

**Investigation of the
impact of eco-driving on
fuel consumption using
smartphone data**

Armira Kontaxi
Transportation Engineer

Together with: George Yannis, Aimilia
Triantafyllou

**National Technical University
of Athens, Greece**



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Introduction

- Eco-driving emphasizes **energy-saving driving practices**, focusing on:
 - reducing fuel consumption
 - lowering gas emissions
 - enhancing road safety
- Key aspects of eco-driving: **smooth acceleration**, timely braking, adhering to speed limits, and **harmonizing speed** with other vehicles
- Considerable **impact on road safety**; however, certain practices might have negative implications under specific traffic conditions



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Objective

- Impact of eco-driving on **fuel consumption**
- Identification of **parameters** affecting fuel consumption
- How parameters **interact** with each other to predict fuel consumption



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Experimental Design

- Naturalistic driving experiment of 15 participants, aged 20-30
- 2 different driving scenarios
 - 4 months of normal driving (before)
 - 2 months eco-driving (after)
- A large database of thousands of trips
- Fuel consumption recording table by the participants themselves (questionnaire with the general driving data, the habits towards eco-driving, and the demographic data of each driver)



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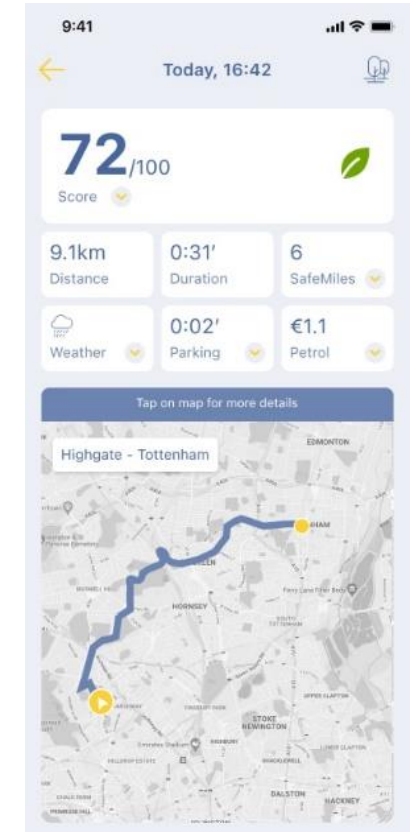
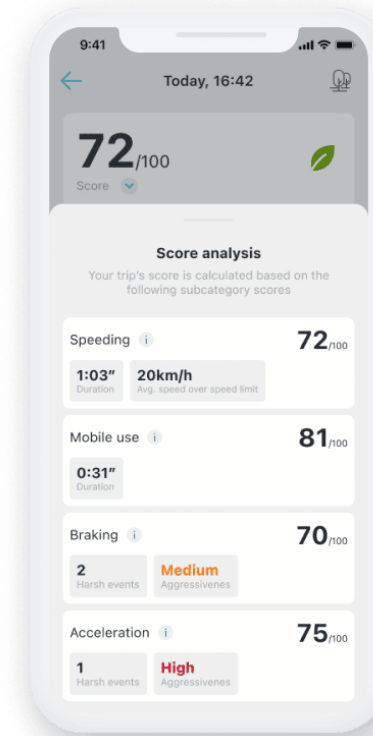


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Smartphone Application

- Eco driving characteristics
 - Fuel Consumption
 - Speeding
 - Harsh braking/ acceleration/ cornering
- Travel behaviour characteristics
 - Total distance
 - Total duration
 - Road network type
 - Risky hours driving
 - Vehicle type



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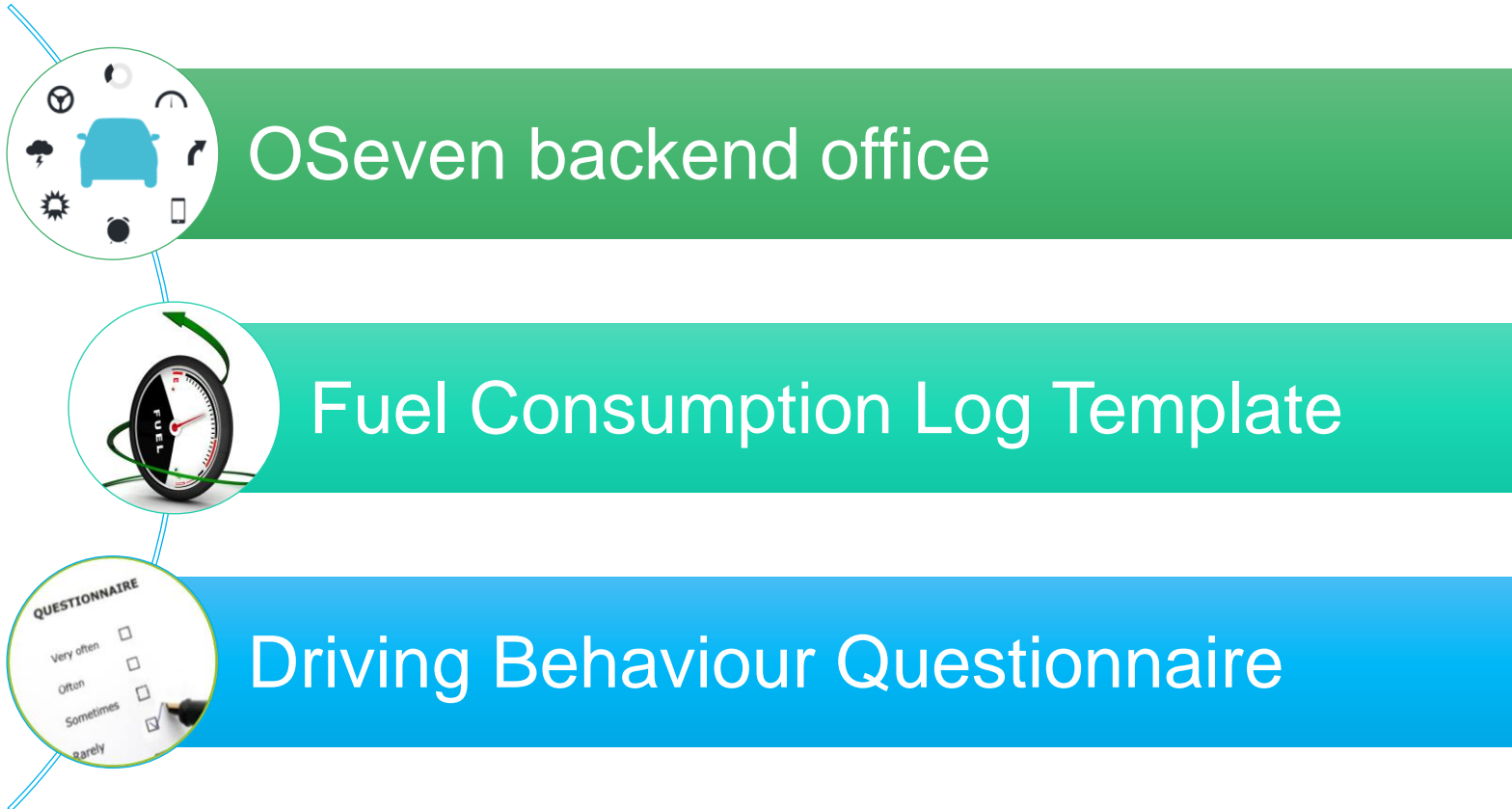
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Data Collection



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Summary Statistics

- 60% male, 40% female drivers
- Majority vehicles over 10 years old
- Reduction in harsh accelerations (3.79%) & braking (27.42%)
- Reduction in speeding (14.22%) & fuel consumption (8.14%)



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Statistical Models

- 3 Lognormal Regression models to identify driving characteristics influencing the fuel consumption
 - Model 1: General fuel consumption prediction
 - Model 2: Fuel consumption during regular driving
 - Model 3: Fuel consumption during eco-driving

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Results

	Overall Model		
Parameters	Estimate	p-value	Odds Ratio
(Intercept)	9.214	<0.001	-
dec_avg	-2.027	<0.001	0.132
acc_avg	-2.827	<0.001	0.059
harsh_acc_per_km	5.794	<0.001	328.324
duration_stops_avg	-0.021	0.005	0.979
before_after	-0.116	<0.001	0.890
veh_date	0.141	0.006	1.151
age	-0.231	<0.001	0.794
dr_exp	0.113	0.054	1.120
quest_resp_speed	-0.207	<0.001	0.813
R ²	0.9835		

	Before phase model			After phase model		
Parameters	Estimate	p-value	Odds Ratio	Estimate	p-value	Odds Ratio
(Intercept)	-336.8	<0.001	0.000	-191.6	0.015	0.000
harsh_brk	-0.233	0.063	0.792	0.08	0.319	1.083
dec_avg	-0.636	0.286	0.529	0.648	0.089	1.912
duration	-0.001	0.037	0.999	0.001	0.029	1.001
liscense_date	0.167	<0.001	1.182	0.096	0.015	1.101
daily_trip_dist	0.014	0.005	1.014	-0.007	0.052	0.993
vehicle_cc	0.001	0.007	1.001	0.001	0.011	1.001
R ²	0.7243			0.5899		

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Conclusions

- Improved driving reduces fuel consumption by 8.14%
- Aggressive driving increases fuel consumption
- Increased abrupt accelerations lead to higher fuel consumption, especially in interurban areas
- Experienced drivers struggle to adopt eco-driving



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Recommendations and Further Research

- Raise awareness of eco-driving benefits
- Stricter enforcement of driving laws
- Use apps to monitor & improve driving behavior
- Larger driver samples
- Different driving conditions & road types
- Study of motorcycle drivers



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