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Base-rate use in prediction: an attribution process.

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BASE-RATE USE IN PREDICTION: AN ATTRIBUTION PROCESS

A Thesis Presented
By
Judith Foster Karshmer

Submitted to the Graduate School of the University of Massachusetts in Partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

September 1981
Department of Psychology
BASE-RATE USE IN PREDICTION: 
AN ATTRIBUTION PROCESS

A Thesis Presented 
By 
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September 1981
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CHAPTER I
INTRODUCTION AND LITERATURE REVIEW

Interest in how people make judgments about the likelihood of future events has sparked a lively area of theory and research over the past decade. The psychology of prediction has burgeoned across the traditional psychological interest areas. The intriguing and compelling work of Kahneman and Tversky (1972) has motivated a number of studies that demonstrate how subjects utilize important information inappropriately and are less than accurate in making predictions when compared with normative models. Since this original work, several researchers (Lyon and Slovic, 1976, Bar-Hillel, 1977, Ajzen, 1977) have manipulated aspects of the information provided subjects during performance of a prediction task in an attempt to determine when and under what conditions certain types of information are used or ignored.

The present research is concerned with these questions: what information do people use and why do they use it when making a prediction? The focus of the paper is on the prediction task as a process. Instead of contending that one type of information will be used and another type will not, this paper suggests that information is used if it satisfies a logical causal process established by an individual when faced with the task of making a prediction. The nature or content of an isolated piece of information is less critical than how that information fits into the process.

In order to understand this approach, it is appropriate to present a brief overview of existing prediction research. Much of this research has been concerned with the use and nonuse of base-rates and
with the impact of these base base-rates on predictions. Consequently, special emphasis is placed upon that type of research. Then a selected summary of some attribution literature is presented, as it may offer a way to explore the prediction process. Conclusions drawn from this summary will provide a framework upon which the present research is based.

Prediction

At present a majority of the empirical work on prediction has been primarily concerned with a comparison of the outcomes predicted by normative models and the results actually obtained when individuals are asked to make predictions about the future occurrence of an event. Such work has not consistently addressed the way people evaluate the information that is available to them or how they determine its relevance to a given population.

Typical of this approach, and of particular interest to the present research, is the work of Kahneman and Tversky (1972, 1973, Tversky and Kahneman, 1974). They suggest that three general types of information are relevant to predictions: 1) prior background information (base-rates; 2) specific evidence concerning individual causes; 3) expected accuracy of the prediction. From their research, they suggest that people intuitively ignore factors and violate statistical rules in systematic ways. They label these violations "heuristics." To explain, one heuristic is what they term representativeness. Subjects were presented with a series of short personality sketches of people
on base-rates revised their earlier position that suggested people use a "representativeness heuristic", and concurred with the Ajzen position. They too developed the thesis that subjects will use base-rates when they are perceived as causal and not ignore base-rates in all cases.

Base-rates.

The Ajzen study (1977) explored base-rate use by varying the causal nature of the content. He asked subjects to judge the likelihood that a given student has passed a final exam. Half of the subjects were given base-rates that provided causal information, the other half were given non-causal base-rates. The causal base-rates reported that 75% of the students in a given course passed (failed) an exam. Ajzen inferred that this sort of base-rate carried a causal component: information concerning the ease or difficulty of the exam. The non-causal base-rate reported that an educational psychologist interested in scholastic achievement interviewed a large number of students who had taken a course and since he was primarily interested in reactions to success (failure), he selected mostly students who had passed (failed). This format of the base-rate was presented as carrying no causal component; no conclusions about the ease or difficulty of the exam could be drawn. Ajzen found that the "causal base-rate" was used by subjects when making their predictions, whereas, the "non-causal base-rate" was not used. From these findings he concluded that use of a base-rate is affected by whether or not it is causal in nature, and labeled this tendency as the "causality heuristic."

Nisbett and Borgida (1975) conducted a study that may raise some
problems for Ajzen's causality heuristic. They gave subjects the percentage results from a previous experiment on helping behavior and asked them to predict how likely a particular subject was to have helped the individual in distress. Their findings indicate that subjects did not use the base-rates (the actual results or numbers of people who helped) when making their predictions. The nature of the base-rate in this study is similar in fashion to the causal base-rate Ajzen provided his subjects. The causal link established by the data on helping behavior parallels the inferred ease of an exam and/or the brightness of the students from the Ajzen study, yet the base-rate was not used. It appears that the general statement that subjects will use base-rates if they are perceived as causal may not hold true in all situations. At the very least, review of the Nisbett and Borgida study in this light sheds some doubt on the generalizability of the "causality heuristic."

Tversky and Kahneman (1977) attempt to resolve the apparent conflict between these two studies. They suggest that "base-rate data which describe the difficulty or attractiveness of an action are used when they complete a schema that is not fully specified, but not when they conflict with an existing schema" (p.33). This would seem to imply that conditions in the Ajzen study present schema which are not "fully specified;" the causal base-rate completes this schema and is used, but the non-causal base-rates either conflicts with or does not fully round out the schema and is not used. This form of post hoc explanation, which is difficult to fully comprehend, sheds little light upon the predictable use of base-rates.
Other research has addressed the issue of conditions under which base-rates are used or ignored. Lyon and Slovic (1976) manipulated particular aspects of the base-rate information given subjects. They varied the order of presentation of base-rates and case descriptions (individuating information), the base-rate percentages as well as the stated validity of the base-rates, and they still found base-rates to be under utilized or ignored. Though the findings were pervasive, they were unable to offer any generalizable reason for this finding.

Bar-Hillel (1977) has attempted to codify the plethora of explanations and interpretations of the base-rate phenomena and has concluded that "people order items according to their perceived relevance to the required judgment. More relevant items dominate less relevant ones. Items are combined only if they are perceived as equally relevant. The base-rate fallacy [underuse of base-rates] is a direct result of these base-rates having been (subjectively) less relevant than the indicators" (p.9). Bar-Hillel did not directly measure "relevance," but rather intuitively identified items as "more or less relevant." She designed over 40 situations and presented them to 1500 students in order to test her hypothesis. Her results clearly demonstrate both the generalizability of the base-rate fallacy, as well as considerable support of exceptions to it. Under conditions that she "designed" to make base-rate relevant, she found that subjects did use base-rate informations in making predictions. Her subjects were given information about the number of blue vs. green cabs in a city and a case of an eyewitness report concerning the color of a cab involved in an accident. The eyewitness was characterized as being able to identify
the color of the cab correctly "about 80% of the time, but confusing it with the color of the other cab about 20% of the time" (p.1).

Given such individuating information, subjects ignored the base-rate (percentage of green vs. blue cabs) and based their judgments solely upon the data from the eyewitness. However, when the base-rate information concerning cabs was made relevant, a different pattern emerged. Relevance was introduced by giving subjects a base-rate that 85% of the cab accidents in the city involve green cabs and 15% involve blue cabs, followed by the eyewitness report. In this case both individuating information and base-rate were used in making a judgment. Bar-Hillel concluded that such results support the relevance hypothesis, even though no direct relevance measure was taken for subjects and alternate explanations may exist.

The present state of affairs regarding use or non-use of base-rates is in greater flux than after the initial experiments that proposed people predict by using "heuristics." Fewer consistencies have been discovered and the impact of content, intuitive relevance or causality and post hoc explanations each offers some form of interpretation.

Prediction and attribution work have been, for the most part pursued from separate and distinct theoretical frameworks and research paradigms. Fischhoff (1976) has highlighted these differences. He suggested that attribution research finds people to be effective processors of information who organize their world in a systematic way with few biases; whereas, judgment research reveals people to be quite inept information processors. It is appropriate to reflect upon the
impact these different fundamental conceptual biases may have on the research that is designed and the interpretations that are favored by these empirical traditions. But the focus of the present paper is on the insights that may be generated when attribution theory and research are brought to bear upon the process of predicting. Because of the similarities between base-rates and consensus information, particular attention will be paid to attribution literature that pertains to the use of consensus data.

Attribution.

Attribution is a process whereby an individual "explains" his world. In an attempt to impose order and meaning on the maze of events daily encountered, people seem to find comfort in believing that things do not just randomly happen; they happen "because..." Heider (1958) was concerned with the phenomenological picture all people have of themselves and other people. He suggested that people, seeking to establish cognitive consistency, explain responses and situations by integrating certain cues and inferring more stable factors from them, i.e., they make attributions. Heider was interested in the common tendency for a person to see others as having caused their actions, and in particular, in whether a person's behavior was seen as a result of internal or external forces.

Kelley (1967) detailed a more precise and generalizable model of attribution. He pointed to three kinds of information which determine internal vs. external attribution. The first, distinctiveness information, refers to whether the person being considered makes the same
kind of response to many different kinds of entities or whether the response is made only to this particular class of entities. The second is consensus information which refers to whether other persons would be likely to make the same response in the same situation. The third is modality/time information from which one infers consistency, i.e., whether or not a particular response occurs whenever a particular stimulus is present. Generally these factors are considered in combination, as in the example:

John likes very few movies, but does like a particular movie (high distinctiveness); everyone else likes this particular movie (high consensus) and John's liking for the movie does not depend on whether he sees it at home or in the theater (high consistency). Under these conditions, one can be relatively certain that John's liking for a particular movie is a function of the movie, rather than of John. The attribution would be an external one. (Kelley, 1967)

McArthur (1972) designed an approach for testing the Kelley model. Basically she attempted to study how attributions are facilitated by various combinations of consensus, distinctiveness and consistency information. Her findings suggest that consistency and distinctiveness are more informative than consensus information. This lack of impact of consensus information on attribution has generated a considerable body of work in an attempt to discover when and under what conditions consensus information might be used. [See, for example, Nisbett, Borgida, Crandall, and Reed (1976), Hansen and Donoghue (1977)]

A short summary of these studies may demonstrate the status of understanding which exists concerning the use of consensus information. Nisbett, Borgida, Crandall, and Reed (1976) failed to find an impact of consensus information on self-attribution. They asked subjects to
eat crackers and drink a sweetened liquid and then to compare the amounts they consumed with other subjects. The subjects were then asked to explain why they ate and drank the amounts they did. Their findings indicated no impact of consensus information. The subjects did not use the information on the amounts consumed by others when explaining their own behavior. Nisbett, Borgida, Crandall, and Reed argue that one reason for this may be that consensus information is "abstract, pallid and remote" and that perceivers tend to rely on perceptually vivid data for making an inference (p.127). In this light it would be expected that subjects would ignore the consensus information on personal attributions. They suggest that knowledge of one's own behavior in a given situation renders sample-based consensus less compelling. Additional explanations exist to account for the failure of subjects to use consensus information. Wells and Harvey (1977) and Hansen and Donoghue (1977) demonstrated that subjects were less willing to use consensus when the representativeness of the sample was in question. When the randomness of the information was assured, (Wells and Harvey, 1977) subjects were more likely to utilize the data.

The original Nisbett, Borgida, Crandall, and Reed study (1976) was predominantly concerned with subjects' attributions for their own behavior. Hansen and Stoner (1978) in a replication of this study also asked subjects to explain the behavior of other persons. They were asked to make causal attributions about the impact of the crackers' taste on other subjects' thirst. The results indicated a failure of the consensus information to have an impact on the observers' judgments of the taste of the crackers. However, when asked to determine
how thirsty the subjects were, the consensus information did have a
great deal of influence. Hansen and Stoner conducted additional exper-
iments designed to explore the factors influencing these different
patterns of results. Generally, their findings indicated that whether
explaining one's own behavior or another's, people are quite willing
to infer dispositions discrepant from that of the consensus. Observers
were more likely than actors to infer stimuli attributes from consensus
information and there was a greater impact of consensus on observers
than actors when making a causal attribution. However, even observers
did not use consensus information in all cases. Hansen and Stone suggest
that this is a result of their inability to infer a clear and logical
relationship between consensus and the attribution. Kassin (1979) in
a recent literature review points out that existing evidence has dem-
onstrated that consensus has a substantially larger effect on the
attribution of occurrences than on actions.

Hansen and Lowe (1976) suggest that the underuse of consensus
information may be a result of an individual's ability to generate
a "consensus" by virtue of knowing or surmising what his or her own
behavior might have been in a given situation. Feldman, Higgins,
Karlovac, and Ruble (1976) suggest that the use of consensus information
may be related to the subjects receiving information about the target
person. With information from their own personal experience with the
stimulus, or enough information to take the role of the target person,
consensus has no impact. However, without such information consensus
may be utilized by subjects when making an inference.

This brief review of attribution literature indicates the complexity
of findings concerning the use of consensus information. In some conditions studies demonstrate that subjects do use consensus information, but in others they seem to ignore it. Although the various authors have offered explanations as to why subjects do or do not utilize consensus information, none has outlined a comprehensive framework that would parsimoniously account for the existing data, let alone allow for the generation of predictions about the conditions for use of consensus data.

The close relationship of the attribution task and the prediction task, and the similarities and differences between base-rates and consensus information, have not escaped the scrutiny of several authors. Nisbett, Borgida, Crandall and Reed (1976) state "an attribution, moreover, is more complicated and indirect inference than a prediction" (p.124). "When faced with the task of making a prediction, subjects are asked to produce a rather direct and uncomplicated chain of inferences. If the majority of members of the population belong to a particular category, the odds are the target does also" (p.124). In attribution, a still more elaborate chain of inferences is requested. "If the majority of the population behave in a particular way, then the situation must exert strong pressure toward that behavior and, therefore, it is unparsimonious to involve personal idiosyncracies to account for the behavior that is modal" (p.124). Ajzen (1977) points out an important difference between the effect of the base-rates on prediction and consensus information in attributions. He suggests that in the case of predictions, base-rates directly affect the event's (objective) probability, since they provide actual facts about the relative frequency
of the event to be predicted. However, the link between an event's relative frequency and a potential underlying disposition is merely inferential.

However, such explicit distinctions no longer seem so clear. Recently, attribution researchers, troubled with the lack of impact consensus information seems to have on attributions, have attempted to understand the finding by citing the parallel to the underuse of base-rate data found in prediction research. Nisbett, Borgida, Crandall, and Reed (1976) have made explicit the similarity between consensus information and base-rate information. "Consensus information is precisely base-rate information. It is base-rate information about behavior responses rather than category membership" (p.124).

Ross (1977) has suggested an inherent connection exists between the often distinct areas of attribution and prediction, that they are implicitly related and the latter is a natural extension of the former. "Explanations for and inference from an event are obviously and intimately related and together they form an important basis for speculation about unknown and future events" (Ross, 1977, p.1975). How can the attribution literature help explore the process of prediction making? An important first consideration is "why does someone, outside of the experimental setting, attempt to explain behavior or events, i.e., make attributions?" It seems logical that one dominant response might be "to understand why something happened in order to predict what may happen in the future." The example given earlier for attribution dealt with John attending a movie. Someone might be interested in
determining the reasons John likes a particular movie because of a desire to decide whether or not it's worth spending money to go oneself -- to make a prediction about movie quality.

The present study attempts to consider the two processes--attribution and prediction--as parts of a whole and suggests an inherent connection between them. Specifically, the contention is that when faced with the task of predicting an event or behavior, one formulates a sort of hypothesis that the specific event or behavior has occurred and then seeks confirmation. The prediction question itself is considered as a "given." "How likely is John to attend a movie?" becomes "John attended a movie. What factors suggest this to be true?"; "Why might that be?"; or, "What may have caused this?" The task is now akin to that of attribution. It is likely that the individual seeks the potential causes of what might induce someone to see a movie (eg: moviebuff, excellent reviews for the movie, nothing else to do in a particular town, etc.) and then attempts to establish which items of information about John in this situation corresponds to these potential causes. It is these items which are used, the others ignored when making the actual likelihood judgment. In brief summary, an individual may first consider the prediction question as a statement to be verified. The task becomes one of attribution, explaining the factors which may have caused the event to occur. Information which confirms this "hypothesis" is utilized, otherwise it is ignored.

There is some evidence that people do exactly this type of hypothesis confirming in other situations. Snyder (1979) has explored and presented a theory concerning the way individuals hold onto preset
notions about people. His finding suggest that people engage in behaviors that will confirm hypotheses already held. In a series of investigations, his subjects preferentially solicited behavioral evidence that tended to confirm their hypothesis by treating their targets as if they were the type of person they were hypothesized to be. They planned to search preferentially for behavior evidence that would confirm their hypothesis." (p.41). His findings concerning hypothesis-testing strategies appear to be pervasive. It seemed to matter not at all to participants where their hypothesis originated, or how likely it was that their hypothesis would prove accurate or inaccurate (implicit base-rate) or whether or not the hypothesis explicitly defined the confirming or disconfirming attributes.

Snyder suggests that it may be this mechanism which helps so many beliefs remain stubbornly resistant to change. Even when sufficient doubt about the accuracy of a belief leads one to test it, one nevertheless may be likely to attend to only that evidence which would be needed to confirm a belief. It is reasonable to consider these findings in order to understand the proposed process of hypothesis testing that one implicitly engages in when making a prediction.

Research question.

This paper suggests that people, when faced with the task of predicting, treat the prediction question as if it were an hypothesis that requires confirmation. In order to elicit those factors which confirm the hypothesis, the task implicitly becomes one of attribution,
or explaining what may have caused that particular event or behavior. In such a process it is identification of the factors which establish possible reasons for the event or situation occurring that determines which information is to be used.

It is possible that one way to treat this notion is to provide subjects with base-rates for use as potential reasons. Base-rates consist of knowledge about the relative frequency of an event in a relevant population. Base-rates which would provide potential reasons for an outcome would be "causal" in nature, i.e., present a logical connection between the outcome and antecedents. Base-rates which would not serve as potential reasons, would be non-causal or statistical and offer no logical causal link. The Ajzen (1977) paradigm suggests a manner in which this information distinction may be established. He provided a causal base-rate that inferred ease or difficulty of an exam. "Causal base-rate information: Two years ago, a final exam was given in a course at Yale University. About 75% of the students passed (failed) the exam." (p.308). The non-causal base-rate on the other hand implied no such causal information about the exam. "non-causal base-rate information: Two years ago, a final exam was given in a course at Yale University. An educational psychologist interested in scholastic achievement interviewed a large number of students who had taken the course. Since he was primarily concerned with reactions to success (failure), he selected mostly students who had passed (failed) the exam. Specifically about 75% of the students in his sample had passed (failed) the exam." (p.308)

The other type of information to provide to subjects as possible
reasons for particular outcomes would be case histories or individuating information. This would follow the Kahneman and Tversky (1972) design and specifically provides data regarding the individual or event in question. As opposed to information about population ratios, this sort of information is singular. For the purpose of the present study, both types of information, causal and non-causal base-rates and individuating information, will be used. One study will look at the possible combinations of base-rates alone and their impact on predictions. In this fashion it is possible to make explicit predictions about which base-rates will be used, i.e., in all cases causal base-rates will be used when available, and only in their absence will the non-causal base-rates be used. The causal nature of the base-rates will provide compelling explanations for an event or behavior.

A second study will then consider how the use of causal and non-causal base-rates is mediated by individuating information that is or is not hypothesis confirming. Three types of individuating information will be presented, 1) confirming, 2) disconfirming, and 3) vague. Hypothesis confirming data will provide information which is consistent with and supportive of the hypothesis one naturally establishes from the prediction question. Example: John attended a movie (from - How likely is John to attend a movie?). Confirming individuating information: John is a movie-buff and likes to go out often. Disconfirming data provides information that is in opposition to the hypothesis established by the prediction question. Example: "John hates to attend movies and hasn't seen one in years." This sort of information would not tend to support the established hypothesis. Vague information
provides little to support or refute the hypothesis. Example: "John is an English major and attends the state university". The second study will combine either a causal or non-causal base-rate with one of three types of individuating information, both items will be used in generating the prediction. However, with non-confirming individuating information, even the causal base-rate will be ignored and subjects will rely solely upon the diagnosticity of the individual case history. When information, that singular information will provide the basis for the prediction and the base-rate will be ignored. Only in the conditions when no individuating information is provided will subjects use the non-causal base-rates.
CHAPTER II

STUDY I

Method

Subjects.

The subjects were 40 American undergraduate students of both sexes in the "Year Abroad Program" at the Hebrew University of Jerusalem. Participation was entirely voluntary. Subjects were recruited from a variety of courses and assigned at random and in equal numbers to the four cells of the experimental design (10 subjects per cell).

Procedure.

The empirical core of the thesis was a collection of prediction problems. Each subject was instructed to read an introduction sheet (see Appendix #1) which provided some information about the general health status of college age students. They were then given one of the four prediction problems which consisted of two different base-rates concerning male and female propensity for contracting and/or suffering from a particular illness. Two types of base-rates were used, causal and statistical or non-causal.¹ The different base-rates provided were

¹Note: Ajzen (1977) points out that causal and non-causal base-rates for research purposes are based largely upon intuitive consideration. Although manipulation checks validate these opinion, we have only limited knowledge about the factors which lead people to attribute causal characteristics to given variables.
as follows:

Casual base-rate #1 read, "Records from Israeli University Health services indicate that upper respiratory infections (common colds) are the most common illnesses among all college age students. During the 1978-79 academic year, 70% of all cases were of female students and 30% were male students."

Casual base-rate #2 read, "Nationwide the percentage of upper respiratory infections that last in excess of two weeks is three times higher among male students than among female students."

Statistical base-rate #1 read, "A nursing student at Hebrew University did a study on the health behavior of students. Because she was primarily interested in how women react to illness, she chose to interview mostly female students who had or were suffering from upper respiratory infections (common colds). As a result, 70% of her sample were women and only 30% of those interviewed were male students suffering from upper respiratory infections."

Statistical base-rate #2a read, "As it turned out, she was also interested in how the length of an illness affects males and females differently. Consequently, she chose her subjects such that three times more male students than female students had upper respiratory infections that lasted in excess of two weeks."

Statistical base-rate #2b read, "At Hebrew University there are three times more male students than female students."

As can be seen, the causal base-rates imply that female students are more likely than male students to get ill (70/30) but that male students who get ill are more likely to have the illness last longer
(3 times more likely). The statistical base-rates offer no such implications. Statistical base-rates #1 and #2a present population ratios that were structured by the nursing student for her study and in no way represents the natural state of affairs. The base-rates consequently do not suggest anything about the nature of illness in males or females. Statistical base-rate #2b is merely a population ratio and not in any way connected to illness. The four conditions in this study are: 1) causal base-rate #1, causal base-rate #2; 2) causal base-rate #1, Statistical base-rate #2b; 3) statistical base-rate #1, causal base-rate #2; and 4) statistical base-rate #1, statistical base-rate #2a.

For each condition, after reading the scenario, subjects were asked to judge the likelihood of a person drawn at random with a particular illness being male. The question read, "What is the probability that a student selected at random from those with upper respiratory infections lasting in excess of two weeks was a male student?" Predictions were measured on a scale:

<table>
<thead>
<tr>
<th>0%</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all likely</td>
<td>Absolutely likely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

Participants were allowed as much time as they wanted to complete the question and in no case did the amount of time exceed ten minutes. After all questionnaires were completed and returned, anyone wishing to discuss the study was invited to remain. A number of students at each administration session chose to remain and partake in the discussion. The content of the stimulus materials seemed to generate a good deal of
interest and several students hoped the discussion could be a forum for seeking professional advice.

**Normative Prediction vs. Predictions Suggested by the Theoretical Model.**

The thesis evolves a model that predicts in what conditions the base-rates would be used. Bayes' Rule suggests a proper normative way to combine the two different pieces of information. In odds from, this rule can be written as \( O = Z \times R \) where \( O \) denotes the posterior odds in favor of a particular inference; and \( R \) denotes the likelihood ratio for that inference. In this study, of interest is the probability that a student with a particular illness lasting over 2 weeks is a male student. Denote illness in males and females by \( M \) and \( F \), respectively, and denote the duration of the illness by \( m \).

\[
0 = \frac{P(M/m)}{P(F/m)} = \frac{P(m/M)}{P(m/F)} = \frac{P(M)}{P(F)}
\]

in condition #1

\[
\frac{.75}{.25} \times \frac{.30}{.70} = \frac{225}{175}
\]

\[
P(M/m) = \frac{225}{175+225} = .56
\]

Therefore, the normative prediction under condition #1 would be 56%. In fact, for all cases, 56% would be the normative prediction as it reflects the use of both base-rates. However, as has been explained previously, the theoretical model of the paper suggests that
the predictions made by subjects depends upon the perception of the base-rate as causal or statistical.

For all conditions, it has been hypothesized that causal base-rates be employed for making a prediction. That is, only in condition 4 will the statistical base-rates be used, and in conditions 1, 2 and 3 the causal base-rates will be used exclusively.

Results.

Table 1 presents the results and comparisons among the predicted results that would be obtained by using Bayes' Rule.

Clearly, the results of conditions 1, 2 and 4 correspond directly to the thesis' predictions. Both causal base-rates are used in condition 1 and, in fact, the results correspond almost exactly with a Bayesian combination of the information. As was predicted for condition 4, both statistical base-rates were used as no causal base-rate was offered. Once again the results fairly duplicate the answers arrived at through Bayes' Rule. The distribution of the results (see graph 1) demonstrates how consistent these responses are.

Conditions 2 and 3 provided one causal base-rate and one statistical base-rate. The premise of this paper predicted use of only the causal base-rate. The findings of .32 for condition 2 clearly demonstrates this. Obviously the statistical information is ignored and only the 30/70 ratio considered. In fact, all but 2 of the respondents gave 30 as their prediction. This is a predicted deviation from the results one would obtain using Bayes' Rule. Condition 3 presents a deviation from the correspondence between the predictions laid out in the paper.
and the results. Subjects seem to attempt to combine both base-rates in some fashion and do not ignore the statistical base-rate. The mean of .49 is quite close to a simple unweighted average (.52) of the two numbers offered by the base-rates. This finding is contrary to proposals in the paper and different from the finding in condition #2 in which subjects do ignore the statistical base-rate and rely solely upon the causal base-rate.

Discussion.

When subjects are given two causal or two statistical base-rates, they are able to combine them using a method whose outcome parallels Bayes' Rule. Subjects do not show any of the Kahneman and Tversky (1972) tendency to ignore or underuse a base-rate as long as the two are of equivalent nature, i.e. statistical or causal. They, in fact, appear to be quite competent Baysians. On the other hand, when the base-rates are of mixed nature, i.e. one statistical and one causal, they do not necessarily attend to both items of information. It is of interest to consider why it is that in condition 2 the subjects totally ignore the statistical base-rate (as per prediction) yet for condition 3 they attempt to use both base-rates. A critical look at the content of the different statistical base-rates may suggest a reason for this discrepancy. Statistical base-rate #2b presents a mere population ratio and the number of male and female students is in no way specifically related to the content in question (although it clearly would affect the actual probabilities). The hypothesis that is established by subjects from the prediction question is not related to this
population ratio. On the other hand, statistical base-rate #1 presents a relevant population so clearly that subjects find it almost impossible to ignore. The health/illness content in statistical base-rate #1 and #2a does relate to that which is to be predicted even though it does not necessarily define a population for consideration. It provides a "because" for the subjects' response to the prediction question and serves as a sort of confirmation for any hypothesis established by the prediction question. Statistical base-rates in previous research are often of this population ratio type (Kahneman and Tversky, 1972). However, Ajzen (1977) used a similar statistical base-rate about a researcher choosing to stratify a population such as was presented in statistical base-rates #1 and #2a, and also found lack of impact. Why it is that these results conflict with the Ajzen study finding of minimal impact of non-causal base-rate is a question that requires further research. It may be that subjects did see a "causal" aspect to the statistical base-rates; or it may be that because of the two non-causal base-rates which were used had explicit content related to the hypothesis subjects might have generated for confirmation. Possibly confirmation is not based upon whether or not information is causal, but whether it passes a cursory requirement of serving as a "because".
CHAPTER III
STUDY II

Method

Subjects.

The subjects were 80 undergraduate American students of both sexes in the "Year Abroad Program" at Hebrew University of Jerusalem. Participation was entirely voluntary, as it was with Study I. Subjects were recruited from a variety of courses and assigned at random and in equal numbers to the eight cells of the experimental design (10 subjects per cell).

Procedure.

Each subject was instructed to read an introduction sheet (see Appendix #1) which provided some information about the general health status of college age students. They were given one of six prediction problems which presented one base-rate, either causal or statistical and a case history about a coed named Deborah, i.e. indicant information. Two additional conditions offered the base-rate only, with no case history. Each subject answered only one question. They were instructed to make a judgment about the likelihood of the person in question contracting a particular illness. The question read, "What is the probability that Deborah will develop an upper respiratory infection?"

The causal base-rate read, "Records from Israeli University Health Services indicate that upper respiratory infections (common colds) are
the most common illnesses among all college age students. During the 1978-79 academic year, 70% of all female students contracted an upper respiratory infection at some time during the year. Only 30% of the female students did not."

The statistical base-rate read, "A nursing student at Hebrew University did a study on the health behavior of students. Because she was primarily interested in how women react to illness, she chose to interview mostly female students who had or were suffering from upper respiratory infections (common colds). As a result, 70% of her sample were women suffering from upper respiratory infections and only 30% of those she interviewed were women who were not."

In conditions 1, 2, 3, 5, 6, 7, the base-rate was followed by the indicant information, or case history of the coed, Deborah. Three different cases were presented. In the positive conditions (conditions 1 and 5) the protagonist was portrayed as very active, under much pressure, undernourished and generally prone to contracting upper respiratory infection. The positive condition read, "Deborah Cohen is a Hebrew University freshman who has an "undecided" major. She is interested in history but wants to be able to find a job after graduation. Consequently, she is carrying 18 credits for taking courses in several departments in order to get a feel for what is offered. She is struggling to maintain a B+ average. Deborah is very involved with social activities and feels a great deal of pull from both academic and social commitments. She finds little time to eat well and is slightly underweight. Deborah lives in the dorm and has two roommates."

The negative or non-confirming conditions (conditions 2 and 6)
present a coed as being in very good health, under mild pressure and consequently unlikely to contract an upper respiratory infection. The negative condition read, "Deborah Cohen is a Hebrew University freshman who has an "undecided" major. She is interested in history but wants to be able to find a job after graduation. She is carrying 12 credits and easily maintains a B+ average. Deborah is a health food enthusiast and enjoys cooking her own meals. She runs at least 4 kilometers a day to help her stay in shape. Deborah has a single room in the dorm."

The vague conditions (conditions 3 and 7) gave only a general description of the university coed. The vague condition read, "Deborah Cohen is a Hebrew University freshman who has an "undecided" major. She is interested in history but wants to be able to find a job after graduation. She is carrying the usual 12 credits and maintains a B+ average."

Pretesting was conducted in order to establish that the cases were in fact sufficiently strong to permit subjects to distinguish among them. Forty-eight undergraduates, not participants in the study itself, were asked to read one of the three case histories and make a judgment as to the likelihood of Deborah contracting an upper respiratory infection. There were 16 respondents for each history. The results for each condition ($\bar{X} = .55$ -- confirming or positive condition, $\bar{X} = .15$ -- non-confirming or negative condition, and $\bar{X} = .28$ -- vague condition) demonstrated a significant difference $F (2,45) = 23.55$, $p < .05$. The three were considered to be adequately divergent from one another. The finding from this pilot testing also provided the numerical weight for computing the predicting outcomes for the study itself by using Bayes'
Rule. The final two conditions presented merely the base-rates with no individuating information.

After reading the scenario, subjects were asked to predict the likelihood of Deborah developing an upper respiratory infection. Their judgments were measured on the following scale:

<table>
<thead>
<tr>
<th>0%</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all likely</td>
<td>Absolutely likely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Participants were allowed as much time as they wanted to complete the question and in no case did the amount of time exceed ten minutes. After all questionnaires were completed and returned, anyone wishing to discuss the study was invited to remain. And as with Study 1, a number of students at each administration session chose to remain and partake in the discussion. The content of the stimulus materials seemed to generate a good deal of interest and several students hoped the discussions could be a forum for seeking professional health advice.

Results

The results for Study 2 are presented in Table 2. The "hypothesis confirming" strategy that is suggested in this paper establishes differing predictions for each condition. Condition 1 and 3 provide causal base-rates that establish hypotheses which are "confirmed" by the positive and vague case histories. In these conditions it is predicted that both items of information will be used by subjects to generate the prediction. Condition #2 also provides a causal base-rate but it is
followed by a nonconfirming case history. It is suggested that this case history does not confirm the hypothesis established by the base-rate and consequently it is predicted that the base-rate will be ignored and only the case history used. Conditions 5, 6, and 7 provide statistical base-rates. Because they in no way lend support to the hypothesis established by the prediction question, they ought not to be used by subjects for making their predictions. Conditions 4 and 8 provide only a base-rate and in light of no additional information, it is predicted that subjects will use the base-rates given.

Alternatively the predictions that are established by use of Bayes' Rule suggest that for all conditions the causal or statistical nature of the base-rate is not relevant and the base-rates would be used to the same extent in combination with the numerical weight of the individual case-histories. For example, conditions 1 and 5 present the subject with a base-rate of 70% of all female students contract an upper respiratory and a positive case history that establishes Deborah has a .55 chance of contracting the illness herself. Denote females contracting the illness by I and females not contracting the illness by N. Denote the likelihood of Deborah contracting the illness by i.

\[
P(I/i) = \frac{P(I)}{P(I) \times P(i/N)} = \frac{P(I)}{P(N)}
\]

\[
= \frac{.55 \times .70}{.30 \times \frac{385}{135}}
\]

\[
P(I/i) = \frac{385}{135+385} = .74
\]

If subjects use a Baysian approach, their predictions about the
likelihood of Deborah contracting the illness, both the base-rate and case history, should be around 74%. For conditions 2 and 6 this percentage is 29% and for conditions 3 and 7 the percentage is 47%.

The most dramatic finding of the study is the lack of any difference between the causal base-rate and the statistical base-rate impact on the predictions. In all conditions they were used to relatively the same extent. Additionally, subjects seemed to "systematically" use both the base-rate and case history in making their predictions and did not follow the results predicted either by the theoretical model of the paper or Bayes' Rule. (See Table 2). For conditions 1 and 5 (positive case history) the means of .64 and .68 hover very close to 62.5, the results one would obtain through simple averaging of the two results one would obtain through simple averaging of the two pieces of data provided. Also, for conditions 2 and 6 (negative case history), simple averaging would result in 42.5, close to the obtained means of .48 and .45. Conditions 3 and 7 (vague case history) produce results, .68 and .67, startlingly like those found in conditions 1 and 5. Results of .34 and .36 for conditions 4 and 8 (no case history) correspond to the hypothesis that subjects use either causal or statistical base-rates accurately when no additional information influences them. Figure #2 presents the distribution responses for Study 2 and highlights the relatively small amount of variance. No significant statistical difference exists between causal and statistical base-rate use or among the results for the positive, negative or vague conditions F(5,54) = .09, ns. However, the mean results for the negative condition is quite a bit lower than for the positive or vague conditions. The lack of
statistical significance may be due to the small number of subjects tested in these cells.

Discussion

Several issues raised by the results will be explored. The first of these is the finding that subjects used the causal and statistical base-rates to the same extent. This is not consistent with either the predictions of this study or findings of previous studies which demonstrate that causal data have a greater impact in predictions than do diagnostic data (Ajzen 1977; Bar-Hillel, 1977; Tversky and Kahneman, 1977). At first glance this suggests that the entire notion that predictors use some form of hypothesis confirming strategy is erroneous. However, it may be that the causal link which must be established in this confirming process does not necessarily conform to an actual causal relationship but to a notion that people are able to "feel" something happened "because" of a certain situation and consequently see the data as lending support or confirmation to a notion or hypothesis.

Tversky and Kahneman (1977) discuss the idea that data must correspond to some preexisting causal schema and when they do, base-rates are used. They point out that an individual's causal schema represents an association between a cause and an effect in which the cause precedes the effect both logically and temporally; an individual's existing causal schema is one that connects earlier manifestations as a cause of subsequent manifestations of the same system. This outlines a notion regarding causality as more complex than that implied by
merely offering subjects a causal base-rate. A single isolated item of information cannot be viewed as "causal" unless considered in the larger causal schema. It may be just his conceptualization that helps sort through the discrepancy between the hypothesis of the study and the findings. Perhaps what is of importance isn't so much whether the base-rate is actually "causal" or not, but whether it is seen as explicitly related to the content area potentiating the prediction and consequently available as a piece of confirming information for the hypothesis generated. Cause may not be used by subjects in a fashion that is logically satisfying but in a way that corresponds to the notion of causal schema. Antecedent data from students about why they used or didn't use particular base-rates suggests a similar process at work for both causal and statistical base-rates.

"I used the information about girls getting sick (causal base-rate) because Deborah is a girl."

"I had to use all of the information because Deborah was like a student in that nursing study so it was more probably she'd get sick." (statistical base-rate).

Both of the base-rates related specifically to the content area (girls getting sick) and are viable items for support of a causal schema. The subjects seem to hold an hypothesis and any particular information which may help explain why the hypothesis is true.

In addition to the hypothesis concerning the use of causal vs. statistical base-rates, this paper put forth the contention that when individuating information is contrary to the causal notions suggested by the base-rate or not confirming of the hypothesis, the individuating
information takes priority over the base-rate and the base-rate is essentially ignored. However, it is clear that in all cases, subjects used both the individuating information and the base-rates. It may have been erroneous to assume that the notion of hypothesis confirming strategies would cause the total ignoring of a base-rate when followed by a case history in conflict or not confirming of that hypothesis. In fact, it now seems likely that if the subject supposes that what is to be predicted has happened (e.g., illness in Deborah), he/she searches for the information that might confirm or disconfirm why that may be, such as considering the high incidence of illness in women and Deborah's personal state of health. In the negative or non-confirming condition Deborah's state of health is perceived as quite good and it is of course a crucial assessment in making the prediction. But "because" women get sick quite often and a large percentage of ill women were interviewed, this must be taken into consideration. If the prediction question established an hypothesis (e.g., how likely is Deborah to develop an upper respiratory infection? -- becomes -- Hypothesis: "Deborah will contract an upper respiratory infection" the subject searches for plausible reasons why that may be even though she is "healthy." This parallels Snyder's (1979) findings that people go to great lengths in order to find data which confirm existing hypothesis. In this case it may not seem logical to say she's susceptible to developing an illness because she's in the nursing student's study but it does suggest a "because" link. It would be interesting to explore the results that would be obtained if the question had asked "How likely is she to remain well?".
Conditions 4 and 8 correspond to the hypothesis that subjects use either causal or statistical base-rates accurately when no additional information is provided, replicating a multitude of previous studies. People are able and do use base-rate when they have nothing else upon which to base their prediction.

In the vague conditions, subjects not only used the base-rates as well as the individuating information, but in some fashion increased either the impact of the base-rate in the prediction or increased the perceived likelihood of Deborah's vulnerability to contracting an illness. As discussed previously, pretesting had established the likelihood at $\bar{x} = .28$, whereas results for these conditions with the statistical or causal base-rate and vague case produced $\bar{x} = .67$. Regardless, the findings conform with those for the positive condition which was designed to confirm the hypothesis and encourage one to make a prediction that illness was likely to occur (pilot data -- $\bar{x} = .55$). Because the findings for the vague conditions are so close to the findings for the positive conditions, it seems reasonable to suggest that in some fashion the diagnosticity of vague indicant information is mediated by the causal base-rate provided; the likelihood ratio is therefore increased. Perhaps because the case is vague, once an hypothesis is established, subjects are allowed to use the given information in either direction as confirmation for the hypothesis. As long as the information does not directly invalidate the hypothesis, then conceivably it "supports" it. In this way the vague material may take on weighted value and in this case a positive one. This too seems consistent with the pervasive attempts by Snyder's subjects (1979) to
seek confirmation for their hypothesis using most un-useful forms of information. (It would be interesting to invert the statistical base-rate using the same vague case presentation in order to explore whether vague information is influenced in both directions.)

Abelson (1974), Ajzen (1977) and Tversky and Kahneman (1977) have suggested that individuals carry with them scripts or causal schemata that they apply to predicting events and occurrences in the world; that this is so seems likely. The notion of these scripts or schemata conveys a sort of stable or consistent overtime idea. However, what may look stable or constant because it is well defined and logically consistent may in fact be much more transient and a product of the continuous process of people always being directed to attend to particular information based on hypotheses that they generate in specific points in time.
One basic contention of this paper has been that the prediction task may undergo redefinition by people into one that establishes an hypothesis that requires confirmation by specific information. It was suggested that implicitly this altered task is one of attribution, or explaining why something "is" or "happened" in a certain way. The overall hypothesis made by the two studies contended that base-rates would be used if they were causal and additionally even causal base-rates would not be used if pertinent indicant information was not confirming of the hypothesis established by the base-rate. However, the findings of the two studies do not conform to these predictions. A critical analysis must be taken to explore what in fact may be producing the present results.

Initially, the "causal" nature of a base-rate must be considered. As was pointed out previously, (Ajzen, 1977) the distinction between what is causal and what isn't has been based largely upon researcher intuition. From the informal discussion with subjects, it seems that people tend to use information as a "cause" or "because" whether or not it actually possess a logical cause and effect relationship. The parallel finding between statistical and causal base-rates in all but one condition of both studies tends to confirm that indeed subjects regarded both types of base-rates as similarly relevant to them in their predictions. Consideration of the one condition in which subjects failed to use the statistical base-rate to the same extent as the
causal may be helpful in explaining the dynamic at work. In that condition (study 1, condition 2) the statistical base-rate presents a mere population ratio regarding the number of male and female students and it is in no way specifically related to the content of the prediction question. As such, it offers no information with which to confirm the hypothesis that might be established from the prediction question which is asked.

In Study 1 subjects were asked the probability that a person, selected at random from those with upper respiratory infections lasting in excess of two weeks was a male student. The two relevant items of content are males developing the illness and the duration of the illness for males, not the proportion of males and females. Subjects may consider the question to establish an hypothesis with clear dimensions of what one ought to consider in order to confirm its truth, and then attend to only those base-rates with that content.

In Study 2 the subjects were asked the probability that a particular student, Deborah would develop an upper respiratory infection. The hypothesis that might be generated would direct the subject to consider that information that would confirm illness occurring in Deborah; in other words, both the indicant information and base-rates on incidence of the illness.

Contrary to the present findings, Ajzen (1977) found that causal base-rates had a stronger effect on predictions than non-causal. However, his findings also indicated a significant effect for conditions that were presented "75% passed" as opposed to "75% failed." The question used to measure responses was "the probability that Gary W.
was among the students who passed the exam is ---%." In light of the present discussion the content of the question would recommend to subjects that they attend to information about Gary and passing the exam, not necessarily failing the exam. Perhaps this accounts for the variation in use of statistical and causal base-rates and may be consistent with the present analysis.

The findings of these studies are not those that were initially predicted. The discussion attempts to resolve the apparent conflict and offers an explanation for the results. The notion that the prediction question tells the subject what is relevant information to consider must, of course, be empirically tested. Snyder (1979) has pointed out that people tend to seek to confirm hypotheses as if those hypotheses were a reality. And Ajzen, Dalto and Blyth (1978) have pointed out that one's cognitive set may produce a tendency to interpret ambiguous information as consistent with the hypothesis in question. It follows that people might consider the prediction question (i.e. hypothesis) as real and use related ambiguous information as confirming.

It is unfortunate that non-significance is rarely reported in journals because it may be that other researchers have also had difficulty duplicating the lack of difference between causal and statistical base-rates. Recent studies under the direction of Pollatsek (1980) have had a similar experience in failing to replicate the causal/non-causal difference.

Contrary to conclusions from previous prediction studies, the findings of the present research indicate that when two base-rates are used, subjects' predictions conform quite well to a Bayesian analysis
and are consistent with the tradition that people form and revise beliefs in an orderly and rational fashion in accordance with normative principles of statistical models (see Slovic and Lichtenstein, 1971). However, such outcomes shed little light on the actual process one uses when predicting; how does the subject choose what information to use, and what form of expression does he use to combine that information? Reliance on paper and pencil questionnaires limits the understanding of the process and encourages conclusions drawn from results. It would be the essential next step for the theoretical process presented in this paper to be explored through in-depth interviews and discussion with subjects about their conscious rationale for decisions. Pollatsek (1980) has been doing studies in this fashion and has thus far found it a useful tool for understanding the subjects' thinking process.

Central to all of the issues raised by the present studies is the question of what is or is not "causal." A series of studies designed in a fashion that offered information to subjects in a range of content areas and asks them to make particular predictions and to explain why would be a first essential step. Wedded to this could be the attribution task, that is, to provide subjects with an hypothesis and ask them to determine what factors influenced its occurrence and why. It seems in this fashion both the problem of the causal link could be explored as well as its relationship to the proposal made by this paper, that part of the prediction task is hypothesis confirmation and somewhat attributional in nature.

A second area of study ought to center upon varying the specific content areas in the prediction question in order to see if use of
particular base-rates can be manipulated by the content of the question.

The third area might explore similarities between treating a hypothesis as a reality and seeking confirmation and the manner in which subjects use base-rates. It appears that the present limited research raises a number of questions more than it answers.
Table 1

The Mean Probabilities of Male Being Chosen at Random, Compared to the Predicted Means and Means Produced by Use of Bayes' Rule

<table>
<thead>
<tr>
<th>Type of base-rate&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Mean Probabilities (Results)</th>
<th>Thesis Predictions</th>
<th>&quot;Bayes'&quot; Predictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence of colds by sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>.57</td>
<td>.56</td>
<td>.56</td>
</tr>
<tr>
<td>Duration of colds by sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidence of colds by sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>.32</td>
<td>.30</td>
<td>.56</td>
</tr>
<tr>
<td>Sex distributions at Hebrew University</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Designed incidence by sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>.49</td>
<td>.75</td>
<td>.56</td>
</tr>
<tr>
<td>Duration of cold by sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Designed incidence by sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>.58</td>
<td>.56</td>
<td>.56</td>
</tr>
<tr>
<td>Designed duration by sex</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. n = 10 per cell; F (3, 36) = 9.72, p > .05
<sup>a</sup>Numbers in parentheses indicate the "condition number."
Table 2

Mean Probabilities of Deborah Contracting an Illness Under Different Experimental Conditions Compared to the Predicted Means and Means Produced by Use of Bayes' Rule

<table>
<thead>
<tr>
<th>Type of base-rate (^a)</th>
<th>Type of Indicant Information</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>Results</td>
</tr>
<tr>
<td>Incidence of colds in females (causal)</td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>.64</td>
</tr>
<tr>
<td>Designed incidence of colds in females (statistical)</td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>.68</td>
</tr>
<tr>
<td></td>
<td>*.74</td>
</tr>
</tbody>
</table>

Note.  \( n = 10 \) per cell

\(^a\) Numbers in parentheses indicate the "condition number."

* Denotes results one would obtain through use of Bayes' Rule.
Figure Captions

Figure 1: Distribution of responses for subjects' predictions using two base-rates. In this graph, the numbers in parentheses identify the condition; Md stands for Median; X stands for Mean. The range presented subjects runs from 0% to 100%.

Figure 2: Distribution of responses for subjects' predictions using one base-rate and indicant information. In this graph, the numbers in parentheses identify the conditions; Md stands for Median; X stands for Mean. The range presented subjects runs from 0% to 100%.
Figure 1
Figure 2
REFERENCES


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APPENDIX
University students are at risk for a range of particular health problems. The typical age span of 18 to 24 years predisposes students to contract certain illnesses and the nature of group living inherent in campus life enhances the spread of contagious disease. Information concerning the health behavior of students suggests that they are often either unaware of these problems or have difficulty using information to prevent or treat an illness once contracted. Usually illnesses for this group are mild and relatively self-limiting. However, a large number of students, because of risk factors such as general health status, diet, and stress and the like become quite ill and require hospitalization. Some may even develop chronic, long-term conditions. Prevention and early diagnosis would decrease the number of individuals whose illnesses become severe enough to require hospitalization. Students themselves are in the strongest position to prevent these diseases through early self diagnosis. It is important to be able to combine one's knowledge of an illness with predisposing factors and existing patterns in order to make a judgment about ways to avoid or restrict the severity of an illness.

In order to assess students' ability to take into account factors affecting contracting and treating an illness, you will be presented with information describing the prevalence of an illness and/or an individual case history of a university student chosen at random. You will be asked to make a probability judgment about occurrence of a particular illness.
After you have completed the questionnaire, you will be given information pertinent to understanding this process of diagnostic prediction.
APPENDIX 2

STUDY I
Condition 1

Records from Israeli University Health Services indicate that upper respiratory infection (common colds) are the most common illnesses among all college age students. During the 1978-79 academic year, 70% of all cases were female students and 30% were male students.

The percentage of upper respiratory infections that last in excess of two weeks is three times higher among male students than among female students.

What is the probability that a student, selected at random from those with upper respiratory infections lasting in excess of two weeks, was a male student?

<table>
<thead>
<tr>
<th>0%</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Absolutely likely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Records from Israeli University Health Services indicate that upper respiratory infections (common colds) are the most common illnesses among all college age students. During the 1978-79 academic year, 70% of all cases were of female students and 30% were male students.

At Hebrew University there are three times more male students than female students.

What is the probability that a student at Hebrew University, selected at random from those with upper respiratory infections, was a male student?

<table>
<thead>
<tr>
<th>%</th>
<th>0%</th>
<th>10%</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not at all likely</td>
<td>Absolutely likely</td>
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STUDY I
Condition 3

A nursing student at Hebrew University did a study on the health behavior of students. Because she was primarily interested in how women react to illness, she chose to interview mostly female students who had or were suffering from upper respiratory infection (common colds). As a result, 70% of her sample were women and only 30% of those she interviewed were male students suffering from upper respiratory infections.

Nationwide the percentage of upper respiratory infections that last in excess of two weeks is three times higher among male students than among female students.

What is the probability that a student selected at random from those with upper respiratory infections lasting in excess of two weeks was a male student?

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As it turned out, she was also interested in how the length of an illness effects males and females differently. Consequently she chose her subjects such that three times more male students than female students had upper respiratory infections that lasted in excess of two weeks.

What is the probability that a student selected at random from those with upper respiratory infections lasting in excess of two weeks, was a male student?

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STUDY II

Condition 1

Records from Israeli University Health Services indicate that upper respiratory infections (common colds) are the most common illnesses among all college age students. During the 1978-79 academic year, 70% of all female students contracted an upper respiratory infection at some time during the year. Only 30% of the female students did not.

Deborah Cohen is a Hebrew University freshman who has an "undecided" major. She is interested in history but wants to be able to find a job after graduation. Consequently, she is carrying 18 credits and taking courses in several departments in order to get a feel for what is offered. She is struggling to maintain a B+ average. Deborah is very involved with social activities and feels a great deal of pull from both academic and social commitments. She finds little time to eat well and is slightly underweight. Deborah lives in the dorm and has two roommates.

What is the probability that Deborah will develop an upper respiratory infection?

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STUDY II
Condition 2

Records from the Israeli University Health Services indicate that upper respiratory infections (common colds) are the most common illnesses among all college age students. During the 1978-79 academic year, 70% of all female students contracted an upper respiratory infection at some time during the year. Only 30% of the female students did not.

Deborah Cohen is a Hebrew University freshman who has an "undecided" major. She is interested in history but wants to be able to find a job after graduation. She is carrying 12 credits and easily maintains a B+ average. Deborah is a health food enthusiast and enjoys cooking her own meals. She runs at least 4 kilometers a day to help her stay in shape. Deborah has a single room in the dorm.

What is the probability that Deborah will develop an upper respiratory infection?

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STUDY II
Condition 3

Records from the Israeli University Health Service indicate that upper respiratory infections (common colds) are the most common illnesses among all college age students. During the 1978-79 academic year, 70% of all female students contracted an upper respiratory infection at some time during the year. Only 30% of the female students did not.

Deborah Cohen is a Hebrew University freshman who has an "undecided" major. She is interested in history but wants to be able to find a job after graduation. She is carrying the usual 12 credits and maintains a B+ average.

What is the probability that Deborah will develop an upper respiratory infection?

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STUDY II
Condition 4

Records from the Israeli University Health Service indicate that upper respiratory infections (common colds) are the most common illnesses among all college age students. During the 1978-79 academic year, 70% of all cases were of female students and 30% were male students.

What is the probability that a student, selected at random from those with upper respiratory infections, was a male student?

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What is the probability that Deborah will develop an upper respiratory infection?

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STUDY II
Condition 6

A nursing student at Hebrew University did a study on the health behavior of students. Because she was primarily interested in how women react to illness, she chose to interview mostly female students who had or were suffering from upper respiratory infections (common colds). As a result, 70% of her sample were women suffering from upper respiratory infections and only 30% of those she interviewed were women who were not.

Deborah Cohen is a Hebrew University freshman who has an "undecided" major. She is interested in history but wants to be able to find a job after graduation. She is carrying 12 credits and easily maintains a B+ average. Deborah is a health food enthusiast and enjoys cooking her own meals. She runs at least 4 kilometers a day to help her stay in shape. Deborah has a single room in the dorm.

What is the probability that Deborah will develop an upper respiratory infection?

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STUDY II

Condition 7

A nursing student at Hebrew University did a study on the health behavior of students. Because she was primarily interested in how women react to illness, she chose to interview mostly female students who had or were suffering from upper respiratory infections (common colds). As a result, 70% of her sample were women suffering from upper respiratory infections and only 30% of those she interviewed were women who were not.

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What is the probability that Deborah will develop an upper respiratory infection?

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What is the probability that a student selected at random from those with upper respiratory infections was a male student?

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STUDY II
Condition 8