Chapter 6 – BEHAVIOUR GENERATION: VARIABILITY AND CHOICE

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6.1 BACKGROUND

Human variability, or human variation, is often used to refer to the range of possible values for any measurable human characteristic (mental or physical). Examples such as the ability to learn, differences in physical strength or endurance, all may serve as moderators to behaviour in some contexts. Expanding the definition of human variability to include the range of possible behavioural outcomes, or behavioural variability, which may be observed for any given human operating within an operational context (e.g., the representation of fight versus flight behaviour), provides a significant challenge for the modelling community. In the context of improving realism and increasing the predictive abilities of Human Behaviour Models (HBMs), developing accurate and representational models of behavioural variability remains a desirable yet elusive goal.

Indeed, the NATO M&S Master Plan (NATO, 1998) notes that current computational models and simulations of operator and entity behaviour do not adequately represent human performance, neither at the individual nor the small group level. Current Computer Generated Forces (CGFs) rely largely on rule-based behaviours that are tied closely to doctrine, and while doctrine is often modelled, it is seldom observed in a pure form in practice. Predictability (i.e., lack of variability), based on textbook doctrine, may be desired for preliminary instruction or training basic skill development, but it is inadequate for advanced training in decision making, situation assessment, experimentation with tactics, or the evaluation of novel systems and procedures.

This session will attempt to clarify a number of questions that remain unanswered with respect to modelling behavioural variability. Are there adequate analysis techniques that can be leveraged to generate an adequate understanding of the factors underlying behavioural variability? How do we integrate the generation of behavioural alternatives and provide a mechanism from which these alternatives are executed? How does one characterize appropriate versus inappropriate behaviour, and how does behaviour relate to the concept of error?

6.2 SPEAKER PRESENTATIONS

Mrs. Carol Cooper-Chapman, Defence Science and Technology Laboratory

Dr. Chapman and colleagues at DSTL are establishing a modelling framework based on the works of Endsley (Endsley, 1993, 1995, 1998), Klein & Rasmussen that will support the inclusion of behavioural variability in their paradigm.

Dr. Emiel Ubink, TNO

Dr. Ubink presented an HBR modelling paradigm using a pandemonium model of behaviour that TNO is using to explore the performance and behavioural characteristics of soldiers in operational contexts. The representation of behaviour is produced through the combination of the effects of stressors (fatigue, core body temperature, workload, etc.) with task-specific knowledge. Changes in the states of stressors are used to modify task selection thereby producing behavioural variability in the HBR. In their current application, the TNO tool supports the representation of multiple entities, and is somewhat reminiscent of a SAF system in that the level of representation appears to be more tailored towards modelling the behaviour of an overall force structure (platoon, company, etc.) than individual entities.

The pandemonium model employs daemons that shriek for attention (a metaphorical prioritisation scheme) although it isn't necessarily a winner take all rule as it considers the resources that are available to accomplish the goal of the shrieking daemon. The use of a resource by a behaviour leads to a reduced capacity, as do stress and strain, directly resulting in variable behaviour.

6.3 DISCUSSION

6.3.1 Levels of Complexity

Determining the extent that a model must include variability, and therefore complexity, is an important aspect of building better HBRs. The decision to include elements of behavioural variability should be considered carefully, and must be supported by the requirement to represent different aspects of behaviour to support a specific research objective. Caution must be taken not to fall into the trap of providing significant levels of variability without just-cause. Indeed, examples were provided by the audience demonstrating that in extreme cases, overly complex models will often fail to perform at all, or exhibit behaviours that are so unpredictable as to render the model highly unstable. It was also noted that the ability to switch variability on and off may be an important feature both during development and during use of the model.

6.3.2 Types of Variability

Sources of behavioural variability typically arise through two domains: within individuals or between individuals. The ability to provide an accurate representation of the possible actions that a specific individual could use to respond to a situation is important for individual behavioural variability. This implies that modellers must be aware of the breadth of behavioural outcomes, and therefore the task-specific knowledge that must be represented within a model. Data driven concepts from theorists such as Klein and his Recognition Primed Decision Making (RPDM) model reflects the notion that variability is situated in the environment, and that this source of variability is what simple models may process to produce more complex and variable behaviour.

In its simplest form, the representation of between-individual variability reflects both the differences in task-specific knowledge and drivers of task-selection across individuals. In the military domain, obtaining the relevant task-specific knowledge from Subject Matter Experts (SMEs) is critical to achieving realistic behavioural variability. However, extending between-individual variability into the representation of Cultural Variability is challenging due to the lack of available SMEs in most applications. In either case, the use of SME input to establish branches for alternate behaviours is a costly, labour-intensive process, and the SME may not give represented answers that lead to plausible behaviours.

6.4 CONCLUSIONS

Overall it was agreed that variability is best represented through between-subject differences, or through within-subject variability that reflects both differences in the knowledge, states and traits of an individual. Current difficulties arise through the lengthy and time-consuming requirements to identify relevant knowledge for given situations, and establishing realistic links between state, trait and environmental characteristics that give rise to the selection of alternative tasks. Future work should focus on building better learning models that can produce new knowledge based on past experience, and incorporate this knowledge into the selection of behaviours. Ultimately the representation of variability must remain plausible; otherwise the inclusion of variability within models will become random and unexplainable.