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The best papers from BRIMS 2011: Models of users and teams interacting

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The BRiMS Society and Conference (Behavioral Representation in Modeling and Simulation (BRiMS, brimsconference.org) promotes cross-disciplinary and cross-organizational communication for basic and applied scientific research in the realm of modeling and simulation of human behavior, with a particular but not exclusive emphasis on government-related tasks and behavior. Thus, the BRiMS conference brings together scientists, engineers, practitioners, and application users to discuss modeling behavior ranging from that of individuals to the behavior of whole societies, their interactions, and their implications. Each year we get to meet to share ideas and experiences, identify gaps in current capabilities, discuss new directions, highlight promising technologies, and showcase applications.

This special issue is similar to our previous special issues (Kennedy, Ritter, & Best, 2010, 2011) in that it includes articles based on the award winning conference papers of the 2011 BRiMS Annual Conference. These articles were reviewed by the editors, extended to journal article length, and then peer-reviewed and revised before being accepted.

The articles include a new way to evaluate designs of interfaces for safety critical systems (Bolton, in press, 2012), an article that extends our understanding of how to model situation awareness (SA) in a cognitive architecture (Rodgers, Myers, Ball, & Freiman, in press, 2012), an article that presents electroencephalography (EEG) data used to derive dynamic neurophysiologic models of engagement in teamwork (Stevens et al., in press, 2012), and an article that demonstrates using machine learning to generate models and an example application of that tool (Best, in press, 2012). After presenting a brief summary of each paper we will draw some lessons and insights from them.

The first article by Matthew Bolton presents a way to validate that a user interface is able to support the tasks described by a task analyses similar to GOMS (John & Kieras, 1996) or hierarchical task analysis and validate that an interface (it too is modeled) is able to support the tasks in the task analysis. The article includes a worked example for a patient controlled analgesic pump where two of the three subtasks could be completed successfully, and one could not be with the initial design. The example also shows how the interface can be redesigned and it can be proved that the task can be performed. Bolton's approach does not show that the tasks are performed efficiently but can find where tasks cannot be performed. The article's discussion notes several useful insights about automatic interface testing using this approach, including the need for more assistance in using the approach (usability), a concern about scalability, and implications for this approach's use in large scale system design.

The second article by Stuart Rodgers, Christopher Meyers, Jerry Ball, and Mary Frieman, "Toward a situation model in a cognitive architecture", provides an initial implementation of situation awareness (Endsley, 1995) in ACT-R that is part of a synthetic teammate. This article follows previous best papers in exploring computational models of SA published in our series of special issues (R. E. T. Jones et al., 2011) and is related to other models with SA in Soar (R. M. Jones et al., 1999) and CoJACK (Ritter et al., 2012) and creating teammates (Ball et al., 2010).

The third article by Ronald Stevens, Trysha Galloway, Peter Wang, Chris Berka, Veasna Tan, Thomas Wohlgemuth, Jerry Lamb, and Robert Buckles, "Modeling the neurodynamic complexity of submarine navigation teams", applies methods from complexity analysis and from entropy theory to measure how well navigation teams respond to ordinary and unusual situations encountered while piloting a virtual submarine on complex and required training exercises. They find that better performing and more experienced teams have higher entropy in their neurophysiologic measures of engagement, indicating that these teams uses more of the available states of engagement available. Less experienced teams are more prone to becoming highly organized at times, especially during stressful situations, perhaps reflecting a loss of flexibility.

Finally, the article by Bradley Best, "Inducing models of behavior from expert task performance in virtual environments", presents a process to induce models from behavioral traces using machine learning techniques. The machine learning algorithm was enhanced with spatial reasoning knowledge. This approach created a model that was relatively easier to create and that had more nuanced view of space and spatial reasoning (that may be reusable by other models). It was tested by application to a new domain and scenario. It used a lightweight simulator for training and testing, and the Unreal 3D game engine to test transfer across simulators.

This set of articles have several things in common. Not surprisingly, they are about modeling and show a range of work with respect to modeling from gathering particular types of data (e.g., time series, sequential data related to task performance, and measures of task performance) to applications of the results (e.g., predicting individual and team performance with implications for system design).

They also are all models of users and teams interacting, thus the title of this article. The actors being modeled either are interacting with each other (Stevens), with interfaces (Bolton; Rodgers et al.), or with a simulated world (Best). This interaction with external systems will help with applying and transitioning these results because the models and theories already interact with an external system.

They also draw on some themes from previous years. Bolton's article make explicit use of task analysis, as did a previous model from last year (Mueller et al., 2011), and Bolton's article also could make use of high performance computing (Moore, 2011). Rodgers et al.'s article built on their previous work on building a model user (Ball et al., 2010) and models of visual interaction (Jungkunz & Darken, 2011); this time extending it in new ways and working with ACT-R (Moore, 2011; Reitter & Lebiere, 2010). Stevens et al.'s article examines teamwork, which previous articles have done as well (Ball et al., 2010; R. E. T. Jones et al., 2011; Morgan, Morgan, & Ritter, 2010). Best's article explored spatial reasoning (Lin & Goodrich, 2010; Reitter & Lebiere, 2010), an increasingly important skill for agents that move in environments, and used a simulator used by previous journal and conference publications (Morgan, Morgan, & Ritter, 2010; Ritter, Kase, Bhandarkar, Lewis, & Cohen, 2007), and Bolton's can be seen as a very local spatial reasoning.

These articles also have practical applications. Bolton's work on model-based testing can be applied to safety-critical and other high-stakes interfaces. Rodgers' et al.'s model has implications for systems where SA is important. Stevens et al.'s work makes suggestions for the design of interfaces and systems for use by teams as well as measure of team effectiveness because their measure can be taken quickly. Best's article suggests ways to create models more quickly, accurately, and easily.

Based on this work, the BRiMS conference is successfully facilitating discussion and contributing to our understanding of computational modeling and organizational theory, not just with these representative "best papers", but through the conference to journal article process. We intend to continue to bring the best representatives from the BRiMS conference to CMOT.

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