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An Investigation of Patient's Reactions to Therapeutic Uncertainty

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Patients' reactions to uncertainty were investigated using a hypothetical clinical situation that involved lower extremity pain and stiffness. Subjects' uncertainty avoidance was observed under varying types and sources of uncertainty, using a short questionnaire distributed to 306 outpatients and spouses at two hospital locations. It was found that 21.0 percent of the subjects would avoid an ambiguous treatment with the same success probability level at which they previously accepted a nonambiguous treatment; 33.7 percent of the subjects preferred to defer the treatment decision to the physician altogether. Confidence and the context of the decision were related to ambiguity avoidance, and decision avoidance was related to age. The implications of these findings for medical decision making are discussed in relation to the nonunitary nature of partial uncertainty. (Med Decis Making 4:501–511, 1984)

Introduction

Most decisions involve uncertainty. Any method for incorporating patients' preferences in therapeutic decisions must include this construct. The imprecision of this term is highly apparent, however, in recent discussions that have outlined types of uncertainty [1–3], especially by contrast with the traditional categorizations of *ignorance* (the state of total uncertainty), *risk* (the state of partial uncertainty), and *certainty* (the state of no uncertainty) [4,5]. The work of Ellsberg [6] and Knight [7] closely relates to these discussions of uncertainty, the medical implications of which are investigated in

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the present study. Their early partition of *partial uncertainty* was between *ambiguity* and *risk* [6], or between *uncertainty* and *risk* [7]. For clarity of discussion, the former terminology is adopted and illustrated below.

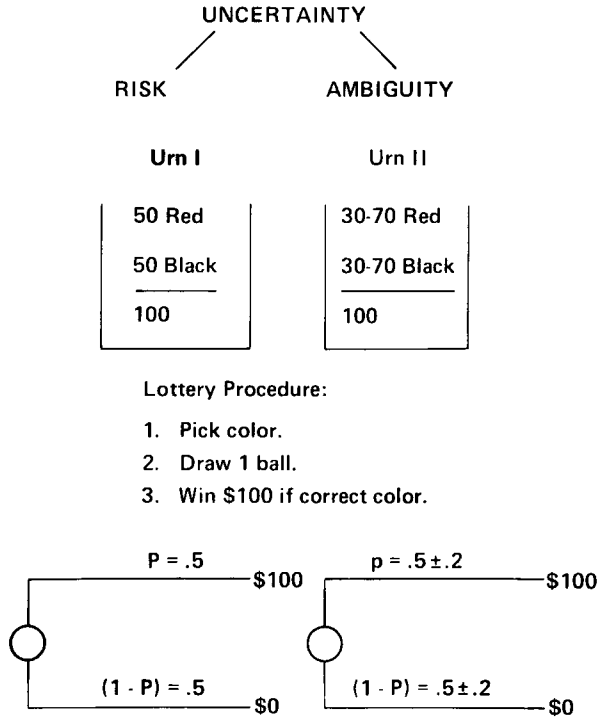

Figure 1. Urns, lottery procedure, and chance nodes, illustrating the difference between risk and ambiguity. Urn I and the left node represent risk, Urn II and the right node represent ambiguity.

Consider two urns and a lottery procedure, as illustrated in Figure 1. In Urn I, there are 50 red and 50 black balls. Suppose you are offered the gamble shown, in which you select a color, red or black, and then draw for that color to win $100. Clearly this situation involves uncertainty in that the outcome that will occur, $100 or $0, is unknown. This exemplifies the partial uncertainty of *risk*, in which the outcomes are unknown but have specifiable probabilities of occurrence.

Alternatively, consider the lottery using Urn II, which also contains a total of 100 red and black balls. In Urn II, however, the exact distribution of the colors is uncertain, with 30–70 being red and the remainder black. Thus, in addition to the uncertainty of risk about which outcome will occur, there is uncertainty about the probabilities as well. The decision tree representa-

tions in Figure 1 clearly illustrate that the sole difference between the two urns is in the precision of the outcome probabilities. This exemplifies the partial uncertainty of *ambiguity*, in which the outcomes are unknown and have inexactly specified probabilities of occurrence.

Ellsberg's [6] claim, supported in subsequent empirical work [8–10], was that many people, given a choice between drawing from Urn I and drawing from Urn II using the lottery procedure in Figure 1, would prefer to draw from Urn I despite an indifference to color. This preference for the nonambiguous urn is termed *ambiguity avoidance* [6]. The strength of this phenomenon has been supported by the willingness of subjects to pay to avoid ambiguity [8], and by the resistance of subjects to changing their preferences despite counterarguments [11].

Ambiguity avoidance indicates that subjects recognize and attach significance to the distinction between risk and ambiguity. The analysis of this distinction in a clinical context is the main focus of the present study. The central instrument is a hypothetical scenario and format similar to that illustrated in Figure 1. Two uncertain treatments were presented, with both having success probability ranges centered at the same level P. One treatment was risky, like the Urn I situation, and the other was ambiguous, like Urn II.

Using this basic scenario, three aims were pursued. First, the generalizability of ambiguity avoidance to the clinical context, as contrasted with the monetary context of the previous literature [6–11], was explored. A similar test of ambiguity avoidance using a hypothetical clinical scenario was presented by Hamm and Bursztajn with evidence suggesting that there exists a minority who will avoid ambiguity.[1] The present procedure's test of the generalizability of ambiguity avoidance differed in two respects. The present study used actual patients, rather than medical students and professionals. Also, instead of comparing the two types of uncertain treatment directly, as was done in that study, a more conservative test of ambiguity avoidance was used by comparing both with a third option, a certain one.

A second aim was to determine whether, in addition to risk and ambiguity being distinguishable as types of partial uncertainty, different types of ambiguity might also be recognized. In particular, the source of the ambiguity was manipulated with the expectation that ambiguity avoidance might vary across these situations.

The third aim of the study was to pursue several factors that might be associated with ambiguity avoidance. The major hypotheses of interest are: (a) that confidence in the treatment's success is lower for the ambiguous treatment, leading to avoidance; (b) that the patients' best guess of the probability of treatment success is actually lower for the ambiguous treatment; and (c) that *decision avoidance* [12, 13], the deferral of the decision to the physician, is, like ambiguity avoidance, a reaction to uncertainty in the treatment decision.

Table 1. Demographic Measures on Study Sample (N = 306)

SITE OF QUESTIONNAIRE ADMINISTRATION	
Ann Arbor VA Medical Center	175
University of Michigan Hospital	131
AGE (YEARS)	
16-29	64
30-39	54
40-49	27
50-59	74
60-69	68
70-86	17
SEX	
Male	184
Female	122
MOBILITY	
(NUMBER OF BLOCKS STATED AS ABLE TO WALK WITHOUT DIFFICULTY)	
Less than 1	31
1 or 2	29
3 to 5	49
More than 5	192

Methods

A questionnaire was administered to 306 outpatients and spouses waiting for general internal medicine appointments at the Ann Arbor VA Medical Center (VA) or the University of Michigan Hospital (UM). Demographic measures are described in Table 1.

The questionnaire used the hypothetical scenario in Table 2. Each subject was asked to provide, for treatment sucess, "the *LOWEST* chance that you think is acceptable for you to have the treatment." They marked one of the eight spaces provided, ranging from "2 in 10" to "9 in 10 or better." This response was interpreted as a minimal success probability P for which the subject would accept the risky treatment given the choice represented by the left decision tree in Figure 2. Note that the procedure allows the value of P to vary between subjects. Also note that for subjects responding "the chance that the treatment will work must be 9 in 10 or better," P was set at 0.8, with the understanding that the risky treatment is *not* preferred in this case. A switch to ambiguity avoidance was not testable for these subjects, and they were omitted from that part of the analysis. The assumption that the subject's choice of lowest probability was interpretable as a choice of the treatment at that value of P was then verified with a check-up question. For example, for $P = 0.5$ the question took the following form:

Table 2. Hypothetical Clinical Scenario

Suppose you find it hard to walk after going several blocks. To keep walking leads to stiffness and a dull pain in your legs.

So you come to the clinic. A treatment is available, but it is risky. The treatment may work well, or it may make you worse.

If the treatment works, you will be able to walk about twice as far before the stiffness begins. And the pain will be less than before the treatment.

If the treatment does not work, you will always have stiffness in your legs when you walk. And you will begin to feel the dull pain after only a block of walking.

If you do not choose to have the treatment, you will stay as you are.

In summary,

IF you DO NOT have the treatment,
THEN you will have stiffness and pain after several blocks of walking.

IF you DO have the treatment,
THEN it works—stiffness only after many blocks of walking; less pain
OR
it does not work—stiffness when walking at all times; pain after 1 block of walking.

You have marked that, if the doctor tells you: "The chance that the treatment will work for you is 5 in 10," then you will have the treatment. Is this right?

Based upon the subject's value of P as determined by the above procedure, an appropriate second part of the questionnaire was administered. The subject was asked if it would be acceptable to have the treatment in the ambiguous situation illustrated in the right decision tree of Figure 2,

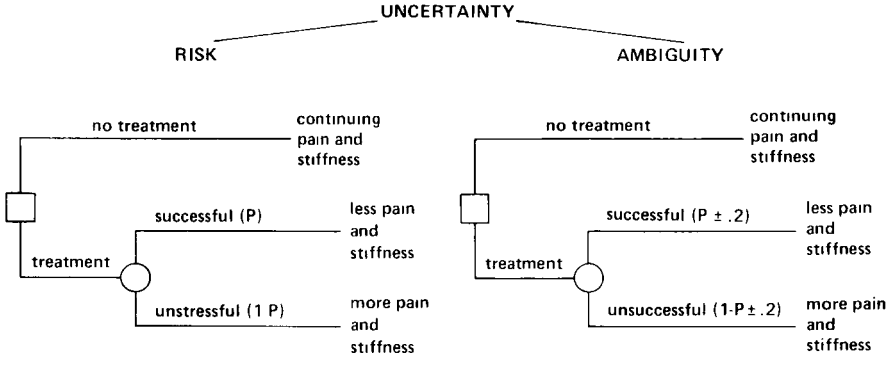

Figure 2. Decision trees illustrating the two treatment options. The left side represents risk and the right side represents ambiguity.

in which the range of the treatment success probability was centered at their particular value of P. Subjects received one of the following three versions of the ambiguous scenario with varying sources of ambiguity. These are labelled *New, Inherent,* and *Inaccuracy of Specialist* to identify the source of the ambiguity, and read as follows for the case of $P = 0.5$:

> [NEW] Instead, suppose the doctor tells you: "The treatment is new. Not much is known about it, but we must decide now. We just don't know, yet, exactly what the chance is that the treatment will work. But I *can* tell you that the chance it will work for you is somewhere between 3 in 10 and 7 in 10." Would you have the treatment?
>
> [INHERENT] Instead, suppose the doctor tells you: "The treatment has been used before, and it varies as to how well it works. The best we can say is that the chance that it will work for you is somewhere between 3 in 10 and 7 in 10." Would you have the treatment?
>
> [INACCURACY OF SPECIALIST] Instead, suppose it is a specialist who tells you: "The chance that the treatment will work for you is 5 in 10." But, when you ask your own doctor, he says: "I know this specialist, and he is not always accurate about your chances. But, if he says your chance is 5 in 10, then you can be sure that the chance that the treatment will work for you is somewhere between 3 in 10 and 7 in 10." Would you have the treatment?

These questions were used to evaluate the effect of the source of ambiguity and the generalizability of ambiguity avoidance to the clinical situation. To test directly for consistency of behavior between the clinical and monetary situations, the choices in Figure 2 were repeated with the health outcomes replaced by monetary outcomes. The monetary values used were \$10 and \$0 for the best and worst outcomes of the uncertain "treatment," or lottery, and \$10P for the certain outcome.

The subject's confidence in the treatment's success was measured on a seven-point rating scale, ranging from "Not at all confident" to "Very confident." This scale was used with both the risky and the ambiguous situations. A third rating scale, bounded by $P - 0.2$ and $P + 0.2$, was used to obtain the subject's best-guess point judgment of the probability of success in the ambiguous situation.

The willingness of the subject to avoid uncertainty by deferring to the physician, evidencing decision avoidance, was indicated by agreement with:

> I would rather not make the choice at all. I would prefer that the doctor decide if I will have the treatment.

Results

UNCERTAINTY PARTITION. To the extent that the subjects switched from choosing the treatment in the situation of risk to choosing nontreatment in the situation of ambiguity, they showed a significant behavioral recognition

that ambiguity and risk are distinct. Of those for whom the treatment was acceptable at P = 0.8 or lower ($n = 229$), 21.0 percent refused treatment with the ambiguous option whose success probability range was centered at the same level of P. For comparison, only 3.1 percent of these same subjects gave choices in the risky check-up situation that failed to correspond to their selections of P. This percentage can be used as an error rate of responding, which can be compared with the percentage of ambiguity avoidance. The difference in proportions is statistically significant ($p < 0.0001$), suggesting a systematic avoidance of the ambiguous option that is not attributable to random error. Subjects evidently differentiated the uncertainty of ambiguity from the uncertainty of risk, and avoided it. Subjects reacted differently in the monetary and clinical situations, however. Although the 24.3 percent ($n = 144$) who switched to ambiguity avoidance in the monetary situation is comparable to the 21.0 percent who switched in the clinical situation, it was not the same individuals who switched. Of the 74 subjects who switched in at least one of the two situations, only 9 (12.2%) switched in *both* of the hypothetical situations. The context of the decision clearly had an influence on the avoidance behavior.

SOURCES OF AMBIGUITY. The secondary partition of ambiguity by source of uncertainty had no significant effect on any of the other major variables in this study, including extent of ambiguity avoidance ($p > 0.8$).

FACTORS RELATED TO AMBIGUITY AVOIDANCE. None of the demographic variables was significantly related to ambiguity avoidance. There was also no relationship between ambiguity avoidance and decision avoidance. A slight, but statistically significant, relationship was found between ambiguity avoidance and the extent to which the best-guess success probability, for the ambiguous option, was biased relative to P ($p < 0.05$). Note that this bias is independent of the individual's accepted level of P. Also, subjects who switched to ambiguity avoidance showed larger decreases in expressed confidence that the treatment would be successful than those who did not switch ($n = 219$, $p < 0.0001$).

Of all subjects who responded ($n = 303$), 33.7 percent agreed that they would prefer to defer the decision to the physician. The percentage was higher for VA subjects (42.8%, $n = 173$) than for UM subjects (21.5%, $n = 130$, $p < 0.001$), but this finding may be due to the greater age of the VA respondents (median = 57 years) than those at UM (median = 34 years). The positive relation between age and decision avoidance is illustrated in Figure 3 ($p < 0.0001$), with a rate of 52.9% ($n = 17$) preferring to defer the decision in the highest age group, 70–86 years.

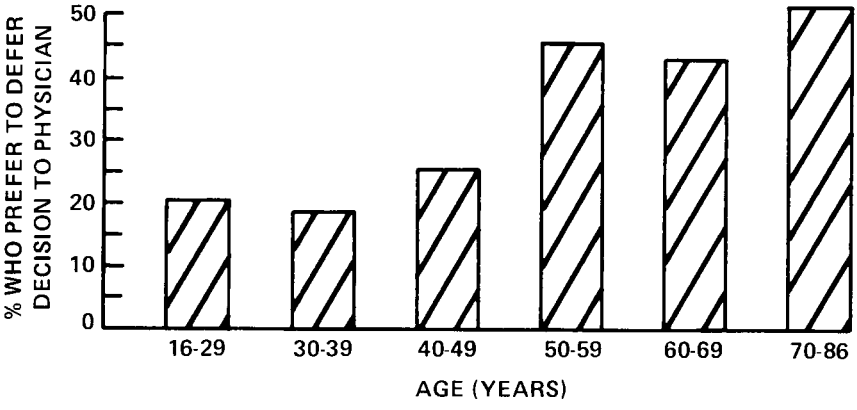

Figure 3. Percentage of subjects who expressed a preference for deferring the decision to the physician; shown for six age groups. The sample size for each group is shown in Table 1.

Discussion

Ambiguity avoidance was found in a hypothetical clinical situation, with a sizable minority of 21.0 percent of patients exhibiting this behavior. Although this is a lower percentage than has been found in monetary situations [8–11], the difference is primarily attributable to the conservative test procedure employed, as evidenced by the 24.3 percent who avoided ambiguity in a monetary situation with the present procedure. This suggests that in another, less conservative situation the extent of ambiguity avoidance in the clinical context may be even higher than the already substantial figure of 21.0 percent.

The findings in the clinical situation generalize those in the monetary situation, yet the behaviors in the two types of situation were not equivalent. Different people avoided ambiguity in each case. It would be erroneous to speak of a general tendency for patients to exhibit ambiguity avoidance across the situations tested. This important result parallels a finding by Slovic [14] of a low convergent validity across various measures of risk-taking behavior.

From the standpoint of developing a classification of uncertainty as viewed from the patient's perspective, the negative findings regarding the effect of the source of uncertainty are encouraging. This result maintains the possibility of deriving some general categories of uncertainty, perhaps beginning with the risk–ambiguity partition of partial uncertainty.

Further study is required to delineate the psychological underpinnings of ambiguity avoidance. The relationship found between confidence and am-

biguity avoidance offers one potential direction. Also pursuable is the tendency for ambiguity avoiders to believe that their actual chances of success are worse in the ambiguous situation, a belief which may in turn be related to the concept of decision regret [15].

The lack of a relation between decision avoidance and ambiguity avoidance makes it unlikely that decision avoidance is solely a reaction to the uncertainty of the situation. Still, the finding of decision avoidance in a substantial number of patients is of considerable interest and importance in its own right. Although the physician may have a number of valid reasons for making paternalistic therapeutic recommendations, it is argued more and more often that this approach may not always serve the patient's best interests [16]. Despite the present era of medical consumer activism in this regard [17], the finding of decision avoidance in 33.7 percent of the patients should be considered in any attempt to incorporate patient preferences in medical decisions. This may be particularly relevant when dealing with a geriatric population, and raises complex ethical issues regarding informed consent and decision making.

In addition to these more immediate potential implications of this line of research, several theoretical points are relevant.

AMBIGUITY SEEKERS. Although not identifiable by the present procedure, previous research suggests that there exists a smaller minority who may be classified as *ambiguity seekers* [8, 9]. These are individuals who prefer ambiguous situations to their parallel risky situations – for example, preferring to draw from Urn II in Figure 1. It is likely that a more sensitive procedure would be necessary to detect such behavior, but this is for future research.

FRAMING. It is worth emphasizing that the present approach is different from that of the "framing" literature [18, 19]. In framing effects, subjects given two theoretically identical situations that differ only in their wording, behave differently. For example, McNeil and associates [19], in examining the results of surgery and radiation treatment for lung cancer, found that preferences shifted depending on whether the outcomes were framed in terms of the probability of living or the probability of dying. The present claim, on the other hand, is that the different behavior in the two situations tested here is due to an *actual* difference between the risky and ambiguous situations.

AMBIGUITY AND DECISION ANALYSIS. The claims that ambiguity avoidance exists and that partial uncertainty is separable into risk and ambiguity have specific implications for decision analysis. Standard practice in the current decision-analytic technique for incorporating patients' preferences has the physician provide the probabilities of the various health outcomes

and the patient provide the utilities via one of the standard lottery elicitation methods [20–23].

This procedure requires several assumptions about uncertainty that the present line of study calls into question. First, as already mentioned, it requires that the patient be willing to address the uncertainty of the lottery procedure in order to have input in the therapeutic decision. Second, it assumes that the patient agrees that all uncertainty is equivalent and reducible to a probability distribution like that which the physician provides. Third, and this point is related, it assumes that it is this same unitary uncertainty that underlies the probabilities used in the standard lottery techniques of utility elicitation. Each of these assumptions warrants investigation, in relation to both the practice of decision analysis and the incorporation of patients' preferences in medical decisions.

Notes

1. Hamm RM, Bursztajn H: A medical version of a decision theory paradox. Is it still a paradox? Presented at the First Annual Meeting of the Society for Medical Decision Making, Cincinnati, September 11, 1979.

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