

The Effect of Sleep Deprivation on Cognitive Performance

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College Essay

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Sleep is not simply a period of inactivity. It is a neurologically active state during which the brain consolidates memories, clears metabolic waste, and restores attentional resources essential for next-day cognitive function (Walker, 2017). Growing evidence suggests that even moderate sleep deprivation — defined as sleeping fewer than six hours per night — produces measurable deficits in working memory, executive function, and sustained attention that compound over consecutive nights of insufficient sleep.

Working Memory

Working memory — the cognitive system responsible for holding and manipulating information over short time periods — shows reliable impairment under sleep deprivation. Harrison and Horne (2000) found that participants restricted to five hours of sleep over two consecutive nights performed significantly worse on novel reasoning tasks requiring active working memory manipulation, compared with rested controls. Critically, the authors noted that well-rehearsed or routine tasks were relatively preserved under sleep deprivation, suggesting that the deficit is specific to executive demands rather than general cognitive slowing.

Sustained Attention

The Psychomotor Vigilance Task (PVT) has become the standard instrument for measuring sleep-deprivation-induced attentional impairment. Van Dongen et al. (2003) demonstrated in a seminal study that participants restricted to six hours of sleep per night for 14 days showed progressive deterioration in PVT performance equivalent to two nights of total sleep deprivation. A particularly important finding was that participants consistently underestimated their degree of impairment — subjective sleepiness ratings did not track the objective performance decline. This has significant implications for populations such as

junior doctors and long-haul transport operators who make consequential decisions under chronic sleep restriction.

Individual Differences

The cognitive response to sleep deprivation is not uniform. Viola et al. (2007) identified a polymorphism in the adenosine A_{2A} receptor gene that predicted differential vulnerability to sleep deprivation: carriers of the minor allele showed significantly greater attentional impairment after one night of total sleep deprivation compared with non-carriers. This line of research suggests that blanket recommendations about sleep — "everyone needs eight hours" — may obscure meaningful individual variation in sleep need and vulnerability.

The evidence consistently shows that sleep deprivation impairs working memory and sustained attention, with effects that compound over time and that individuals routinely underestimate. The neurobiological mechanisms — disrupted synaptic homeostasis, impaired prefrontal cortical function, attenuated adenosine clearance — are reasonably well characterised. What remains less understood is the degree to which individual genetic variation moderates these effects across real-world chronic partial sleep deprivation conditions, which more accurately reflects the experience of most affected populations than total sleep deprivation paradigms.

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