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HIT- HELLENIC INSTITUTE OF TRANSPORT

HELLENIC INSTITUTE OF TRANSPORTATION ENGINEERS

11th INTERNATIONAL CONGRESS on TRANSPORTATION RESEARCH

Clean and Accessible to All Multimodal Transport

Heraklion, Crete, September 20th - 22nd 2023

Analysis of distraction characteristics due to mobile phone use in Greece

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Introduction

- Road crashes are one of the leading causes of death worldwide – 1.35 million annual road fatalities (WHO, 2018).
- Human behaviour plays a critical role in road safety as the vast majority of road crashes (up to 95%) can be attributed to human factors and human error (Singh, 2015).
- Factors such as speeding, distraction, aggressive or impaired driving and non-compliance with traffic regulations can increase the crash risk.

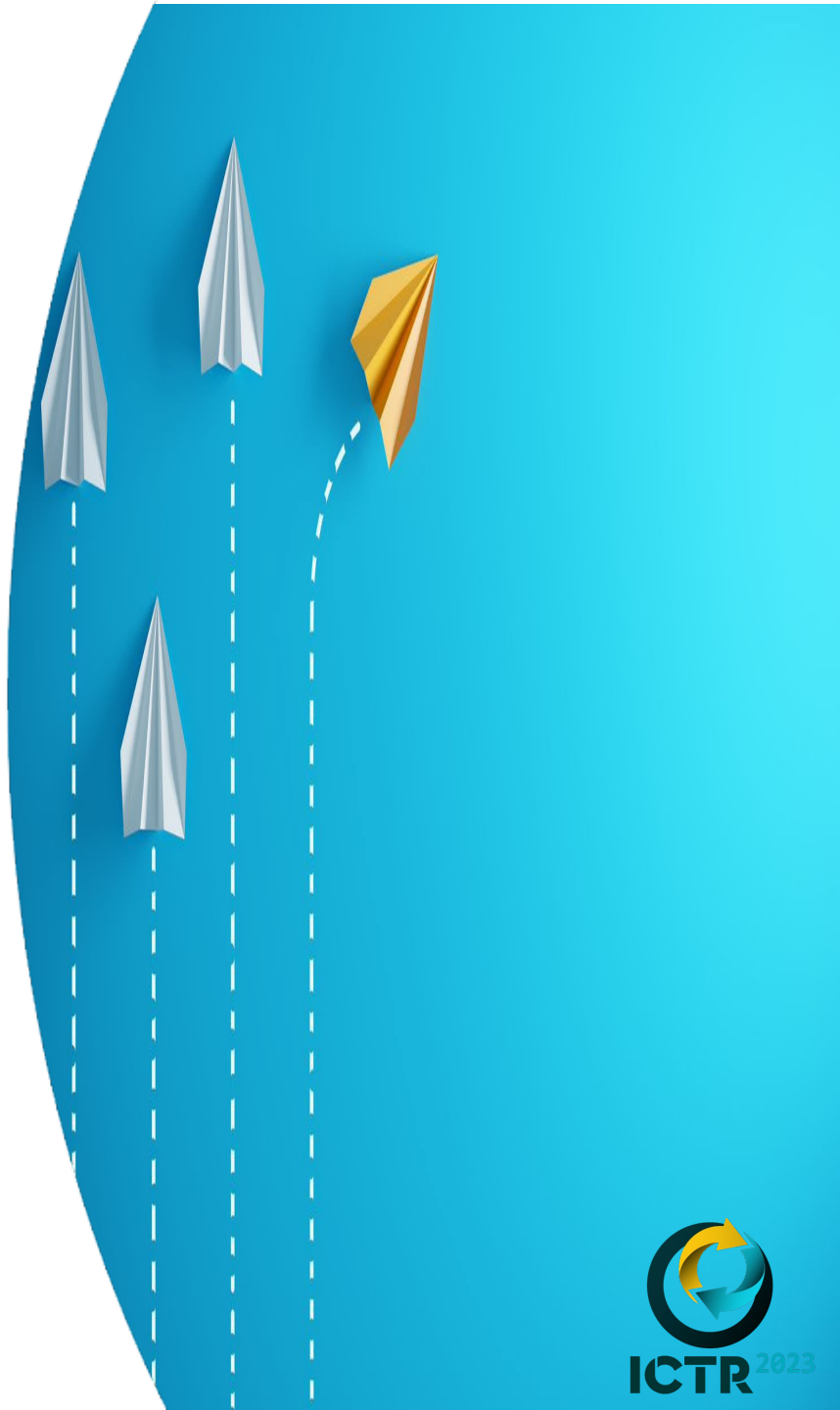
Background

- Drivers tend to reduce their speed during mobile phone conversations, but the risk of crashes increases fourfold when using a mobile phone while driving (Yannis et al., 2014).
- Driver distraction causes significant increases in reaction times (Choudhary & Velaga, 2017).
- Only 2% of Greek road users find it acceptable to use a hand-held mobile phone while driving; however, 45% of Greek drivers admitted to doing so at least once in the last 30 days (Pires et al., 2020).

Objective

- The objective of this study is to analyse the characteristics of driver distraction from mobile phone use in Greece.

- Explore relationships between distraction and various factors:
  - Gender
  - Age groups (young, middle-aged, and elderly)
  - Vehicle types (passenger cars, vans, others)
  - Road types (urban roads, rural roads, motorways)
  - Weather conditions (good, adverse)
  - Day of the week (weekend or weekdays)
  - Study area (Athens, Thessaloniki, Larissa)



Data Collection

- Field measurements (November-December 2021)
- Data were collected for 8.577 drivers in total.
- It is noted that these data cannot be considered fully representative of the entire country due to the limited scale of measurements, which focused only on three major cities locations. (Athens, Thessaloniki, Larissa)

Descriptive Statistics

- 843 out of the 8.577 drivers exhibited distraction (10%).
- Among these drivers, 667 (79%) were male, while 176 (21%) were female.

	Elderly	Middle-aged	Young	Total
No Distraction	**205**	**5.807**	**1.722**	**7.734**
Female	27	928	619	1.574
Male	178	4.879	1.103	6.160
Distraction	**12**	**544**	**287**	**843**
Female	1	85	90	176
Male	11	459	197	667
Total	**217**	**6.351**	**2.009**	**8.577**

	Motorway	Rural Road	Urban Road	Total
No Distraction	**1.805**	**1.756**	**4.173**	**7.734**
Elderly	34	59	112	205
Middle-aged	1372	1.361	3.074	5.807
Young	399	336	987	1.722
Distraction	**290**	**170**	**383**	**843**
Elderly	6	2	4	12
Middle-aged	193	119	232	544
Young	91	49	14	287
Total	**2.095**	**1.926**	**4.556**	**8.577**

	Bus	HGV	LGV	PC	Van	Total
No Distraction	**133**	**258**	**425**	**6.222**	**696**	**7.734**
Motorway	31	208	182	1.189	195	1.805
Rural Road	28	37	141	1.356	194	1.756
Urban Road	74	13	102	3.677	307	4.173
Distraction	**7**	**48**	**50**	**620**	**118**	**843**
Motorway	3	42	30	176	39	290
Rural Road	2	4	10	123	31	170
Urban Road	2	2	10	321	48	383
Total	**140**	**306**	**475**	**6.842**	**814**	**8.577**

Methodological Approach

- **Dependent Variable:**
  Driver Distraction due to hand-held mobile phone use (yes/no: 10%-90%)
- **Independent Variables:**
  Age group, Vehicle Type, Road Type, Weather Conditions
- **Modelling approaches:**
  Binary Logistic Regression (BLR), Random Forest (RF)
- **Dealing with Class Imbalance:**
  Random Over-Sampling Examples (ROSE) R package
- **Statistical tests:**
  Significance z-test (BLR), Accuracy, Recall, Precision, Specificity, F-measure, AUC
- **Variable importance:**
  elasticities (BLR), Gini importance (RF)

Results (1/3)

Binary Logistic Regression (positive prediction: distraction)	1A	1B – Over Sampling	1C- Under Sampling	1D - Both
Accuracy	90,16%	61,45%	62,19%	62,10%
Recall	0,00%	57,2%	55,92%	56,87%
Specificity	100,00%	61,84%	62,88%	62,67%
Precision	0,00%	57,82%	55,92%	56,87%
F-measure	-	57,82%	55,92%	56,87%
Prevalence	9,84%	6,93%	7,10%	6,98%
AUC	60,40%	60,50%	60,39%	60,37%
Random Forest (positive prediction: no distraction)	**2A**	**2B – Over Sampling**	**2C- Under Sampling**	**2D - Both**
Accuracy	0,00%	61,12%	63,68%	66,25%
Recall	100,00%	61,53%	64,89%	68,67%
Specificity	0,00%	57,35%	52,61%	44,08%
Precision	0,00%	57,35%	52,61%	44,08%
F-measure	0,00%	59,36%	58,11%	53,69%
Prevalence	9,84%	7,00%	7,38%	8,16%

Results (2/3)

Binary Logistic Regression model results (dependent variable: distraction (yes/no)

Independent Variables	Estimate	S.E.	Pr(>|z|)	Adj. OR (95% CI)
Intercept	0,887	0,052	< 0,001	-
Reference category: Young drivers				
Middle-aged	-0,654	0,043	< 0,001	0,52 (0,48-0,57)
Elderly	-0,907	0,132	< 0,001	0,40 (0,31-0,52)
Reference category: Passenger Cars				
Van	0,535	0,061	< 0,001	1,71 (1,51-1,93)
Other	0,202	0,063	< 0,001	1,22 (1,08-1,38)
Reference category: Motorways				
Rural Roads	-0,533	0,056	< 0,001	0,59 (0,53-0,65)
Urban Roads	-0,675	0,048	< 0,001	0,51 (0,46-0,56)
Reference category: Good Weather Conditions				
Adverse Weather	-0,243	0,052	< 0,001	0,78 (0,71-0,87)

Random Forest model key elements

Type: Classification
Number of trees: 300
Number of variables tested in each split: 4
OOB estimate of error rate: 40,04 %

Results (3/3)

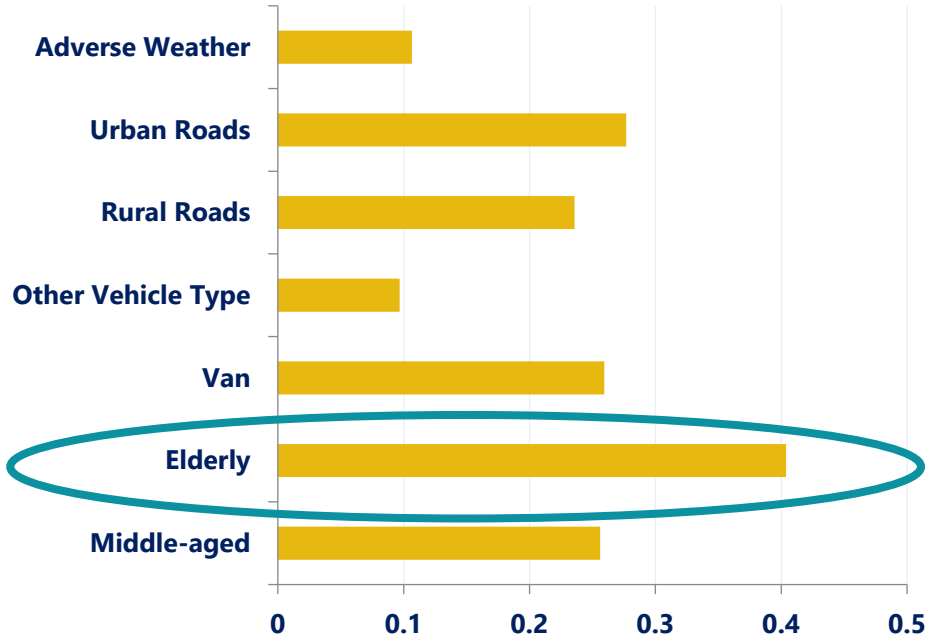


Figure 1: Elasticities of independent variables, BLR model 1B

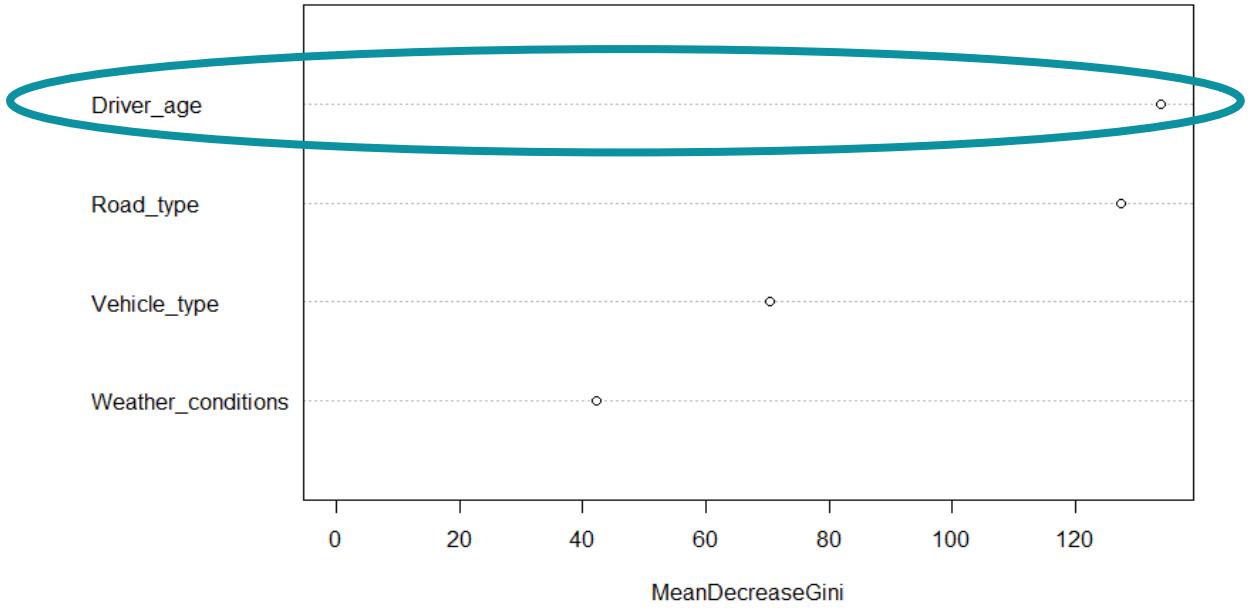


Figure 2: Variable Importance Plot, RF model 2B

Conclusions

- Middle-aged and elderly people are less likely to use a mobile phone while driving compared to young people.
- Van drivers are more likely to use a mobile phone than passenger car drivers.
- Drivers on motorways make more frequent use of mobile phones than drivers on urban and rural roads.
- Drivers are less likely to use their mobile phone in adverse weather conditions compared to good weather conditions.
- The overbalance approach led to the most reliable results.
- The most important parameter in predicting distraction is driver age.

Recommendations

- Systematic enforcement (technical & physical means) in order to prevent mobile phone use while driving.
- Awareness raising campaigns informing drivers about the risks of driver distraction.
- Introduction of a reward system for exemplary drivers (e.g. reduced insurance costs).
- Road infrastructure measures (e.g. rumble strips).

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