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Perspectives on information acquisition: Rethinking its role in the construction of reason-based preferences

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Boe, O., Selart, M., & Takemura, K. Perspectives on information acquisition: Rethinking its role in the construction of reason-based preferences. *Göteborg Psychological Reports, 2000, 30*, No. 2. An experiment (n=192) was conducted in order to investigate whether choosing or rejecting job candidates would lead to different preferences, and whether presenting information about job candidates as probabilities or frequencies would result in changes of preferences. Participants either completed a computerized task in which an eye tracking system (Eyegaze) was applied (Lohse & Johnson, 1996), or were instructed to complete the same task by filling out a booklet. It was also assumed that accountable participants would use more compensatory decision strategies than participants who were not required to justify their choices. It was moreover hypothesized that participants in choice-conditions would focus more upon enriched than on impoverished candidates, as compared to participants in reject-conditions. Another assumption was that the difference between the probability- and frequency conditions in terms of preferences would be larger for single than for group information. The hypothesis that participants instructed to choose would focus more upon the enriched than upon the impoverished candidates than participants instructed to reject candidates gained support in the study. Furthermore, the hypothesis that participants would be expected to reveal larger preferential differences between single and group information in the probability conditions than in the frequency conditions was also substantiated. Finally, the analyses of the eyegaze recordings suggested that accountability resulted in a use of more compensatory decision strategies since response latency time was found to have a longer duration for accountable than non-accountable participants. However, accountability was not found to have any effect on participants´ preferences. In summary, the information acquisition format of the presented information affected both the nature of preferences as well as the duration of depth of search and response latency. It was also found that the participants attended more to negative than to positive information independent of whether their task was to select or to reject. Finally, it was revealed that accountability lead participants to attend more to the information than if they were not accountable.

Key words: Decision making, frequencies, probabilities, accountability

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Uncertainty can be represented in different ways, for instance either by presenting the information in frequency or in probability formats. Psychologists have for a long time been interested in the psychological processes underlying and describing how people assess uncertainty, and how these processes in some cases can lead to a change of preferences when faced with new information (Mellers & McGraw, 1999). Edwards (1968) proposed a normative theory of probability judgments, claiming that Bayesian probability theory could provide an acceptable description of how people performed when making judgments.

The work of Kahneman and Tversky (1972, 1973; Tversky & Kahneman, 1973, 1974) has suggested that the Bayesian model is not always adequate for how people reason about uncertainty. Instead, Kahneman and Tversky found that people base their probability judgments on such psychological cues as ease of retrieval, and similarity. This is known as the availability and representativeness heuristics.

On the other hand, Gigerenzer and Hoffrage (1999) mentioned that frequencies facilitate internal representations involving discrete elements, as has been demonstrated in for instance in Johnson-Laird´s (1983) mental models. Frequencies are also easier for participants to visualize. Another statement made by Gigerenzer and Hoffrage (1995) is that the reference class on which a probability judgment is based, can be clarified, or changed by presenting a problem in terms of frequencies. Gigerenzer, Hoffrage, and Kleinbölting (1991) proposed that by using frequency questions, the "overconfidence bias" tends to disappear.

Offering a new perspective, Gigerenzer and Hoffrage (1995) argued that people are able to reason more accurately when information is presented as frequencies based on natural sampling. They defined natural sampling as "the sequential acquisition of information by updating event frequencies without artificially fixing the marginal frequencies" (Gigerenzer & Hoffrage, 1995, p. 686).

Gigerenzer and Hoffrage (1995) have shown that when inference problems are presented with frequencies based on natural sampling, people reason more in accordance with probability theory. In well-known conjunctive problems, such as for instance the Linda problem (Tversky & Kahneman, 1982), frequencies have also been shown to improve reasoning. It was shown that a frequency format enhanced usage of the reasoning in not only Bayesian inference but also in any probability theory and non-additive probability theory. As shown by Fiedler (1988), the number of conjunction violations in the Linda problem dropped from 91% in the original single-event representation to 22% in the frequency-based representation. Hertwig and Gigerenzer (1994) found approximately the same results. Further evidence in line with this was also obtained by Eddy (1982), who reported that reasoning about single-event probabilities did not seem natural to his sample of 100 physicians. Similarly, Kahneman and Tversky (1972) have argued that our minds are not built to work by the rules of probability, and this idea has also been carried further by Gould (1992). Furthermore, Cosmides and Tooby (1996) suggested that evolution has made human beings better suited to notice,

collect, and reason about frequencies instead of probabilities. This has also been proposed by others (Gigerenzer, 1998; Hertwig, R., Hoffrage, U., & Martignon, L., 1999; Brase, G. L., Cosmides, L., & Tooby, J. 1998).

If information is coded through natural sampling of frequencies, as opposed to single-event probabilities, then a simple conclusion is that frequency information carries with it more information than single-event probabilities (Gigerenzer, 1994). Information about a sample size should therefore be easier obtained from absolute frequencies, for instance "6 out of 10", as opposed to the probabilistic, "p= 0.6". This allows a decision maker to compute the precision, or second-order probabilities of the information (Kleiter, 1993). Gigerenzer and Hoffrage (1995) also showed that Bayesian algorithms are computationally simpler when presented in frequency formats than when presented in probability formats. Frequency formats correspond to the sequential way in which information is acquired if sampled naturally. Mellers and McGraw (1999) showed that by using frequencies, rare events are easier to understand than when using probabilities. When problems contain rare events, participants´ reasoning depends to a greater extent upon the form of the information rather than upon the type of information. On the other hand, if inference problems contain larger probabilities, the type of information (such as rare events vs. frequent events) becomes more important than the form of information (such as frequency format vs. probability format) when it comes to performance in Bayesian inference tasks. For this reason, Lewis and Keren (1999) argued that it is better to represent information in terms of probabilities rather than in terms of natural frequencies.

Trying to make an extension of these results, it is argued that the information format such as frequency and probability would not always have a crucial role in improving probability inference in line with probability theory. Rather, a combination of type of information concerning events and information would be more important for determining information processing under uncertainty.

As previous research on influence of the format on the judgment has indicated (Gigerenzer & Hoffrage, 1995), a frequency format would enhance judgment in line with probability theory. Nevertheless, even if information is presented in the probability format, people would use the same type of inference as in the frequency format especially when information is presented as group's characteristics and not as individual one. Hertwig, Hoffrage, and Martignon (1999) suggested that humans are sensitive to group structure when making decisions. As discussed by Hertwig et al. (1999), information on a group may be evolutionary important "for instance, when they had to make quick decisions about whether to threaten to fight over resources with families, clans, or tribes" (Hertwig, et al., 1999, p.219.).

Therefore, trying to make an extension of this discussion, people would show the same type of preference as in the frequency format when information is described as a group's characteristics even if the information is presented in a probability format. For example, even if the information is presented as "the improved share of the market for the

group is 30 percent" in the probability format, people in this condition would use similar information processing as in the frequency format, and they would behave differently when information is presented as " the improved share of the market for the individual is 30 percent". Thus, we can present the following hypothesis (Hypothesis 1).

Hypothesis 1. Both in the frequency format (group and individual information scenarios), and in the probability format (group information scenarios), it is expected that people will show basically the same preference. In other words, the difference in terms of participants´ responses between a set of frequency conditions and a set of probability conditions was assumed to be larger for individual information scenarios than for group information scenarios.

Select versus reject

People do not always have well-defined values and preferences. Preferences are often constructed during their elicitation. This construction of preferences has been found to be sensitive to various aspects of the decision problem, such as framing (Tversky & Kahneman, 1986), and on the methods of elicitation (Payne, 1982; Tversky, Sattath, & Slovic, 1988). Elicitation methods include judgment or choice. Takemura (1994a) has proposed a contingent focus model to account for the inhibition of the framing effect that decision makers experience because of their different psychological states and situational conditions. The notion of compatibility has recently also been extended in recent work of judgment and decision making. It has been proposed that the more compatible attribute scales are with the response scale, the more weight the attributes receive (Slovic, Griffin, & Tversky, 1990; Tversky et al., 1988). Slovic et al., (1990) reported that probability was a prominent attribute and that a prominence effect was found in choices between pairs of risky decisions. Consistent with Slovic et al.'s (1990) results, the prominent attribute in Selart, Boe, and Gärling´s (1999) study was found to receive a higher weight when it was matched. The results from Selart et al.'s study (1999) supported Slovic et al.'s (1990) idea that reasoning about outcome probabilities and values in preference reversals was governed by a contingent-weighting mechanism. It has also been revealed that people try to focus on considerations that justify the selection of one option over others (Simonson, 1989; Slovic, 1990).

A well-known principle of expected utility theory is the invariance principle stating that decisions should not be influenced by the way in which the choices are presented. However, Russo (1977) reported violations of the invariance principle in his field study on the effect of unit pricing schemes in supermarkets. Russo argued that people preferred to compare alternatives directly on important attributes. Consistent with the notion of compatibility, Shafir (1993) proposed a new feature of making choices. He argued that that the negative and positive aspects of options receive different weights, and that this characteristic is dependent

upon whether the options are being selected or rejected. It was established that the positive dimensions were emphasized more in selecting than rejecting, whereas the negative dimensions were given more weight in rejecting than selecting. Building on these results, another hypothesis was proposed (Hypothesis 2).

Hypothesis 2. It was hypothesized that participants in select conditions were expected to more extensively focus upon positive than upon negative information as compared to participants in reject conditions.

Accountability

Accountability refers to the need to justify one´s views and preferences to others (Tetlock, 1983a). A rather common mistake is to view accountability as a unitary phenomenon. Accountability has been found to significantly reduce several common decision biases, although research has also proved that accountability in some cases also might increase susceptibility to some errors (e.g. Adelberg & Batson, 1978; Simonson, 1989; Tetlock & Boettger, 1989).

As shown by Tetlock (1985a), accountable DM´s were found to use more multidimensional, self-critical, and complex information processes when the socially acceptable option was not obvious. In the present experiment, it was not clear to the participants which options were the normative correct ones. It was assumed that participants would not know which options would be evaluated as the most socially accepted by others. Tetlock and Boettger (1989) provided evidence for that accountable DM´s are more prone to take into consideration all available cues, that is, also cues that are not found to be clearly relevant. In many tasks it is not always obvious which is the option someone else would prefer. This raises an interesting problem for the accountable DM. When an evaluator´s opinion is not known, and the specific problem encountered does not provide the DM with an immediately "correct" choice, more integrative and multidimensional ways of processing the information occurs for the accountable DM (Tetlock & Boettger, 1989; Tetlock & Kim, 1987). In line with this, results provided by Hagafors and Brehmer (1983), and also by Tetlock (1983a, 1983b, and 1985b) have shown that accountability may result in an increased willingness to process information. Moreover, Takemura (1993, 1994b) have found that a required justification inhibited the framing effect in a risky decision tasks (cf. Tversky & Kahneman, 1981). In line with these results, a third hypothesis was stated in the present study (Hypothesis 3).

Hypothesis 3. It was hypothesized that participants assigned to an accountability condition would engage in more thorough and complex information acquisition processes as compared to participants in a non-accountability condition.

To determine the search strategies used by the DM´s, depth of search was used in the present study as a method of measurement (Klayman, 1983;

Payne, 1976; Svenson, 1979). Hence, the degree to which compensatory decision strategies were applied could be established by this measure. Depth of search refers to the total amount of information that is searched (Ford, Schmitt, Schechtman, Hults, & Doherty, 1989), and it was measured by the time in milliseconds that participants spent searching for various parts of the information that was presented on the screen.

However in the present study, we predicted that participants´ preferences would not be affected by accountability, since it has been found to be unable to affect participant´s preferences in multi-attribute decision problems (Simonson & Nye, 1992; Selart, 1996). Research in multi-attribute decision tasks also suggest that the use of different decision strategies do not always influence the final choices (Kerstholt, 1992; Parquette & Kida, 1988; Payne, Bettman, & Johnson, 1988; Takemura & Selart, 1999).

According to the theory of the adaptive decision maker (Payne, Bettman, & Johnson, 1993), final choices are usually stable even if different decision strategies are used because of adaptive nature of human information processing. These findings are also supporting the hypothesis that participants´ preferences would not be affected by accountability in the present study.

Method

Participants

One hundred and ninety-two undergraduates (96 men and 96 women) at Göteborg University participated in return for the equivalent of $7. On prior occasions, these participants had indicated that they were willing to take part in the experiment. Participants were randomly assigned to a 2 (manipulation vs. control) by 2 (frequency vs. probability) by 2 (accountability vs. no accountability) by 2 (select vs. reject) factorial design. Participants mean age was 24.4 years (Sd=3.6) within a range of 18 to 36 years.

Materials

Before the experiment, participants were given two paper and pencil test booklets. The first test measured the degree of biases in different decision heuristics. Participants were given a 24-item questionnaire developed by Selart, Boe and Takemura (2000). The second test measured participants´ social value orientation (e.g. Kuhlman & Marshello, 1975; Van Lange & Kuhlman, 1994). In the experiment, either a computerized version of a job recruiting task or a paper and pencil version of the same task were administered to the participants.

Design

The design was mixed factorial with frequency-based vs. probability-based information as one of the between-subjects factors. Another between-subjects factor used was whether participants were assigned to an accountability or to a non-accountability condition. Moreover, a third between-subjects factor used was whether participants were requested to accept or reject job candidates in the presented tasks. A within-subjects factor that was used was whether participants were presented with individual or group information scenarios.

Process tracing tool

For over 20 years, the information acquisition processes underlying judgment and choice have attracted a lot of attention. By studying the information acquisition processes certain strategies for evaluating information have been suggested (Payne, 1976). Information acquisition behavior has been studied using information boards, eye tracking equipment, and computerized tracing tools (Abelson & Levi, 1985). In the present study an eye gaze tracking equipment was used. The Eyegaze System is using the pupil-center/corneal reflection method to determine eye gaze. This method captures the voluntary, saccadic eye movements that fixate a target object on a region of high visual acuity on the retina (the fovea). Saccadic eye movements can be divided into two different parts: a movement phase ranging from 30 to 120 ms and a latency phase fixating from 100 to 300 ms. The duration of a typical saccadic eye movement is 230 ms. In order to continually observe and capture a participant´s eye movements, the Eye Gaze system uses an infrared video camera positioned below the computer monitor. To process the captured data, specialized image processing software generates x-and y-coordinates for the gaze point on the monitor screen. The Eyegaze System collects data at 60 Hz or about every 16.7 milliseconds within an accuracy of 0.6 centimeters, and the participants´s eye is about 50 centimeters from the computer screen. No attachments to the head are required.

Procedure

Participants took part in the experiment one at the time in the laboratory. When arriving at the laboratory, they were seated in a private boot in front of a computer screen. They were requested to first fill out the test that measured the degree of biases in different decision heuristics and thereafter instructed to complete the test that measured the social value orientation. After having completed the two tests, participants were randomly assigned to either an eye-gaze condition or a paper and pencil condition of the same task. Participants in the eye-gaze condition were first calibrated when using the Eye Gaze equipment before the experiment took place. This calibration procedure usually took less than

two minutes for each new participant. They were then given general instructions about how to perform the experiment and were also instructed that their task in this experiment was to act as a job recruiter, with a variety of different organizations in the trade and industry as their clients. Participants were then told that their task was to make decisions about job candidates or in some cases groups of candidates, and that this task was to be completed based on as thorough judgments as possible. They were also told that the different candidates or groups of candidates would differ to what degree they could fulfill a certain company´s goal. The eight candidates or groups of candidates ability to obtain these goals were either expressed on a probability scale or in terms of how frequent it was that that the candidates would achieve the goals. A total of eight different problems were given to all participants. In four of these problems participants encountered individual information where information about eight single candidates were given, and in the other four problems they were facing group information. The group information consisted of information about eight different groups of candidates. No information was given to the participants about the size of each group of candidates. The participants were informed that these different groups of candidates were applying for work in a division of the organization, for instance in the organization´s production or marketing division. Half of the participants were then told that their task in each situation was to select the best four candidates or groups of candidates for a post in an organization and that these candidates would continue to be further interviewed or analyzed. The other half of the participants were told that their task instead was to sort out and reject the four least suitable candidates or groups of candidates for a post in the organization that would be eliminated and that would not continue to further analyses or interviews. Table 1 gives an overview of the different experimental conditions.

Table 1.
The Different Conditions Used in the Experiment

Accountability			No Accountability		
Condition	Task	Information	Condition	Task	Information
SFA	Select	Frequency-based	SFNA	Select	Frequency-based
SPA	Select	Probability-based	SPNA	Select	Probability-based
RFA	Reject	Frequency-based	RFNA	Reject	Frequency-based
RPA	Reject	Probability-based	RPNA	Reject	Probability-based

Half of the participants in both the select or reject groups were then presented with the information about the job candidates in terms of how frequent it was estimated that they would fulfill the company´s goals, for instance in 3 cases out of 10. The other half of the participants received information about job candidates on a probability scale ranging from 1-100%. In each scenario the information about the job candidates were

expressed with eight different attributes, of which four concerned profit goals (e.g increasing the company´s production), and the other four environmental goals (e.g. increasing the company´s environmental policy). Figure 1 gives an example of one of the four individual information scenarios given to non-accountability participants in the select conditions with probability-based information.

Figure 1.
An example of an Individual Information Scenario given to Non-Accountability Participants in the Select Conditions with Probability-Based Information.

Imagine that you as an outside consultant are going to choose among eight different candidates to a post as president in an electrochemical company. The eight different candidates differ regarding to which degree they can be expected to promote certain aims that the company has. The candidates ability to achieve these aims are expressed in terms of how probable it is that they will reach the expected aims on a scale ranging from 1- 100%. We want you to select the four best candidates that will continue to an interview. Ponder that you as an outside consultant do not have to justify your decision to others and that it will be anonymous in the company who made the decision.

Candidates	Decr-eased effluent-level	Imp-roved share of the market	Incr-eased sales	Imp-proved working environ-ment	Imp-proved environ-mental policy	Imp-proved energy-saving	Imp-proved produc-tivity	Imp-proved profit
Candidate D	60%	50%	60%	40%	40%	50%	50%	50%
Candidate A	20%	20%	30%	80%	30%	80%	80%	90%
Candidate E	70%	70%	80%	20%	80%	30%	30%	30%
Candidate B	80%	30%	90%	30%	70%	20%	70%	30%
Candidate F	80%	70%	20%	70%	30%	20%	90%	20%
Candidate C	40%	50%	40%	50%	50%	60%	60%	60%
Candidate G	40%	40%	50%	50%	50%	60%	60%	50%
Candidate H	50%	40%	60%	40%	50%	60%	50%	60%

Which four candidates do you select?

Half of the participants in the select and reject conditions were instructed that they as outside consultants were not requested to justify their decisions to others, and they were also told that it would be anonymous to the company who made the decision. With the aim of inducing accountability, the other half of the participants were instead told that the company demanded that they in their role as outside consultants would have to justify and give arguments for their decisions in a meeting with the management and the job applicants. They were also required to take personal responsibility for their decisions.

It was stressed in the general instruction that participants did not have to rank order the chosen alternatives, and that it did not matter in which order the alternatives were indicated. Participants were explicitly instructed to carefully consider all the information presented on the screen while making their choices. After having considered the information they were instructed to press the return button and indicate their choices. Thereafter they pressed the return button again and another scenario was presented. Participants assigned to the paper and pencil version simply wrote down their choices on the bottom of each page before continuing to the next page. All participants were given eight scenarios, that is, four with single candidates and four with groups of candidates and the positions of the different candidates or groups of candidates. Furthermore, in both the individual information and the group information scenarios four candidates or groups of candidates were enriched and the remaining four impoverished. The enriched options had more positive as well as more negative dimensions than the impoverished options. In a previous study, Shafir (1993) has reported that the positive dimensions of an option received more weight in selecting than in rejecting, and the negative dimensions of an option received more weight in rejecting than in selecting. This resulted in that the enriched option tended to be both chosen and rejected relatively more often then the impoverished option.

In the present study, the different environmental or profit attributes were randomized for each scenario. The presentation of the scenarios were also randomized for each participant. After having completed the entire session, participants were debriefed and paid. In general, a session lasted for approximately 50 minutes.

Results

Frequency-based vs. probability-based information
Analyses of the preference data for Hypothesis 1

Table 2 displays the mean percentages of choices of the enriched options for single and group information in the groups presented with frequency-based information and with probability-based information. As may be seen, choices of the enriched candidates in the individual information scenarios were as expected more frequent in the probability condition than in the frequency condition. In accordance with the hypothesis stating that the difference between the frequency conditions and the probability conditions should be larger for individual information than for group information, a *t*-test showed that this difference was significant, $t(190)=5.28$, $p<.001$. Also as expected, another *t*-test showed that the difference between the frequency- and probability conditions was not significant for choices of the enriched candidates in the group information. A 2 (group: probability-based vs. frequency-based information) by 2 (type of events: individual vs. group) mixed ANOVA

with repeated measures on the last factor on the choices of the enriched and impoverished options revealed a significant main effect of type of events, $F(1, 190)= 38.15$, $p<.001$, $MS_e=.73$, indicating that choices of the enriched options were more frequent in the individual information than in the group information scenarios. A significant interaction between type of events and group was also revealed, $F(1, 190)= 22.05$, $p<.001$, $MS_e=.42$. Furthermore, a main effect of group was also found, $F(1, 190)= 8.31$, $p<.01$, $MS_e=.63$, indicating that participants in the probability-based information group more frequently chose the enriched options than those assigned to the frequency-based information group.

Table 2.
Mean Percentages of Choices of the Enriched Candidates in the Probability-and Frequency-Conditions for Individual and Group Information Scenarios.

	Condition	
	Probability (n=96)	Frequency (n=96)
Individual information	67.1*	52.3
Group information	51.8	50.3

*p<.001

Analysis of the eye fixation data for Hypothesis 1

Due to limitations with the Eye Gaze recorder´s processing software, only depth of search was used in the present experiment to examine whether participants used compensatory or non-compensatory decision strategies. Usually, depth of search refers to the total amount of information that the decision maker searches in order to make a decision (Ford, Schmitt, Schechtman, Hults, & Doherty, 1989). To investigate the hypothesis that the difference between the frequency conditions and the probability conditions was assumed to be larger for individual information than for group information, depth of search was measured by the time, expressed in milliseconds, participants attended to the information presented in each individual or group information scenario. An index measure for depth of search was constructed by summing the time participants spent on the individual information in the four individual scenarios, and another index measure was likewise constructed for the group information in the other four remaining group information scenarios. A 2 (group: probability-based vs. frequency-based information) by 2 (events: single vs. multiple) mixed ANOVA with repeated measures on the last factor on the time spent on searching the information presented in the single or multiple scenarios yielded a significant main effect of type of events, $F(1, 76)= 23.45$, $p<.001$, $MS_e=34.94$. This revealed

that depth of search was more time consuming in the group information scenarios than in the individual information scenarios. A main effect of group was also revealed, $F(1, 76)= 4.70$, $p<.05$, $MS_e=74.13$, indicating that participants in the probability-based information group attended to the presented information longer than participants in the frequency-based information group. Table 3 shows the mean percentages of depth of search for the single and group information in the groups presented with frequency-based information and with probability-based information. As may be seen, information search had a shorter duration in the individual information than in the group information in both the probability condition and the frequency condition. Separate t-tests showed that this difference was reliable for both individual information and for group information. The probability-based information group differed reliably from the frequency-based information group both for single and for group information, $t(76)=2.13$, $p<.05$, and $t(76)=2.11$, $p<.05$, respectively.

Table 3.
Mean Percentages of Depth of Search Expressed in Seconds for Each Scenario for the Single and Group Information in the Probability-and Frequency-Conditions

	Condition	
	Probability (n=38)	Frequency (n=40)
Individual information	1.76	.66
Group information	2.98	1.33

Analyses of response latency time for Hypothesis 1

Response latency was also included as a strategy indicator, and was measured by the total time participants were attending to the information that was presented on the screen. An index was constructed by applying the mean time participants spent on the four individual information scenarios. A second index was likewise constructed for the four group information scenarios. Another 2 (group: probability-based vs. frequency-based information) by 2 (events: single vs. multiple) mixed ANOVA with repeated measures on the last factor on the total time spent on the scenarios again revealed a significant main effect of type of events, $F(1, 94)= 7.97$, $p<.01$, $MS_e=1188.00$, indicating that participants attended longer to multiple than to individual information scenarios.

Select vs. reject

It was hypothesized that participants in the select conditions would focus more upon positive than upon negative information as compared to the participants in the reject-conditions. It was furthermore expected that this would lead to that the choices of the enriched options would be more frequent in the select conditions than in the reject-conditions.

Analyses of the preference data for Hypothesis 2

In line with the expectations, choices of the enriched options in the select conditions reached 59.5%, whereas they reached 51.2% in the reject conditions. A separate t-test showed that this difference was reliable, $t(190)=2.96$, $p<.01$. A 2 (group: select vs. reject) by 2 (type of candidates: enriched vs. impoverished) mixed ANOVA with repeated measures on the last factor on the choices of the enriched or impoverished candidates revealed a significant main effect of type of candidates, $F(1, 188)= 14.34$, $p<.001$, $MS_e=1.09$. This effect revealed that choices of the enriched options were significantly higher than choices of the impoverished options, A significant interaction between group and type of candidates was also found, $F(1, 188)= 8.86$, $p<.01$, $MS_e=.67$.

Analyses of the eye fixation data for Hypothesis 2

The mean value for each scenario (expressed in seconds) that participants attended to the positive information was 1.6 seconds in the select conditions and 1.4 seconds in for the reject conditions. However, information acquisition for the negative information was 1,8 seconds for participants in the select condition and 1.8 seconds for those in the reject conditions. A 2 (group: select vs. reject) by 2 (type of information: positive vs. negative) mixed ANOVA with repeated measures on the last factor on the information acquisition of the positive or negative information presented in the scenarios yielded a significant main effect of information, $F(1, 76)= 6.47$, $p<.05$, $MS_e=3.01$, indicating that participants attended more to negative than to positive information.

Accountability

It was furthermore hypothesized that participants that were held accountable for their decisions would use more compensatory decision strategies than those who were not accountable. The use of compensatory decision strategies was measured by investigating participants´ depth of search.

Analyses of the preference data for Hypothesis 3

Table 4 shows the mean percentages of choices of the enriched options for single and group information in the accountable and non-accountable groups. As clearly indicated in the individual information scenarios, participants' chose the enriched options to a much higher degree in the probability condition than in the frequency condition. As substantiated by a 2 (group: probability-based vs. frequency-based information) by 2 (accountability: responsible vs. not responsible) by 2 (events: single vs. multiple) mixed ANOVA with repeated measures on the last factor on the choices of the enriched and impoverished options, the main effect of events was significant, $F(1, 188)= 40.71$, $p<.001$, $MS_e=.73$ revealing that participants more frequently chose the enriched options in the individual information scenarios than in the group information scenarios. Furthermore the interaction between type of event and accountability reached significance, $F(1, 188)= 8.93$, $p<.01$, $MS_e=.16$. Finally, a main effect of group was also found, $F(1, 188)= 8.29$, $p<.01$, $MS_e=.63$, revealing that accountable participants reliably more often chose the enriched options in the individual information scenarios than participants that were not held accountable. Separate Bonferonni-corrected t-tests showed at p=.05 that in both the accountability and non-accountability group the choices of the enriched options in the individual information were reliably more frequent in the group that received probability-based information than in the group that received frequency-based information. This effect was weaker in the no accountability group. Choices of the enriched options in the group information did not differ significantly between the probability-based information group and the frequency-based information group. It was also revealed that whether participants were accountable did not have an effect upon their choices in the group information scenarios. Support for the hypothesis that accountability would modify the choices of the enriched options, and that the difference between single and group information scenarios would be larger for accountable participants as compared to non-accountable was substantiated. A separate *t*-test revealed that the choices of the enriched options in the individual information for the groups that received probability-based information, was reliably higher for the accountable participants than for those participants that were not accountable, $t(1, 188)= -4.21$, $p<.001$.

Table 4.
Mean Percentages of Choices of the Enriched Options in the Accountable and Non-Accountable Conditions for Single and Group Information.

	Condition	
	Accountability (n=96)	Non accountability (n=96)
Probability-based information		
Individual information	73.1	61.1
Group information	50.4	53.1
Frequency-based information		
Individual information	52.6	52.1
Group information	49.7	50.8

Analysis of the eye fixation data for Hypothesis 3

Table 5 shows the mean percentages of depth of search for the single and group information in the accountability and non-accountability groups. As clearly can be observed, depth of search was lower in the individual information scenarios than in the group information scenarios in both the accountability group and the non-accountability group. This was independently of whether participants received probability-based or frequency-based information. Separate Bonferonni-corrected *t*-tests at p=.05 showed that the group that had received probability-based information differed reliably from the group that had received frequency-based information both for single and for group information scenarios in the non-accountability group. In the accountability group no significant difference was observed between the two information groups. Furthermore, no significant differences were observed between the accountability and the non-accountability group for single or for group information. A 2 (group: probability-based vs. frequency-based information) by 2 (accountability: responsible vs. not responsible) by 2 (type of event: single vs. multiple) mixed ANOVA with repeated measures on the last factor on the time spent on searching the information presented in the single or multiple scenarios revealed a significant main effect of type of events, $F(1, 74)= 23.73$, $p<.001$, $MS_e=33.87$. This effect revealed that the depth of search had a shorter duration for single than for group information scenarios.

Table 5.
Mean Percentages of Depth of Search Expressed in Seconds for the Enriched Options in the Accountable and Non-Accountable Conditions.

	Condition	
	Accountability (n=38)	Non accountability (n=38)
Probability-based information		
Individual information	1.28	2.24
Group information	2.23	3.72
Frequency-based information		
Individual information	.93	.35
Group information	2.13	.43

Analyses of response latency for Hypothesis 3

Participants in the accountability group was found to attend significantly longer to the information presented in the individual information scenarios than participants assigned to the no accountability group (M=74.0 and 57.9 sec respectively, $t(94)=-2.77$, $p<.01$). The same pattern emerged for group information scenarios (M=67.4 and 54.6 sec respectively, $t(94)=-2.947$, $p<.05$) although this effect was weaker than for individual information scenarios. These results were substantiated by a 2 (group: probability-based vs. frequency-based information) by 2 (accountability: responsible vs. not responsible) by 2 (events: single vs. multiple) mixed ANOVA with repeated measures on the last factor on the time spent on the scenarios, revealing a significant main effect of type of events $F(1, 92)= 7.89$, $p<.01$, $MS_e=1188.00$, indicating that participants attended longer to the information in the individual information scenarios as compared to group information scenarios. Furthermore, the analysis yielded a significant effect of accountability, $F(1, 92)= 7.63$, $p<.01$, $MS_e=10088.56$, revealing that when participants were accountable for their decisions, more time were spent on searching the information presented in the tasks.

Analyses of the preference data for Hypothesis 3

Table 6 reveals the choices of the enriched options in the select and reject conditions. As can be seen, choices of the enriched options reached higher levels in the select than in the reject conditions. Separate Bonferonni-corrected t-tests at $p=.05$ revealed that these differences were significant both for the accountable and the non-accountable group, and that this effect was more pronounced in the group that was accountable.

Table 6.
Mean Percentages of Choices of the Enriched Options in the Select and Reject Conditions

	Condition		
	Select (n=96)	*Reject* (n=96)	*T-values* (df=94)
Accountability	60.7*	52.2	2.15
Non accountability	58.3*	50.2	2.02

*p<.05

Analyses of the eye fixation data for Hypothesis 3

The time participants attended to the positive and negative information presented in the scenarios can be found in table 7. No significant differences were found on participants´ depth of search for positive or negative information between the select and reject conditions. Whether participants were accountable or not didn´t seem to have any effect upon their depth of search. Separate Bonferonni-corrected *t*-tests at p=.05 revealed that no differences between depth of search for positive or negative information was found in any of the select or reject conditions. However, there was a strong tendency for accountable participants in the reject condition to attend more to the negative information, $t(20)$=-2.05, p=.053.

Table 7.
Mean Percentages of Depth of Search for Positive and Negative Information in Each Scenario Expressed in Seconds

	Condition			
	Accountability (n=96)		Non accountability (n=96)	
	Select	*Reject*	*Select*	*Reject*
Positive information	1.25	1.71	1.96	1.11
Negative information	1.35	2.17	2.19	1.40

General Discussion

The basic goal of this research was to investigate whether presenting information about job candidates as probabilities or frequencies would result in changes of preferences, and whether choosing or rejecting job candidates would lead to different preferences. Another aim was to investigate the hypothesis that accountability would lead to the use of more compensatory decision strategies.

The results revealed that whether the information was presented as probabilities or frequencies did have an effect upon participants´ preferences. Both depth of search and response latency time was also affected by the format of the information. Participants´ preferences were also affected due to whether participants were asked to select or reject in the experimental tasks. The depth of search used by participants when choosing or rejecting was however not entirely as expected. Accountability was found to lead to the use of more compensatory decision strategies, although the use of compensatory decision strategies was not always as expected. Accountability also lead to longer response latency times.

One of the hypotheses tested was that the difference between the probability- and frequency conditions with regard to preferences would be larger for single than for group information scenarios. In line with this hypothesis, when facing individual information scenarios, participants in the probability-conditions were found to chose the enriched candidates significantly more frequent than participants in the frequency- conditions. No differences between single or group information scenarios were revealed in the frequency-conditions. It was furthermore revealed that participants in the probability-conditions attended more to the information presented in both the single and group information scenarios than the participants assigned to the frequency-conditions. Moreover, depth of search also had a longer duration in the frequency-conditions when participants were looking at group information scenarios as compared to individual information scenarios. The same pattern emerged with regard to the response latency time. Participants in both the probability- and frequency-conditions were found to have a longer response latency time when facing group information scenarios as compared to individual information scenarios. These results corroborates Bettman and Kakkar´s (1977) conclusion that the display format strongly affects search strategies and the decision processes that they reflect.

Another hypothesis in the present study was that participants in the select-conditions would focus more upon the enriched than upon the impoverished candidates, as compared to participants in the reject-conditions. In support of this hypothesis, participants choices of the enriched options were found to be substantially more frequent in the select-conditions as compared to the reject-conditions. This is consistent with the notion of compatibility, stating that choice is expected to give enriched options advantages over rejection, (Shafir, 1993). The depth of search that participants used was not quite in line with expectations, although participants in the select-conditions were found to attend more

to the positive information than participants in the reject-conditions. However, participants in both the select- and reject-conditions attended longer to the negative information presented in the scenarios. Whether participants were asked to select or reject job candidates did not seem to have any effect upon the time they attended to the negative information. This is in line with Larrick (1993) who reported that decision makers are often more concerned about avoiding negative outcomes than attaining positive ones. The tendency to avoid negative outcomes may also reflect that anticipated negative events receive increased attention and are therefore processed more comprehensively (Peeters & Czapinski, 1990; Taylor, 1991; Weber, 1994).

It was furthermore hypothesized that participants accountable for their decisions would use more compensatory decision strategies than non-accountable participants. It was also expected that accountability would not affect participants´ preferences, as reported by Selart (1996) and Simonson and Nye (1992). Although this result was confirmed on a general level, accountability was found to have some effect on participants´ preferences. Participants in the accountability group were found to chose the enriched options significantly more frequently than those in the non-accountability group. In contradiction to the hypothesis that accountable decision makers would use more compensatory decision strategies, no noticeable differences between the accountable and non-accountable groups were found with regard to the time that participants attended to the single and the group information scenarios. It was revealed that non-accountable participants attended more to the information than accountable participants when the information was probability-based. On the other hand, in line with the expectations, accountable participants attended reliably more to the frequency-based information. Furthermore, supporting the hypothesis, accountable participants had a longer response latency time when processing information in both the single and group information scenarios than non-accountable participants. The present study produced some interesting results, both predicted and not. Support was gained for the hypothesis that differences between single and group information scenarios would be larger when the information was presented in probability format than in frequency format was sustained. Moreover, participants were also found to attend more to the information when it was probability-based than when it was frequency-based. This result is understandable, considering that the process of assessing frequencies may be biased by availability, because of features that are salient, distinctive, vivid, or easy to retrieve (Jones, Jones, & Frisch, 1995). This may have resulted in more complex information acquisition processes when the information was presented in a probability format.

Whether the participants faced single or group information scenarios did not seem to matter, as no noticeable differences were revealed between the accountable and non-accountable groups regarding the time that they attended to the information presented in the scenarios. This result is perhaps not so surprising considering the fact that the only

differences between the single and the group information scenarios was that participants in the individual information scenarios were given information about single job candidates, whereas participants in the group information scenarios were instead given information about groups of job candidates. Otherwise the information was the same.

As found by Bettman and Zins (1979), information processing strategies are dependent upon the structure of the information. In the present study the information was presented either as probabilities or as frequencies. The results from the present study revealed that changes in the presentation format could lead to preference reversals. Johnson, Payne and Bettman (1988) reported that the frequency of preference reversals was increased and a shift in processing strategies was observed when probability information was presented in a more complex format. It is also possible that participants decision performance in the present study was affected by the way that the information is presented, as has been reported by Ashton and Ashton (1988). In the present study it was clear that presenting the information as probabilities or frequencies affected also both the depth of search as well as response latency. It was furthermore revealed that both response latency and depth of search was affected by whether the information concerned individual information or group information. As shown by Lohse and Johnson (1996), the information acquisition patterns have been found to directly influence cognition and memory. The decision making strategies has also been found to be altered by subtle changes in the presentation of the information (Bettman & Kakkar, 1977; Jarvenpaa, 1989; Todd & Benbasat, 1991). Participants in the present study were found to pay more attention to enriched information as compared to information that was impoverished when the task was to select job candidates. A tentative interpretation of this result is that participants used different decision strategies in selecting and rejecting, and that the use of these strategies was governed by the type of task that participants were requested to perform.

It was furthermore revealed that accountability lead to a longer response latency time. This is in line with Ford and Weldon (1981) who reported that accountability appeared to increase decision time. It is also conceivable that the effort that accountable participants in the present study exerted was stronger than non-accountable participants, and that this may have caused the increased response latency time. As reported by Weldon and Gargano (1988), accountability has been found to increase cognitive effort. However, the results regarding the effect that accountability had on participants choice preferences are not conclusive. It is also possible that other factors, such as for instance time pressure, will reveal some interesting differences in both depth of search and response latency time between accountable and non-accountable participants. The present results indicate that there exist several factors that can affect participant´s attention, and influence the decisions that they make. Still, more research is needed in order to pinpoint the degree

of affect that these factors have upon participant´s attention and their following decision processes.

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