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The effect of light on cognitive performance of partially sleep-deprived young drivers

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Introduction: Sleepiness remains a primary cause of road crashes, the major cause of death in young adults. Light is known to produce a direct alerting effect, but little is known about its effects on sleepy drivers. This study aimed to compare the effect of blue-green light and caffeine on young drivers' cognitive performance after chronic-partial sleep loss.

Methods: The sleep-wake times of thirty participants (18-24 years) were monitored via actigraphy, and their bedtimes were reduced to 7 hours over a two-week period. In the last three days participants attended test sessions involving two 30-minute simulated drives. The first drive was conducted under dim red light (Placebo condition) and the second under each of three randomised conditions (Active Condition) which presented either caffeinated (100 mg caffeine) or placebo non-caffeinated gum, in conjunction with either blue-green light (500 nm dominant, 506 lm/m²) or red light (< 2 lux). Reaction times (RTs) were recorded after each drive via the PEBL Psychomotor Vigilance Task (PPVT) to calculate three variables; mean reciprocal reaction time (1/RT), mean of the slowest 10% of 1/RT, and percentage of lapses (RT > 500 ms).

Results: A two-way within-groups ANOVA found that after the Active Condition the percentage of lapses and the mean of the slowest 10% of 1/RT had a significant reduction of 6.5% (95% CI 2.21-10.88; P=0.004) and 0.124 s⁻¹ (95% CI 0.01-0.24; P=0.036) respectively. The percentage of lapses after combination of blue-green light and caffeine was 5.6% lower than receiving light only (95% CI 0.11-11.10; P=0.044). Mean reciprocal reaction time (reaction speed) showed a significant increase after combination of blue-green light and caffeine compared with light only (95% CI, 0.02-0.40; P=0.028). There was no significant difference between mean reciprocal reaction time under Active and Placebo Conditions (95% CI -0.03-0.21; P=0.120).

Discussion: The application of blue-green light alone did not appear to improve sleepy young drivers' reaction time significantly. The combination of blue-green light with caffeine however, significantly improved the drivers' reaction time rather than light only and may have an advantage over caffeine alone. The benefit of this regime for on-road driving performance should be further investigated.