

Does driving at night affect the driving performance of young drivers? A driving simulator study.



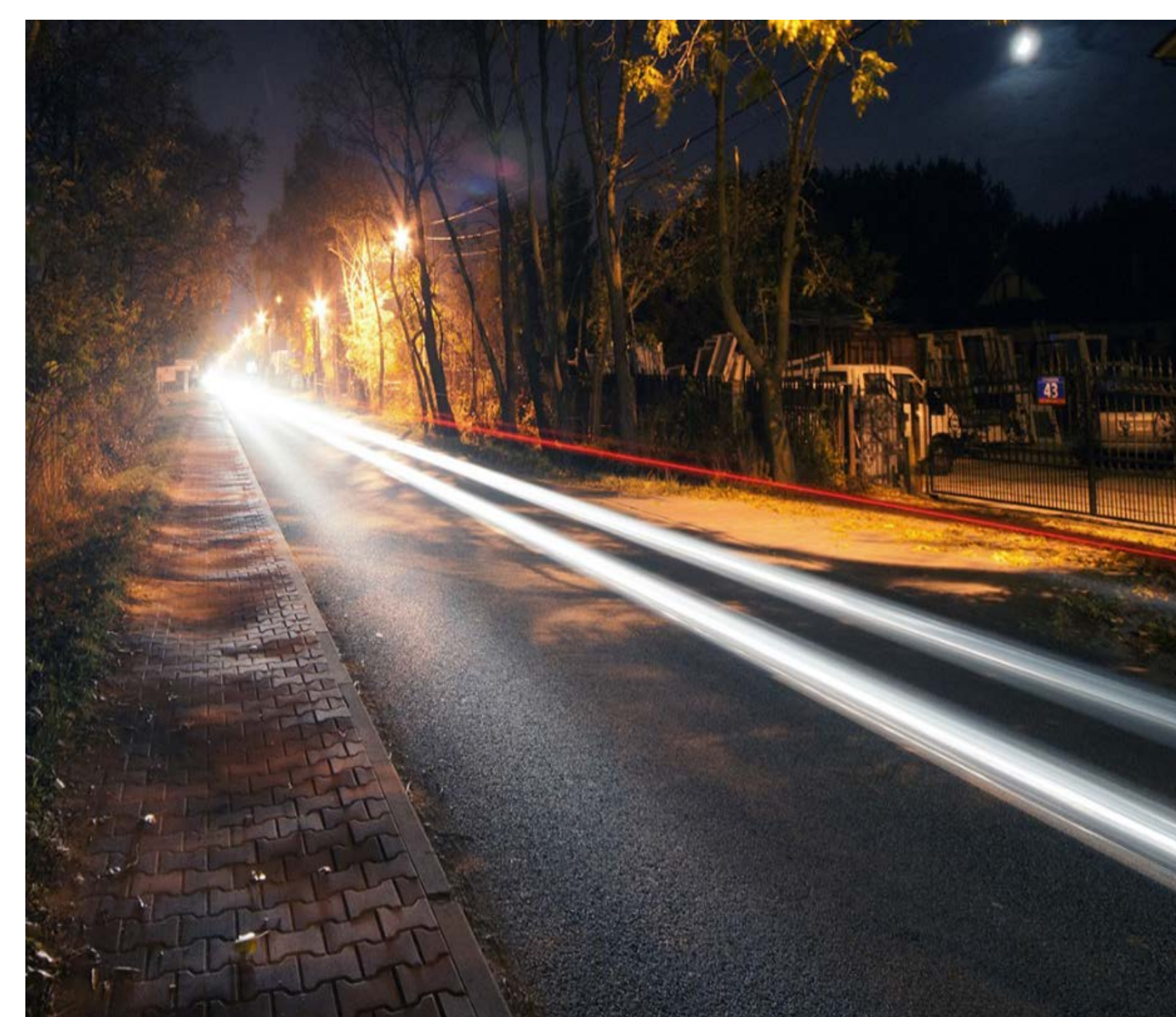
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Introduction

- Road safety is a complicated scientific field of transport research due to the **multidimensional nature of accident occurrence**.
- A disproportionately large number of accidents occur at night: the rate of fatal accidents has been reported to be **three to four times higher at night** compared to daytime, especially since traffic flow is significantly lower at night than during the day.
- Driving during night, in the absence of ambient light, visual information in the driver's field of view is **dramatically reduced**, with the result that the driver faces two main problems:
 - **difficulty in perceiving** "potential" risks; and
 - mainly from **the lights of upcoming vehicles**,
 both closely related to the significant reduction of "functional" low-light vision.

The objective of this study is to **investigate and specify in mathematical terms, the impact of night-time driving** on different driving performance parameters on young drivers' behavior in rural areas through a driving simulator experiment.



Driving at the simulator

- FOERST **Quarter-cab driving simulator** total field of view 170 degrees, validated against a real world environment
- At first, **one practice drive** (usually 10-15 minutes)
- Afterwards, the participant drives **at two rural routes** (approx. 10 minutes), single carriageway, zero gradient, mild horizontal curves: **one at daytime conditions** and then one in fully simulated **night-time conditions**
- During each trial, **2 unexpected incidents** occurred:
 - sudden appearance of an animal (deer or donkey) on the roadway

Methodology

- 35 participants** (66% males) (age: 24,6±2,5 y.o.)
- At first **preliminary statistical approach** was carried out in order to have a first indication of which, probably, will be the impact of night-time driving on several driving parameters.
- Three (3) regression models** were developed to analyze the impact of night-time driving on young drivers' behaviour and safety in rural roads in terms of a) **speed**, b) **accident probability at the unexpected incident**, and c) **reaction time at the unexpected incident**.

Table 1. Log-normal linear regression model for **mean speed**

Independent variables	β_i	t	Elasticity (ei)	Relevant elasticity (ei)
Night-time driving	-0,022	-6,317**	-0,007	4,155
Traffic conditions	-0,007	-1,987**	-0,002	1,344
Brake	0,008	5,813**	0,015	-9,283
Steering Angle Variability	0,030	18,971**	0,362	-23,700
Age	0,003	1,703**	0,004	-2,754
Driven kilometers per week	7E-05	2,134**	0,002	-1,391
Avoid Driving At Night	-0,013	-2,749**	-0,002	1,000
R ²	0,876			

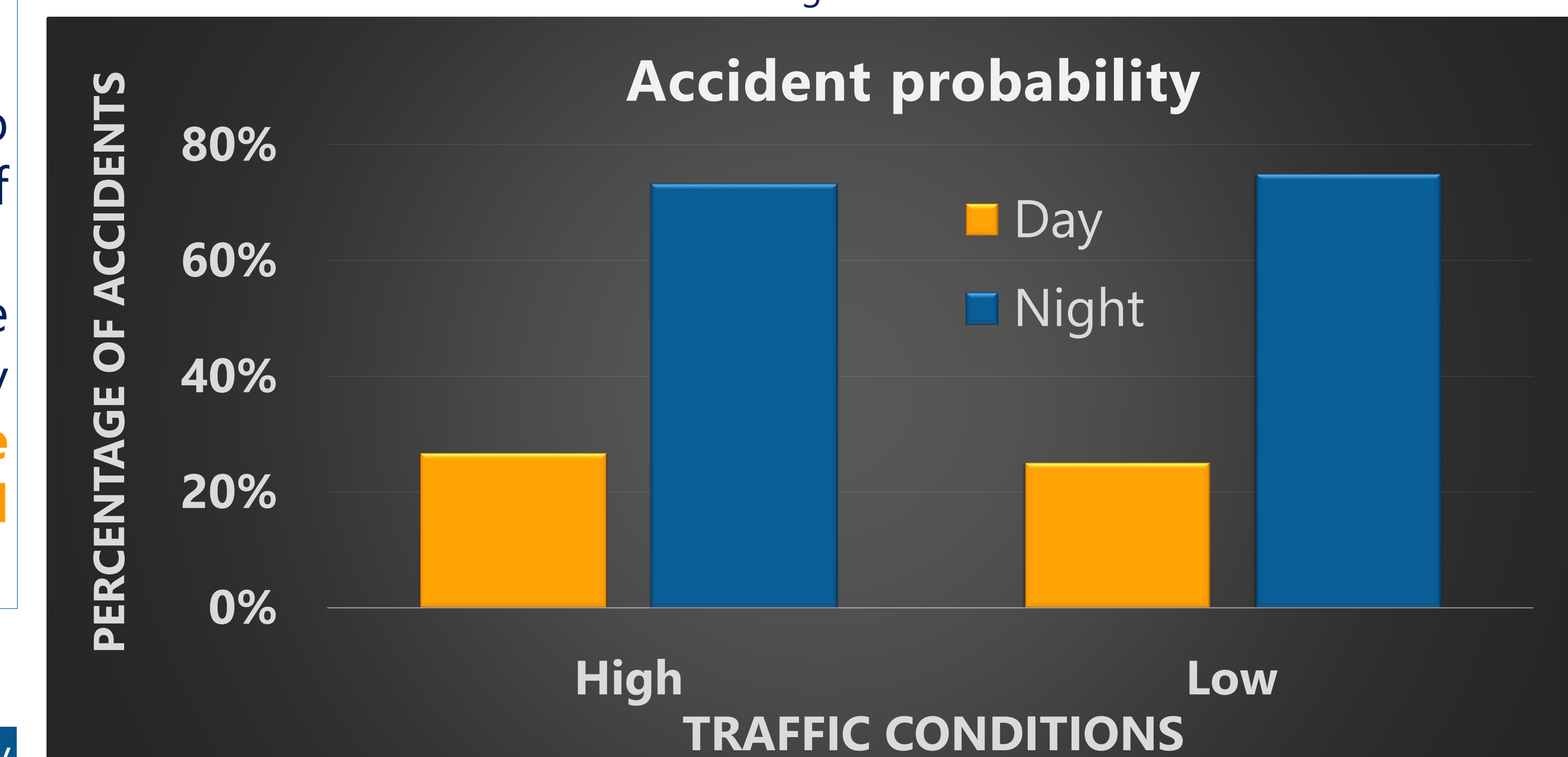
Table 2. Binary logistic regression model for **accident probability**

Independent variables	β_i	t	Elasticity (ei)	Relevant elasticity (ei)
Night-time driving	1,426	9,194**	1,720	4,733
Driving Experience	-0,779	-3,695**	-1,204	3,316
Age	-0,700	3,694**	0,363	1,000
Time headway Variability	0,006	6,470**	0,410	1,129
Gender	0,793	2,246**	0,647	1,780
R ²	0,128			

Table 3. Normal linear regression model for **reaction time**

Independent variables	β_i	t	Elasticity (ei)	Relevant elasticity (ei)
Night-time driving	101,03	1,806**	0,078	1,907
Driven kilometers per week	0,969	2,058**	0,069	1,697
Avoid Driving At Night	141,63	2,001**	0,041	1,000
Gender	148,99	2,307**	0,271	6,618
Driving Speed Variability	-24,15	-2,167**	-0,387	-9,431
R ²	0,226			

Figure 1. Percentage of accidents occurred in the two different driving scenarios under low and high traffic conditions



Discussion

- Night-time driving in both high and low driving conditions **increases the accident probability to more than 70%**, whereas the accident probability in day time is 3 times lower.
- Driving on a rural road during the night, results in a **significant reduction in mean driving speed**
- Night-time driving has a statistically **significant and negative impact on the reaction time** of the drivers at an unexpected incident.
- The riskiest profile of a driver regarding the reaction time during night-time is a **male driver who self-declare that they avoid driving at night** because he considers this as a dangerous condition.
- Drivers seem to have a **compensatory behavior**, as they consider driving at night as a dangerous condition due to limited visibility and for that reason they **reduce their speed** in order to increase their attention to the driving environment.
- This compensatory strategy, however, is **not successful** as indicated by the **worse reaction time and higher accident probability** that they have.

Acknowledgement

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