Operators are often provided with automation support tools that affect situation awareness, attention, and mental workload. It is therefore important to understand ways in which automation alters the way an operator accomplishes cognitive work. The present work was specifically designed to investigate the effects of traffic predictability, and reliable and imperfect automation on air traffic controller (ATCo) performance, attention allocation, and mental workload. These issues are of theoretical interest because models of human-automation interaction postulate the need for feedback to the operator on automation states (Parasuraman et al., 2000). The practical relevance is driven by the need for developing effective and safe future air traffic management (ATM) systems which can transition smoothly from the current system.

We additionally examined the effects of reliable and imperfect automation on ATCo performance and attention allocation. It was expected that ATCos would show better performance when they were supported by automation as opposed to when they were performing the tasks manually. By automation supporting the operator and moving them further away from the decision-making process, it was expected that when the automation was imperfect, operator conflict detection performance would degrade because of high trust in the automation. In the context of signal detection theory, automation may be imperfect by providing a miss or a false alarm (Green & Swets, 1988). It was hypothesized that with miss prone automation: a) eye movements (a measure of visual attention) to the automated task would increase at a cost to the other tasks, and b) behavioral data would show that because the operator would be paying closer attention to the raw data, detection performance should improve. However, with false alarm prone automation it was expected that: a) there would be reduced fixations and dwells to the automated task, and b) behavioral performance would result in either a delayed response or no response to the automated alert.

Results from two human-in-the-loop experiments on the role of automation and attention allocation in human performance showed that: (a) ATCos detected conflicts earlier when the majority of freely maneuvering aircraft provided the ATCo with intentions regarding their proposed new trajectories; (b) reliable automation improved performance compared to manual control and imperfect automation degraded performance supporting previous work with automation in an ATM environment (Metzger & Parasuraman, 2005); (c) attention optimality was better with miss versus false alarm prone automation.

Poor performance in a time critical environment with imperfect automation raises safety concerns. Given that the reliability of automation impacts human automation interaction relationships current findings have implications for human automation interaction and visual attention to various expert domains including unmanned aerial vehicles and medical human factors.