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Rest improves performance, nature improves happiness: Assessment of break periods on the abbreviated vigilance task

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ABSTRACT

The abbreviated vigilance task can quickly generate vigilance decrements, which has been argued is due to depletion of cognitive resources needed to sustain performance. Researchers suggest inclusion of rest breaks within vigilance tasks improve overall performance (Helton & Russell, 2015; Ross, Russell, & Helton, 2014), while different types of breaks demonstrate different effects. Some literature suggests exposure to natural movements/stimuli helps restore attention (Herzog, Black, Fountaine, & Knotts, 1997; Kaplan, 1995). Participants were randomly assigned to one experimental condition: dog video breaks, robot video breaks, countdown breaks or continuous vigilance. We assessed task performance and subjective reports of stress/workload. The continuous group displayed worst performance, suggesting breaks help restore attention. The dog videos did not affect performance, however, decreased reports of distress. These results support the importance of rest breaks and acknowledge the benefit of natural stimuli for promoting wellbeing/stress relief, overall suggesting performance and wellbeing may be independent, which warrants future studies.

1. Introduction

A continuous drop in the level of signal detections over a period of sustained watch is a phenomenon known as the vigilance decrement, and has been widely addressed in literature (Helton & Russell, 2015; Langner & Eickhoff, 2012; Mackworth, 1948). Performance on psychophysically challenging vigilance tasks such as the Abbreviated Vigilance task (see Temple et al., 2000) have been shown to produce a vigilance decrement quickly and reliably, in less than 5 min (Helton & Russell, 2013; Robertson, Manly, Andrade, Baddeley, & Yiend, 1997).

A widely held view of the vigilance decrement is the resource depletion account in which the performance decrement is attributed to the depletion of resources necessary for task performance (Ariga & Lieras, 2011; Hancock & Warm, 1989; Mackworth, 1948). The resource theory account has been criticized (Navon, 1984). For example, one criticism of the resource theory perspective is the lack of an understanding regarding the biological or physical resources necessary for maintaining vigilance (Kurzban, Duckworth, Kable, & Myers, 2013). The basis of this criticism is increasingly being investigated, where many researchers have noted a relationship between vigilance performance and cerebral blood flow (CBF) in the anterior cingulate cortex and prefrontal cortex (Lim et al., 2010). Activation in the prefrontal cortex has also been linked with working memory demands (Smith & Jonides, 1995). An overlap in working memory and sustained attention cognitive resources is plausible (Helton & Russell, 2011, 2013, 2015; Parasuraman, 1979). Researchers have paired vigilance tasks with visio-spatial and verbal memory tasks and have suggested some domain specific sharing of resources between working memory

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tasks and vigilance tasks (Caggiano & Parasuraman, 2004; Helton & Russell, 2011, 2013; Wickens, 2008). While a complete understanding of the actual physical basis of resource depletion is illusive, quality work is advancing in this area and with improvements in brain imaging technologies this issue is proving tractable.

Many of the other current criticisms of resource theory may, however, be due to a lack of understanding regarding the resource theory account itself. The first issue is resource allocation. No resource theory perspective would be complete without taking into consideration the allocation as well as supply of resources. Resource theory does not preclude misallocation or reallocation of resources during a detection task. The depletion account of the decrement does assume that once a person has decided to allocate resources to the task that the decrement in performance is most likely due to the depletion of the necessary resources, not misallocation per se. But a resource theory perspective does not preclude the possibility that the misallocation or reallocation of resources during vigilance could be a cause of impaired performance (Helton & Warm, 2008; Ossowski, Malinen, & Helton, 2011).

More fundamentally, another confusion regarding the resource theory account is that the resources necessary for maintaining vigilance performance are renewable resources not non-renewable resources. The resources necessary to maintain vigilance do self-recover, if the system is allowed to rest. Critiques of the resource theory account appear to occasionally make the mistake of not taking into consideration the renewable nature of cognitive resources, and thus, the actual shape of the vigilance decrement (Thomson, Besner, & Smilek, 2015; Thomson, Smilek, & Besner, 2015), which is not usually truly linear despite simplifications for analyses of the decrement function. Performance changes over time are often characterized by a decelerating linear trend to an asymptote if examined closely (Dukas & Clark, 1995; Mackworth, 1948; Parasuraman, 1979), although simpler linear trends are often used to describe the decrement in order to facilitate data analysis (Helton, Shaw, Warm, Matthews, & Hancock, 2008; Helton & Warm, 2008; Langner, Willmes, Chatterjee, Eickhoff, & Sturm, 2010; Thomson, Smilek et al., 2015). The decelerating trend occurs because the rate of resource expenditure for a vigilance task eventually matches the rate of replenishment of those resources, thus reaching what may appear to be a steady performance state. This does, however, provide another means to further explore the resource theory perspective: the inclusion of rest-breaks.

Vigilance performance recovers with rest breaks (Ross, Russell, & Helton, 2014). In a recent study, for example, by Helton and Russell (2015) participants performed significantly better in a vigilance task after experiencing a rest break, in comparison to a continuous vigilance condition. They also found that a switch of task to a verbal memory, spatial memory or alphanumeric vigilance task during the break elicited results superior to a continuous vigil, but did not improve performance as well as a passive rest break. This suggests that a complete break from task related processing may provide essential time for cognitive resources required for maintaining vigilance to recover. Examining the impact different breaks have on vigilance performance may help resolve the nature of the resources required.

Different types of breaks may have different impacts on vigilance performance recovery. One body of research suggests, for example, that natural scenes and biological movement are beneficial toward attention restoration (Herzog, Black, Fountaine, & Knotts, 1997; Kaplan, 1995). This theoretical perspective is commonly known as the Attentional Restoration Theory (ART; Kaplan, 1995). Within the ART, direct (actively controlled) attention and effortless (passively controlled) attention are considered distinct systems, with only the former subject to fatigue and depletion, labelled direct attention fatigue (Kaplan, 1995). From this perspective one way to facilitate the recovery of actively controlled attention resources, the kind presumably necessary for maintaining vigilance, is to engage the effortless attention system with natural scenes and natural movement (animals), even using still pictures or video (Berto, 2005; Herzog et al., 1997). Other researchers express some scepticism of the attentional benefits of natural stimuli and believe instead that exposure to natural stimuli increases self-esteem and mood, improving how one subjectively feels (Barton & Pretty, 2010; Myers, Saunders, & Birjulin, 2004). From this perspective, though performance may not increase, people may report feeling better when exposed to natural as to non-natural stimuli (Wells, 2005). Research by Wells (2005) suggests that exposure to videos of animals, for example, significantly lowers levels of heart rate and blood pressure when compared to videos of humans and random motion, and is believed to help buffer viewers from short-term anxiety during a cognitive stressor. From this latter perspective, exposure during a break may not improve vigilance performance better than other breaks, but may make people report feeling better after the vigil. If this were the case, it may help researchers dissociate the subjective reports of distress during vigils from the psychophysically induced decrement in performance. The relationship between reports of vigilance tasks being boring and subjectively unpleasant and the changes in vigilance performance (the decrement) may not be as tight as some resource theory critics suggest (Kurzban et al., 2013; Thomson, Besner et al., 2015).

In the current experiment, we examined the performance effects of breaks on vigilance performance. Participants were assigned at random to one of four vigilance conditions. In the control condition, participants performed the vigilance task continuously without breaks or interruptions. In the experimental conditions, the vigilance task was periodically interrupted with a break consisting of completely passive breaks, videos of dogs, or videos of robots. The inclusion of dog videos during a rest period in vigilance, compared to robot videos, a passive countdown and a continuous vigil was therefore examined. Based on a resource theory perspective we expected breaks -all breaks that do not make use of the same resources for the task- to be equally beneficial for performance recovery. If in addition the ART perspective is correct, then we expected that the dog stimuli will provide additional recovery of performance when compared to the robot video or even the completely passive break. In addition, we measured participants' self-reported stress state. Aside from performance, we expected the natural stimuli (dog video) to make people feel better. Considering vigilance tasks are usually subjectively unpleasant, any intervention which can nullify these negative feelings may be beneficial, even if there are no real advantages regarding performance.