The effect of acute stress and perceptual load on selective attention

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Under high perceptual load that is assumed to reduce cognitive resources, selective attention is improved because no spare resources are left for distractor processing. Are cognitive resources also consumed under high stress circumstances? The present study examined whether perceptual load and acute stress share a common attentional resource by manipulating perceptual and stress loads. Participants identified a target embedded in an array of nontargets, flanked by compatible or incompatible flankers. Prolonged reaction time to the incompatible relative to compatible flankers was used as an index of interference. Participants in the stress group received a speech test that increased anxiety and threatened self-esteem. The effect of perceptual load interacted with stress manipulation. Participants in the control group demonstrated substantial interference with low perceptual load, whereas such interference was eliminated with high perceptual load. Importantly, the stress group showed virtually no interference with low perceptual load whereas substantial interference occurred with high perceptual load. These results suggest that perceptual and stress loads consume the same attentional resources.

Key words: acute stress, perceptual load, selective attention, distractor interference

The view that attention can be likened to a limited resource or capacity is generally accepted. One observation supporting this view is the finding that the distractor interference that arises when a solitary target appears under low perceptual load conditions is reduced when the target is embedded among non-target items under high perceptual load conditions (Lavie, 2005). This implies that no spare resources are left for distractor processing under the high perceptual load. Similarly, in the context of stress research, acute stress is viewed as a resource-consuming situation by similar capacity approaches. The question is whether perceptual load and acute stress drain a common attentional resource.

The present study examined this question by varying perceptual and stress loads. Specifically, we used a flanker interference task (Eriksen & Eriksen, 1974; Lavie, 2005) and varied the number of nontarget items as a within-subject factor and manipulating stress as a between-subject factor. In this task, it has been established that reaction times for identifying the target are longer when the flanker letters (i.e., incompatible distractors) are associated with the inconsistent response to the target than when the flankers (i.e., compatible distractors) are associated with the consistent response with the target. We define the differences between the reaction times to the target in the incompatible trials and those in the compatible trials as the interference effect: lower attentional selectivity results in greater interference from the distractors, and therefore longer differences in the reaction times. It is known that interference is decreased when perceptual load is high.

We predicted that for the low stress group, the interference effect would be decreased under higher perceptual loads, as demonstrated in previous studies (e.g., Lavie, 2005). Critically, when stress is high, interference would be decreased under the low perceptual load condition because stress deprives residual resources.

Method

To induce stress, participants in the stress group (N=19) were subjected to the Trier Social Stress Test (Kirschbaum, Pirke, & Hellhammer, 1993). The control group (N=20) received a filler task. Immediately after the stress manipulation participants conducted...
an Eriksen-type flanker interference task. The display consisted of a target letter (N or Z) embedded in a central array of nontargets (Xs). Perceptual load, defined as the number of nontargets, could be low or high (2 or 5 nontarget items, respectively). Participants identified the target as quickly and accurately as possible by pressing one of the designated keys. The central array was accompanied by two flankers, one each on each side. Under the compatible condition, the identity of the flankers was identical to that of the target. Under the incompatible condition, the identities of the target and flankers differed. Reaction times were recorded.

Results

In the stress group, stress induction was successful as indicated by the increase in scores of the State-Trait Anxiety Inventory-Form JYZ (Hidano, Fukuhara, Iwawaki, Soga, & Spielberger, 2000) and the levels of salivary cortisol sampled before and after stress induction.

The effect of perceptual load interacted with stress manipulation (F(1, 37)=9.65, p<.01). Participants in the control group demonstrated substantial interference with low perceptual load, whereas such interference was eliminated with high perceptual load, replicating previous studies (Lavie, 2005). Importantly, the pattern of the results was opposite for the stress group. In this group there was virtually no interference with low perceptual load, whereas substantial interference occurred with high perceptual load.

Discussion

The interaction identified in the present study clearly indicates that perceptual and stress loads drain the same attentional resource for nontarget processing, resulting in an improvement in selective attention. We argue that attentional selectivity increases (i.e., minimum interference) when either perceptual load or stress reduces spare capacity. In other words, stress enhances selective attention as seen by the result that interference was eliminated in the stress group when there was a low perceptual load. However, the stress group exhibited severe interference under a high perceptual load. Although the source of this impairment was unidentified in the present study, we surmise that under high perceptual load with high stress, the visual system could lose the ability to maintain focus on a task. This results in interference from flankers and therefore unstable visual selection and occasional selection of irrelevant items.

References


