Study of cognitive fatigue across different tasks and populations provides new insights

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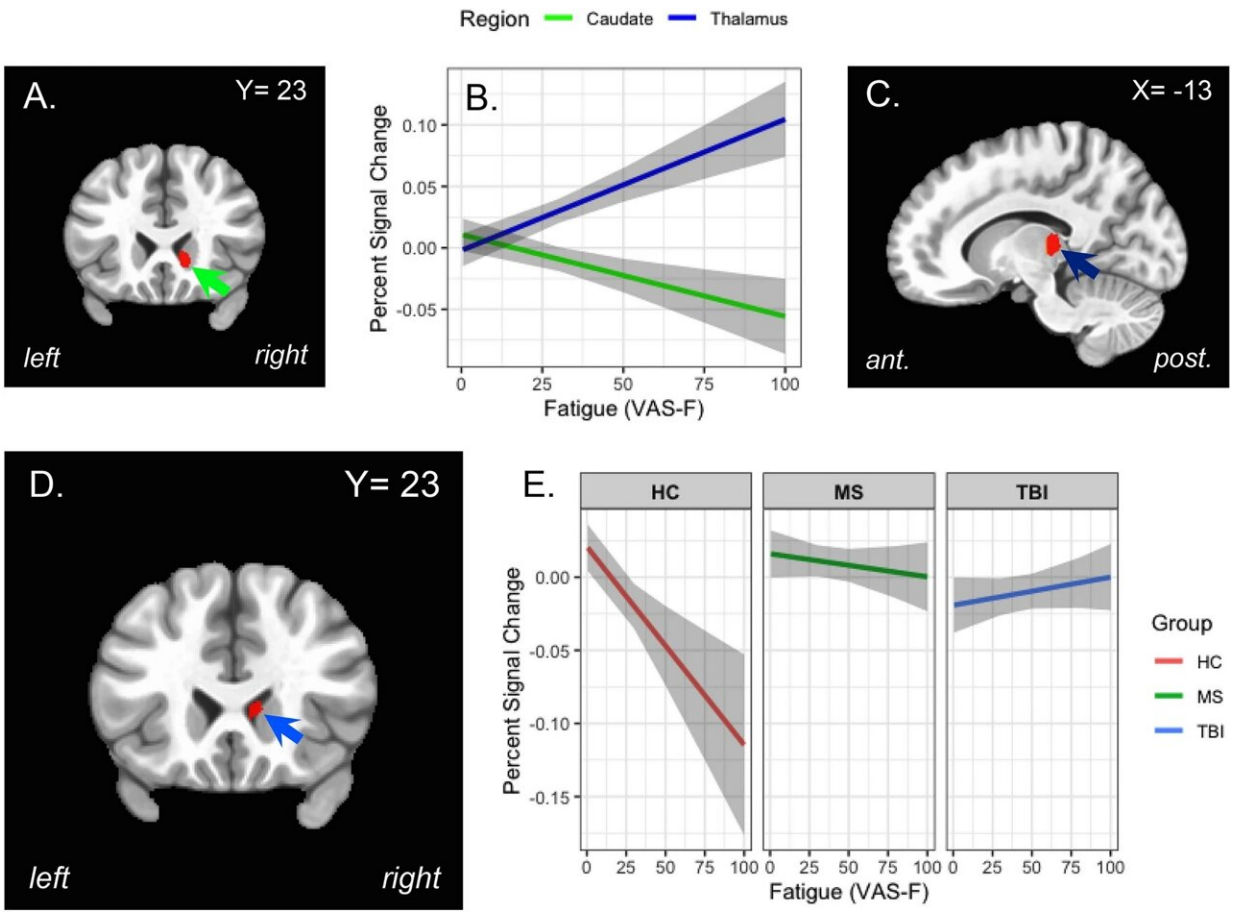

The effects of cognitively fatiguing tasks on brain activation. (**A**) The location in the caudate of brain activation showing the main effect of CF (green arrow). (**B**) The significant negative relationship between the CF (VAS-F scores) and brain activation in the caudate nucleus (green line) and the significant positive relationship between CF and brain activation in the thalamus (dark blue line). (**C**) The location of thalamic brain activation showing the main effect of CF

(dark blue arrow). (**D**) The location of brain activation showing at interaction between Group (HC, MS and TBI) and CF: the caudate nucleus of the basal ganglia (blue arrow). (**E**) Activation in the caudate nucleus as a function of CF for each of the three groups; Controls are shown in red, the MS group in green and the TBI group in blue. For panels B and E the shaded areas represent 95% confidence intervals. Credit: *Scientific Reports* (2023). DOI: 10.1038/s41598-023-46918-y

In an innovative study, researchers at Kessler Foundation have conducted the first systematic investigation of the effects of cognitive fatigue by using two different tasks across three distinct populations: multiple sclerosis, traumatic brain injury, and controls.

The study, Evaluating the effects of brain injury, disease, and tasks on cognitive fatigue," was published in *Scientific Reports.* The authors are Glenn R. Wylie, DPhil, Helen M. Genova, Ph.D., Bing Yao, Ph.D., Nancy Chiaravalloti, Ph.D., Cristina A.F. Roman, Ph.D., Brian M. Sandroff, Ph.D., and John DeLuca, Ph.D.

This study compared a group with multiple sclerosis (MS) (n=31) and a group with traumatic brain injury (TBI) (n=31) to a control group (n=30) to assess the relationships among cognitive fatigue, behavioral performance, and brain activation.

Two distinct tasks—a working memory task and a processing speed task—were used to induce cognitive fatigue while functional neuroimaging data were collected.

Findings revealed that while the two clinical groups reported more cognitive fatigue than the control group, the accrual of cognitive fatigue was consistent across all participants, and cognitive fatigue ratings remained stable across tasks. This suggests that the experience of

cognitive fatigue is not task-specific but rather a consistent state triggered by cognitive exertion.

Moreover, the study uncovered that an increase in cognitive fatigue correlated with longer response times in tasks across all groups.

Neuroimaging data showed that activation in the caudate nucleus and thalamus was consistently related to cognitive fatigue levels across all three groups, underscoring these brain regions as central to the experience of cognitive fatigue. Interestingly, variations in activation patterns were observed more dorsally in the caudate nucleus, indicating that this region's sensitivity may be linked to the type of brain damage sustained.

"The similarities and differences of our findings across populations, regardless of the task used to induce fatigue, provide new insights into cognitive fatigue resulting from brain injury and disease," said Dr. Wylie, director of the Rocco Ortenzio Neuroimaging Center.

"Demonstrating that cognitive fatigue is not task-dependent provides the direction needed to develop effective strategies for managing debilitating cognitive fatigue that severely impacts individuals' daily functioning and quality of life."

More information: Glenn R. Wylie et al, Evaluating the effects of brain injury, disease and tasks on cognitive fatigue, *Scientific Reports* (2023). DOI: 10.1038/s41598-023-46918-y

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