing process not limited to preparing for any specific decision. Preparing for a known decision might result in an unnatural encoding of presented information. Second, there is some reason to believe that memory can have a different (or larger) impact on decisions when the decision is unexpected and time limited (Fox, 1980). Given unlimited time to marshall the facts and to evaluate them in the light of alternative positions might reduce the overall effects of immediate fact recall. But it is also possible that the results will not change materially. If the "encoding operations" we required, categorization and evaluation, are essentially those used by subjects in filling a decision-relevant schema, the observed effects might be very much the same whether or not a decision goal is announced. These results establish a reliable effect of memory on judgment under an incidental encoding paradigm. Considerations such as those discussed here would suggest the need to compare intentional and incidental encoding for any differential effects on delayed judgment.

If our assumptions about the dynamic properties of memory are sound, then there is another obvious line of investigation. Several different retention intervals need to be examined. The bias introduced by encoding manipulations should increase in time. More interesting are possible qualitative changes that might be reflected in decisions other than the simple yes/no task used in this study. For example, if asked for a rationale, subjects might, with increasing probability over time, offer explanations which distort facts that are inconsistent with their decision. Such an outcome would suggest a complex interplay between judgment and memory processes. It might be not only that judgment is based on and biased by memory data but also that judgment, once reached, affects and can bias memory. Thus memory for inconsistent facts might in time drift in the direction of judgment.

Finally, we note that memorability, while important, is probably not the only determiner of judgment. The importance attached to a particular category of informa-

tion should exert an independent effect. The multiplicative combination of memorability and importance did not correlate significantly more strongly with judgment than fact memorability alone in these data. But the likely contribution of importance to memorability is not well isolated in the present data because of procedural limitations on the categories selected and the range of evaluations they represented. The integration of evaluation and memory is a significant process in need of further investigation in its own right.

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Footnote

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TABLE 1

Proportion Correct Decisions

Materials			Correct Decision: Yes	Correct Decision: No
Stock	Group	Experimental	.428	.312
		Control	.375	.800
Medical	Group	Experimental	.067	.600
		Control	.375	.867
Trial	Group	Experimental	.000	.688
		Control	.429	.823

TABLE 2

Proportion Correct and Incorrect Decisions

		Correct Decision	
Availability manipulation		Yes	No
	Yes	.444	.714
Concreteness	Subjects decision		
	No	.556	.286
	Yes	.400	.667
Frequency	Subjects decision		
	No	.600	.333

TABLE 3

Free Recall, Probability Correct

All Subjects

Materials		Fact Set: Minority (High Avail)	Fact Set: Majority (Low Avail)
Stock	Experimental Group	.361	.353
	Control	.193	.218
Medical	Experimental Group	.319	.127
	Control	.292	.334
Trial	Experimental Group	.632	.584
	Control	.551	.527

Subjects Making Judgmental Errors

Stock	Experimental Group	.450	.220
	Control	.282	.096
Medical	Experimental Group	.350	.142
	Control	.308	.310
Trial	Experimental Group	.648	.523
	Control	.468	.487

TABLE 4

Proportion Correct Free Recall of Facts

Consistent and Inconsistent with Decision

Materials		Consistent	Inconsistent
Stock	Experimental Group	.606	.514
	Control	.296	.116
Medical	Experimental Group	.236	.194
	Control	.334	.292
Trial	Experimental Group	.626	.560
	Control	.559	.519

TABLE 5

Importance Ratings for Facts Consistent and Inconsistent with Decision

Materials		Consistent	Inconsistent
Stock	Experimental Group	4.45	4.20
	Control	4.10	3.73
Medical	Experimental Group	3.78	3.57
	Control	3.35	3.46
Trial	Experimental Group	4.36	3.62
	Control	3.39	3.17

Table 6

Importance Ratings of Consistent and Inconsistent

Facts for Subject Making Correct and Incorrect Decisions

	Consistent	Inconsistent
Correct Decision	4.11	3.77
Incorrect Decision	4.22	3.82

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