Tenth International Conference on Managing Fatigue: Abstract for Review

Can we convince tired drivers to take a break from driving?

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Problem

Evidence from the simulator shows that drivers can make informed decisions about driving (or not driving) when tired. We know that drivers are aware of, and can report increasing fatigue while driving and can even predict the likelihood of falling asleep before they crash. Despite this, many drivers fail to make the safe choice about driving when tired. The question is whether drivers can be motivated to take breaks from driving when tired. The aim of this study was to investigate the impact of motivational factors on drivers' decision to respond or not to fatigue while driving.

Method

This study examined the effects of three motivational conditions (Safety or Time related incentives or No incentive). Drivers in all three motivation groups were told that they would receive $100 at completion of a 201 km simulator drive. Safety group participants were told they would lose $20 the $100 every time they drove off the road, crashed, or crossed the centreline, thus providing motivation to avoid fatigue-related driving errors. Time group participants were told they would lose $20 for every minute over 2 hours that they took to complete the drive, thus providing motivation not to stop, even if fatigued. Fatigue was induced for all groups fatigue by a shortened sleep in the night before, conducting the drive in the mid-afternoon period and using a monotonous drive scenario. Driving performance was indexed by the occurrence of adverse events (crashes, centreline crossings, lane departures and lane edge touches) and variability in lane position. Subjective ratings of sleepiness (Karolina Sleepiness Scale, KSS), the likelihood of falling asleep and of crashing in the following few minutes were measured regularly throughout the drive. The Optalert Drowsiness Management System measured objective blink indices of drowsiness using the proprietary Johns Drowsiness Score (JDS). Ninety fully licenced drivers were recruited via electronic and actual noticeboards at UNSW, with 30 in each motivational condition.

Results

Actigraph data showed that participants had an average of 4:49 h sleep and there were no significant differences between incentive conditions on any diary recorded sleep variables, nor on actigraph measures of sleep. Similarly, there were no significant differences between the motivation conditions in maximum rated sleepiness, maximum JDS measured during the drive, or percentages of people who fell asleep while they were driving (or at any time during the drive).

Comparison of the motivation conditions on measures of driving performance showed significant differences between conditions in minutes taken to complete the drive and the percentage of drivers taking breaks. Consistent with their incentive instructions, the Time group took significantly less time to finish the drive than the No motivation condition, and were less likely than both the other conditions to stop during the drive. The number and length of breaks was also significantly lower in the Time group than in the No motivation group. Number of lane edge touches and variability of lane position both showed a significant effect of motivation condition. Safety motivation participants had fewer lane edge touches and less variability of lane position than No motivation drivers. The conditions did not differ significantly on any other measures of lane departure or the proportion of people who crashed although as this was low in all groups.

Table 1: Driving results for the three motivation groups across the two hour simulator drive.

	No motivation	Safety motivation	Time motivation	p values
Minutes to complete drive (Mean, SD)	122.31, 5.80	121.65, 7.86	118.28, 3.01	$F_{(2,87)}=4.02$, p=.02
Drivers who stopped (%)	36.7	40	6.7	$X^2_{(2)}=10.08$, p=.006
Number of stops (Mean, SD)	1.4, 2.3	1.0, 1.7	.1, .3	$F_{(2,87)}=4.71$, p=.01
Total time stopped (Mean SD)	129.1, 295.3	40.9, 69.3	0.2, 0.8	$F_{(2,87)}=4.25$, p=.02
Drivers who crashed (%)	16.7	6.7	10	$X^2_{(2)}=1.58$, p=.46
Drivers with centreline crossings (%)	13.3	3.3	6.7	$X^2_{(2)}=2.17$, p=.34
Number of lane edge touches across the drive (Mean, SD)	85.63, 101.87	29.80, 47.66	54.70, 71.15	$F_{(2,87)}=3.98$, p=.02
Variability of lane position across the drive (Mean, SD)	.45, .23	.32, .17	.38, .18	$F_{(2,87)}=3.27$, p=.04

Discussion

Providing safety-related incentives to respond to increasing fatigue meant that drivers were more likely to take breaks from driving than drivers provided incentives to complete the drive under time pressure. The Time incentive group, as expected, completed the trip faster with only a small minority stopping. The Safety incentive group produced the best driving performance overall. In contrast, the No motivation group, who were given no incentive instructions, showed poorest driving performance with more lane edge touches and greater lane variability than the Safety group.

Participants reached similar levels of fatigue in all study conditions and all three groups were similarly affected by the sleep restriction protocol during the drive. The results suggest the

simultaneous operation of two processes. First, the poor performance of the No motivation group suggests that any incentive can improve the driving performance of tired drivers in monotonous conditions. Second, the finding that driving performance was best for the Safety incentive group suggests that this incentive encouraged more breaks from driving which would be expected to refresh the drivers and improve driving performance, at least in the short term. Further, in-depth analysis should reveal more about the relations between break-taking, driving performance and sleepiness under different incentive conditions. The strengths of the current study are that it manipulated motivators to take breaks from driving or not and investigated actual driving behaviour when drivers were experiencing fatigue.

Summary

Overall, these results suggest that providing incentives to drivers to modify their driving behaviour can be effective. Drivers will take breaks from driving if provided a motivation to do so. On the other hand, however, drivers motivated to 'push on' and reach their destination quickly will also do so. Clearly, our attempts to reduce driver fatigue must develop strategies that highlight and increase drivers' motivation to take breaks strategically in response to their fatigue state. This is especially important for professional and long distance drivers who already face incentives that favour continuing to drive rather than taking breaks to manage fatigue.