Research Report

ON THE FRAMING OF MULTIPLE PROSPECTS

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Abstract—*We investigated decisions involving multiple independent uncertain prospects. At the extremes, a decision maker may either consider each prospect as a separate event (segregation) or evaluate the overall distribution of outcomes (aggregation). Contrary to choice by segregation, people sometimes reject a single gamble but accept a repeated play. On the other hand, people tend to choose by segregation when a particular gamble is singled out from a larger ensemble. Similarly, physicians make different choices when they evaluate problems on a case-by-case basis than when they consider the broader picture. Peoples' tendency to segregate multiple prospects represents a significant violation of the standard theory of rational choice.*

Decision makers often face independent uncertain prospects that are repetitive in character. For example, a gambler may play the same game many times in an evening, an entrepreneur may encounter several comparable business ventures over time, and a physician may treat many patients with similar problems in the course of practice. How do people make decisions involving such multiple prospects? At one extreme, the decision maker may evaluate each prospect as a separate independent event. At the other extreme, one may evaluate the overall distribution of outcomes that results by aggregating all the prospects. We refer to these strategies as choice by segregation and choice by aggregation.

Normative decision theory prescribes aggregation, but the amalgamation of prospects is difficult both conceptually and computationally. Mental economy, therefore, favors segregation. As an example of choice by segregation, consider the following problem taken from Tversky and Kahneman (1986):

> Imagine that you face the following pair of concurrent decisions. First examine both decisions, then indicate the options you prefer.
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> *Decision 1:* Choose between: (A) a sure gain of \$240; (B) 25% chance to gain \$1,000 and 75% chance to gain nothing.
>
> *Decision 2:* Choose between: (C) a sure loss of \$750; (D) 75% chance to lose \$1,000 and 25% chance to lose nothing.

Most subjects chose the sure gain in Decision 1 (84%) and most avoided the sure loss in Decision 2 (87%), thereby exhibiting risk aversion for gains and risk seeking for losses. Another group of subjects presented with either Decision 1 or Decision 2 separately gave essentially the same responses (A and D were chosen by 85% and 86%, respectively). Evidently, people made the same choices when evaluating the decisions jointly or separately, as implied by segregation.

Whenever people face two or more concurrent decisions, however, rationality demands that they consider the joint consequences of their choices rather than treat each decision as a separate event. As we next show, the failure to combine outcomes can lead to an inferior decision. Overall, 73% of respondents selected both A and D and only 3% of respondents selected both B and C. However, it is easy to verify that the combination of B and C dominates the combination of A and D; the former yields a better outcome for each probability.[1] Indeed, no subject chose the inferior combination when presented with the aggregated prospects. This dramatic difference (73% vs. 0%) shows that people did not spontaneously aggregate concurrent prospects. As a consequence, they made different choices in the separated and the combined formulations.

1. Because C is a sure loss, the combination of B and C is obtained by subtracting \$750 from all outcomes of B, yielding a 25% chance to win \$250 and a 75% chance to lose \$750. Similarly, because A is a sure gain, the combination of A and D is obtained by adding \$240 to all outcomes of D, yielding a 25% chance to win \$240 and 75% chance to lose \$760. Clearly, the former prospect dominates the latter.

In this article we investigate conditions that influence the tendency to aggregate or segregate multiple prospects.

EVALUATING REPEATED PLAY

It appears that people sometimes choose by segregation, especially if the prospects are not identical. In other situations, however, people attend to some features of the overall distribution of outcomes. Perhaps the best known departures from segregation involve repeated identical prospects with a positive expected value. For example, Samuelson (1963) tells of a colleague who was unwilling to play one time a bet that offered an even chance to win \$200 or lose \$100, although he was willing to play it 100 times. Evidently, repeated play of a bet with positive expected value can be attractive even when a single play is not.

To document this phenomenon, we presented subjects[2] (n = 185) with the following question:

> Imagine that you have the opportunity to play a gamble that offers a 50% chance to win \$2,000 and a 50% chance to lose \$500. Would you play the gamble?

Subjects were then asked a second question:

> Now, suppose you have the opportunity to play the gamble five times, not just once. Would you play it five times?

As expected, more respondents were willing to play the fivefold gamble than the single gamble (63% vs. 43%, $p < .005$).

We also asked another group (n = 84) to directly compare the single gamble to the fivefold gamble. The majority (74%) preferred the fivefold gamble over the single gamble. Similarly, most (70%) preferred to play the mixed gamble six times

2. Unless otherwise specified, subjects were college students participating in a brief survey conducted in a classroom setting.

over playing it five times; and most (68%) preferred a twelvefold play to a sixfold play. Hence, the attractiveness of these multiple prospects increased with the number of repetitions. For other examples, see Keren and Wagenaar (1987).

Apparently, people are sometimes sensitive to the aggregate nature of a multiple prospect. Note that this pattern of preferences does not follow from consideration of the law of large numbers; the repeated play corresponds to the sum, not the average, of individual gambles. Indeed, expected utility theory implies that the repeated play should not be accepted if the single play is rejected at any asset position. For further discussion, see Chew and Epstein (1988), Lopes (1981), Samuelson (1963), and Tversky and Bar-Hillel (1983).

The preceding problems indicate that people do not always choose by segregation.[3] The following problem shows, however, that such choices are not based on proper aggregation. We presented another group of subjects (n = 47) with the aggregated version of a fivefold play of an even chance to win \$2,000 or lose \$500:

> Imagine that you are offered an opportunity to play the following gamble. The probabilities and outcomes of the gamble are listed below:
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> | | |
> |---|---|
> | 3% chance to gain | \$10,000 |
> | 16% chance to gain | \$7,500 |
> | 31% chance to gain | \$5,000 |
> | 31% chance to gain | \$2,500 |
> | 16% chance to gain | nothing |
> | 3% chance to lose | \$2,500 |
>
> Would you accept or reject the gamble?

A great majority of respondents (83%) accepted the gamble when presented in the aggregated form, whereas fewer (63%) had accepted it when described as a fivefold gamble ($p < .005$). Hence, the fivefold prospect was less attractive than the formally equivalent aggregated prospect but more attractive than the single gamble (83% vs. 63% vs. 43%). Thus, people recognize the impact of aggregation, albeit insufficiently.

The observation that the aggregated prospect above was more attractive than the corresponding fivefold prospect represents a framing effect, or a violation of description invariance, because the two prospects yield the same distribution of outcomes. (In contrast, the observation that the fivefold play was more attractive than the single play is not a framing effect because the two options yield very different outcomes.) Formal decision theory provides no reason for favoring the aggregated representation over the multiple play representation as a basis for a decision. From a psychological standpoint, however, the aggregated version appears to provide a better basis for choice because it presents the distribution of final outcomes that is not transparent in the multiple play representation.

ISOLATING A SINGLE PLAY

In the previous section we observed that many people rejected an even chance to win \$2,000 and to lose \$500 once, but were willing to play this gamble five times. What happens when people are offered an additional play after a fivefold prospect? To explore this issue, we asked the original group of subjects the following question:

> Suppose that you have played the gamble [50% chance to win \$2,000 and 50% chance to lose \$500] five times, but you don't yet know your wins and your losses. Would you play the gamble for a sixth time?

Most subjects (60%) rejected the opportunity to play the gamble for a sixth time. The unwillingness to accept the additional play is tantamount to preferring the fivefold gamble over the sixfold gamble. Recall, however, that when these gambles had been compared directly, most subjects preferred the sixfold gamble over the fivefold gamble. This reversal of preference suggests that the last play was segregated from the rest of the ensemble. Indeed, the percentage of respondents who rejected the sixth gamble was essentially the same as the percentage of respondents who rejected the single gamble (60% vs. 57%).

By treating the sixth play as a separate event, rather than combining it with the distribution of outcomes induced by the fivefold play, subjects violate a basic normative principle. A person who holds a prospect X should prefer Y over Z if and only if the combination of X and Y is preferred to the combination of X and Z. This principle, called *asset integration*, is normatively unassailable even though it is not descriptively valid. In the above example, X corresponds to the fivefold play, Y corresponds to the sixth play, and Z corresponds to maintaining the status quo.

Redelmeier and Tversky (1990b) have demonstrated the effects of singling out a particular case from a larger ensemble in the framing of medical decisions. For example, physicians (n = 356) received a question concerning the management of college students who had unexplained fatigue, sleepless nights, and difficulty concentrating. They were asked to consider an extra blood test that involved a nontrivial cost, which the student would need to pay out-of-pocket, but that could detect an uncommon treatable disease. Half the physicians were asked to consider a single hypothetical patient, whereas the other half were asked to consider a group of such patients. The blood test was recommended more frequently in the individual than the aggregate perspective (30% vs. 17%, $p <$ .005). These observations suggest that physicians sometimes make different decisions when they evaluate patients on a case-by-case basis than when they consider them as an ensemble.

The discrepancy between the aggregate and the individual perspectives is recognized as a professional norm: Other physicians correctly predicted the difference between considering an individual and a group, and some sought to rationalize the conflicting recommendations (Redelmeier & Tversky, 1990a). As we see it, however, the discrepancy in these problems cannot be easily justified on normative grounds because all the scenarios involved frequent illnesses, so that physicians actually treat many similar patients.

Another type of medical decision problem involving multiple prospects concerns repetition over time, rather than over individuals. For example, consider a chronic medical condition where cure is not possible. The patient can anticipate many flares during the course of a lifetime, although the flares vary in duration. We propose that physicians are more likely to recommend a risky medi-

3. For related evidence that does not involve multiple play, see Thaler and Johnson (1990).

cation with positive expectation if they consider many treatments instead of just one. To test this hypothesis, we asked a group of practicing physicians (n = 230) to consider the following problem:

Consider a patient having a flare of systemic lupus erythematosus [type of arthritis] characterized by waxing and waning knee pain. With the usual form of therapy she can expect between 5 and 7 hours of discomfort per day. By using an additional medication every day there is a 50% chance that the pain will last 3 hours less than with standard treatment, and a 50% chance that the pain will last 2 hours more than with standard treatment. Whether the new medication makes things better or worse depends on unknown biologic factors that change from day to day and can't be predicted ahead of time.

Half the physicians were told that this particular flare was going to last one or two days, whereas half were told that the particular flare would last several weeks.

As expected, the risky medication was recommended more frequently when considering repeated treatments rather than one treatment (42% vs. 15%, $p < .005$). We replicated this experiment using students with no training in medicine (n = 113). As before, the risky medication was recommended more frequently when considering many treatments rather than just one (51% vs. 36%, $p < .05$). Treating a particular flare as unique, however, is difficult to justify given the chronic nature of the disease, which involves many flares over time.

DISCUSSION

We investigated choices involving multiple, uncertain, independent prospects. We observed that people accepted the repeated play of a prospect with positive expected value even though they rejected the single play. This finding indicates that people do not always choose by segregation and that they respond to some features of the aggregate distribution of outcomes. However, people did not fully appreciate the impact of aggregation; the aggregated prospect was more attractive than the equivalent fivefold prospect.

On the other hand, people tended to choose by segregation when a prospect was isolated from the rest of an ensemble. Having played five times, people rejected an additional play even though they would prefer six plays over five plays. Similarly, physicians made different choices when they considered patients as individuals rather than as members of a group. Furthermore, both physicians and lay people were more likely to segregate when they considered the outcomes of a chronic condition as a brief flare rather than as one flare in a larger course.

These observations indicate that the tendency to segregate prospects depends critically on the representation of the problem. Furthermore, they highlight the discrepancy between peoples' preferences and the normative analysis of multiple prospects. The contrast between single and multiple play is at variance with expected utility theory. The tendency to segregate isolated prospects is inconsistent with asset integration. Finally, the difference between the aggregated and the multiple play representations violates the principle of description invariance.

We suggest that many decision problems (e.g., in business and medicine) encourage people to choose by segregation, especially if the prospects are not identical, the ensemble is not explicitly defined, and the decisions are distributed over time. Treating each prospect as unique, however, hinders the application of knowledge gained in past encounters to present situations. A decision maker who acts on a case-by-case basis may devote too much attention to the specific features of an individual case with insufficient regard to the predictive validity of these features and to the relevant base rate of outcomes (Griffin & Tversky, in press; Kahneman & Lovallo, 1991). Framing decision problems in an aggregated manner might improve the quality of judgment and decision making.

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