**How Does Gaze Cueing Influence the Decision-Making Process? A Computational Investigation of the Gaze Cueing Effect**

Gaze cueing refers to the tendency for people’s selective covert visual attention to shift towards the direction of another person’s gaze, as indexed by faster and more accurate responses to targets appearing at gazed-at locations (see Posner, 1980; Posner et al., 1980; Posner & Petersen, 1990). is tendency for people to follow the direction of other people’s gaze inIndeed, the gaze-cueing effect seems to be remarkably robust, with a recent meta-analysis of more than 400 gaze-cueing effects finding that it emerged across a number of task and cue-feature parameters in a large, healthy adult sample (see McKay et al., under review).

Empirically, ing in the direction of eye-gaze cues congruentincongruent

Using the gaze cueing paradigm, the gaze cueing effect has been studied widely and across a range of contexts. Indeed, the majority of research assessing the gaze cueing effect has focused on testing its generalisability. Example topics of interest within this area have included how the gaze cuing effect differs across gaze-cue type (e.g. real versus cartoon () or computer-generated () human gaze-cues), gaze-cue emotional expression (), threat level of the target stimuli (), or the timing of cue and target presentations (). However, there has been little formal theoretical investigation attempting to understand the cognitive processes underlying the gaze cueing effect.

By prioritising testing the robustness and generalisability of this effect over a rigorous theoretical understanding of the cognitive processes underlying the effect, it is difficult to provide a compelling explanation as to why people are faster and more accurate at responding to gazed at locations compared to gazed away from locations (von Rooj).

One way in which rigorous theory development can be achieved is through building computational models of cognitive processes (). Computational models are formal, mathematical models which attempt to explain and mimic real cognitive capacities. In this study, we will demonstrate how the application of computational models can allow for a deeper theoretical investigation of the decision-making process underlying the gaze cueing effect.

Computational models facilitate rigorous theoretical investigation for several reasons. Firstly, computational models allow for precise predictions to be made that clearly outline psychological parameters and auxiliary assumptions which could otherwise be vague and difficult to falsify. These parameters and assumptions can easily be isolated or controlled which allows for simple and clear identification of how each component of a model influences a theory’s predictions. Secondly, computational models can be directly mapped against data, which allows for direct quantitative evaluation of a given theory. Hence, computational modelling approaches can be useful for improving our theoretical understanding of psychological phenomena.

Using computational models, we can isolate key components of the cognitive process in order to understand which of these components are contributing to a given effect.

, which attempts to describe the cognitive processes that gives rise to certain psychological constraints and capacities

This means that

Many have claimed that psychology is an effect driven discipline. That is, much of psychological science consists of

Many have argued that

Why is Understanding Cognitive Processes Important?

Because we are interested in stimulus-driven response time benefits driven by the central gaze cue, we focus specifically on gaze-cueing tasks where an equal number of cued and miscued trials were presented and where participants were aware that the central cue was task irrelevant. Within these non-predictive gaze-cueing tasks, it has consistently been observed that healthy adults respond faster to the targets cued rather than miscued by eye gaze cues.

At present, the uncontested interpretation of the gaze-cueing effect is that the response time benefit on cued rather than miscued trials is driven by a shift in covert visual attention by the eye gaze cue to the cued location that results in facilitated responding on cued trials and delayed responding on miscued trials. We suggest though that the gaze-cueing effect is not uniquely predicted by a shift in covert visual attention and that a mathematical modelling approach that can achieve a more nuanced picture of the nature of the response time data would be a benefit to this literature by providing a more nuanced understanding of the potential cognitive processes subserving the observed gaze-cueing effect.

We suggest that another plausible cognitive process may subserve the reliably observed gaze-cueing effect. Specifically, it may be the case that the gaze-cueing effect is driven by cued trials being easier than miscued trials because cued trials are more consistent with the observer’s experience. In other words, it may be that, if, in the observers’ experience, objects of interest usually appear at gazed-at, rather than gazed-away from locations, cued locations are consistent with expectations while miscued trials are inconsistent with expectations. This would reasonably result in cued trials being easier than miscued trials (i.e., because consistent information is easier to process than inconsistent information), resulting in faster responses on cued trials without a need for covert visual attention to have been shifted.

The Drift Diffusion Model, a mathematical process model, is a model of response time data that can differentiate between the two parameters *Start Time* and *Drift Rate.* Start Time refers to where in the process of responding, drift towards a decision begins. We suggest that if the gaze-cueing effect is driven by a pre-conscious cue-driven shift in covert spatial visual attention to the cued location, start time will be closer to the response threshold on cued trials compared to miscued trials.

~~Selective covert visual attention is necessary given limitations on the amount of visual information we can process at a given time (see Desimone & Duncan, 1995 for a review). In order to ensure this selective covert attention mechanism is preferentially processing visual information of potential importance, specific cues within the visual field are used as spatial signals to guide our attention to areas where perceptual processing is supposedly increased, Selective covert visual attention appears to be shifted by a number of cues but, in particular, by others’ averted eye gaze (see Frishen et al., 2007, Dalmaso et al., 2020 for reviews).~~

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