Capacity and Control of Multiple-Target Search

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We spend a considerable amount of our time searching for visual information that is relevant for whatever we are currently doing. This is necessary because the shear amount of information that is available at any moment vastly exceeds what we can actually process. Despite tremendous research efforts, there are still many open questions about the principles underlying visual search. This thesis deals with the question: Can people look for multiple objects at the same time? And if not, how do they manage search so that eventually they find all the objects they were looking for? To test these research questions, I presented four studies in this thesis that tackled them from different angles, using psychophysics, eye tracking, electroencephalography, and functional magnetic resonance imaging. Based on my findings, I propose a framework in which preparation for and engagement in multiple-target search needs to be dissociated. While former is possible for multiple target simultaneously, latter is strongly limited. Specifically, preparing multiple targets in anticipation of a search at essentially the same time is possible. In tasks when two targets are potentially task-relevant and individuals cannot predict which one of them will eventually occur, individuals can prepare to look for both targets, and only once the search display appears, the target that is currently relevant receives a boost and is being processed. The reason why sometimes a residual cost associated with target switching is observed is that preparing to search for multiple targets is probably related to search targets being in competition with each other, so that their relative preparedness dynamically fluctuates over time. As a result, one of them has a slight head start and causes more swift guidance. This advantage is more likely to occur for the target feature that has been relevant on the previous trial–hence the switch costs. Our findings also suggest that selecting multiple unique search targets from the visual input is costly, representing the true bottleneck of multiple-target search. In this sense, individuals can prepare to look for multiple targets, but as soon as these targets need to be selected, they will interfere with each other and cause a considerable decline in search efficiency, the multiple-target search cost. These findings essentially limit efficient multiple-target search to a single item.