**University of Leicester**

**BBSRC MIBTP Studentship Project 2025-6 entry.**

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**Section 2 – *Project Information***

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| **Project Title** | Exploring Visual Search Efficiency in a Multidimensional Framework |
| **Project Summary** | |
| **Proposal**:  The ability to detect and select objects in the scene is fundamental to goal-directed behaviour.  Models of visual search have been developed to understand the neural mechanism that contribute to search strategies that optimise the accuracy and speed of target detection.  Empirical data, however, reveal variability in the extent individuals adopt optimal search strategies both within and between tasks.  Understanding how and when individuals optimise search, has important implications for understanding performance in everyday tasks (e.g., driving), as well as the effectiveness of target detection in safety critical situations (e.g., medical imaging, air traffic control).    Research from our laboratory has highlighted considerable individual differences in visual search efficiency, underscoring the importance of understanding and improving search performance via the strategic allocation of attention to the most relevant areas of visual scene1,2. Critically, our research also showed that all participants can apply the most efficient search strategy, yet most of them do not3. Many factors, including variation in sensory acuity across the visual field, the ability to maintain proactive control of eye movements during search, and personality type have been examined separately to explain the source of individual differences in search strategies with varying success4.    The approach of comparing performance between different studies and tasks, incurs methodological limitations associated with effect sizes and the reliability of statistics based on variation in the number of trials used5.  An alternative, yet unexplored avenue would be to use a more holistic approach to determine the relationships between task characteristics and individual differences across multiple factors that influence observers’ search strategies in one task. As far as we are aware, no comprehensive work has been undertaken to investigate to what extent different efficiency metrics interact with each other, and with other perceptual and personality factors to influence search strategies and performance.    To address this question, the current proposal aims to shift the focus from comparing performance *between* individuals in different task to identify multiple dimensions of (in)efficiency *within* individuals. Our research will establish how broad psychological constructs, such as personality, combine with individual differences in perceptual sensitivity and cognitive control to influence search strategies and performance.  More specifically, we will investigate how personality and task demands affect observers’ use of different search strategies (e.g., the extent that observers attend to areas containing most information or use organised or disorganised scan paths), the prevalence of specific errors (e.g., returning to areas previously inspected or incorrectly rejecting fixated targets), and how these factors interact.    Findings from our analysis will contribute to theoretical models of visual search and our understanding of individual variability in both strategies and performance.  The results will also inform predictions of search efficiency in safety critical situations, such as medical imaging, security and search and rescue.  The proposed project will focus on specifying the complex relationships between individuals and task demands, as well as how individuals can be trained effectively to optimise their performance and maximise the efficiency of the processes involved in visual search.      **Key objectives**:   * Explore multiple efficiency metrics: Move beyond the traditional use of a single efficiency metric by validating and applying multiple metrics to capture individual differences in visual search performance. * Examine strategic eye movements: Investigate the role of eye movements and fixation patterns in search efficiency, identifying optimal and suboptimal strategies within individuals (e.g., types of errors, regularity of scanpath, proportion of fixations to areas with highest information gain). * Analyse trade-offs in search behaviour: Understand the relationships between cognitive strategies, search tasks, and individual traits, focusing on why some individuals consistently exhibit efficient search behaviour while others do not. * Generate models and practical implications: Develop models to predict individual search efficiency, with potential applications in high-stakes roles like search and rescue or medical diagnostics   Techniques that will be undertaken during the project   1. Questionnaires 2. Bayesian modelling 3. Eye movement recording | |
| **References** | |
| 1Barrett, D., & Zobay, O. (2019). Concurrent evaluation of independently cued features during perceptual decisions and saccadic targeting in visual search. *Attention, Perception & Psychophysics,* 82, 966-984  2Nowakowska, A., Clarke, A.D.F., & Hunt, A. R. (2017). Human visual search is far from ideal. *Proceedings of the Royal Society: B*, 284, DOI: 10.1098/rspb.2016.2767  3Nowakowska, A., Clarke, A. D. F., Reuther, J., & Hunt, A. R. (2024). Variable search for orientation, uniformly optimal search for identity. *Journal of Experimental Psychology: General*, 153(2), 495–510.  4 Wagner, J., Zurlo, A., & Rusconi, E. (2024). Individual differences in visual search: A systematic review of the link between visual search performance and traits or abilities. Cortex.  5Rouder, J. N., & Haaf, J. M. (2019). A psychometrics of individual differences in experimental tasks. *Psychonomic Bulletin & Review*, 26(2), 452-467. | |