# Text-Based Decisions: Changes in the Availability of Facts Due to Instructions and the Passage of Time

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were threefold. First, once decisional processing was equated through the use of a schema-building task, instructions were found to have little effect on decision accuracy. Second, subjects' decisional performance was found to be a reflection of memory biases. Finally, subjects tended to better remember statements they believed to be important and to make decisions consistent with those statements. This effect was substantially magnified if subjectively important statements were repeated, thereby further enhancing their availability in memory.

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ABSTRACT

A study was conducted to examine the relationship between availability of information in memory and decisional accuracy. Subjects were required to read three texts while engaging in a pre-determined schema-building task, and to make decisions about them. Relative availability of information was manipulated by repeating certain information within the texts, by requiring decisions to be made either immediately after reading the texts or 24 hours later, and by giving subjects either incidental or intentional learning instructions. The results were threefold. First, once decisional processing was equated through the use of a schema-building task, instructions were found to have little effect on decision accuracy. Second, subjects' decisional performance was found to be a reflection of memory biases. Finally, subjects tended to better remember statements they believed to be important and to make decisions consistent with those statements. This effect was substantially magnified if subjectively important statements were repeated, thereby further enhancing their availability in memory.

# Text-Based Decisions: Changes in the Availability of Facts Due to Instructions and the Passage of Time

One of the most important tasks encountered by an individual is that of decision-making. Regardless of the complexity of the decisions to be made, it is often necessary to rely, at least partly, on one's memory for relevant information in making decisions. Since memories often serve as data upon which decisional processing proceeds, it follows that decision can only be as accurate as the memory data upon which they are based, or conversely, that inaccurate memories should result in inaccurate decisions. Despite this fact, few models (e.g., Fox, 1980) of human decision-making have included memory parameters to constrain decisional processing. Recognizing this short-coming, we (Antos, Bourne, and Kintsch, Note 1) endeavored to explore the role of memory and schemata in decision-making under naturalistic conditions.

We proposed that decision-making could be characterized in part by two important processes: (1) schema building and use, and (2) reliance on the availability heuristic, as defined by Tversky and Kahneman (1973). These two processes were thought to interact as follows: Subjects approach the decisional task with a general knowledge schema that consists of a set of empty slots and an operative set of procedures for filling these slots. (We assume here that decision-relevant information is to be gleaned from a text.) The slots correspond to predefined categories of information. Empty slots acts as requests for information during reading. In this way, a problem-specific schema is constructed containing all the information that can be abstracted and fit into the general control schema. Decisions are then generated on the basis of information retained in the problem-specific schema and <u>available</u> at the time (usually later) the decision is made. It is at this time that the second of the proposed characteristics, the availability heuristic, becomes operative.

Certain information may be more readily available in memory than other information, and as a result will be given a disproportionate amount of weight in producing a decision.

Using this model, several predictions can be made about the accuracy of decisions. First, since it is assumed that decisions will be heavily influenced by the relative availability of information in memory, it follows that text manipulations which enhance the memorability of certain types of information over others should yield decisions that are consistent with the so-enhanced information. We presented data which showed precisely that: Subjects were found to make far fewer correct decisions about texts they had read if information that was inconsistent with a correct decision was made more memorable in those texts. Second, since memories serve as input to the decision process, and memories fade over time, a decision made after a passage of time should differ quite significantly from what it would have been if made immediately after encountering decision-relevant information. More specifically, the effects of memory manipulations should become more pronounced following a passage of time. Finally, since we assume that under normal conditions, subjects use a schema-based procedure in making decisions, it should make little difference whether they know they are to make a decision or not as long as they are induced to use a schema-based procedure while evaluating decision-relevant information. In other words, as long as decisional processing is held constant, the intention to make a decision should contribute little to decision accuracy.

The present experiment addresses the latter two predictions. Subjects were induced to use a schema-based procedure to evaluate information contained in texts. Half of the subjects knew they were to make decisions about the texts while the other half did not. Half of each of these instruction groups were required to make their decisions immediately after reading the texts, while the remaining halves made their decisions 24 hours later. The texts contained a majority of either positive or negative information, and subjects were told to make decisions that were consistent with the valence of the majority of information. The minority information (which was opposite in valence to the majority) was, however, repeated, thereby making it more memorable. It was predicted that (1) more incorrect decisions would be made following a 24 hour delay than no delay, (2) no difference in decision accuracy would be noted between the intentional and incidental learning groups, and (3) differential decisional accuracy would be a reflection of differential memory for repeated and non-repeated information.

## METHOD

Subjects. Eighty-six subjects were randomly chosen from Introductory Psychology classes at the University of Colorado-Boulder for participation in the study.

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, 1981). Four statements were selected for each category. Each statement was either a positive or negative statement. The statements provided 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" text "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. Statements in the minority fact set were repeated using different phraseology throughout the text.

For medical diagnosis, there were eleven fact categories (symptoms): Vomiting, Fever/Chills, Tonsillitis, Numbness, Abdominal Cramps, Headache, Cough/Cold, Muscular Ache, Diarrhea, Shortness of Breath, and 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 statement 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 doctors, initiated by Doctor 2 asking for clarification of earlier statements made by Doctor 1. The clarifications served as repetitions of the minority fact categories.

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.

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, and Alibi. Fourteen basic testimonies were constructed, a positive and negative one for each of the above seven fact categories. Statements labeled positive made the accused look guilty, and negative testimony made him look innocent. Fourteen extra testimonies were devised that represented corroborative testimony on the fourteen basic testimonies, the corroborative testimonies serving as fact repetitions. Texts for each subject were prepared as explained for the stock market and medical text.

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 represented.

Procedure. Subjects in all conditions read first a stock market text, then a medical text and finally a criminal text. A majority of statements within each text supported either a positive (Buy, Hospitalize, or Guilty) decision, or a negative (Don't Buy, Don't hospitalize, Not guilty) decision. Order and number of positive decisions was counterbalanced across subjects. All subjects engaged in a categorization and evaluation task while reading the texts. They were asked to (1) read each text, one statement at a time, (2) circle the label below each statement that represented the fact category described in the statement, and (3) place 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 the worth of the stock, sickness of the patient or the guilt of the accused. The integers one through three were considered to be negative, and four through six positive.

Subjects were run in groups of approximately 20, one group for each of the four Instruction X Delay conditions. Subjects in the intentional learning groups were told that they would be asked to make a decision about each text, and the nature of the decision (Buy, Don't Buy etc.) was explained to them. Subjects in the incidental learning groups were simply told that the researcher was gathering normative data on the texts in order to use them in subsequent studies.

Following completion of the categorization task for all three texts, subjects were required to make decisions about the texts, and their retention of the texts was measured using free recall, cued recall and recognition tests. All subjects underwent the same testing procedure, but the time at which the tests were given differed. Subjects in the No-Delay condition were tested immediately following completion of the categorization tasks; subjects in the Delay condition were tested 24 hours later.

The testing procedure was as follows: Subjects were given three test booklets, one for each text. Beginning with the stock text, subjects were asked to decide whether or not to buy the stock of the company in question, and to write down their decisions on the first page of the booklet. They were told that some of the facts regarding each decision had been repeated and that they were to disregard those repetitions. Each decision was to be based on the valence of the majority of the facts in the text. After making their decisions, subjects were asked to turn to a blank page and to write down as many of the statements as they could remember from the text. They were given approximately 10 minutes to complete their recall. The next page they encountered listed the fact category labels, and using these as cues, they indicated the valence of the statement that pertained to each category. A forced-choice recognition test followed, which consisted of both the positive and negative passages for each category presented in blocks of two. Subjects indicated which statement was the one originally presented to them by putting a confidence rating (from 1 to 6) next to their choice. Presentation order of the positive and negative statements were counterbalanced in the test. Targets and foils were very similar with the exception of a few words which changed the valence of the statement. Some examples are presented in Appendix A.

Following the recognition test, subjects were again presented with the fact categories and were asked to rate (on a scale of 1 to 6) the importance of each category to their decision. Finally, subjects were asked to write down their personal decision about the text and to indicate how and why they decided as they did, particularly if their personal decision differed from the one they made using the majority rule. This procedure was then repeated for the remaining two texts.

## RESULTS

Unless otherwise specified, rejection probability was .05 for all statistical tests.

Decisions. The percentage of correct decisions (which the texts were biased against) within each instructional and delay group is presented in Table 1. Consistent with our expectations, instructions appeared to have had virtually no effect on decision performance. We tentatively conclude from these results that once decisional processing is equated, the intention to make a decision contributes very little to decision accuracy. Moreover, subjects tended to make fewer correct decisions following a delay than they did immediately after reading the texts, although this difference is statistically marginal (1)=3.13, $.10 > p > .05$.

Free Recall. Recall protocols were scored in terms of valences of categories recalled. More specifically, reproduction of a previously presented statement was scored as a correct recall if both the subject matter (e.g., sales) and the valence (e.g., increased/decreased) were correctly reproduced. If an error occurred in either, the entire reproduction was scored as an intrusion error. Therefore, maximum correct recall was the number of categories presented in each text. For the stock, medical, and criminal texts, the maximums were seven, eleven, and seven, respectively. The mean proportion of statements correctly recalled are presented in Table 2.

Analysis of variance on these data included five variables: instructions (Intentional or Incidental), delay (Immediate or Delayed Testing), decision (Correct or Incorrect), text (Stock Market, Medical Diagnosis, or Criminal Trial), and frequency (Once- and Twice-presented Statements), with repeated measures on the last variable.

Not surprisingly, subjects recalled more twice-presented than once-presented statements, $F(1,234)=53.41$, $MSe=.05$, $p < .001$, and more immediately after reading the texts than after a 24 hour delay, $F(1,234)=7.11$, $MSe=.06$, $p < .01$. These variables did not, however, interact with decision accuracy; regardless of decision made, subjects tended to recall more twice- than once-presented statements, and the magnitude of this preference did not change significantly over time. (The text variable interacted with some of the other variables, but analyses of these interactions did not appreciably change the interpretation of the overall results, and are not reported here.)

Cued Recall. These protocols were scored in terms of the correctness of the valence recalled for each category, that is, given a category name, the subject had to produce the correct valence of the statement associated with that category. Like free recall, then, maximum scores for the stock, medical and criminal texts were seven, eleven, and seven, respectively. The proportion of statement valences correctly recalled is presented in Table 3. Analysis of variance on these proportions included the same variables as the previously described analysis of the free recall data.

The results of the analyses on these data provided evidence of differential memory among correct and incorrect deciders. Correct deciders correctly recalled more valences of once-presented statements than twice-presented ones, while the opposite was true of incorrect deciders, $F(s)(1,234)=8.37$ and 13.06, respectively, $MSe=.02$, $p(s) < .01$. Correct deciders also tended to recall more valences under intentional learning conditions than incidental, while recall of incorrect deciders benefitted more from incidental instructions, $F(s)(1,234)=6.27$ and 5.59, respectively, $MSe=.05$, $p(s) < .01$. Finally, all subjects performed less well after a delay, $F(1,234)=11.85$, $MSe=.05$, $p < 001$.

Recognition. The mean proportions of items correctly recognized on the forced-choice recognition test are presented in Table 4. The results of the analysis of variance included several significant effects, all of which were modified by a significant five-way Text X Decision X Instruction X Delay X Frequency interaction, $F(2,234)=4.88$, $MSe=.02$, $p < .05$. Simple effects tests indicated recognition memory differences among incorrect deciders on the stock text only. These subjects recognized more twice-presented than once-presented statements under incidental conditions only, and only after a delay, $F(1,468)=24.33$, $MSe=.038$, $p < .001$. Correct deciders' recognition memories were not significantly affected by any of the manipulations.

Personal Decisions and Importance Ratings. Subjects made two decisions concerning the texts: a rule-based decision and a personal decision. Subjects were first divided into two groups based on the accuracy of their rule-based decisions (Correct vs. Incorrect), and then these groups were further divided into subjects whose personal decisions matched their rule-based decisions (Same) and those whose personal decisions differed from their rule-based decisions (Different). The mean importance ratings given to once- and twice-presented statements by each of these four groups is presented in Table 5. Memory protocols for each subject in each of the four groups were divided into those statements given high importance ratings (4-6) and those given low ratings (1-3). The mean proportion of the statements correctly recalled (free and cued) and recognized is presented in Table 6. Subjects exhibited the same trends in all three retention measures, with only absolute magnitude of retention differing across the three measures.

The pattern of results exhibited in Tables 5, 6, and 7 seem to indicate that a statement's availability (and hence its impact on decision-making) was affected by both its frequency of occurrence and the subject's perception of its importance. The data presented in Table 6, for example, shows that subjects tended to recall more high- than low-importance statements after a 24 hour delay, regardless of decision accuracy or instruction conditions. An equivalent amount of both types of information was retained in the immediate condition. Table 7 presents the same data but from a different viewpoint. Whereas Table 6 presented the proportions of statements retained of those rated as high and low in importance, Table 7 shows the proportion of statements correctly retained that were rated high and low in importance. In other words, Table 7 shows what proportion of the contents of memory were high-importance statements and what proportion were low-importance. As is apparent, far more of the statements in subjects' memories were high-importance statements. A finer grained analysis of the data is presented in Table 7, where the relationship between availability and decisional accuracy is more clearly demonstrated. For example, subjects who made both incorrect rule-based and incorrect personal decisions tended to remember more twice- than once-presented statements, and to rate twice-presented statements as more important than once-presented. Thus, these subjects were doubly prone to the influences of memory, having certain statements highly available both because they were repeated and subjectively highly important. On the other hand, subjects who made an incorrect rule-based decision but a correct (different) personal decision tended to remember more twice- than once-presented statements, but believed the once-presented statements to be more important. Therefore, these subjects, dutifully followed directions in making their rule-based decisions (having more minority items in memory), but made a personal decision that was consistent with the valence of the statements they believed to be more important. Following in the same vein, subjects who made both correct rule-based and personal decisions remembered more once-presented than twice presented statements, and believed once-presented statements to be more important than twice-presented. These subjects, therefore, made decisions that were both consistent with the valence of statements they believed to be important and more numerous in memory. The final group presents a paradox. These subjects made a correct rule-based decision but an incorrect personal decision. They tended to remember more twice-presented statements, and to give these statements higher importance ratings than once-presented statements. Thus, twice-presented statements should have been more highly available on both counts; therefore, it is unclear why these subjects made a correct rule-based decision at all.

## DISCUSSION

The results of this study substantially supported our hypotheses. First, once decisional processing was equated through the use of a schema-building task, instructions were shown to have little effect on decision accuracy. Second, subjects' decisional performance was found to be a reflection of memory biases. More importantly, the pattern of results exhibited in this study seem to indicate that a statement's availability (and hence its impact on decision accuracy) was affected by both its frequency of occurrence <u>and</u> the subject's perception of its importance. Subjects tended to better remember statements they believed to be important and made decisions consistent with those statements. This effect was substantially magnified if subjectively important statements were repeated, thereby rendering them all the more memorable.

The effect of differential importance on memory was not entirely unexpected. Several researchers (e.g., Caccamise & Kintsch, 1978; Johnson, 1978) have reported better memory for statements objectively rated as important to the larger prose passage in which the statements were contained than those rated as less important. Moreover, Caccamise and Kintsch employed both an immediate and delayed recognition test of memory for both types of information and noted significant differences only after a delay, a trend also exhibited in our data.

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1. Antos, S., Bourne, L. E., and Kintsch, W. Text-based Decisions: Changes in the Availability of Facts Over Time. Technical Report #106-ONR, University of Colorado, Boulder, 1981.

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Table 1

Percent Correct Decisions Made

| Text | Instruction Type | |
|---|---|---|
| Stock | Intentional | Incidental |
| No Delay | 56.5 (a) | 57.1 |
| Delay | 50.0 (b) | 40.9 (d) |
| Medical | | |
| No Delay | 50.0 (a) | 42.8 (c) |
| Delay | 25.0 (b) | 46.4 (d) |
| Criminal | | |
| No Delay | 45.0 (a) | 52.4 (c) |
| Delay | 39.1 (b) | 31.8 (d) |

Note: (a) n=23
(b) n=20
(c) n=21
(d) n=22

Table 2

Mean Proportion of Statements Correctly Recalled

| | Decision Accuracy | | | |
|---|---|---|---|---|
| | Correct | | Incorrect | |
| Repetition Frequency | Once | Twice | Once | Twice |
| Instructions | | | | |
| Intentional | | | | |
| No Delay | .531 | .703 (32) | .534 | .659 (37) |
| Delay | .469 | .668 (24) | .543 | .691 (36) |
| Incidental | | | | |
| No Delay | .603 | .699 (29) | .589 | .691 (34) |
| Delay | .462 | .594 (27) | .473 | .643 (39) |

Note: Numbers in parentheses indicate the number of subjects in each group.

Table 3

Mean Proportion of Statement Valences Correctly Recalled When Cued

| | Decision Accuracy | | | |
|---|---|---|---|---|
| | Correct | | Incorrect | |
| Repetition Frequency | Once | Twice | Once | Twice |
| Instructions | | | | |
| Intentional | | | | |
| No Delay | .888 | .814 (32) | .743 | .898 (37) |
| Delay | .838 | .690 (24) | .637 | .813 (36) |
| Incidental | | | | |
| No Delay | .864 | .816 (29) | .796 | .974 (34) |
| Delay | .727 | .622 (27) | .715 | .821 (39) |

Note: Numbers in parentheses indicate number of subjects in each group.

Table 4

Mean Proportion of Statements Correctly Recognized

| | Decision Accuracy | | | |
|---|---|---|---|---|
| | Correct | | Incorrect | |
| Repetition Frequency | Once | Twice | Once | Twice |
| Instructions | | | | |
| Intentional | | | | |
| No Delay | .900 | .914 (32) | .839 | .914 (37) |
| Delay | .878 | .873 (24) | .785 | .865 (36) |
| Incidental | | | | |
| No Delay | .928 | .923 (29) | .904 | .956 (34) |
| Delay | .785 | .802 (27) | .784 | .940 (39) |

Note: Numbers in parentheses indicate the number of subjects in each group.

Table 5

Importance Ratings of Once- and Twice-presented Statements

| Decision Type | | Frequency | |
|---|---|---|---|
| Rule | Personal | Once | Twice |
| Correct | Same | 3.74 | 3.25 |
| | Different | 3.59 | 4.28 |
| Incorrect | Same | 4.26 | 5.62 |
| | Different | 4.63 | 4.11 |

Table 6

Proportion Correct Retention of High vs. Low Importance Statements

| | Immediate | | Delay | |
|---|---|---|---|---|
| Importance | High | Low | High | Low |
| Correct | | Free Recall | | |
| Intentional | .587 | .543 | .585 | .543 |
| Incidental | .767 | .580 | .557 | .458 |
| Incorrect | | | | |
| Intentional | .549 | .523 | .655 | .525 |
| Incidental | .599 | .623 | .583 | .485 |
| Correct | | Recognition | | |
| Intentional | .907 | .941 | .936 | .753 |
| Incidental | .922 | .946 | .811 | .756 |
| Incorrect | | | | |
| Intentional | .948 | .901 | .867 | .769 |
| Incidental | .918 | .953 | .881 | .907 |

Table 7

Proportion Correct Retention of High vs. Low Importance

Repeated vs. Non-repeated Statements

| | | Frequency | | | |
|---|---|---|---|---|---|
| | | Once | | Twice | |
| Importance | | Low | High | Low | High |
| Decision Type | | | | | |
| Rule | Personal | Free Recall | | | |
| Correct | Same | .080 | .440 | .203 | .273 |
| | Different | .163 | .313 | .120 | .407 |
| Incorrect | Same | .173 | .330 | .083 | .413 |
| | Different | .100 | .393 | .193 | .313 |
| | | Cued Recall | | | |
| Correct | Same | .110 | .483 | .293 | .217 |
| | Different | .240 | .353 | .097 | .313 |
| Incorrect | Same | .210 | .303 | .077 | .413 |
| | Different | .117 | .407 | .193 | .283 |
| | | Recognition | | | |
| Correct | Same | .397 | .623 | .477 | .500 |
| | Different | .467 | .507 | .417 | .607 |
| Incorrect | Same | .483 | .543 | .393 | .583 |
| | Different | .407 | .590 | .473 | .530 |

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