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Technical Risk Information: Decision Tool or Rhetorical Ammunition? Undisputed Facts in the Yucca Mountain Debate

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Abstract

This paper examines how both opponents and proponents of the proposed high-level nuclear waste repository at Yucca Mountain Nevada claim that uncontroversial information supports their conflicting positions. Four pieces of information in particular are claimed by both sides: the distance of the proposed site from Las Vegas, the volume of waste that has been produced, the threat of terrorism since 9/11/01, and the occurrence of an earthquake in early 2002. Possible explanations for the difference include Naïve Positivism, Social Constructionism, Persistent Beliefs and Implicit Warrants. The latter two models better explain observed knowledge / preference states. If so, more or better information alone will not improve the dialog about Yucca Mountain. Rather, dialog should include a discussion of the ways in which they interpret information and draw conclusions based on their beliefs and warrants. This conclusion may be generalized to a range of information-intensive risk decisions

1. Introduction

Since the early 1980's Yucca Mountain in Nevada has been the single site under consideration as the future repository for civilian high-level radioactive waste. A variety of governmental, non-profit, individual and commercial stakeholders have engaged in intense and often inflammatory debate about the site selection process. Each side claims that existing technical information about the site supports its position. Each side claims that the other side is either ignorant about the information, or is disingenuous in its use of information.

Both of these claims imply that technical information can determine whether or not to open Yucca Mountain to

nuclear waste. For example both Al Gore and George W. Bush, in their 2000 campaign tours through Nevada, claimed that they would "let the science decide" about Yucca Mountain. Subsequently, the Bush administration has claimed [1] that the science supports his decision to go forward with the project, while opponents complain that he has reneged on his promise to rely on science. Greenspun [2], for examples, asserts Bush relies on bad information, and in light of recent scandals, "it can no longer be claimed by anyone that the science is sound."

Several possible conditions could explain why opposing sides of a contested issue argue that technical information supports their positions. One is that one side or the other is truly ignorant. This is the most commonly heard argument from the two sides in this debate [3],[4]. Another possible explanation is that of social constructionism, in which "truth" is seen as being constructed through discourse, and a discourse community's view of "truth" is influenced by both beliefs and evidence. In this case, there are two different discourse communities--those who favor Yucca Mountain and those opposed. The two differ in their beliefs, values, and languages; therefore, they have little common ground from which to engage in productive dialogue [5]. A final, largely neglected possibility is that the two sides agree on the information, are unaware of such agreement, and disagree on how to interpret information.

This paper explores the final possibility. We argue that, so long as opposing sides wield agreed-upon information about Yucca Mountain to support their positions, debate about the technical merits of the site is unlikely to improve stakeholder dialog. We consider several possible models to explain disagreement: two versions of a "Naïve Positivist" model, a "Social Constructionist" model, a "Persistent Belief" model, and an "Implicit Warrants" model. We conclude that the Naïve Positivist model is held by individuals of both sides in the debate, but that neither is supported by observed combinations of knowledge and

preference. The Social Constructionist model does not explain the cases we review, since there is no claimed disagreement on the truth. Both the Persistent Belief and Implicit Warrants models better explain existing knowledge and preference. The Yucca Mountain decision process will be best served by addressing preferences and beliefs. Further analysis, *even if undisputed*, will continue to undermine the process.

2. Three Models of Knowledge and Preference

2.1. The Naïve Positivist Model(s)

Shrader-Frechette [6] identifies nuclear power advocates as “Naïve Positivists,” in that they insist that technical information about nuclear power necessarily will favor nuclear power, and that ignorance about technical information best explains opposition. We consider this model in the context of the Yucca Mountain Project. Implied in this model (Table 1) is that informed individuals will only be found in the upper right quadrant, where knowledge intersects with support for opening Yucca Mountain. The uninformed could be found in either of the two left quadrants. Resolving the current conflict on Yucca Mountain, then, would be best effected through education, since learning would move people from the left to the upper right.

Table 1. Naïve Positivist Matrix: Advocates

	Ignorant	Knowledgeable
For	Possible	Some
Against	Some	No one

The inverse (Table 2), not suggested by Shrader-Frechette but certainly implicit among Yucca Mountain opponents, is a Naïve Positivist position against Yucca Mountain. Here, technical information answers the Yucca Mountain question in the negative: the best available information belies the credibility of the project. Again, education is the solution. The implication of this model is that only the lower of the two right-hand quadrants can be populated, and learning will move individuals from either quadrant on the left to the lower right quadrant.

Table 2. Naïve Positivist Matrix: Opponents

	Ignorant	Knowledgeable
For	Some	No one
Against	Possible	Some

Either of the Naïve Positivist models would be validated by first determining whether there is general agreement about what constitutes information, observing whether informed individuals fall only in one of the two quadrants to the right, and evaluating whether learning

moves individual from the left into the populated quadrant on the right.

2.2. The Social Constructionist Model

In the Social-Constructionist Model (Table 3), any of the four quadrants can be populated. Of key importance is that the source and nature of information in the upper right hand quadrant differs from that in the lower right hand quadrant. Learning could not shift individuals already on the right up or down, since the nature of that information will be dependent upon their preferences for or against Yucca Mountain. It would be possible (but unlikely) for people on the left to move up or down as they chose which information to accept, or if they accept either information or values from the other.

Table 3. Social Constructionist Matrix

	Ignorant	Knowledgeable
For	Some	Some
Against	Some	Some

2.3. The Persistent Belief Model

Baron [7] posits that people frequently use information uncritically to bolster their established beliefs. He observes “irrational persistence of beliefs” among individuals who hold on to beliefs in the face of information that they should accept and that should undermine their beliefs. We adopt his language to propose the “Persistent Belief” model (Table 4). If we apply this to the Yucca Mountain case, we assume that individuals have established preferences for or against Yucca Mountain. New information is not interpreted critically, but is automatically assumed to support existing positions. While everyone on the right is equally well informed, some or all of those individuals have not thought critically about the meaning of that information. Critical thinking could move individuals on the right up or down.

Table 4. Persistent Beliefs Matrix

	Ignorant	Knowledgeable
For	Some	Some
Against	Some	Some

2.4. The Implicit Warrants Model

The logical theory of Stephen Toulmin [8] suggests that individuals move from data, or available evidence, to conclusions by means of warrants, or general propositions that are not stated explicitly. Data answers the question, what have you got to go on?, while warrants answer the question, how did you get there?, or how did you draw a conclusion from a given piece of data? Warrants, as Toulmin explains, are field-dependent; that is, the context that surrounds an argument—i.e., its field—will determine the nature of the argument [9]. Different arguments can be

said to come from different fields if they rely on different warrants to reach their conclusions, even if they rely on the same evidence. In this case, individuals on the right will move up or down only if they use different warrants; that is, a different type of reasoning. Thus the final model we consider here is the “Implicit Warrants” model (Table 5).

Table 5. Implicit Warrants Matrix

	Ignorant	Knowledgeable
For	Some	Some
Against	Some	Some

3. The “Facts” About Yucca Mountain

Here we consider four well-established pieces of information about Yucca Mountain [10],[11].

The total amount of waste that will be interred at Yucca Mountain

The distance from Yucca Mountain to the Las Vegas metropolitan area

The history of earthquakes near Yucca Mountain

The heightened concern about terrorism since September 11, 2001

Each of these four points has been used in arguments for and against the establishment of Yucca Mountain as the nation’s high-level civilian waste repository. We describe each case, and note how the information has been used by the two sides of the Yucca Mountain debate.

By 2000, civilian reactors had generated about 25,000 cubic yards of waste slated for Yucca Mountain. Wolfe [12] used this figure to argue in favor of the Yucca Mountain Project, while Flynn et al [13] felt it was a reason to hold off on the project. Interestingly, both employed the same analogy, describing the waste in vertical feet covering a football field.

Yucca Mountain is located about 90 miles northwest of Las Vegas, at the northern edge of the Nevada Test site. In 2001, a number of students were interviewed session for the “Silver State 100,” a selection process to identify the top 100 high school seniors in Nevada 2001. To evaluate their critical thinking skills, they were asked to argue their position for or against the Yucca Mountain Project. Students arguing in opposition claimed that the site is unacceptably close to Las Vegas, while those who favored the site described it as in the middle of nowhere. One of the authors (Hassenzahl) participated in this selection process as an interviewer. The intent of the interviews was not to gather data on how students use information, so this is an observation, not formally recorded information.

A number of earthquakes have been recorded over the past several decades within 20 miles of Yucca Mountain. In 2002, an earthquake was centered 12 miles from the site. This prompted two types of responses. A letter to the editor of the Las Vegas Review Journal argued that this should provide assurance, since no significant damage was recorded at the site [14]. In contrast, the State of Nevada official Yucca Mountain website identifies known earthquakes as definitive disqualifying data [15].

Finally, since 2001, there has been increased concern about terrorist use of a “dirty bomb” or physical dispersal of high-level waste. Yucca Mountain Project advocates note that because wastes are currently stored on-site in populated parts of the country, it should be removed as soon as possible to avoid terrorist attack [16]. Opponents observe that waste will be transported through major metropolitan centers on its way to Yucca Mountain, a concern that they expect will eventually coalesce opposition around the country [17],[18].

4. Discussion: Explaining Preferences for / against Yucca Mountain

Each of the examples above indicates that the two sides do appear to hold Naïve Positivist models. That is, both opponents and advocate of the Yucca Mountain Project claim that technical information supports their positions. This contrasts with Shrader-Frechette’s [6] Naïve Positivist model, in which only the YMP advocates hold Naïve Positivist positions. Since the two sides appear to know and agree on the information, neither version of the Naïve Positivist model explains the observed knowledge / preference matrix illustrated in Tables One through Five. Since identical information is claimed as support for both positions, neither side can learn the information and consequently change preferences.

The Social Constructionist model also fails to explain the differences observed here. The two sides do not claim different knowledge in support of different positions. Rather, they agree on the information, but disagree on which preference set that information supports. What is missing, however, is the link between the information and the claim, which suggests that the Persistent Belief and Implicit Warrants models merit further consideration.

Under the Persistent Belief model, individuals unthinkingly adopt new information to buttress their positions. This implies the possibility that carefully considered information could change the beliefs of one side (or both). For example, it seems unlikely that the amount of waste generated to date, as a stand-alone value, could obviously support either position. Yet both sides have explicitly made such claims. Likewise, it is possible that either current on-site storage or transportation could be universally accepted as the greater hazard; both sides have looked to the aspect of this issue that best supports their positions.

In the Implicit Warrants model, individuals are using the same sets of evidence to come to different conclusions by using different warrants. Because data are generally explicitly stated, whereas warrants are generally appealed to implicitly, it is possible to take a particular piece of information such as “Yucca Mountain is 100 miles from Las Vegas,” and, by using the implicit warrant “it is likely that the repository will leak,” or “waste being hauled through Las Vegas is likely to spill” conclude that “Yucca Mountain will threaten the city of Las Vegas.” On the other hand, if one’s implicit warrant is “the science indicates that Yucca Mountain will contain the waste for 10,000 years,”

then the evidence that “Yucca Mountain is 100 miles from Las Vegas” leads to the conclusion that the city will be safe. According to Toulmin’s theory, the two sides are in fact existing in two separate argument fields. In this model, it is necessary for each side to make their warrants explicit—to explain the “backing” or credentials of the warrant—and accept that the other side uses different warrants in order for persuasion to occur, and for people to change their positions.

5. Conclusions

The Persistent Belief and Implicit Warrants models have received less attention in the literature than have the two Naïve Positivist models and the Social Constructionist model. Yet Persistent Beliefs, Implicit Warrants, or some hybrid of the two, best explains the conflict. The main strategy of Yucca Mountain advocates and opponents alike is to promote more and better information. We conclude that additional knowledge—without careful attention to its context and origins—cannot plausibly lead to consensus, and is likely to deepen disagreement.

More fruitful, then, is to probe for existing beliefs and implicit warrants. Either advocates, opponents, or both may be undermining their own preferences by not considering alternatives. At the same time, both actively undermine useful debate by accusing their counterparts of ignorance and disingenuousness. While these two characteristics can surely be found on both sides, they probably are not as prevalent as often assumed. Unfortunately, it will be very difficult to convince either side to consider the possibility that they could change their minds.

We do not argue that there is no contested information about Yucca Mountain. The recent scandal over USGS scientists possibly misrepresenting information about groundwater flow through the site demonstrates the complexities, tensions, and political nature of the science at issue. However, it is clear that disagreement about information is at best an incomplete explanation for the existing conflict. Our conclusions do suggest that consensus resolutions of informational disputes is unlikely to improve stakeholder dialog, since whatever the outcome, both sides will claim that their positions have been bolstered.

Finally, we have provided cases, not an extensive analysis. We have found examples that suggest knowledge of individual facts, and the use of those facts to support either position on Yucca Mountain. It is not clear how knowledge / ignorance and preference are distributed among the four quadrants among individuals in the general population. Likewise, we cannot make claims about the extent to which people in general believe that the four items considered here support their preferences for or against the project. However, preliminary analysis of some recent data (Hassenzahl and Laidler, unpublished) suggests that all four quadrants are at a minimum populated, and that people do identify these four pieces of information as supporting their preferences.

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