A critical analysis of an applied psychology journal about the effects of driving fatigue:

*Driver fatigue and highway driving: A simulator study.*

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Driving has had a huge impact on psychological research today and particular attention is paid at looking at results of fatigue on driving, this is partly due to the high rate of accidents as a result of tiredness. The journal analysed in this essay ‘*Driving fatigue and highway driving: A simulator study*’ (Ting, Hwang, Doong & Jeng, 2008) researches the impact of fatigue on a number of performance-measures of driving. The advantages and criticisms of the study are discussed with reference to complimentary and contrasting research.

Ting et al's (2008) journal on driving fatigue explored a number of previous studies into effects of tiredness on driving. For example, it was found that time on driving task increased sleepiness (Kecklund & Akerstedt, 1993) and that a significant proportion of sleep-related accidents occur during early morning and early afternoon. These accidents are thought to be related to circadian and homeostatic influences, where activities carried out during these periods (early morning and afternoon) have found significantly reduced alertness (Pack, Pack, Rodgman, Cucchiara, Dinges & Schwab, 1995). Taking into account previous findings, Ting et al (2008) aimed to measure the effects of fatigue on a number of driving performance measurements, for example; average headway, standard deviation (s.d.) of car speed, s.d. of lateral position, frequency of extremely large steering wheel movement (SWM, shown to occur at times of high fatigue), frequency of edge line crossings on the sides of the road and frequency of car crashes. Additionally they aimed to identify a reasonable and safe limit for duration of highway driving.
30 fully licensed, male participants took part in a within-subjects design, driving-simulator study. The experiment took place between 14.00 and 17.00. Participants were asked to complete 3 SSS’s (Stanford sleepiness scale’s) to measure changes in alertness throughout the experiment. Participants drove a simulator vehicle after a practise period of 10 minutes for a total of 1.5 hours. Subjects were asked to drive 50m behind the car in front at a constant speed of 100 km/h. Reaction times (RT) were recorded by participants response to a stimulus on the screen, and additionally the 6 driving performance measurements mentioned above were measured.

The results showed a significant increase in sleepiness scores on the SSS when comparing the pre and post simulator scores. Additionally as driving time increased so did participants RT’s, and when comparing the RT to the 6 other aspects of driving-performance, a significant correlation was generally noted. Furthermore, car speed, average headway, s.d. of lateral position and frequency of edge line crossing all varied significantly with time. However extreme SWM and car crash frequency did not prove significant results.

Comprehensively it was discussed that increased fatigue did lead to an impaired alertness, vigilance and driving performance. SSS scores clearly identified a scale like effect that, as fatigue increased, alertness decreased. The significant increase of over 30 seconds in RT (when comparing the last 10 minute period to the first) has important implications when equating to a stopping distance. A 30-second period works out as 8m stopping distance, whilst driving at 100km/h, and these factors may have a considerable impact on driving
accidents. The correlation coefficient for headway and s.d. of lateral positioning was greater than 0.9 providing great evidence of peoples operation of vehicles becoming unstable over time. Ting et al (2008) concluded that the most favourable duration time of highway driving should not exceed 80 minutes and the most reliable indicator of fatigue, to measure its progressing effects, was RT.

As mentioned, driving is a widely examined area in psychology and therefore Ting et al (2008) had a large amount of research to work from. The study sits very comfortably amongst previous research as it supports many measures of fatigue on driving. The seven various performance measures, (for example RT, frequency of car crashes and s.d. of car speed) are all proven by prior research to be influenced by fatigue whilst driving. However, interestingly there is very little research in to average headway as a result of fatigue. This lack of evidence makes Ting et al's (2008) study untested and due to the cross analysis of the several performance measures, the study brings together areas of research that have formally not been investigated.

The methodology of Ting et al's (2008) study is clear, replicable and well fit to questions they were investigating. However, some limitations can be noted on the design and variables chosen. Ting et al (2008) stated that for a more ‘conservative estimate’ they tested participants driving alone and during a three hour period between 14.00 and 17.00 (a period of reduced alertness due to human circadian rhythms). Although it is recognised that some standardisation must occur for reliable results, conclusions made from this study could not be generalised to maximum driving limits for driving at a alternative periods of the day. Interestingly Tsuneo (2003) found that both driving alone and driving with two or more
people in the vehicle significantly increases the likelihood of an accident. These findings therefore suggest that Ting et al's (2008) conclusions can only be projected to lone drivers.

Ting et al (2008) aimed to eliminate many effects of extraneous variables by minimising individual differences in the participant sample. Aware of age and gender influences on driving performance, only male participants between the ages of 20-26 years were used in the study. Ting et al's (2008) reason for gender choice is explained by male drivers being within ‘a high-risk group for fatigue-related accidents’ (Ting et al, 2008) however there is evidence to support gender differences in driving behaviour. Lonczak, Neighbours and Donovan, (2007) found that women are highly associated with drinking frequency and driving anger and therefore Ting et al's (2008) study could be criticized for ignoring gender differences and producing conclusions only valid to males. The intention of age choice is unstated in the study and the use of a small age bracket again makes generalisation of results difficult. There is a substantial amount of research looking into the effects of age and driving incidents, such research provides evidence in favour of increased risk of injury most likely occurring with older drivers, 75+(Dulisse, 1997). Therefore it could be suggested that there is unclear reasoning for the age choice of subjects as there is no previous evidence showing this age group has an influence on driving performance. However it may have been Ting et al's (2008) intention to use a neutral age group, with no evidence of driving effects, to produce a more reliable account of driving performance.

A final limitation of the methodology used, is the form of measurement for participants reaction times. Ting et al (2008) recorded subjects RT’s by their response (turning off an indicator) to two red circular images appearing in the centre of the screen. This evaluation of
RT lacks realism as it is a very artificial task, in particular when investigating driving related measures. Ting et al (2008) were using RT of participants to test alertness not driving related skills therefore it could be argued that the task can be unrelated to driving. However, it would be more ecologically valid to test RT in terms of an emergency stop for example, because participants may respond to this with a faster reaction time compared to an unrelated, mundane task.

The statistical analysis used for the data collected by Ting et al (2008) is appropriate and shows statistical significance. The SSS scores show a general trend in the direction of participants becoming sleepier with time, and significant differences between the three tests. However the error bars shown in the histogram do show considerable overlap suggesting that the differences in population means may be debatable.

Ting et al's (2008) study concluded with a number of practical implications. For example it was implemented that results of increased RT over time showed a correlation between time on task and increasing fatigue, which as a result impairs driver vigilance. This conclusion is supported by previous studies an example is a study by Akerstedt, Peters, Anund and Keckland (2005), which demonstrated the influence of impaired alertness on driving performance. The conclusive implication of an optimum duration for safe highway driving provides a suitable guideline and this could perhaps be put into practise as a recommended principle to all drivers. Ting et al (2008) comment on a number of limitations spotted in the study, one of which suggests drivers’ motivations to maintain vigilance may be higher for actual driving in comparison to simulator driving. This recognised limitation is highly likely and as a result it may be interesting to further research into this area by constructing a Meta
analysis of real drivers performance and fatigue to counterbalance the lack of realism experienced in the simulator.

To conclude, the study analysed provides a clear and appropriate account of the effects of fatigue on long distance driving. Although potential limitations have arisen through detailed analysis, Ting et al (2008) recognised that some of these were present. With such a large and diverse population in the world it is impossible to construct a study that can generalise to all, whilst maintaining such experimental control. The study provides interesting and indicating results that potentially suggest the need for alternative regulations for maximum driving duration on highways.
References


