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(Temporal) Visual Attention NOT in Crisis

--Manuscript Draft--

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Abstract:	Extensive research using the attentional blink phenomenon illustrates, through behavioural, modelling and cognitive neuroscience approaches, that distinct selection and attention capacity limits exist. Crucially, these effects cannot reflect peripheral visual processes nor distinct task operations across conditions controlling for issues raised by Rosenholtz. Moving away from attention and selection concepts hinder rather than facilitate a mechanistic understanding of vision.

01. THE NAME OF THE AUTHOR(S) OF THE TARGET ARTICLE
Dr. Ruth Rosenholtz

02. FOUR SEPARATE WORD COUNTS (ABSTRACT, MAIN TEXT, REFERENCES, ENTIRE TEXT (TOTAL + ADDRESSES etc.)
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10. 60-word ABSTRACT

Extensive research using the *attentional blink* phenomenon illustrates, through behavioural, modelling and cognitive neuroscience approaches, that distinct selection and attention capacity limits exist. Crucially, these effects cannot reflect peripheral visual processes nor distinct task operations across conditions controlling for issues raised by Rosenholtz. Moving away from attention and selection concepts hinder rather than facilitate a mechanistic understanding of vision.

11. 1000-word MAIN TEXT (with paragraphs separated by full blank lines, NOT tab indents)

The world is highly dynamic, constantly changing across the dimensions of time and space. Consequently, in any given instant, far too much information is generated for it all to be processed up to the level of consciousness. Indeed, a number of behavioural phenomena illustrate that we only become aware of a small fraction of the information presented to us. Faced with this challenge, if humans (and many other species) are to behave adaptively they must identify and devote limited resources to information that is relevant for survival over that which is less relevant (Marois & Ivanoff, 2005)!

What cognitive and neural processes determine this prioritization of information is arguably the biggest question in brain and cognitive sciences and for decades it has been considered that attention drives selection and the capacity limits of information processing (Pashler, 1998). However, Rosenholtz questions the use of terms such as selection and attention, arguing these are not useful or necessary when attempting to describe the mechanisms underlying the capacity limits of vision. Rather these reflect properties of summary statistics, characteristics of peripheral vision and aspects of task requirements.

However, selection and attention do not just operate across space to drive perception, and not all tasks designed to tap these operations have spatial manipulations of information. Indeed, perhaps the most inarguable contribution of selection and attention is in facilitating memory (Wyble, Bowman & Nieuwenstein, 2009). Here we focus on work employing Rapid Serial Visual Presentation (RSVP) wherein an object is selected at a moment in time. When stimuli are presented rapidly (tens of ms), subjects are only able to remember the one item that matches their goal/attentional template (Potter, 1976) with high accuracy. If this process of selecting and encoding a singular piece of information into memory according to active mental goals should not be called attention, how else can it be described?

Over the last 3 decades considerable research has been devoted to understanding attentional selection and encoding over time. Crucially, for the current arguments put forward by Rosenholtz, the relevant behavioural markers cannot be due to summary statistics, perception, the characteristics of peripheral vision and/or aspects of task requirements. Chief amongst these phenomena is the attentional blink (AB). This is a highly investigated effect: the second most highly cited article in the *Journal of Experimental Psychology: Human Perception and Performance* is the first paper describing the AB (Raymond, Shapiro & Arnell, 1992) and Dux and Marois's (2009) review on the AB is the 4th most highly cited paper in *Attention, Perception and Performance.* In the typical AB paradigm, an RSVP approach is taken with items appearing one after each other in the same central spatial location for a fraction of a second each (e.g., 100ms/item). To elicit an AB, subjects search for two targets, such as letters, among a stream of distractors, such as digits, and report them at the end of the stream, without speeded time pressure. A key finding is that if target 1 (T1) and target 2 (T2) appear within 200-600ms of one another, T2 is likely to *not* make it into working memory and consciousness. However, if T1 and T2 appear sequentially, T2 performance is not impacted or is "spared" (e.g., Lag-1 sparing). Crucially, all this happens in the same foveated spatial location and for each condition the task requirements are identical and explicit without any "cloak and dagger" experimental psychology tricks.

Numerous models have been introduced to explain Lag-1 sparing and the AB using attentional mechanisms. Across all the relevant theories there are nuances, however there are essentially 3 AB frameworks: attentional gating (e.g., Olivers & Meeter, 2008), loss of attentional control (e.g., Di Lollo, Kawahara, Ghorashi & Enns, 2005) and attentional encoding bottlenecks (e.g., Wyble et al., 2009). Attentional gating models predict that T1 generates an attentional episode which drives the consolidation of this item into working memory, the trailing distractor causes an attentional gate to close to prevent interference for a period of ~500ms. As a result, when T2 appears in this window it is less likely to be reported. Loss of control models are similar in that it is the distractor item following T1 that triggers the AB, however in this case it causes the system to rapidly reconfigure attentional templates from target processing to distractor processing, which temporarily impairs processing. Finally, bottleneck models hypothesise that encoding information into working memory, an attentional operation, is capacity limited and takes ~500ms to complete. Consequently, at short T1-T2 lags, T2 must wait for T1 to be encoded leaving its fleeting representation open to interference/masking from distractors.

Irrespective of one's theoretical persuasion, it is difficult to characterise the AB as being perceptual in nature and no framework makes this prediction. Indeed, Lag-1 sparing is particularly difficult to imagine as a simple perceptual bottleneck since individuals are apparently selecting two items in succession when they are close in time but have more difficulty when they are farther apart in time. In addition, Lag-1 sparing can spread across multiple targets (spreading of the sparing) if these items are not separated by distractors (Di Lollo et al., 2005). It is difficult to characterise this phenomenon without reference to something like attentional selection. Similarly, the AB must represent processes between perception and memory as no T2 deficit is observed if one is presented with the same dual-target paradigm but instructed to ignore T1 (Raymond et al., 1992). In addition, AB magnitude is increased when T1 is made more difficult to process (e.g., Dux & Harris, 2007) - the classic bottleneck effect.

Collectively, this paradigm clearly illustrates that, under conditions where summary statistics, perception, characteristics of peripheral vision and/or aspects of task requirements cannot drive effects, selection and attention are important for describing mechanisms underlying the encoding of information into memory. Moving away from these concepts will hinder rather than facilitate our understanding of vision as we would end up having to re-invent attention-like operations.

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13. COMPETING INTERESTS STATEMENT
The authors have no conflicts of interest of competing interests

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15. ALPHABETICAL REFERENCE LIST (APA STANDARD)

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