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Response Surface Mapping of Neurobehavioral Performance: Testing the Feasibility of Split Sleep Schedules for Space Operations.

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Abstract

The demands of sustaining high levels of neurobehavioral performance during space operations necessitate precise scheduling of sleep opportunities in order to best preserve optimal performance. We report here the results of the first split-sleep, dose-response experiment involving a range of sleep/wake scenarios with chronically reduced nocturnal sleep, augmented with a diurnal nap. To characterize performance over all combinations of split sleep in the range studied, we used response surface mapping methodology. Waking neurobehavioral performance was studied in N=90 subjects each assigned to one of 18 sleep regimens consisting of a restricted nocturnal anchor sleep period and a diurnal nap. Psychomotor vigilance task performance and subjective assessments of sleepiness were found to be primarily a function of total time in bed per 24 h regardless of how sleep was divided among nocturnal anchor sleep and diurnal nap periods. Digit symbol substitution task performance was also found to be primarily a function of total time in bed per 24 h; however, accounting for nocturnal sleep duration and nap duration separately provided a small but significant enhancement in the variance explained. The results suggest that reductions in total daily sleep result in a near-linear accumulation of impairment regardless of whether sleep is scheduled as a consolidated nocturnal sleep period or split into a nocturnal anchor sleep period and a diurnal nap. Thus, split sleep schedules are feasible and can be used to enhance the flexibility of sleep/work schedules for space operations involving restricted nocturnal sleep due to mission-critical task scheduling. These results are generally applicable to any continuous industrial operation that involves sleep restriction, night operations, and shift work.

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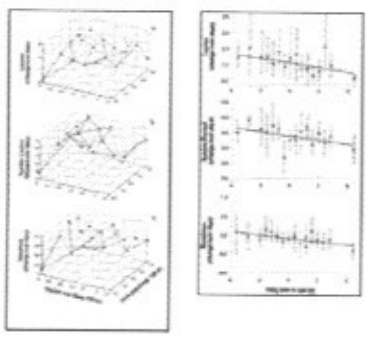

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