Capturing Skilled Performance of Complex Tasks in a Dynamic Domain.

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A fundamental step in building a constructive model of skilled performance and expertise is eliciting knowledge from participants of different skill levels. This paper presents an attempt to do so based on well-established psychological techniques. For example, sixty years ago, Kelly evolved the Repertory Grid technique to elicit people's individual constructs of aspects of the world, along with their strategies for interacting with their constructed world. While this technique requires systematic elicitation of data from individuals in a controlled manner that is not viable for military operational circumstances, the general idea of capturing the thought processes of participants based on their own individual constructed view of the world is common in applied domains.

For this study, we instructed participants (5 male; 4 female) to engage in a dynamic motion-based racing car simulation while having their vision repeatedly occluded via occlusion spectacles (intervals varied between 1- and 6-seconds, summing to an accumulated 18 seconds of visual occlusion over 54 seconds). Participants completed four variations of the task, in which each track difficulty (Easy; Hard) was paired with each visual occlusion sequence type (Predictable; Unpredictable). While this does not purport to be an actual military operational task, many of the characteristics of military operations and skilled performance in other dynamic task domains are analogous.

We employed a broad range of quantitative, qualitative, and biometric measures. The quantitative measures encompassed task performance parameters (vehicle speed, tracking errors) and subjective workload. The qualitative measures, including semi-structured interviews, collected data concerning participants' perceptions of task success and difficulty, as well as strategies adopted to maximise performance. Biometric measures were employed to capture localised muscle tension in the forearms and shoulders, as well as heart rate variability and video of face and arms during the dynamic task, and are not reported here.

Overall, the best performers completed a track faster with fewer errors and exhibited more anticipatory behaviour. The qualitative analysis confirmed these findings, and revealed significant differences in the pattern of strategies adopted by the better performers versus the poorer performers. Better performers were able to execute their strategies with more precision and they were more successful coping with the challenging aspects of the task, adopting more diverse strategies. This suggests that better performance relies on more developed understanding of the task and its context.

We are confident that the combination of traditional psychological debriefing techniques and the analysis of task-specific biometric and performance data can help set parameters for constructive modelling of dynamic, interactive tasks in complex environments.