

# Why a wandering mind does not blink:

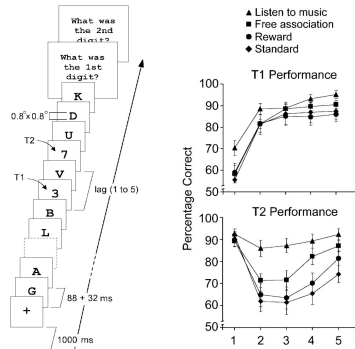
## Internal diffuse attention and its perceptual benefits

Azenet Lopez, LMU Munich/CVBE Jocelyn Yuxing Wang, MIT Philosophy



### 1. A puzzle: Mind wandering reduces the attentional blink

- When a visual target T2 appears 200-400 ms after another target T1, participants miss T2. This effect is called **attentional blink** (AB; see Raymond et al. 1992).
- Olivers & Nieuwenhuis (2005): Mind wandering participants show a significantly reduced attentional blink.



(Figure credit: Olivers and Nieuwenhuis, 2005)

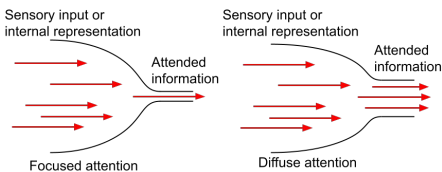
#### The puzzle:

- If S is not paying attention to their visual inputs, S will do worse at detecting visual targets.
- If S is mind wandering, then S is not paying attention to their visual inputs.
- When S is mind wandering, S does better at detecting certain visual targets.

**Our solution:** Revise (2). Mind wandering subjects plausibly switch their mode of attention to these targets from focused to diffuse.

### 2. Diffuse attention and its benefits for perception

- Diffuse attention** is a mode of attention characterized by (i) a **broad and spread-out focus**, and (ii) **relaxed or absent inhibition** of non-target information
- Diffuse attention can be both **internal** (e.g. some forms of multi-tasking, mind wandering) and **external** (diffuse perceptual attention).

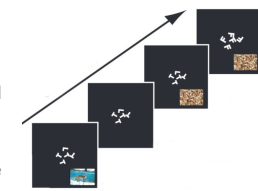


- In visual perception, diffuse attention can be instantiated as **gist or scene perception** (Prettyman 2014; in press). Subjects can perceive a scene without perceiving local details.



"Gist perception" (Figure credit: Oliva and Torralba, 2006)

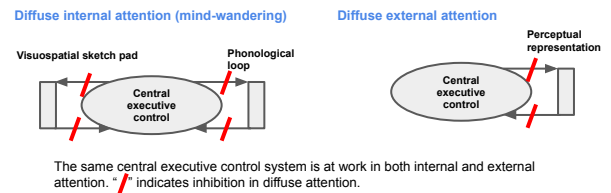
- Another form of diffuse attention is **multi-tasking**. Li et al. (2002) show that subjects are able to perform two perceptual tasks (a letter discrimination task and a natural scenery categorization task) simultaneously just as well as they are able to perform the two separately.



Performing two simultaneous perceptual tasks (Figure credit: Li et al, 2002)

### 3. Interaction between internal and external attention

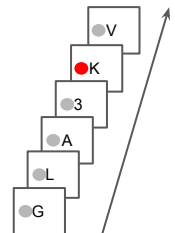
- Recent findings in psychology suggest that there might be a **common mechanism** for sustaining top-down attention to internal representations in visual working memory and sustaining top-down attention to perceptual representations of external objects (Chun et al. 2011).
- Also, subjects with lower **working memory capacity** tend to mind-wander more because they are less capable of sustaining top-down attention (McVay and Kane, 2009).
- Mind wandering subjects also exercise **less top-down control** over what they attend to externally, hence the reduction of AB.
- In our view, **diffuse internal attention** (e.g., mind wandering) switches **external** (e.g. visual) attention from focal to diffuse.



### 4. Diffuse attention and models of the attentional blink

#### 1. AB as a result of overexerting cognitive control

- According to the **threaded cognition model** (Taatsgen et al. 2009), the visual system uses a **protection rule**, such that the processing of the second target needs to wait until consolidation of the memory of the first target is complete.
- This rule is disabled when the subject performs a simultaneous task of tracking when a gray dot turns red. Subjects show reduced AB in this condition.

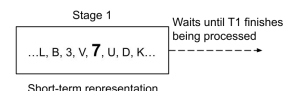
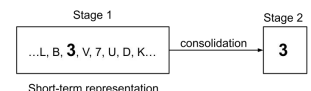


Two simultaneous tasks from Taatsgen et al. 2009.

**Fit with this model:** Deactivation of the protection rule is a result of the **relaxed inhibition** that comes with diffuse attention.

#### 2. AB as attentional resource limitation

- According to the **two stage theory** (Chun & Potter 1995), visual perception has two stages: rapid **detection** and generation of short-lived representations, and **consolidation** and encoding of more durable representations in visual working memory.



- There is a **bottleneck** between the first and the second stages. AB occurs because stage 1 representation of the second target vanishes before stage 2 frees up.

**Fit with this model:** The bottleneck for the second stage is plausibly expended when we switch to external diffuse attention, as it has a **broad focus** (compared to external focused attention).

### Take home points

- We solve the initial puzzle by showing that mind wandering does not in fact direct attention away from the perceptual targets but rather shifts the mode of external attention from focused to diffuse.
- There is an intimate connection between internal and external attention, even though the two seem quite different *prima facie*. The interaction between mind wandering and the attentional blink is emblematic of this connection.