Multiple Causes and the Discounting Principle

A Linear or Nonlinear Function?

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Portia Payne

Portia L. Payne

Approved, May 1985

Kelly G. Shaver

Kelly G. Shaver, Ph.D

Deborah Foss-Goodman

Deborah Foss-Goodman, Ph.D

Neill Watson

Neill Watson, Ph.D

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ABSTRACT

Although Kelley (1973) argued that causes would be discounted in direct proportion to their number, Shaver (1981) suggested that because of combinations, the discounting function should be nonlinear. A third alternative (Shaklee & Fischhoff, 1977) suggested that the search for a cause ceases once a sufficient explanation is found for an event. A story describing the hiring of a senior executive for a small business firm was presented to 77 male and 78 female undergraduate students using an interactive computer program designed specifically for the research. After being given one of three sets of instructions, 12 possible causes for the hiring decision were listed by the program. The subjects were then informed that only a randomly selected 3, 6, 9, or 12 of these multiple sufficient causes actually entered into the hiring decision. The mean causality assigned to each causal element was compared across conditions. Results showed no effect for the number of causal elements presented to the subjects, supporting none of the theories. Results demonstrated that instructions did have an effect on the causality judgments, indicating the need for further research.

Multiple Causes and the Principle of Discounting:

A Linear or Nonlinear Function?

INTRODUCTION

Very few events or behaviors are explainable by one cause; therefore, a fundamental task for attribution theory is to describe how multiple causes might be thought to combine. But often single factors _are_ identified as "the cause." This tension leads to the question about how causes combine. If the attributor is able to gather information over time, through repeated observations, he or she can then rely on the analytical method of covariation (Kelley, 1973) to simplify the decision. The attributor makes his causal decision by applying the principle that "An effect is attributed to the one of its possible causes with which, over time, it covaries" (1973, p. 108).

This requires multiple observations of the effect, but the attributor is also able to make causal decisions by applying the principle of covariation along the source dimensions--entities, persons, and time/modality. Each dimension has its own criterion; distinctiveness, consensus, and consistency, respectively. As an example of the use of the criteria, an internal state of satisfaction following the hiring of a new employee would be attributed to the employee if the attributor found the new employee to be exceptionally bright (distinct from the other potential hirees), if the employee presented himself as an exceptionally bright person when meeting with both staff and the board of directors (consistency), and if other members of the management team agreed on the exceptional brightness of this particular employee (consensus). These three dimensions collectively account for the majority of variance in open-ended attributions of causality (Elig & Frieze, 1975), establishing the value of this classification system (Shaver, 1981).

On the other hand, when there is only a single instance of an event, there must be some other guiding principle for distinguishing causes from conditions. Modern philosophical discussions of causes and conditions usually begin with reference to Mill's (1888) account, which states that the sum of the positive and negative antecedents of an effect compose the sufficient condition for the effect. He emphasized, however, that people often arbitrarily label the conditions (or condition) as the cause. But are peoples' selection of causes among conditions really so arbitrary? In order to answer this question, it is important to redefine cause using the terms set forth by a more recent philosopher, Collingwood (1940).

Collingwood distinguished three types of causes. In the first, historical sense, what is caused is a "free and deliberate act of a conscious and responsible agent and 'causing' him to do {the event} means affording him a motive for doing it" (p. 285). This sense of the word cause is more appropriately used in a discussion between causes and reasons, than here, within a description of how multiple causes might combine. Note, though, that Buss (1978) urged psychologists, especially attribution theorists, to draw the distinction conscientiously between causes and reasons in order to identify valid attributions. According to Buss, Collingwood's "free and deliberate . . .," behavior is intended behavior, an action explained by the actor by citing reasons, by the observer by citing causes and/or reasons.

The third sense of the word cause describes cause and effect relationships in nature, independent of human action, so it is not important for present purposes and will not be dealt with here. In Collingwood's second, practical science sense of causality, human intervention plays an integral role. What is caused "is an event or state of things which is in our power to produce or prevent, and by producing or preventing which we can produce or prevent that whose cause it is said to be" (1940, p. 285). A weighty definition, but what is important here is the idea of controllability. Collingwood views man as a manipulator for his own intentions, of both nature and other men.

Although Collingwood defines cause by distinguishing three different senses of the word, the important point here is that people can and will extract different causes for an event from the same set of antecedent conditions. While Collingwood agrees with Mill that causes are selected differentially, he does not agree that this selection is an arbitrary one. A principle is derived from this view: the relativity of causes. For any given person, the cause of an event is not an arbitrarily chosen condition, but it is that one antecedent condition that the person feels is relative to his personal control. For example, a woman interviews for a job, and is not hired. If an associate told her that she was not selected for the job because the depressed state of the world economy in recent years has created a demand for highly specialized technical workers, the woman will not be satisfied as to why she did not get the job. She <u>would</u> be satisfied, however, with the explanation that someone with a solid background in personal computer data analysis was hired for the job. The woman had no sense of control over the state of the world economy, but she did have control over her education and technical skills.

Collingwood's explanatory contribution to cause and effect has been criticized for its naivete (Gorovitz, 1965) but the points brought out within his principles are important because they bring causality to a more personal level. The perceiver's viewpoint will affect his or her causality judgments. Collingwood's principle of relativity of causes also emphasizes the subsequent importance of control. The attributor seeks knowldege not for its truth, but for the control that its power affords. The analogy of man as a naive scientist is used by Kelley (1972) to explicate man's attempt to organize the world around him into forms that he can understand. Knowledge may give power, but understanding gives a sense of control.

Selecting the cause from among the conditions may be a difficult task when there is only a single instance of the event or behavior. Causes and conditions co-exist within the same parameter--the entire set of antecedent conditions. Causes and their effects do not occur in a vacuum. The person cannot stop a situation, composed of causes, conditions, relevant histories, and irrelevant factors, in order to isolate a single cause and effect. Yet, the inquiry into causation is not an inquiry into laws. Rather, necessarily, the inquiry is concerned with single, individual events (Ducasse, 1924).

What is needed is a mental process that may unite conjoined perceptions of causes, conditions, and effects into a pattern, thereby aiding the observer in his comparisons and subsequent decisions. Such a simplification principle is embodied in Kelley's (1973) notion of causal schema--an assumed pattern of data that relates the partial information available to the individual's past experience and beliefs of how certain kinds of causes might interact to produce an effect. Though Kelley postulates a variety of schemata, only two will be addressed here.

When more than one antecedent is required to produce an effect, the multiple necessary cause schema is invoked. For example, a salesman for a computer firm receives a large bonus check not just for contracting with three new, large accounts (salespeople are expected to produce new growth within their territory), but also because he sold all of his existing accounts the idea of upgrading their computer systems. This kind of schema, for multiple necessary causes, allows the inference that more than one cause was present. Only two causes are used in the example, but it should be noted that "multiple" here may indicate any number of causes.

Multiple necessary causes make the attributional analysis fairly straightforward: Occurrence of the effect indicates that all of the causes were present. Identifying the presence of a single cause or multiple causes is more complicated when the effect has multiple <u>sufficient</u> causes. Assuming an effect or behavior that could have been brought about by either of two causal elements, the effect can actually produced in <u>three</u> ways.

The first causal element could produce the effect alone, the second could produce the effect alone, or both causes could be present for the effect (Shaver, 1981). For example, a man interviews for a position, and is hired. The personnel director with whom he interviewed remarked during the interview that the man's recommendations were very impressive, and also that his knowledge of data analysis far exceeded that of the other applicants. Which characteristic got him the job? Or could it have been a combination of the characteristics?

As a guiding principle in the instance of multiple sufficient causes, Kelley suggests the <u>discounting</u> principle: "The role of a given cause in producing a given effect is discounted if other plausible causes are also present" (p. 113). Each sufficient cause will be discounted as the explanation for the effect in direct proportion to the number of alternatives (Shaver, 1975).

The notion of causal schema and research of the concept were recently criticized by Fiedler (1982). While he acquiesced that the concept of causal schema is an important one, he contended that the concept is used in a circular manner, not discerning the actual encoding process of the stimulus information and subsequent attributions. He reviewed research in the area (e.g., Cunningham & Kelley, 1977; Shaklee & Fischhoff, 1977; Smith, 1975) and criticized the tenuous basis for the concept of schemata as being merely a report of the relationships between verbal concepts established by the experimenters in the beginning moments of the research studies. Fiedler cited the Shaklee & Fischhoff (1977) experiments as typical research designed to reveal the discounting process. The experiments will be summarized here, as their research is also used in testing the central theoretical hypothesis in this study.

Subjects in the Shaklee and Fischhoff (1977) experiments were asked to estimate probabilities of the causes of 24 separate events, such as "Susan made made a $25 donation to a cancer research fund." Depending on the experimental condition, subjects were given either one possible cause for the event, ("Susan often gives money to charities",) or two possible causes for the event, ("Susan often gives money to charities and someone close to Susan recently died of cancer"). In the third condition, subjects were informed that one cause was <u>known</u> to have produced the event, and another cause could have possibly produced that event, such as the fact that Susan's friend died of cancer causally influenced her donation, but Susan's charitable disposition was an uncertain influence.

The probabilities assigned to the one possible cause were lower when it was paired with either a known cause or a possible cause than in the two possible causes condition. The multiple sufficient cause schema would predict that a second possible cause would decrease the probability that the first possible cause produced the effect. The results conclusively indicated that discounting did not occur when an alternate (possible) cause was given as the explanation for the event.

Fiedler contended that the subject in these experiments was being asked merely to recall the semantic relations initially established by the experimenter. While Fiedler criticized the research methodology, Shaklee (1983) defends it, and, in turn, criticized the multiple sufficient schema as an explanatory concept of causal judgments. It is interesting to note that the very research Fiedler criticizes is interpreted by Shaklee as adequately falsifying the discounting principle.

It is empirically indicated, according to Shaklee & Fischhoff (1977), that another principle is guiding the causal decision process when there are multiple sufficient causes, and they have labeled it the principle of minimum causation. Their research, along with that of other investigators (Kun & Weiner, 1973; Smith, 1975), has produced results that propose that subjects do not indicate <u>uncertainty</u> about the presence of a second cause when one cause is known, which is what the discounting principle would predict. Rather, subjects indicate <u>certainty</u> about the <u>absence</u> of the second cause. For example, Kun and Weiner (1973) gave subjects information concerning task difficulty and task outcome (success or failure). The subjects were then given information about the one personal determinant causing the success or failure, either ability or effort. The subjects were then asked to give attributions of the certainty that one personal cause (ability or effort) was a determinant of the outcome, given knowledge about the presence of the other personal cause. Again, contrary to the predictions of the discounting principle, subjects were no more uncertain about the role of the first possible cause when it was paired with a second possible cause than when it appeared alone. Rather, the second cause was judged to be irrelevant.

Current research by Shaklee & Fischhoff (1982) explains these results in terms of an information-search paradigm. When given the opportunity, subjects did not ask themselves about a potentially relevant cause when they knew the role of one cause in producing the effect. This lack of information gathering was termed a "truncated search." It is inferred from these results that causal analysis ceases once any one sufficient cause has been established. Alternative causes, possible in a multiple cause condition, would be rejected, held in ambiguity, or would not be considered at all (Shaklee & Fischhoff, 1982).

One of Fiedler's (1982) primary contentions was that the notion of causal schema could acquire conceptual status (rather than explanatory status) only through the confirmation of predictions that could not have been made in its absence. But showing that a conceptual idea is "better" than common sense is only one way to demonstrate its predictive power. Another way is to compare it to an alternative theoretical idea. When the question is "How much will a particular cause be discounted if other plausible causes are also present?" another possible explanation of the principle will be contrasted here to the minimum causation principle of Shaklee (1976). That alternative is the "multiple discrete causes" theory of Shaver (1981).

While Shaver's (1981) theory addresses the question of presence or absence of a cause, the premise begins from a differnt theoretical perspective. This perspective is built upon identification of an inherent weakness in Kelley's (1972, 1973) discussions of multiple plausible causes. That weakness lies in defining one of causal schemata's central conceptual terms in two disparate ways.

According to Kelley (1972, 1973), a cause may influence behavior by virtue of variations in its strength, or by its presence-absence. In order to emphasize that these are indeed two different types of causes, Shaver (1981) has labeled the former a continuous cause, and the latter (present or absent) a discrete cause.

Theoretically, as well as conceptually, a choice must be made between the two, and in the simplest categorical terms of Aristotelian efficient causes, a continuous cause can be neither a cause nor a noncause (Shaver, 1981). Various strengths are not measured on a causal continuum. Rather, each variation may constitute a cause in and of itself, and that particular variant may bring about the effect by its presence. The cause may then be identified as a discrete cause, and, according to Shaver (1981) discrete causes are the kinds of causes implicitly present in the multiple sufficient causal schema.

The multiple discrete causes theory is based on the assumption that events regarded as "the cause" are among several causal elements that together combine to form the sufficient cause for the occurrence of an event. For example, many times faulty wiring is said to have caused a fire. But faulty wiring may cause a fire only if flammable materials and oxygen are present (Jones, 1973). And, while the flammable materials and the presence of oxygen are causally relevant to the occurrence of the event, there are also causally irrelevant events present in this, (and in any), situation. The fact that the building was an office building, for example, is not relevant to the starting of the fires. Identifications of causally irrelevant events are logical designations, not necessarily attributional ones (Shaver, 1981).

Given the general conditions for the occurrence of an effect, and knowing that discrete causes rarely occur in total isolation, the possibility of causal subsets is deduced. Taking into consideration only causally relevent conditions, the subset consisting of causal elements able to bring about an effect, labeled by Shaver (1981) as a minimal sufficient causal subset, must meet two criteria.

First, the subset must produce the effect. Second, each element of the subset must be what Mackie (1965) calls <u>nonredundant</u>: it must be able to produce the effect in concert with other elements, but must not be able to produce the effect by itself. Every cause is discrete, and, in conjunction with the other elememts of the minimal sufficient causal subset, contributes to the creation of the effect (Shaver, 1981).

A minimal sufficient subset consisting of internal, relevant causes is present, as is a minimal sufficient subset of external causes. A <u>redundant causal</u> subset therefore exists: The union of these two minimal sufficient subsets (Shaver, 1981). Considering these premises, the discounting principle can be restated: The role of a given minimally sufficient cause in producing a given effect will be discounted to the extent that other minimally sufficient causes are also present (Shaver, 1981). The change from Kelley's original theory may sound slight, but there is one very important difference.

In Kelley's view of multiple sufficient causes discounting should increase as a linear function of the number of other causes present. In the present model, however, if people consider not only the nonredundant subsets, but also the redundant subsets, discounting should increase as a geometric function of the number of nonredundant minimally sufficient causes. Specifically, when multiple causes are present, the discounting principle concerns itself with the distributive weighting of each potential cause.

Recall that with two causes, there are three ways to produce an action, not two ways. The attributor may combine the causes present; each cause would then be weighted to distribute the amount of redundant information made available by the combination of events. Because the number of possible combinations increases geometrically with increasing numbers of elements within the minimal sufficient subsets, the resulting discounting function should be nonlinear.

In order to test these hypothesis, a study was designed to manipulate the number of elements within the causal subset (Payne & Shaver, 1984). Specifically, subjects read and reacted to a story designed to manipulate the number of causes given by a personnel manager for hiring a newly employed executive. The cover story read that although the person had acceptable scores on 12 characteristics important to any hiring decision, only a subset of those 12 had actually differentiated the chosen candidate from the other potential hirees. The major independent variable in the study was the size of this subset: 2, 6, or 10 elements. Subjects were given 100 causality points to divide among the characteristics presented in the condition (2, 6, or 10 characteristics). Subjects were also given an "Other" category to which to assign points if they felt that the characteristics presented did not represent all of the influence in the hiring decision, and were also told that they did not need to use up all of the causality points. Confidence ratings were taken after each cause had been rated for importance, in order to examine how subject's confidence might vary as a function of the different causal element set sizes.

The materials were displayed on a cathode ray tube computer terminal, connected to the university's mainframe interactive computer, using a Pascal program written specifically to conduct the research. The program presented the story, randomly assigned subjects to conditions, and collected the causality judgments.

The only significant effect was for the number of causes, demonstrating that the number of elements within a causal subset had some differential effect on the mean number of tokens assigned to a cause. This was contrary to the predications made by the minimum causation theory. The mean confidence rating did not produce any significant effects. Yet interestingly, across all conditions, confidence closely approximated the mid-point of the scale ($\underline{M}$ = 4.61

on a seven point scale).

To test the competing linear versus nonlinear hypotheses, a trend analysis was performed on the data, and while the analysis revealed a significant linear component, it also revealed a nonlinear component that did not reach conventional levels of significance. The present study was designed to examine this nonlinear component. Several changes were made in the research design.

Additional causal subsets were added which provided more data points for the causal element variable. Causal subsets consisting of 3, 6, 9, and 12 causes were randomly presented to the subjects. And, while the subjects were still given 100 causality points to which to assign the characteristics, they were instructed that <u>each</u> characteristic could possibly be assigned a total of 100 causality points. This modification served to lift the previous restriction of having to divide the points among the characteristics. An additional variable was also added, that of instructional set. One set of instructions emphasized that single causes often produce events, one set emphasized that combinations of causes may produce events, and the third instruction set gave no explicit prompting. Subjects in the third, no instruction condition served as a control group, to see if people "ordinarily" combine causes, or consider them individually.

Method

Subjects

Subjects were 78 male and 79 female undergraduate students enrolled in introductory psychology courses at the College of William and Mary. Participation in this study partially fulfilled a course requirement. Five subjects were run in mixed-gender sessions.

Stimulus Materials

All subjects read and reacted to a story designed to manipulate the number of causes claimed to have influenced a personnel manager in hiring a newly employed executive. The description included 12 characteristics that, so the cover story claimed, have proven to exhaust nearly all of the information that could be used in a hiring decision. The 12 characteristics presented were: organizational skills, enthusiasm, poise, knowledge of computers, grooming, attractiveness, steadiness of work record, strength of recommendations, vocabulary skills, sense of humor, appropriateness of dress, and voice quality.

Extensive pretesting had established the plausibility and importance of these 12 causes. The story noted that although the person hired had "acceptable" scores on all 12 characteristics, only a limited subset of the 12 had actually constituted the deciding factor in favor of the candidate chosen. The major independent variable in this study was the size of this limited set: 3, 6, 9, or 12 from the total set of 12 characteristics, as the number claimed to have been used by the personnel manager.

Apparatus

The materials were displayed on a cathode ray tube (CRT) computer terminal, connected to the university's Prime 850 computer using a Pascal program written specifically to conduct the research. The program was designed to present the stories, randomly assign subjects to conditions, obtain the causality judgments, and create a cumulative data file of the subjects' responses and biographical information. Development of the program is described in Powell, Shaver, and Payne (1985).

Procedure

Upon arriving at the designated meeting room, subjects were informed that they would be taking part in a causal judgment study, and that a CRT wuld be used instead of a paper-and-pencil questionnaire. Five subjects were run in mixed-gender sessions. Subjects received the customary introduction regarding consent, and the consent forms were then signed and collected.

Cross-cutting the causal conditions was a manipulation of instructional set with three different levels, and subjects were given one of the three sets of instructions. In a single-causes condition the instructions emphasized the role that individual causes play in bringing about effects. In a combined-causes condition the instructions explicitly noted that in many cases causes combine to produce effects. Finally, in a control conditon there were no explicit references either to single causes or to combinations.

In this control condition, subjects were given the following instructions:

> Looking for the causes of events is something we clearly do all the time. For example, think of the last time your roommate was in a bad mood. Didn't you try to understand why?

When you leave college, chances are many of you will go into some type of business environment. On the job, your performance will be evaluated, and you may or may not get salary increases. Wouldn't you search for the causes of getting a poor raise, or no raise at all?

It is obvious that causal explanation is an important process. But we do not know how these judgments are made. The research that we are conducting is an attempt to clarify the process one goes through in finding the causes of events. Because so little is currently known about the process, we have to begin by simplifying it, and controlling it as much as we can. So we will ask you to explain a simple event that has more than one plausible cause. And that is what we're going to do tonight. First, we will provide you with the event, and then with the possible causes. We're going to list the possible causes, and get you to tell us how important each possible cause is. Specifically, we will ask you to evaluate an executive hiring decision made by a personnel director.

In the single-causes condition, several different causal explanations were given for the example situations noted in the first two paragraphs of the instructions. "Was it because he/she may have failed an exam? Was it something you had done? Trouble at home? All have to do with causes of your roommate's bad mood and your trying to understand why," were used as single-cause examples in the first paragraph. Within the second paragraph, instances of possible causes affecting a salary increase were given: "Was it your productivity? Your attitude? The way you dressed?"

The combined-causes instructions emphasized that, in these situations, causes may have combined to bring about the effect. In the first paragraph of instructions, "Perhaps the roommate's bad mood was a combination of things, such as a bad grade coupled with trouble at home, or even these two combined with something you had done." And, in the second paragraph, "Or could it have been a combination of factors--perhaps both your productivity and your attitude together could have affected the boss's impression of you." In addition, these subjects were also told, "Keep in mind that individual causes can also combine with one another," in the sentence immediately preceding obtaining consent for their participation in the study.

Subjects were then taken to a terminal room, and were seated at a terminal. An assistant had previously switched on the terminal and entered the subject's identification number, which caused the instructions to be displayed on the screen.

The program displayed the story, the possible causes and the subset selected, all at a pace controlled by the subject. At several points subjects were asked questions and prompted for answers. The program was designed to tell the subjects exactly when and which keys to type in response, and it terminated if an inappropriate response was given. Because different set sizes needed to be presented to the subjects in order to test the predictions of the three theories (Kelley's, Shaver's, and Shaklee & Fischhoff's), the program was written to randomly select elements according to the set size, not the specific elements. The program also presented each subject with a different group of elements, thereby ensuring that no experimental artifacts would result from response to any specific characteristics. Subjects were given up to 100 "causality points" to designate to each characteristic presented (3, 6, 9, or 12 causes). They were also given an "Other" category to which to assign points if they felt that the characteristics presented did not represent all of the influence on the personnel manager's decision.

Subjects answered questions designed to reveal the discounting process, such as, "This personnel manager's decision was based only on the three characteristics denoted by the asterisk. How important do you believe each one of these characteristics was in influencing the manager's hiring decision?" After each cause was rated for importance, the next cause was presented. At any point during the program the subjects were also given the opportunity to see the complete list of characteristics by typing in a code number. The subjects were also asked to give a confidence rating (1 = not confident at all, 7 = extremely confident) of their attributions of importance to each cause. This confidence question was designed to measure the hypothesized inverse function of confidence and the number of causes present. After all of the causes were shown for a particular condition, subjects were asked to rate how confident they were that the personnel manager had made a good decison in hiring the candidate who had been described by the characteristics within the scenario. At the end of the program, subjects were instructed to notify the experimenter. The subjects were then thanked for their participation and excused.

Results

Recall that Kelley's (1973) principle predicts that discounting should increase as a linear function of the number of other causes present. In Shaver's (1981) model, discounting should increase as a geometric function because of combinations made available by the increased number of elements within a minimal sufficient subset. The principle of minimum causation predicts that the number of causes given in a scenario would have no differential effect on the mean number of causality points assigned to the characteristics. In addition to testing these hypotheses, the present study attempted to assess the effect of instruction (none, single-cause, combined) on causality judgments.

Mean causality judgments, as presented in Table 1, were calculated by summing the number of causality points assigned to each characteristic by the subject. Points assigned to the "Other" category were not included in this sum. This total was then divided by the number of characteristics presented to the subjects per condition (3, 6, 9, or 12).

A 4 x 3 (Number of Elements x Instructions) analysis of variance was conducted on the mean number of causality points shown in the upper portion of Table 1.

Insert Table 1 about here

Contrary to all theories noted above, the analysis revealed no significant effects attributable to the number of elements. Although no specific prediction was offered, there was a significant main effect for instruction, F (2, 145) = 3.90, $p < .05$. Orthogonal comparisons revealed that there was no significant difference between the no instruction and combined-causes instruction conditions, F (1, 133) = .01, $p > .10$, (M = 58.81 for no instruction vs. 58.31 for combined-causes instruction), but subjects who were given single-cause instructions had significantly lower causality judgments than those given the combined-causes instructions (M = 58.31), F (1, 133) = 5.48, $p < .05$ or no instructions (M = 58.81) subjects, F (1, 133) = 6.66, $p < .05$.

An analysis of variance was performed on the mean confidence rating assigned to each cause. These means are presented in the lower portion of Table 1. There was a significant instruction. by condition interaction, F (6, 145) = 2.80, $p < .05$. This interaction is illustrated in Figure 1.

Insert Figure 1 about here

In order to isolate the source of this significant interaction, simple main effects for number of elements at each type of instruction were examined. For the no instruction condition, there was no significant effect for causes. In the single-causes instruction condition, there was a significant effect of causes, $\underline{F}$ (3, 145) = 5.63, $\underline{p} < .05$. To break down this significant effect further a trend analysis was conducted on the number of elements, revealing a significant quadratic component, $\underline{F}$ (1, 133) = 6.57, $\underline{p} < .01$. As can be seen in Figure 1, in the single-causes instruction condition, from the six to nine causes conditions there was an increase in confidence, which tapers off in the 12 causes condition.

There was also a significant simple main effect of number of elements for within combined instructions, $\underline{F}$ (3, 133) = 4.62, $\underline{p} < .05$. Two significant components were identified when a trend analysis was conducted on this effect. The quadratic component was significant, $\underline{F}$ (1, 133) = 5.38, $\underline{p} < .01$. The cubic component was also significant, $\underline{F}$ (1, 133) = 3.78, $\underline{p} < .01$. Both of these nonlinear trends are illustrated in Figure 1. Based on these results, there appears to be an area from the six cause condition to the 12 cause condition where confidence is differentially affected. Evidently, a different process is superimposed over the initial linear rise in the confidence curve.

Simple main effects were also examined for instructions at each causal element subset. The only significant simple main effect occurred at six causes, $\underline{F}$ (1, 133) = 19.04, $\underline{p} < .01$. Specific comparisons within this causal subset indicated that the no instruction condition ($\underline{M}$ = 4.99) had significantly lower confidence ratings than either the single-causes condition ($\underline{M}$ = 5.62), $\underline{F}$ (1, 133) = 6.15, $\underline{p} < .05$, or the combined-causes condition ($\underline{M}$ = 6.12), $\underline{F}$ (1,

133) = 18.97, $p < .001$.

Discussion

The conceptual interpretations of the discounting principle are varied. Each interpretation is an attempt to operationalize the principle. But not all of these conceptualizations seem equally plausible in light of this research. While this study may have planted more trees in the forest (via the significant effects for instructional sets), it also weeded out some of the dense underbrush to enable a clearer view of the issues involved in describing the discounting principle.

The purpose of the three instructional sets was to identify how subjects naturally responded when faced with a decision involving multiple sufficient causes in comparison to how they responded when they were told to combine causes. Because there was virtually no difference between the attributional judgments made by subjects when they were given no instructions (M = 58.31), and when subjects were instructed to combine causes (M = 58.81), it appears that subjects do indeed form combinations, supporting Shaver's (1981) theory of multiple discrete causes. The finding that subjects who were given the single-causes instructions gave significantly lower causality judgments than both the control condition and the combined-causes instruction condition supports this hypothesis: Causes considered singly were judged to be less important than those in combination.

The "conjunction fallacy" introduced by Tversky and Kahneman (1974) also provides support for this view. They have found that subjects assign greater probability to conjoint assertions than is objectively possible based on the probability that either one alone is true. The conjoint statement implies that each of its components are true, yet each component only makes a statement about its own probability. The multiple discrete causes theory explains this inflated probability as the result of the addition of combinations. For example, a "third" cause results fom uniting two (or more) plausible causes.

This support is qualified by the lack of effect attributable to the number of elements given in a causal subset. These results are similarly ambiguous with regard to Kelley's (1973) interpretation of the discounting principle. But lack of evidence for the discounting effect did not substantiate Shaklee & Fischhoff's (1977) theory of minimal causation. On the contrary, in all conditions, subjects used all of the information that they were given, rather than dismissing it once a sufficient cause had been identified. This conclusion must be qualified regarding the theory of minimum causation: the instructions implied that all of the characteristics were important. This perhaps prevented the subjects from identifying any one cause as the sufficient cause, and consequently disregarding subsequent causes.

Perhaps these subjects were not differentiating between the plausible causes presented to them. Perhaps they were not considering the sufficient property that the causes were meant to exhibit. They may have been relying on representativeness, a heuristic principle suggested by Tversky and Kahneman (1974) to guide them in their causal judgments. They were told that all of the characteristics given (within the scenario) were important. In terms of representativeness, the subjects were told that the outcome (the hiring decision) was a good match with the input (the particular characteristics). But perhaps the subjects then viewed the input indiscriminately, as a whole causal entity, rather than several differentially weighted parts.

An inverse function of confidence and number of plausible causes appeals not only to common sense, but is also well-founded in theory (e.g., Jones & Davis, 1965). The presence of alternative explanations for an event makes the importance of each plausible explanation ambiguous. Yet, this effect occured only in an interaction with instructional set, and then only for two of the instruction conditions (single and combined causes). In the single-causes instructional set, it appears that subjects were using the additional information provided by the three additional characteristics from 3 to 6 causes conditions, and that this additional information increased their confidence in the causal judgments they made concerning the importance of the characteristics. But, with the addition of even more information (from 6 causes to 9 causes to 12 causes), their confidence waned. This indicated support for the hypothesis that additional information served only to make the role of the characteristics ambiguous. Within the combined-causes instruction condition, confidence was also differentially affected by the number of causal elements presented. Given that both the quadratic component and the cubic component were significant indicates that the confidence that was gained from the presentation of 6 causes (from 3 causes) was detrimentally affected by the addition of more information (9 causes and 12 causes).

It is interesting to note that the function of the curves for the confidence variable in the single-causes instruction condition and the combined-causes instruction condition are similar, and both differ substantially from the function of the no instruction condition. The similarity in the single-causes and combined causes instruction set curves (as illustrated in Figure 1) may indicate that a definite instructional set prompted the subjects to use some type of information processing strategy. The no instruction condition did not cue the subjects to use any strategy and therefore they considered all of the information equally, and became more confident of their decisions as the amount of information increased. The differences in the instruction sets at the six causal element condition brings to mind George Miller's (1956) article about the "magic" number seven (plus or minus two). Subjects might have been displaying support of the hypothesis that the immediate memory has a finite span of seven for holding categories, objects, digits, and in this case, causal elements.

Although the instructional set effect yielded discrepant results between causal judgment ratings and confidence ratings, this difference may not be as blatant as these results indicate. Comparing the interactions between instructional set and confidence ratings of

Figure 1, and the same interaction for causal judgments, illustrated in Figure 2, it does appear that the function of the two instrucitonal sets (single-cause and combined-causes) are similar to one another and different from the no instruction condition.

Insert Figure 2 about here

There were obvious discrepancies between the pilot study (Payne & Shaver, 1985) and this study. No linear trend was found in the present data. But the first study limited the causality points to a total of 100, to be divided among the characteristics presented to the subject. This design limited the means of the 2, 6, and 10 condition. This insured at least a linear function. The first study also made no attempt to assess systematically different instructional sets, while in the present study this variable accounted for for more variance in causal and confidence attributions than did the number of causal elements.

The current research design responded well to some of Fiedler's (1982) misgivings concerning previous research in the discounting principle. The prestructuring of the stimulus information was limited only by giving each subject a set of characteristics used in the hiring decision--the subjects were then free to assign as many or as few causality tokens as they wished, and were also given the "Other" category to which to assign tokens. Subjects were therefore not restricted to the designated categories. Yet the subjects were not left to guess randomly in their attributions of causality. Displaying the set of all possible characteristics (12) to each subject before the presentation of their conditional set of characteristics actually used in the hiring decision (3, 6, 9, or 12) provided the subjects with a discriminative causal cue pointing to plausible causes. With this part of the design, subjects were allowed the freedom to select which causes were relevant to the decision, and which ones were irrelevant. In this way, subjects could decide independently on the weight and force that different causal relationships carried in the hiring decision.

Within all three theories of the discounting principle compared here, (Kelley's, Shaver's, and Shaklee & Fischhoff's) the number of plausible causes considered by an observer is an important variable. Yet, one current line of research considers the number of causes unimportant in making causal judgments (Hull & West, 1982; Wells & Ronis, 1982). Rather, they believe that the valence of the causes given for an effect determine the decision that the attributor will make. This notion is based on interpretation of work by Jones & McGillis (1976), which implies that discounting is a function of the assumed desirability (valence) of the causes involved in bringing about an effect.

This interpretation of the discounting principle postulates that the discounting effect for increasing the number of causes occurs only if the given cause becomes proportionately less of the total valence. The studies found no evidence that the number of causes is important to an attributor when the total perceived valence of the additional causes is held constant. This is an interesting interpretation, but valence and number of causes are inextricably interwoven within attribution judgments. Valence is not an easy label to apply, and the desirability of a cause as the explanation for an event may differ from individual to individual.

More recent research indicates that the study of the schema concept (and therefore of the discounting effect) has come full circle. The most current studies explain causal judgments in terms of framework: "When subjects are asked to explain an event, they use their content knowledge of the situation and their abstract knowledge of causal relations to construct an explanatory frame" (Leddo, Abelson, & Gross, 1984, p. 941). Schema research, back when its concentration was more cognitive, rather than social, also described a schema as an empty frame, to be completed, filled in (e.g., Woodworth, 1938).

Yet this current research goes much further into the intricacies of "filling in." The authors state that whether multiple causes are utilized depends on the situation. In some situations, such as completed actions, the frame needs to be filled in both by typical goals (reasons) for the action, and by conditions that made the action possible. This situation would therefore require multiple explanations. On the other hand, when there is action failure, one explanation seems to be sufficient. To provide multiple explanations for failure may appear excessive and unnecessary. The situation and the knowledge structures that the attributor brings to the situation are the key factors in this interpretation of multiple sufficient causes.

The quest for the function of the discounting principle is far from over. The approaches are varied. The ideas within the various studies are often not consistent with each other, yet each provides more understanding of causal judgments. Yet one important aspect of the discounting principle has not been as much overlooked, as assumed in most of the research. That aspect is the operational definition of a "sufficient cause." The discrepencies between the results of the various experiments cited here could be the consequence of the respective authors' definitions of plausible, relevant, and sufficient causes. Do these words designate the same type of causes?

Because the experimenters decide on the various conditions within their experiments, they are putting tags on what is a sufficient cause, what is a necessary cause, etc. They assume that subjects respond to these conditions as such, and further, analyze the data and make their conclusions based on these same assumptions. Even extensive pretesting, as was conducted in this experiment, may not take into account experimenter-subject discrepancies in the interpretation of the relationship between the type of cause given and the situation to be accounted for. To remedy this reliance on face validity of the concepts used in this research, pretesting could involve asking subjects open-ended questions as to what they think the sufficient causes could be for a particular, given event. Less assumption at this level of the research design would benefit future inquiries of the judgmental processes that are invoked when an observer is faced with an event that has more than one plausible cause.

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Table 1

<u>Mean Causality Points and Confidence Ratings as a Function of Causal Elements and Instructional Sets</u>

	Number of causal elements			
Instructional Set	3	6	9	12
		Causes		
Control (None)	59.72	55.64	55.64	65.03
Single-causes	50.83	47.32	49.94	46.29
Combined-causes	60.00	58.76	59.23	54.61
		Confidence		
Control (None)	4.97	4.99	5.14	5.67
Single-causes	4.67	5.62	5.46	5.31
Combined-causes	5.03	6.12	5.62	5.39

Figure Caption

Figure 1. Mean confidence ratings assigned to causes as a function of causal elements and instructional set.

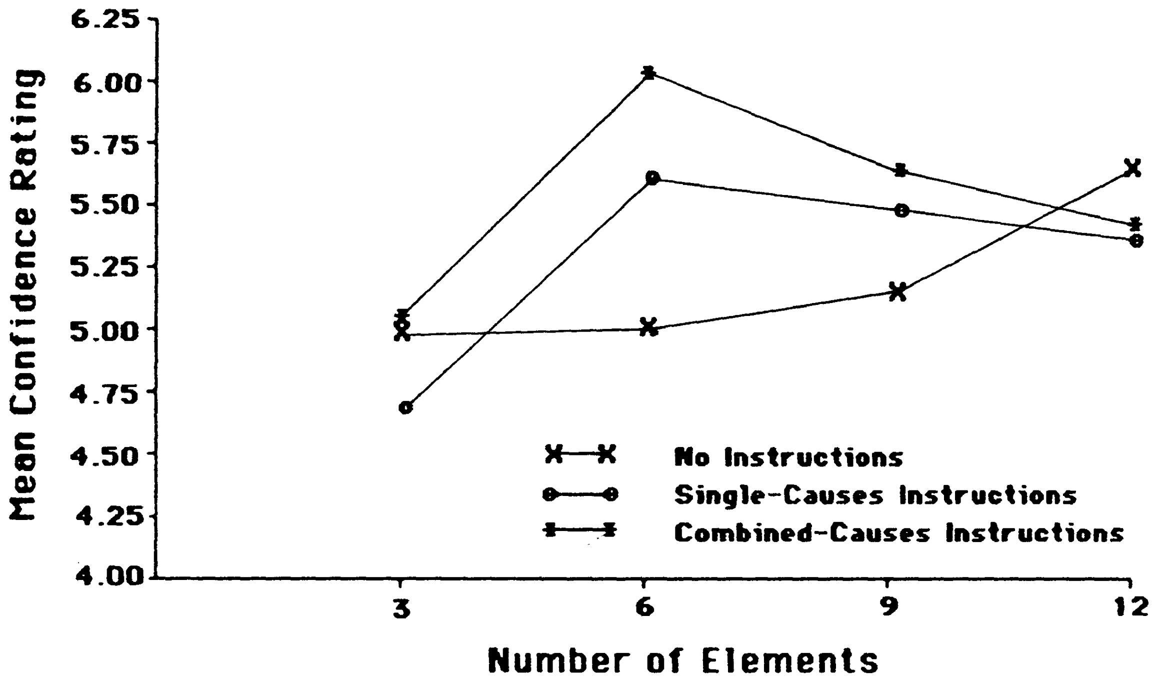
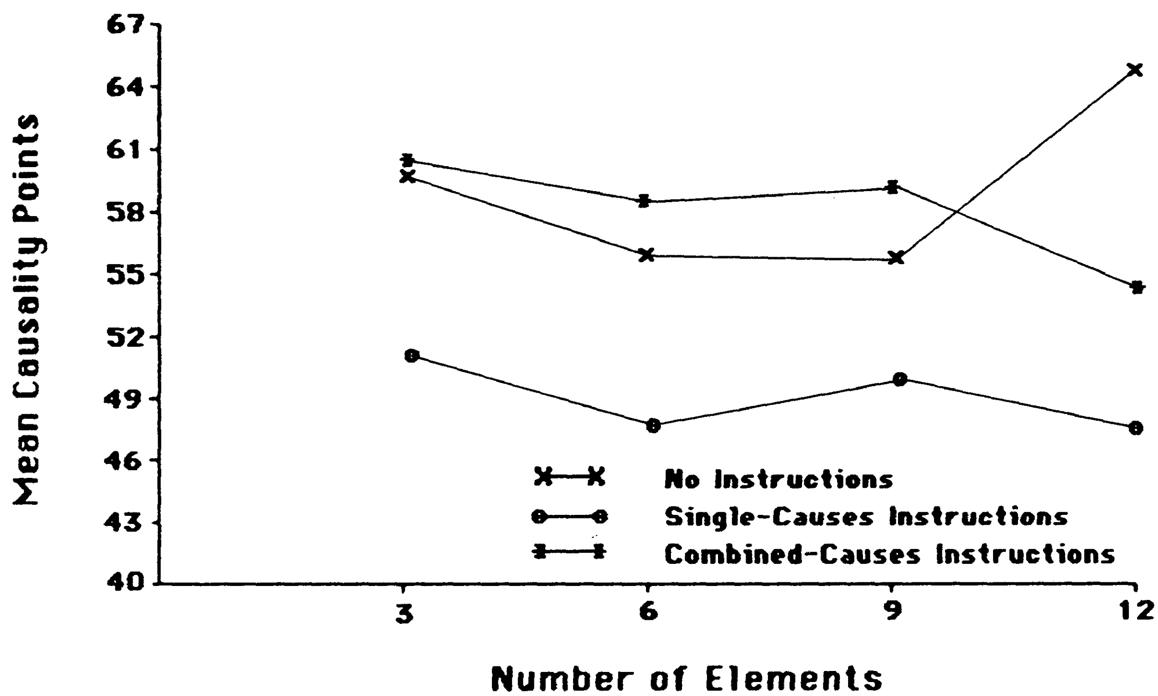

Mean Confidence Rating
6.25
6.00
5.75
5.50
5.25
5.00
4.75
4.50
4.25
4.00
3
6
9
12
Number of Elements
No Instructions
Single-Causes Instructions
Combined-Causes Instructions

Figure Caption

Figure 2. Mean causality points assigned to causes as a function of causal elements and instructional set.


67
64
61
58
55
52
49
46
43
40
Mean Causality Points
3
6
9
12
Number of Elements
No Instructions
Single-Causes Instructions
Combined-Causes Instructions

VITA

Portia Payne

Born in Rome, Georgia on July 6, 1956, the author attended the University of Virginia for undergraduate training. She graduated with distinction and received a Bachelor of Arts degree in August, 1978. She entered the College of William and Mary as a graduate assistant in psychology in August 1983. She is now a candidate for the Master of Arts degree. The author will be attending Lehigh University in September 1985, where she will be pursuing a doctorate in psychology.