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Estimating the Likelihood of Terrorism Events and Public Response

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This research project has two primary objectives: (1) Develop methods to estimate the likelihood of terrorism events (attack modes), and (2) Develop methods to predict both immediate and long-term public response to various terrorism events. During Year 3 we made progress on both of these objectives by focusing on the decisions faced by terrorist leaders planning attacks, and on the decisions faced by U. S. residents following an attack directed toward the United States. In each case, we developed methods to identify the motivations and beliefs upon which decisions for future action would be based.

Estimating likelihood of terrorism events

We have developed a model of terrorist objectives and values that substitutes for more traditional physical, chemical, and biological models common in probabilistic risk analysis of natural disasters (e.g., earthquakes) and technological hazards (e.g., nuclear power plants). The model aims to demonstrate that the relative likelihood of terrorist attacks is functionally related to the terrorists' utility of attack. We illustrate a method for constructing terrorist value structures, including an objectives hierarchy and a multi-attribute utility model of terrorist values.

To start, the research team conducted an extensive literature review as well as interviews with four separate surrogate terrorist intelligence analysts, all knowledgeable about terror motivations and beliefs, to determine the optimal layout of the objectives hierarchy. On this basis, nine attack scenarios (assumed to be U.S.-based) were selected for further analysis based upon a set of eleven elicited attack values. These include considerations such as economic impact, number of Americans killed, psychological impact (on both the impacted community and affiliated terrorist organization) and so forth.

Next, extensive interviews (60+ hours) were conducted with four separate surrogate terrorist intelligence analysts. The results of these interviews are four separate decision analytic models of alternative attack modes for a hypothetical terrorist group. Uncertainties are included in the decision model to capture both terrorist and analyst uncertainties about the outcome of each attack model, analyst uncertainties about terrorist risk attitudes and trade-offs among conflicting objectives, and terrorist uncertainties about success in obtaining required materials for the attack, success in avoiding interdiction, and success in final execution of the attack.

Monte Carlo simulation was used to obtain a risk profile for each of 9 separate attacks, spanning a range of possible attack modes of some concern to DHS. These risk profiles reflect uncertainties for both the surrogate analyst and the terrorist leader, but ultimately capture the total uncertainty regarding the desirability of alternative terror attack modes. Simulation methods are applied to the risk profiles of the 9 attack mode options to estimate the probability that each attack modes would have the highest utility when evaluated by the hypothetical terrorist leader. Assuming that the terrorist leader rationally selects the attack mode with highest utility, we are able to estimate the likelihood that the hypothetical terrorist leader will select each of the possible attack modes.

Results from Year 3 demonstrate that the most likely choice for the hypothetical terrorist leader is to not attack the U. S. at this time. Evidence of both convergent and discriminate validity is evident when we compared results among the 4 surrogate intelligence analysts. While there is general agreement among the models assessed from the 4 analysts, there are also important discrepancies that capture significant and relevant differences in their personal backgrounds, as well as differences in knowledge and beliefs

"This research was supported by the United States Department of Homeland Security through the Center for Risk and Economic Analysis of Terrorism Events (CREATE) under grant number 2007-ST-061-000001. However, any opinions, findings, and conclusions or recommendations in this document are those of the authors and do not necessarily reflect views of the United States Department of Homeland Security."

about the hypothesized terrorist leadership. Further insight into uncertainties is gained by partitioning the total uncertainty about the attractiveness of each attack mode into uncertainties about impacts, trade-offs, risk attitudes, and likelihood of attack success (acquiring required materials, avoiding interdiction, and executing final attack).

Future research plans include additional studies validating the methodology developed during Year 3 for estimating terrorist attack mode probabilities. We plan to conduct retrospective analysis and compare probabilities derived from surrogate intelligence analysts with relative frequencies of past terrorist events. We also intend to construct decision models for well known terrorist leaders of organizations with presumed motivational differences and examine whether these differences can be captured in the decision model and subsequent derived attack mode probabilities. One important extension of this methodology is to assess decision models from intelligence analysts whose inputs are based on a richer information source than the surrogates we have used to date.

Predicting public response to terrorism events

We explored public response to terrorism events with an experimental study of over 300 undergraduate college students. The objective of this research is to discover how public response to terrorism events is shaped by underlying characteristics of those events. This study was designed to address the following research questions: (1) Does perception of risk vary by attack type, location and consequence? (2) How might individuals' behavior change in response to an attack? (3) What are individuals willing to pay/give up in response to an attack? (4) How are cognitive, emotional, and behavioral responses to terrorism events unique compared to responses to natural hazards?

Subjects responded to 5 separate vignettes describing 4 different terrorist events and one natural disaster from a large earthquake. Subjects provided their reaction to each vignette, written in the style of a news press release, in terms of: (1) Intentions to restrict behavior and change lifestyle following a terrorist event, (2) Duration of the intended avoidance behavior, (3) Willingness to pay for increased counterterrorism efforts, (4) Willingness to take personal precautionary measures, (5) Feelings of security, risk, worry, expectations for future, (6) Beliefs about ability to protect self and family from a similar event, (7) Feelings of continued risk following the event, (8) Frequent daily worry about safety following the event, and (9) Beliefs about the likelihood of a similar attack occurring within the year following the event.

The study included one specific vignette describing the 4 terrorist events (Conventional explosive, MANPADS, Dirty bomb, and Smallpox virus release), and the one natural disaster (7.6 Earthquake). We systematically varied 3 salient characteristics of the 4 terror events, including the following: (1) Attack Proximity: Includes LA or throughout U.S. only, (2) Number of attacks: single city or multiple cities, (3) Attack outcome: Successful or failure. This resulted in 8 possible combinations of features (2 X 2 X 2) for each of the 4 terrorist events. Subjects responded to a packet of 5 different vignettes, and 8 survey groups counterbalanced order of attack mode and levels of proximity, number of attacks, and outcome for each attack mode.

One important finding from this study is that undergraduate subjects were able to provide meaningful responses to the event vignettes. In addition, we found a number of reliable effects suggesting that subjects' responses to terrorist events depend on various salient features of those events. We did find that feelings of risk, vulnerability and worry following an attack were relatively insensitive to the mode of attack. The one exception being that perceived risk and worry were lower following a MANPADS attack compared to other terrorist events or an earthquake. Presumably, subjects felt that they could mitigate the risk from a MANPADS attack by simply not flying.

We did find that willingness to pay a tax was highly sensitive to mode of attack. Subjects reported strong intentions to avoid situations related to the terrorist event, with strongest avoidance of flying after MANPADS attack and areas near epicenter of a large earthquake. Most subjects reported an intention to persist in avoidance behavior for between 1 and 6 months, depending on the mode of attack. Subjects reported a high willingness to pay for increased security on commercial airline flights and to consider alternative modes of travel following a MANPADS attack.

We found that proximity to the event, multiplicity of events, and success of the attack event(s) were all important factor in determining subjects' responses to all of the attacks. Generally, for all modes of attack, subjects cognitive, emotional, and behavioral responses were more extreme when the events are located closer, when there are multiple events, and when the attack(s) are successful. Despite these general trends, we did find significant and important deviations from this overall pattern. A number of interaction effects were also discovered, indicating that these features of terror events may not all be additive. These results suggest that some terrorist event features may combine in a synergistic fashion, while other features may serve to moderate the effect of one event feature on the subject's response to the event.

Future research plans are to refine our assessment instrument to include more questions and to obtain data from an older, more representative sample of adults. In addition, we are exploring the option of conducting a longitudinal study from a National sample that would in effect serve as a natural experiment, tracking changes in respondent cognitions, emotions, and behavior over time. This design would provide a type of natural experiment in which an actual terrorist event would serve as an IV. In addition, we plan to study more extensively responses to repeated terrorist events and how these responses might be amplified by both the frequency and detail of media reporting.