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ISSUE Nº 11 FALL 2011

CUSTOMER OVERVIEW – THE HSCB PROGRAM'S SUPPORT TO COMBATANT COMMANDS

By John Boiney

Overview of Program Operational Support

The HSCB Program exists to support innovative, rigorous research that is well grounded in the social and behavioral sciences. This kind of work is advancing the validation of theory, yielding new data, providing innovative methodologies, creating knowledge products, and, in general, building a solid foundation of applied research. The Program is committed to devoting the time needed to accomplish this type of work, and to providing tools to meet the present, urgent needs of those at the front lines of engagement with foreign populations.

Some of the Program's most exciting work is being performed in support of the nation's Combatant Commands (COCOMs). The Program now has technology transition agreements in process or completed with all appropriate geographic commands and the US Special Operations Command (USSOCOM). These agreements will enable transition of research designed to address core US challenges, including strengthening international and regional security, monitoring instability, and countering violent extremism. Some of the highest priority efforts that the Program will pursue in FY12 and beyond are:

- Expanding operationally focused projects, including those for the International Security Assistance Force (ISAF) in Afghanistan, US European Command (USEUCOM), US Africa Command (USAFRICOM), US Army Training and Doctrine Command Analysis Center (TRAC), and USSOCOM
- Expanding prototypes that support operations to counter violent extremism
- Creating prototype models for broad regional security / nation-state instability (whole of government and social media included)
- Focusing on measurements of non-kinetic messages and effects
- Working with the US Army and others to ensure COCOMs have access to validated socio-cultural behavior data

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WELCOME TO THE ELEVENTH EDITION

Welcome to the eleventh edition of the Human Social Culture Behavior (HSCB) Modeling Program newsletter. In this issue we look at the ways in which our funded research has developed in the past year.

We recently hosted the second HSCB Capability Open House, allowing HSCB-funded researchers to interact with leaders across government and develop the relationships and understanding necessary to transition more effective and useful tools in the future. This year's Open House included HSCB-funded projects from a wide variety of academic, private sector, and government organizations, including Pennsylvania State University, Seattle Pacific University, BAE, Strategic Analysis Enterprises, the Army Geospatial Center, and Arizona State University, to name only a few. Performers who participated in the Social Network Analysis Reachback Capability (SNARC) project highlighted one of the successes of the HSCB Program: working directly with deployed warfighters to improve analytic capability and respond directly to requests for information from the field. These performers show the ability of HSCB research teams to work together and directly support our deployed warfighters with applied tools and real-time support. In this issue, we briefly describe the Open House and provide short summaries of each of the participating projects.

In addition to providing direct support to our warfighters in Afghanistan through the SNARC program, the HSCB Program has worked with many of the Combatant Commands, including US European Command, US Africa Command, and US Special Operations Command. In our Customer Overview article we discuss some of the ways in which the HSCB Program has coordinated with these organizations to develop tools focused on their particular needs. As an example, we describe the work of GeoEye, which is developing tools to assist in the analysis of migration patterns – one of US European Command's current concerns.

As our performers continue to develop their tools for transition to support US warfighters, we must always remain aware of the limits of our understanding and keep our research grounded in good social and behavioral science. In our final article, Dr. Gary Klein discusses the importance of recognizing uncertainty in our research, and suggests how to deal with that uncertainty in order to deliver better tools to our warfighters.

Finally, I encourage all of you to mark your calendars for July 21-25, 2012, for the 2nd International Conference on Cross-Cultural Decision Making: Focus2012 (http://www.ahfe2012.org/). This meeting, which will take place at the Hilton San Francisco Union Square, will be the premier event for sociocultural research and engineering in 2012. The majority of HSCB Performers will be presenting their findings at this public event. Upcoming issues of our newsletter will contain more information about this event. I look forward to seeing you there.

CAPT Dylan Schmorrow, MSC, USN, PhD
Deputy Director, Human Performance, Training and BioSystems Research Directorate
Office of the Assistant Secretary of Defense (Research and Engineering)

FEATURE

Customer Overview – the HSCB Program's Support to Combatant Commands

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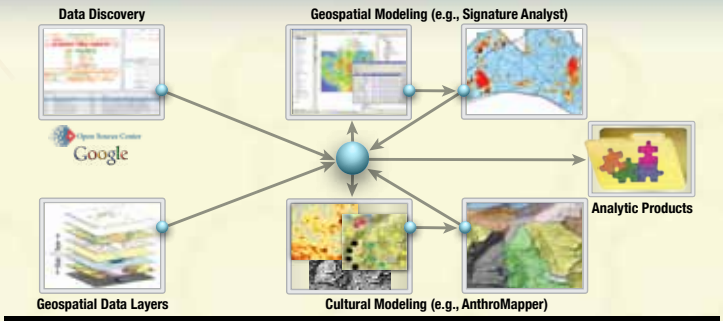
Understanding Mass Movements in Europe

One example of the Program's support to the COCOMs is analysis of large-scale human movements for USEUCOM. Immigration and migration cause temporary or permanent changes in a population profile that can directly affect such factors as economics, politics, social unrest, and crime. Transient populations are often associated with local unrest and conflict, whether due to close interaction between incompatible populations or to struggles over key resources. In the USEUCOM Area of Responsibility (AOR), movement of people from the Maghreb region into Europe presents an important set of challenges. The Command would like enhanced capabilities to understand the most likely points of origin for migration, destinations and waypoints of that migration, factors that most attract or repel population migration, and the impact of migration on origin and destination economics, politics, crime, and other conditions.

GeoEye Analytics is using hybrid technologies and advanced algorithms to demonstrate the ability to identify these aspects of large-scale human movements within Europe. The Signature Analyst model enables analysis of both country-level and local area factors to reveal which ones make the greatest statistical contribution to the selection of a given country as a migration destination. GeoEye's work is characterizing the most influential factors in these movements, showing how advanced HSCB technologies can significantly reduce human analytic time and increase analytic product quality, and demonstrating how a hybrid approach combining social science theory and statistical modeling can address problems related to mass migration.



OVERVIEW OF TECHNICAL APPROACH

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Layout and Design
Amy Cauffman

Technical Editor
Becky Bortnick

FEATURE

Capability Open House Summary

By John Bornmann

The Human Social Culture Behavior (HSCB) Program hosted the second annual Capability Open House on September 12–13, 2011, to showcase a selection of the mature work supported by the Program. More than eighty representatives from across the US government, including the military, diplomatic, and intelligence communities, attended and interacted with a wide variety of HSCB performers who demonstrated their research and shared their plans for future development. Direct discussions with government attendees helped the performers gain a better understanding of the operational environments and the needs of prospective transition partners. This will enable them to better direct their research and development toward creating stronger and more relevant final products. At the same time, the Open House provided a venue for government officials to spend as much time with individual performers as they needed, gaining deeper insight into the research projects. Many Open House attendees stated that the opportunity to speak at length with performers allowed them to discuss the implications of specific research projects and draw connections to their own interests more comprehensively than from a traditional briefing or a written project synopsis.

The HSCB Capability Open House highlighted the diversity of projects currently funded, and allowed performers to demonstrate the utility of the applied research, modeling tools, and software applications developed within the Program. This year's event featured fifteen HSCB-funded projects carried out by teams across government, industry, and academia whose work demonstrates the progress the Program has made in meeting its objectives, advanced our understanding of the sociocultural factors influencing behavior, and provided validated theories for instantiation in computational models. HSCB performers have developed these models into tools that can assist in collection, standardization, integration, and transfer of sociocultural data and allow for more efficient delivery of sociocultural training at both tactical and operational levels. Together, these tools will assist warfighters in understanding sociocultural factors during analysis, planning, and operations.

Arizona State University
Identifying and Countering Extremist Narratives

Arizona State University is fusing humanities and social science methods of narrative analysis to map the narrative landscape in operational areas and identify critical narrative threats. The project has collected and coded over 2000 extremist texts containing over 3700 stories, and used that data to analyze the structural and cultural patterns and develop an agent-based model to investigate the factors involved in message traction. This project will allow analysts to better understand how extremists use narrative to persuade contested populations to support or tolerate them, and provide commanders and non-kinetic operators with appropriate tools to counter extremist narrative strategies

eCrossCulture
Precision Aid for Warfighters, NGOs, USAID, and PRTs

eCrossCulture is developing a tool that captures years of Department of Defense, non-governmental organization, and United Nations experience in humanitarian relief programs. It will allow warfighters, US Agency for International Development (USAID), and Provincial Reconstruction Teams (PRTs) to initiate aid, humanitarian assistance, and economic development projects more efficiently. eCrossCulture uses models created from nine international interventions, including Aceh, Afghanistan, Haiti, Iraq, Kosovo, and Somalia.

GeoEye Analytics
Unbiased Analytics

GeoEye is improving the capability for unbiased quantitative analysis of geospatial patterns, temporal trends, and textual content. These analytics provide guidance to decision-makers and scientifically based input for further study by subject matter experts. For example, to better understand the events in Tahrir Square in Egypt, GeoEye developed a prototype capability to analyze Twitter feeds to identify clustering and crowd density. Monitoring trends in geospatial distribution over time can alert officials that a gathering is approaching critical mass before social disorder and dangerous situations occur.

Carnegie Mellon University
Architecture to Support Sociocultural Modeling

Carnegie Mellon University's Center for Computational Analysis of Social and Organizational Systems (CASOS) has developed a variety of tools to assist

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Capability Open House Summary

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warfighters with planning and analysis, including SORASCS [Service Oriented Architecture for Socio-Cultural Systems], AutoMap, ORA [Organization Risk Analyzer], and Construct. Key features of these technologies include rapid extraction of meta-network data, support for reasoning about dynamic spatially embedded networks, capabilities for visual analysis of dynamic geo-embedded social networks, workflow management and sharing technologies, and utilities to support targeting, strategic assessment, and human geography assessment. These technologies have been applied in a variety of domains from counter-IEDs and counter-narcotics to strategic nuclear deterrence and resiliency assessment of C2 architectures. Analysts are currently using the ORA technology in Afghanistan and Iraq.

Arym Geospatial Center International Stability Assessment and Analysis Capability (ISAAC)

ISAAC aims to fill gaps in current Humanitarian Assistance and Disaster Relief practices by providing a framework within which to collect and visualize data in near-real time, analyze them in a relevant data-to-decisions process that results in actionable information, and disseminate the outputs using standard interoperable data formats and protocols.

Kinection Task-Based Communications Training System

Kinection is designing a training toolkit (TCTS) to develop communication skills at the tactical level. The goal is to equip all warfighters with the language, nonverbal, and cultural skills needed to build rapport, interpret behavior, and work effectively with local counterparts. Employing methods based on research about second language acquisition, the training is available on demand, on computers and mobile devices, and is tailored to each warfighter's individual communication needs.

Seattle Pacific University Mining Afghan Lessons from the Soviet Era (MALSE)

The MALSE Program seeks to help US military and civilian leaders make better informed decisions in complex environments – such as the Afghan conflict – by providing relevant practical lessons from historical and modern primary sources, rigorous analysis, and education. MALSE leverages the valuable lessons learned and to be learned from the Soviet experience, and takes advantage of unique unused sources that can provide new information about the conflict.

Milcord Complex Operations Wiki

Milcord has developed a semantic wiki whose structured format allows users to document their datasets and analytical products, providing a rich repository of sociocultural information for collaborative knowledge sharing. The Complex Operations Wiki supports semantic and meta-level knowledge organization, which enables the discovery of new relationships. Milcord's semantic wiki approach allows users to query information as they would query a database and enables the import and export of semantic annotations to a variety of formats.

Pennsylvania State University CATNet

Competitive Adaptation in Terrorist Networks (CATNet) uses a multidisciplinary method blending computational network analysis with primary, ethnographic field research to analyze militant networks. In addition to constructing networks based on hundreds of thousands of open-source documents—news articles, group websites, and court transcripts—the project augments these data with data drawn from in-depth, semi-structured interviews with disengaged terrorists and counterterrorism officials. From these analyses, CATNet can illuminate the processes of learning and adaptation that occur between terrorist and counter-terrorist networks in complex adaptive environments, assisting US warfighters in planning their own counter-terrorism strategies.

Strategic Analysis Enterprises (SAE) Pathos

SAE's automated sentiment analysis software program, Pathos, extracts near-real-time "multi-adic" emotions, attitudes, and opinions from electronic

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Capability Open House Summary

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sources such as blogs and news stories. It aids users in examining strategic relationships among governments, dissidents, ethnic-religious actors, and the broader population. Automated sentiment analysis allows decision-makers to understand how US government actions can mitigate the intensification of violent political conflict and simultaneously aid reconstruction and development operations. SAE's Pathos tool offers a viable alternative to polling especially when accessibility, manpower, and time are limited.

University of Washington Modeling Insurgent Rhetoric, Networks, and Strategic Decision Making

The Modeling Insurgent Rhetoric, Networks, and Strategic Decision Making project exploits insurgent rhetoric as a data source for the development of computational models of insurgent decision-making and behavior. This project quantitatively investigates three key components of insurgent rhetoric that can help users to understand and anticipate insurgent decision-making. The project also assists analysts in understanding dynamics such as the interplay between insurgent strategic use of violence and rhetoric, insurgents' choices of allies, and inter-insurgent rivalries and rifts.

Lockheed Martin Worldwide Integrated Crisis Early Warning System (W-ICEWS)

DARPA's ICEWS program developed a comprehensive, integrated, automated, generalizable, and validated system to monitor, assess, and forecast national, sub-national, and international crises in a way that supports decisions on how to allocate resources to mitigate them. ICEWS will provide combatant commanders with a powerful, systematic capability to anticipate, recognize, and analyze challenges to stability in their area of responsibility. ICEWS will operationally extend this work and enable user evaluation and transition of HSCB capabilities to the STRATCOM Integrated Strategic Planning and Analysis Network (ISPAN) program of record starting in Spring 2012.

BAE Planning Research and Intelligence Scalable Modeling Project (PRISM)

The HSCB Program's PRISM Project is leveraging over $50M in DoD technology investments to provide HSCB software services for analytic and planning capabilities to DoD programs of record. PRISM will supply end-to-end capabilities that support a wide variety of users – both DoD intelligence analysts and planners. The PRISM concept of operations supports analysis of the topography, planning and anticipation of the effects of US actions, and tracking of the effects of those operations.

University of California, Davis ABAT

The Automated Behavior Analysis Tool (ABAT) provides a reusable framework for automated simplification and explanation of behavior. This research has potential applications for understanding the Gray Layer (explaining the drivers and cultural signature/beliefs of the local population where adversarial events occur), and building a Semi Automated Forces (SAF) wargame player (through explaining the stimuli/response relationship between red and blue). ABAT applies the latest research in computer science to simplify the event cube into underlying behavior: a heat map and its activation level.

Eastern Michigan University Cross-National Analysis of Islamic Fundamentalism

Eastern Michigan University is conducting a comparative study of values, trends in values, and religious fundamentalism in Egypt, Iran, Iraq, Lebanon, Pakistan, Saudi Arabia, and Syria, drawing on survey data on Middle Eastern values. These data enable the project to make connections among culture, values, religious fundamentalism, and violence against US troops.

Northeastern University Spatiotemporal Description of Group Formation in Social Systems

Northeastern University is constructing weighted social networks based on a variety of inputs, including cell phone calls, emails, and Twitter posts. These networks can be used to forecast patterns of human movement, investigate communities and determine hierarchical organization, and respond to emergencies with disaster relief and humanitarian assistance.

Dealing with Uncertainty in Using Sociocultural Behavior Models

By Gary L. Klein

Dealing with uncertainty is crucial to the usage of sociocultural behavior models. Uncertainty is a major concern in trying to determine how these models can support operational planning and analysis, as well as for verification and validation of these models. This article describes how dealing with uncertainty will require a movement from seeking optimal decision-making (regrettably a specious search in the human terrain) to seeking robust decision-making that identifies courses of action (COAs) which will work across the widest range of plausible futures. It is this shift in perspective that enables the most effective use of sociocultural behavior models that indeed can facilitate planning even under circumstances of irreducible uncertainty. Used properly, these models will support improved sociocultural understanding and thereby the identification of more robust COAs and policies, which will inherently improve the success of our decision-making.

Warfighters are familiar with helpful deterministic models. For example, a ballistic trajectory is determined completely by the acceleration of gravity, the launch speed of the projectile, and the launch angle—provided air friction is negligible. But forecasting the trajectory of human behavior is more like forecasting the trajectory of a hurricane: the value, influence, and interaction of factors affecting that trajectory are all highly uncertain. In the case of hurricanes, meteorologists deal with this uncertainty by executing an ensemble of models that cover the plausible values, influence, and interactions. The result of this *exploratory* modeling (Bankes, 1993) is a forecasted distribution of plausible hurricane landfalls. Even though no point prediction can be made, the distribution of possible landfalls is still useful for robust emergency planning that will prove effective for the broadest swath of the hurricane's plausible paths.

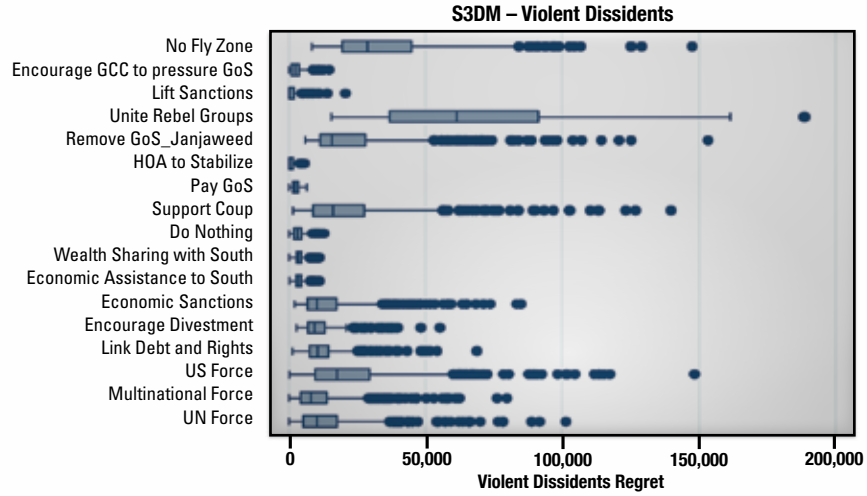
In the area of human behavior, as with hurricanes, we can make useful forecasts that can identify robust COAs that will work across the broadest swath of plausible sociocultural futures. To do this we must use sociocultural behavior models in an exploratory fashion in order to enhance our understanding.

David Alberts and Richard Hayes describe the complexity of the situations facing today's decision-makers—a complexity that motivates our use of sociocultural behavior models to enhance our understanding and planning:

It is becoming increasingly clear that the complexity of the situations faced and the responses needed have outpaced not only decision theoretic approaches, but have also outpaced the ability of even the best of experts (super stars) … These sources of complexity … make it difficult to relate a cause to an effect and almost impossible to predict cascading effects. (Alberts and Hayes, 2003)

Moreover, uncertainty multiplies the impact of all the factors cited above. When uncertainty is present, every situational factor takes on a range of values. Furthermore, when modeling sociocultural phenomena there are many irreducible sources of uncertainty: the data may be uncertain, it may not be clear how to translate qualitative real-world data into quantitative model factors (e.g., if group A hates group B *a lot*, is that a 7 or an 8 value for the *hatred* parameter?), sociocultural models are by necessity incomplete, and it sometimes requires judgment to determine the meaning of modeling results. Even under irreducible uncertainty, the exploratory use of sociocultural models can help us better understand the interaction between what is known and what is not, and the range of plausible outcomes for each COA under consideration. This degree of insight has been termed *Option Awareness Level-1*. (Klein et al., 2003)

The figure below illustrates an example of a model-generated *decision space* (Hall, Hellar, and McNeese, 2007) that yields this level of option awareness. It shows the results of an exploratory modeling effort using a system dynamics model of state stability that illuminates the sources and consequences of insurgent recruiting (Choucri et al., 2006). In this example, each COA listed along the vertical axis of the graph was translated into parameter values in the model. Uncertainty around each of these *endogenous* variables was estimated and systematically varied across multiple executions of the model. In addition, other *exogenous* variables that would fall outside the control of a COA, but would likely interact with that COA, were similarly varied systematically across these multiple executions of the model. The result was a hyperspace of combinations of different endogenous and exogenous variable values, which in turn led to a hyperspace of plausible future situations. Each of these situations can then be evaluated in terms of how much *regret* (in this case, how many violent dissidents are recruited) is generated by that situation. When the regret of each situation is mapped against each COA, we obtain a two-dimensional projection that allows us to compare robustness in the users' decision space.



THE RESULTS OF EXPLORATORY MODELING IS A DISTRIBUTION OF PLAUSIBLE OUTCOMES FOR EACH COA ANALYZED

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Dealing with Uncertainty in Using Sociocultural Behavior Models

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The figure shows that the option of "uniting the rebel groups" is apparently both the least optimal and the least robust. It has the highest median regret (the vertical line inside the gray box). Moreover, it has a wider range of results that are sensitive to the interaction between the COA and the exogenous variables in the model. On the other hand, "doing nothing," having the "North fairly share wealth with the South," and "providing economic assistance to the South" are all relatively robust lines of operation; that is, these options are apparently insensitive to the changing exogenous variables that had such a wide-ranging effect on "uniting the rebel groups." This illustrates how such exploratory modeling allows decision-makers to probe uncertainty and reveal its differential impact on different COAs, thereby identifying COAs that will likely work across a broad range of plausible futures.

Such modeling can reveal an even deeper understanding. Although the plot shows that many of these options can result in no violent dissidents being recruited, we cannot infer that similar outcomes would occur under similar conditions. However, because each outcome results from a different combination of exogenous and endogenous values executed through the simulation model, decision-makers can data mine the decision space to identify the combinations that yield low (or high) regret. They may find that low regret for some options occurs under conditions that we can facilitate with additional shaping actions. This would certainly enhance the desirability of those options. This deeper level of understanding has been termed *Option Awareness Level-2* (Kelin et al., 2010).

Finally, such additional shaping actions would be translated into new options to be modeled and a new round of modeling would be executed to verify the relative effectiveness of these modified options. This deepest level of understanding has been termed *Option Awareness Level-3* (Ibid.).

Steve Bankes wrote, "When used for exploratory modeling, the computer functions as a prosthesis for the intellect, supporting the discovery of implications of a priori knowledge, novel explanations of known facts, or unrealized properties of conjectures." We have called this capability *night-vision goggles for the mind* (Klein, Drury, and Pfaff, 2011): allowing decision-makers actually to see otherwise obscured relationships between options rather than requiring them to mentally simulate each one. By making choice a perceptual comprehension process, we enable decision-makers to apply their more powerful visual, pattern matching, and recognition capabilities rather than their more limited capacities for mental simulation. Visual processing that displays the simulation results in terms of frequencies (like the box plots in Figure 1) rather than probabilities has been shown to greatly improve users' understanding of the data (Hoffrage and Gigerenzer, 1998).

The exploratory use of models described above is also crucial to addressing the issues raised regarding validation of sociocultural models. These models should be validated in terms of their ability to improve the understanding of the decision-maker. To do this we must both determine that the understanding to be conveyed is valid, and that this information is received and properly cognitively processed by the decision-maker.

The understanding we are trying to convey is the relationship between sociocultural factors and better and worse outcomes for different COAs. Different verification and validation issues must be addressed. First is determining rigorously that the relationships in the models are based on sound social and behavioral science (SBS) theory. We can rely on the scientific peer review process to vet the theories themselves. However, a critical validation task is to gain expert assurance that the right theories are being applied to the right problem. Exploratory modeling can ease this task, because if there is an honest disagreement among experts as to which theory applies such modeling can apply multiple competing theories to the same problem via multiple models. A COA would be particularly robust if it achieves good simulated outcomes across the greatest number of theories as well as sociocultural futures. If a COA fails under some theories and succeeds under others, this, too, can provide useful information about the factors critical to better and worse outcomes.

Given a sound SBS theory, we must verify that the construction faithfully implements the theory. Here modelers must follow standard quality assurance practices, which are well documented elsewhere.

With sound social science, faithfully implemented, subject matter expertise can be used to validate the model for understanding. Research has shown subject matter experts to be well calibrated in identifying the key factors and relationships that link a given set of inputs to an observed outcome, even though these same experts are not themselves reliable forecasters. To make the identifications necessary in this context, experts must be trained in the internals and usage of the model to ensure that they know and focus on the factors and relationships actually represented in the model. These experts can then be presented with pairings of initial conditions and simulated outcomes and asked to identify *a priori* which key variables and causal connections in the model could indeed account for each condition-outcome pair. The expert explanations can be compared with the variables and causal relationships indicated by the model. Agreement between the experts and the model would certainly provide evidence of the model's explanatory validity. However, even if the model produces a different causal chain than that produced by the experts, the experts can still validate that causal chain as reasonable after the fact. By contrast, if the experts do not accept a model's causal chain, this would be a basis for reviewing both the construction of the model and its application to the problem.

We noted above the general importance of presenting exploratory modeling results in a frequency format to improve human

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Dealing with Uncertainty in Using Sociocultural Behavior Models

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understanding. For our decision-making purposes, understanding consists of both correct situation awareness (Endsley 1997) and correct option awareness (Klein et al., 2010). Endsley defines three levels of situation awareness: perception of the elements of a situation, comprehension of their meaning, and projection from those facts to possible futures. A considerable literature discusses how to measure these levels of situation awareness (e.g. Endsley and Garland, 2000). As described above, we have defined similar levels of option awareness: perception of the relative robustness of alternative COAs, comprehension of the relationships among factors underlying better and worse outcomes, and projection of these relationships to adjusted or new options. Because option awareness can be considered essentially an extension of situation awareness to the decision space, the same measurement approaches can be applied to validate that users actually achieve proper option awareness.

Using an exploratory modeling approach for dealing with uncertainty enables robust decision-making. Even under circumstances of irreducible uncertainty, we can improve sociocultural understanding, identify more robust COAs and policies, and ultimately improve the success of our decision-making. Moreover, we can systematically validate that sociocultural models improve both understanding and decision-making.

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CALENDAR

DATE	EVENT	LOCATION	WEBSITE
April 3–5, 2012	2012 International Conference on Social Computing, Behavioral-Cultural Modeling, & Prediction	University of Maryland, College Park, MD	http://www.umiacs.umd.edu/conferences/sbp2012/
July 21-25, 2012	2nd International Conference on Cross-Cultural Decision Making	San Francisco, CA	www.ahfe2012.org