ABSTRACT

Multitasking is common in operational workspaces, from air traffic control through to military command and control. Within many of these environments, efficient processing of visual information, such as warning alerts or cues, is fundamental. In this thesis, I explore whether increasing task load reduces visual processing efficiency. More specifically, I examine whether efficiency decreases when people are engaged in a demanding concurrent task, and whether display characteristics such as clutter, target salience, and signal location modulate processing efficiency.

In the first study, participants performed a visual target recognition task either by itself, or while engaged in a visuo-manual tracking task. Analysis of response times revealed that processing was consistently limited-capacity when targets were large enough to be discriminated in peripheral vision (Experiments 1 & 2), and was super-capacity when targets were small enough to demand serial visual attention (Experiment 3). However, I found no difference in visual processing efficiency as task-load increased.

The second study replicated Study 1, but for displays absent of any distractors. Consistent with the earlier experiments, processing capacity was consistently limited capacity and did not vary as a function of task load.

The third study assessed the effect of target location on visual processing under load by manipulating the location of target information within the visual field. Participants responded to targets appearing at either high or low eccentricities (Experiment 1), or else in the upper or lower visual field (Experiment 2), while performing the tracking task. Processing efficiency was consistently capacity-limited and did not vary between target locations in either experiment.

The fourth study examined changes in processing efficiency associated with manipulating both task load and target–distractor discriminability. Overall, highly

discriminable targets were processed with greater efficiency than poorly discriminable targets, but efficiency was again similar across load conditions. These findings suggest increasing the discriminability between targets and distractors is more effective for increasing processing efficiency than reducing task load.

The fifth study applied the basic dual-task paradigm from the earlier experiments to a higher-fidelity simulated military task. Participants monitored for visual targets within a simulated humanitarian aid scenario while either monitoring (low load) or teleoperating (high load) an unmanned vehicle. Despite greater mental workload during teleoperation, monitoring performance did not vary between conditions and was extremely poor across the board.

These studies demonstrate one robust central finding: that increasing task load does not reduce processing efficiency for visual information. The studies also show that, in general, processing efficiency is limited capacity, being less efficient than a standard parallel model. Finally, I find that target salience, but not target location or distractor presence, is effective at increasing capacity. These findings have implications for display design of complex operational environments that optimise operator responding under concurrent task load.