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How emotional arousal can flexibly enhance processing of whatever has highest priority at that moment

Abstract:

The locus coeruleus is a small brainstem nucleus that is a hub region for integrating arousal signals. When activated, its neurons stimulate release of norepinephrine in cortical and subcortical brain regions to modulate physiology and cognition. Its anatomy makes it ideally suited to broadcast messages about arousing situations broadly throughout the brain – but nevertheless, experimental findings suggest it can target specific representations such that activation of salient items is enhanced while other lower priority representations are suppressed. How can it have such specific effects? Our GANE model proposes that glutamate serves as a flexible marker of what matters at any particular moment and modulates local norepinephrine levels, leading to ‘hot spots’ of high excitation at the site of high priority representations under arousal. Our neuroimaging results indicate that this hot spot mechanism is maintained in older adults, but that the locus coeruleus is less effective at amplifying frontoparietal attention network activity under arousal, reducing older adults’ ability to hone in on what really matters under arousal. These age-related differences and similarities are particularly interesting in light of recent findings that the locus coeruleus is the first site of Alzheimer’s-related tau pathology, and that tau pathology in the locus coeruleus is a ubiquitous feature of aging.