Computational Modelling of the Attentional Blink

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The Attentional Blink (AB) [2] is a prominent experimental phenomenon, which clarifies the capacity of humans to deploy attention over time. It employs Rapid Serial Visual Presentation (RSVP) in which a sequence of items is presented at around 10 items / sec, with each replacing the previous item in the same spatial location. In the AB, two target items (*T1* and *T2*) are presented within an RSVP stream. At this rate, processing of *T1* has a significant impact on the processing of *T2*; as demonstrated by the manner in which, *T2* | *T1* (the probability that *T2* is reported conditional upon report of *T1*) varies according to the lag at which *T2* follows *T1*. In particular, while *T2* | *T1* is at baseline from lags 7 onwards, if *T2* appears between lags 2 and 6 there is a significant decrement in *T2* | *T1*. Surprisingly, when *T2* immediately follows *T1*, *T2* | *T1* is at near baseline levels; this is the lag 1 sparing phenomenon. In this paper we provide a revision of a model that we presented at NCPW8 [1], which fits with a broader spectrum of the available data and is more consistent with theoretical explanations of the AB.

Our new model has four main theoretical inspirations: 1) that visual trace strength is the central factor in regulating target difficulty; 2) that there are two discrete stages in the processing pathway [2]; 3) that *type* and *token* information differentially contribute to Working Memory (WM) consolidation [3]; and 4) that the AB bottleneck is late in the processing pathway [4]. We obtain 1) through a combination of feedforward and lateral inhibition, which ensures that RSVP items are backward masked by following items. With respect to 2), our 1st stage extracts type information, which is a detailed representation of the identity of items, including perceptual and semantic features. While stage 1 enables items to be processed in parallel, it is only through the serial stage 2 that tokens can be allocated to types and thus items can be consolidated into WM. Tokens are compact WM encodings, which record episodic information, such as how and when the item occurred (e.g. its temporal position relative to other items) and which enable type information to be regenerated during retrieval. It should be clear that this mechanism realises theoretical inspiration 3). However, it also realises 4) because the system attempts to protect the *T1* process of binding a token to a type by withholding attentional resources from *T2*. It is for this reason that the system blinks.

Using these principles the model generates a broad spectrum of AB data. Specifically, it produces a basic blink curve, in which *T2* | *T1* performance is reduced at lags 2 to 6. Furthermore, lag 1 performance is at near baseline levels since the allocation of attentional resources to *T1* benefits an immediately following *T2*. However, lag 1 sparing is not obtained without cost, since the model reproduces the decline in *T1* performance and increase in temporal order confusion that is known to arise at lag 1. Further data that the model reproduces includes the blink attenuation if *T1* and / or *T2* are unmasked by placing blanks at *T1*+1 and *T2*+1; distractors in the *T1+1* position prime *T2*s and the system fails to allocate a new token to a repeated target (repetition blindness).

1. Bowman, H. et al (2004) “Towards a Neural Network Model of the Attentional Blink.” NCPW 8, World Scientific.
2. Chun, M. M. and M. C. Potter (1995). "A Two-Stage Model for Multiple Target Detection in Rapid Serial Visual Presentation." JEP: HPP **21**(1): 109-127.
3. Kanwisher N. (1991) “Repetition blindness and illusory conjunctions: errors in binding visual types with visual tokens.” JEP:HPP, **17**(2):404-21.
4. Luck, S. J., et al. (1996). "Word Meaning can be Accessed but not Reported during the Attentional Blink." Nature **382**: 616-618.