

# Effects of music and open window as countermeasures to driver sleepiness during day and night driving on real roads

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## Summary

Sleepiness is a major risk factor for road accidents [1]. Listening to music and opening the window are among the most popular countermeasures, being more often applied than intake of caffeine and napping [2]. Yet, in the driving simulator, music and cold air were shown to be not sufficient as countermeasures to driver sleepiness [3], which might be due to a simulator effect.

The present study investigated if opening the window and listening to music were effective against driver sleepiness during real road driving.

Applying these in-car countermeasures showed significant, but only minor and transient effects in counteracting driver sleepiness and they are unlikely to be of any practical significance.

## Results

### Subjective sleepiness:

- Including the countermeasure application significantly improved the model fit for subjective sleepiness ( $\chi^2(1) = 5.22$ ;  $p = .022$ ). Empirical Bayes Estimates for individuals are shown in figure 1.
- The effect was limited to the actual countermeasure application interval and estimated to be minor (-0.16 KSS steps) compared to the pronounced effects of night driving (+1.5 KSS steps) and driving duration.

### Driving performance:

- Including the countermeasure application improved the model fit for SDLAT ( $\chi^2(1) = 6.41$ ;  $p = .001$ ).
- The effect was limited to the actual countermeasure application interval (figure 2).
- A relatively large residual error in the SDLAT model indicated that also other factors such as road conditions influence this parameter.

### Physiological sleepiness:

- Condition and driving duration had significant effects on KDSmax ( $p < .05$ ).
- The factor group or interactions with group were not significant.

## Methods

### Sample:

- Control group: 8 healthy participants (4 female, mean age+SD: 38.75+10.55years).
- Countermeasure group: 16 healthy participants (8 female, mean age+SD: 43.13+8.93years).

### Experimental Design:

- 90 min driving on a highway during day and night.
- Experimental group: received countermeasures open window and music for 10 minutes in intermittent intervals. The timing was based on (i) driving duration during the day, (ii) subjective sleepiness during the night.

### Measures:

- Subjective sleepiness: Karolinska Sleepiness Scale (KSS) (every 5<sup>th</sup> minute).
- Driving performance: Standard Deviation of Lateral Position (SDLAT).
- Physiological sleepiness: Karolinska Drowsiness Score (KDS), which is based on Alpha-Theta activity in the EEG and slow eye movements.

### Statistical Analysis:

- Multilevel mixed effects linear regression models were fitted for KSS and SDLAT using the STATA 11.1 procedure xtmixed. Likelihood Ratio Tests were applied to evaluate nested models.
- KDSmax was analysed using repeated measurements ANOVA.

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