Symposium
"Road Safety - European Reality and Perspectives"

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# Driver distraction and road safety in Greece and international

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***Road Safety is a typical field***

***with high risk of important investments not bringing results***

***If you can not measure it, you can not improve it***

***Lord Kelvin***

# Objective and Methodology

## Objective

To provide a comprehensive picture
of the impact of driver distraction to road safety.
Both internal and external distraction factors are considered.

Particular focus is put on mobile phone use (internal)
and advertising signs (external) related distraction.

## Methodology

- review of international literature and synthesis of results
- presentation of results from experiments in Greece

# Review of Literature

More than 60 studies on driver distraction have been reviewed

## Statistical methods

1. Before and after studies
2. Comparison of the number of crashes
3. Comparison of the number of near - crashes

## Field studies

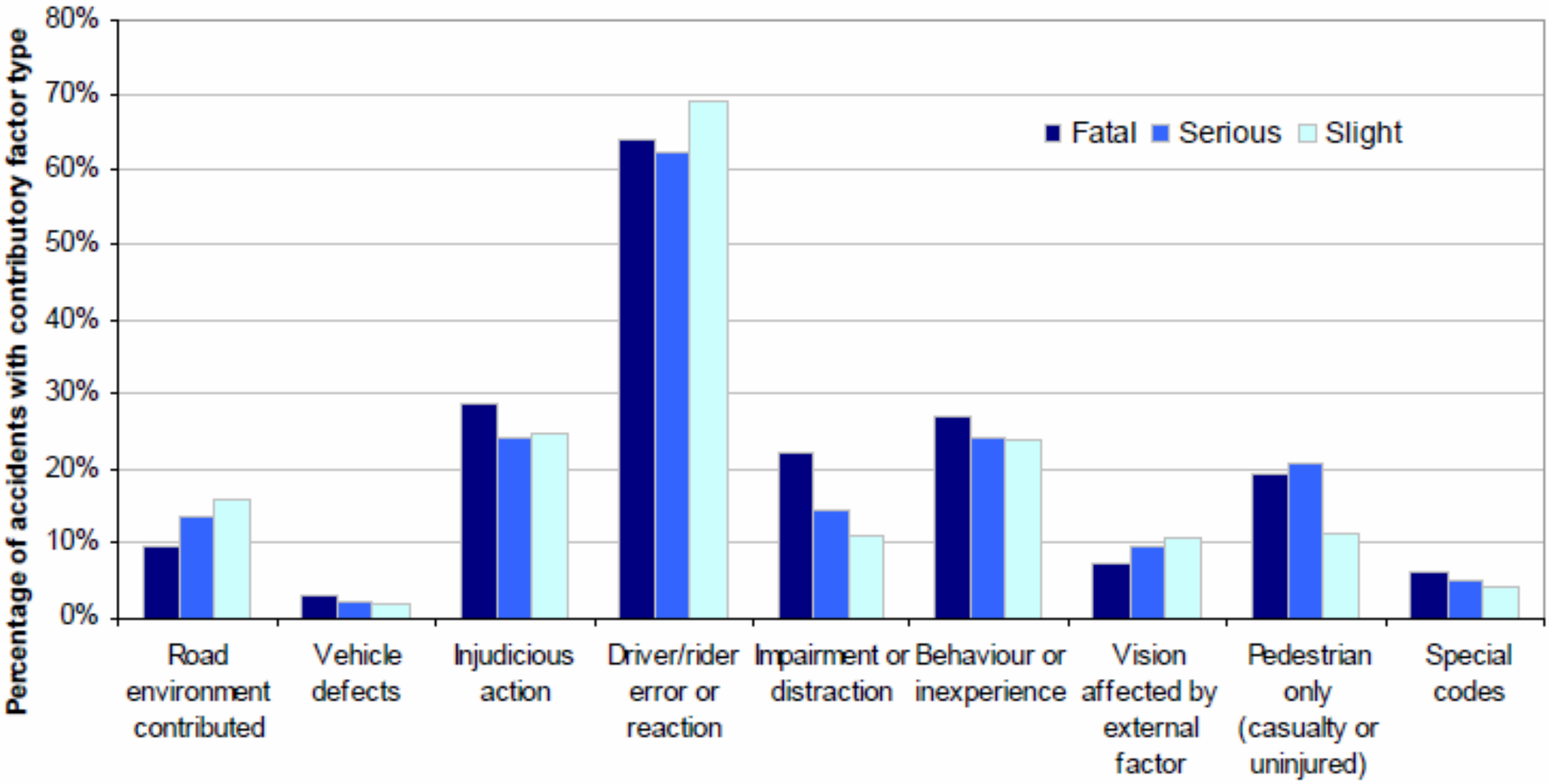
4. Recording driver's behavior with roadside observations
5. Recording driver's behavior with in-vehicle observations
6. Recording driver's behavior with in-vehicle observation with special tracking systems (naturalistic driving studies)
7. Questionnaires

## Laboratory studies

8. Driver simulator and eye tracking systems

# Road Accident Contributory Factors

***Source: GB 2008, Department for Transport***




Impairment or distraction factors
account totally for 12% of all contributory factors

# Road Accident Contributory Factors related to Impairment or Distraction

***Source: GB 2008, Department for Transport***

| Road accident contributory factors * | Fatal accidents (%) | Total accidents (%) |
|---|---|---|
| Road environment | 9 | 16 |
| Vehicle defects | 3 | 2 |
| Injudicious action | 29 | 25 |
| Driver/rider error or distraction | 64 | 68 |
| Impairment or distraction | 22 | 12 |
| Alcohol | 11 | 5 |
| Drugs | 3 | 1 |
| Fatigue | 3 | 1 |
| Illness or disability | 5 | 1 |
| Mobile phone use | 1 | 0 |
| In-vehicle distraction | 3 | 2 |
| External distraction | 2 | 1 |
| Behaviour or inexperience | 27 | 24 |
| Vision affected | 7 | 10 |
| Pedestrian accident | 19 | 13 |

* The sum of percentages may exceed 1 due to multiple contributory factors per accident

Internal distraction factors account for 2/3 of the total distraction factors

# Driver Distraction Factors

| In-vehicle | External |
|---|---|
| Passengers | Traffic control |
| Communication devices | Other vehicle |
| Entertainment system | Looking for destination / location |
| Vehicle systems | Pedestrian / Bicyclist |
| Eating / drinking | Accident / incident outside the vehicle |
| Smoking | Police / Fire brigade / Ambulance |
| Animal / insect in the vehicle | Landscape / Buildings |
| Coughing / sneezing | Animal |
| Driver stress | Advertising sign |
| Daydreaming | Road signs and markings |
| | Sun / vehicle lights |

***Source: Regan et al., 2005***

# Driver Distraction Factors

Driver distraction occurs when a driver's attention is, voluntarily or involuntarily, diverted away from the driving task by an event or object to the extent that the driver is no longer able to perform the driving task adequately or safely.

Driver distraction may have an impact to:

- vehicle speed
- headway
- acceleration/deceleration
- vehicle direction in relation to road direction
- distance from the road/lane boundaries
- time-to-collision

These parameters have a mixed positive and negative effect on the accident probability. Risk compensation plays also a crucial role.

# Driver Distraction Factors

- The distraction caused by interacting with in-vehicle devices while driving seems to impair a driver's ability to maintain speed, control and lateral position on the road more than external distractions

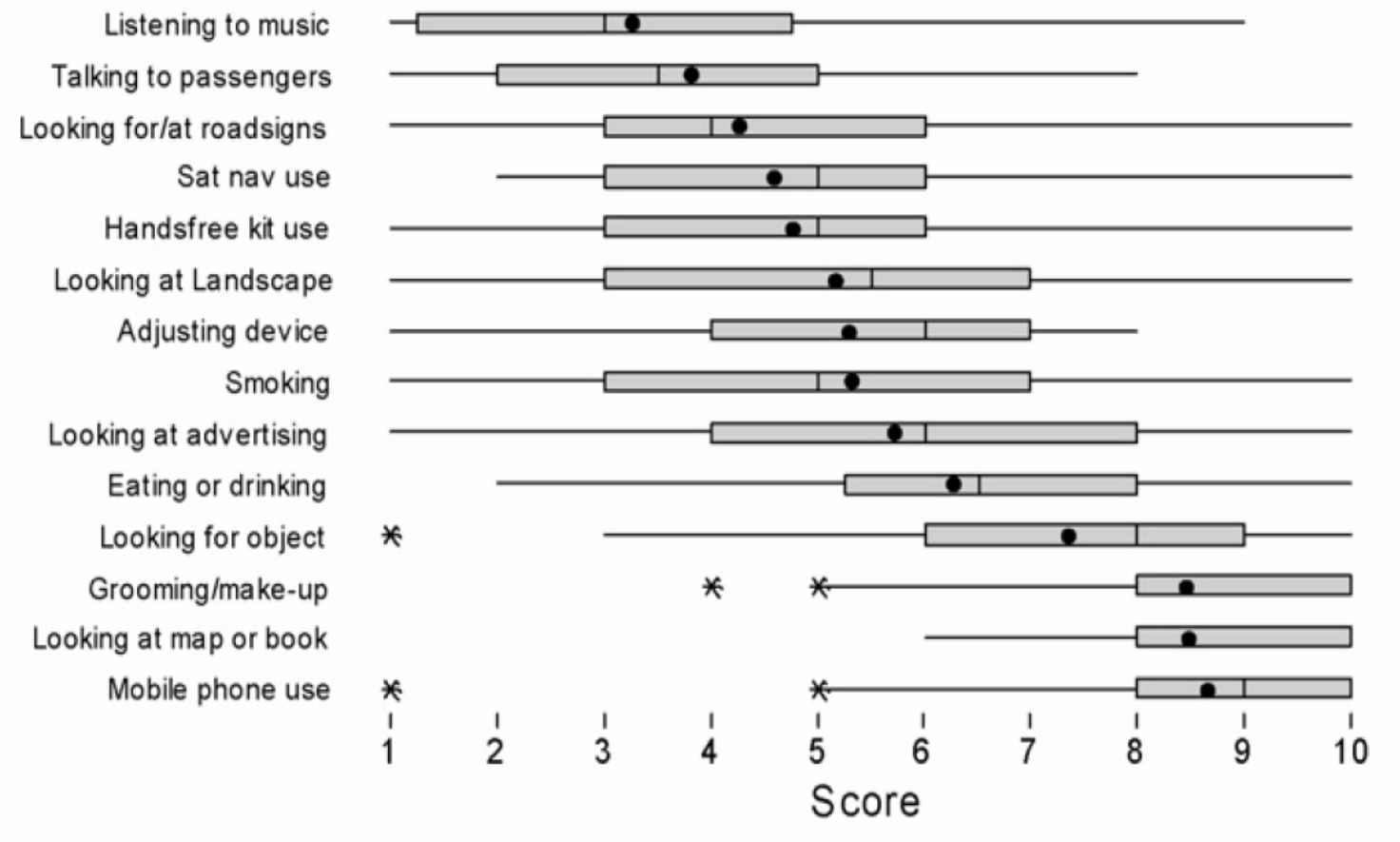
- The complexity of the secondary task being performed and of the driving environment, as well as driver characteristics (age and driving experience) can all influence the potential for non-driving tasks to distract drivers

- As the difficulty of the secondary and/or driving tasks increase, the potential for the task to degrade driving performance also increases

- Older drivers and inexperienced drivers are more susceptible to the distracting effects of engaging in secondary tasks while driving, than experienced or middle-aged drivers

# Perceived Road Accident Contributory Factors related to Distraction

***Level of perceived risk associated with each driver distraction. (Source: Patel et al. 2007)***




The highest perceived risk ratings are associated with the use of mobile phones

The lowest perceived risk ratings are associated with listening to music

# Influence of In-vehicle Distraction Factors

***Odds ratio for secondary tasks in the 100-Car study (Source: NHTSA. July, 2008)***

| Type of Secondary Task | Odds Ratio |
|---|---|
| **Reaching for a moving object** | **8.82** |
| Insect in vehicle | 6.37 |
| **Reading** | **3.38** |
| **Applying makeup** | **3.13** |
| **Dialing hand-held device** | **2.79** |
| Inserting/retrieving CD | 2.25 |
| Eating | 1.57 |
| Reaching for non-moving object | 1.38 |
| Talking/listing to a hand-held device | 1.29 |
| Drinking from open container | 1.03 |
| Other personal hygiene | 0.70 |
| Adjusting the radio | 0.50 |
| **Passenger in adjacent seat** | **0.50** |
| Passenger in rear seat | 0.39 |
| Child in rear seat | 0.33 |

Reaching for a moving object is the most risky behavior observed, increasing crash risk by more than eight times that of just driving

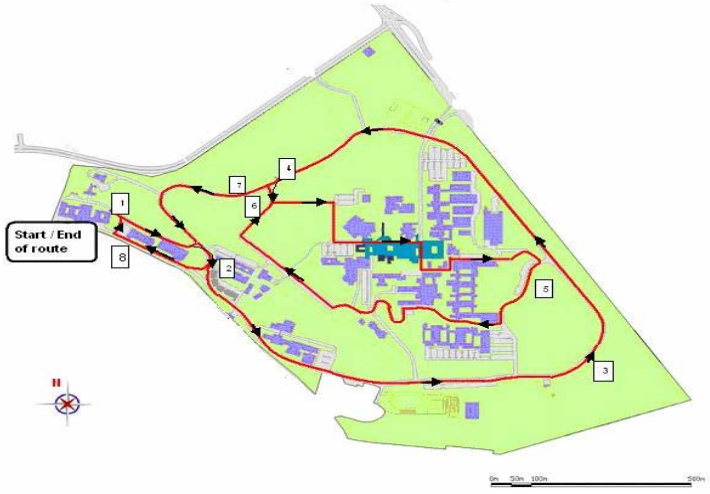
# Mobile phone use, driver speed and headways

***In-Vehicle observations, Karekla-Kontodima, NTUA, 2007***

- Effects of mobile phone use while driving on traffic speed and headways, focused on young drivers

- Experiment with 37 participants took place in NTUA Campus area, under either free flow or interrupted flow conditions.

***Field survey area and routes***




- Separate models were developed for average free flow, interrupted flow, as well as for total average speed

# Mobile phone use, driver speed and headways

*In-Vehicle in-vehicle, Karekla-Kontodima, NTUA, 2007*

***Best fitting models for vehicle speed***

| Variable | Total average speed ($V_t$) | | | Free flow average speed ($V_f$) | | | Interrupted flow average speed ($V_i$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | $\beta_i$ | Relative effect | | $\beta_i$ | Relative effect | | $\beta_i$ | Relative effect | |
| | | $e_i$ | $e_i^*$ | | $e_i$ | $e_i^*$ | | $e_i$ | $e_i^*$ |
| Mobile phone use | -0.047 | 0.017 | 2.46 | -0.049 | 0.017 | 3.12 | -0.063 | 0.023 | 1.97 |
| Gender | -0.032 | 0.007 | 1.00 | -0.028 | 0.005 | 1.00 | -0.050 | 0.012 | 1.00 |
| Driving experience | - | - | - | 0.030 | 0.010 | 1.79 | - | - | - |
| Annual distance | 0.020 | 0.008 | 1.12 | +0.032 | 0.012 | 2.15 | - | - | - |
| Average headways | -0.033 | 0.069 | 10.33 | -0.023 | 0.047 | 8.81 | -0.026 | 0.059 | 5.08 |

- Mobile phone use leads to statistically significant reduction of traffic speeds
  - Total average speed, Vt: ↓ 15,6% ± 0,1%
  - Free flow average speed, Vf: ↓ 14,3% ± 0,6%
  - Interrupted flow average speed, Vd: ↓ 16,4% ± 1,0%

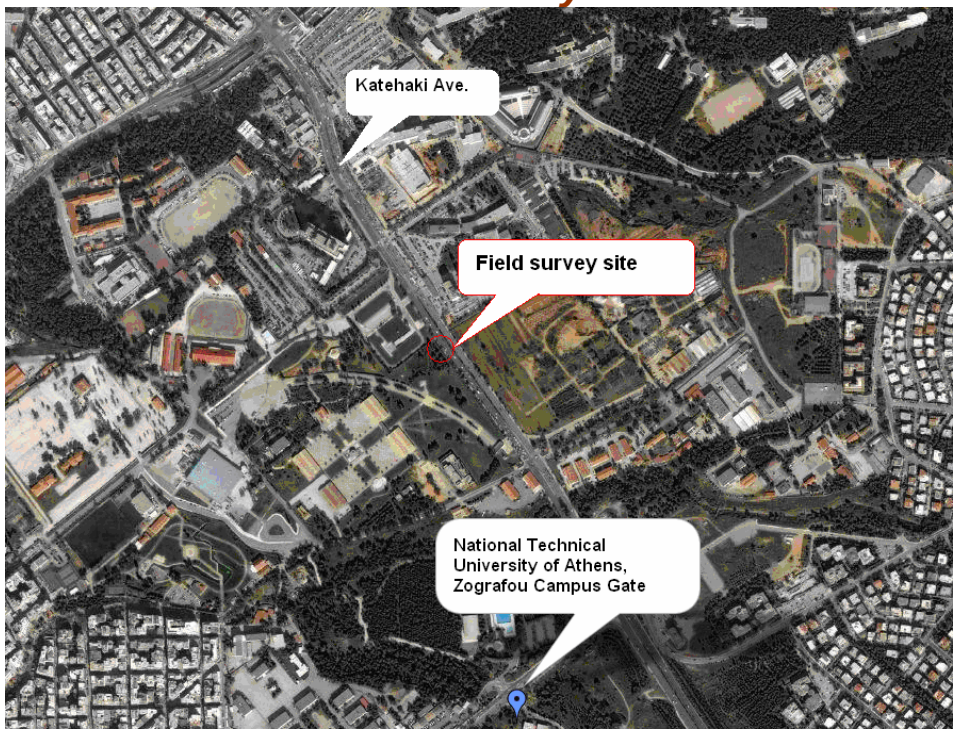
- Experienced drivers (annual distance traveled exceeds 10,000 per year) drive faster while speaking on cell phone

# Mobile phone use, driver speed and headways

***Roadside observations, Papantoniou-Petrelis, NTUA, 2008***

- Impact of cell phone use on vehicle traffic speed and headways
- Field survey in real traffic conditions, Katehaki ave., in which 3048 vehicles were captured by means of a video camera and a speed gun

***Field survey site***




- 2 linear regression model models were developed for vehicle speed and headspace

# Mobile phone use, driver speed and headways

## *Elasticities of vehicle speeds and headspaces*

| | Vehicle speed (V) | | | Headspace (Hs) | | |
|---|---|---|---|---|---|---|
| **Variable** | **β** | **e** | **e*** | **β** | **e** | **e*** |
| Taxi | 0.692 | 0.00154 | 1.13 | - | - | - |
| Gender | -0.688 | 0.00318 | 2.34 | - | - | - |
| Age 18-25 | 0.441 | 0.00228 | 1.68 | - | - | - |
| Age 25-55 | - | - | - | 7.299 | 0.14733 | 1.63 |
| Age >55 | -1.503 | 0.00297 | 2.18 | - | - | - |
| Cell phone use | -0.726 | 0.00136 | 1.00 | -28.824 | 0.09023 | 1.00 |
| Speed difference dv | - | - | - | 7.134 | 0.87752 | 9.73 |
| Headways difference dHw | - | - | - | 7.174 | 1.28655 | 14.26 |

The use of cell phone is a significant additional determinant of vehicle speeds and headspaces, although other driver and traffic characteristics are the main determinants.

Moreover cell phone use:

- brings a slight decrease of vehicle speed
- leads to a reduction of vehicle headspaces

# Mobile phone use, driver speed and accident probability

***Driving Simulator Experiment, Roumpas, NTUA, 2010***

- Investigation of the interrelation between mobile phone use, driver speed and accident probability

- The research focuses on the behaviour of 30 young drivers aged between 18 and 30 years old

- A driving simulator experiment took place, in which participants drove in

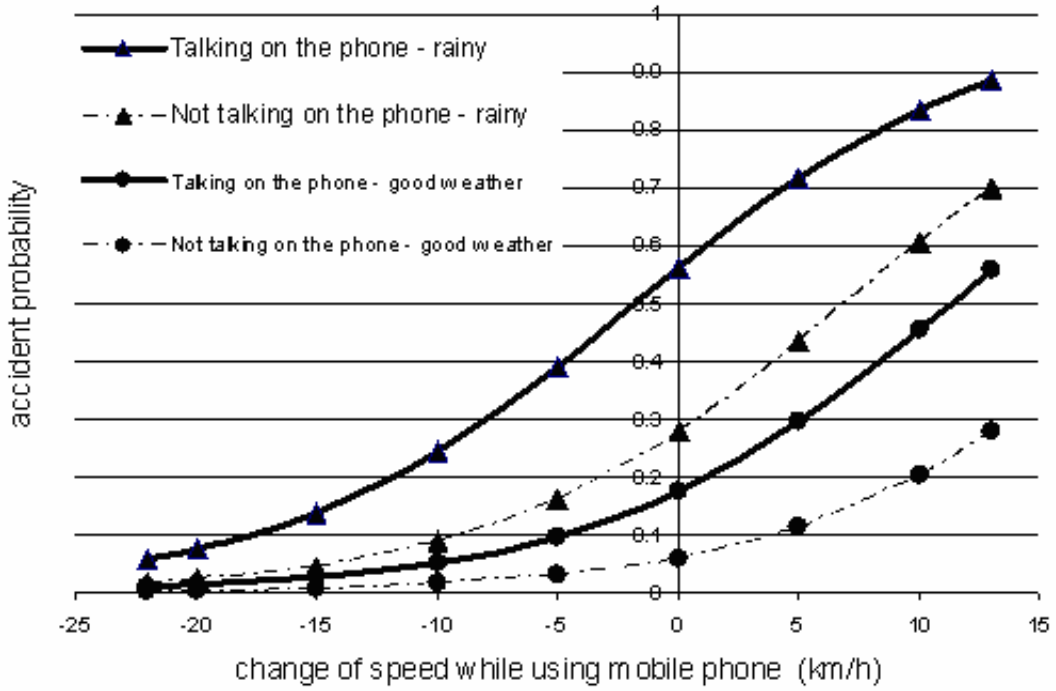
  ✓different driving scenarios
  ✓urban / interurban areas
  ✓good / rainy weather conditions
  ✓with / without the occurrence of an incident

- Binary logistic regression methods were used to analyse the combined influence of mobile phone, driver speed and other parameters on the probability of an accident

# Mobile phone use, driver speed and accident probability

***Driving Simulator Experiment, Roumpas, NTUA, 2010***

***Accident probability in relation to mobile phone use, change of speed and weather conditions in case of an incident while driving***




Cell phone use leads to :

- Statistically significant decrease of the mean speed both in urban and interurban environment
- Increase of accident probability

# Labels and advertising signs

An extensive literature review was carried out, which led to a series of findings:

- Labels and advertising signs impact on road accidents is over - emphasised, as it concerns just a fraction of 1% of accident contributory factors

- Research on labels and advertising signs is rich but not conclusive so far:
  - some impact on driver behaviour has been identified
  - impact of changed behaviour to accident risk is not identified
  - research does not converge on the impact on accidents

# Labels and advertising signs

- Labels and advertising signs resembling (in size and form) to traffic signs or other traffic indicators create confusion

- Blinking and animation objects have proven to be difficult-to ignore, dynamically changing advertising and information are ill-advised

- Labels and advertising signs are used worldwide and special rules apply for:
  - their location
  - their position
  - their height
  - their characteristics (blinking, etc.)

# Conclusion

- The potential for a task to distract drivers can be influenced by:
  - the complexity or demand of the secondary task
  - the current demands of the driver task
  - driver age
  - driver experience

- Driver distraction is a safety problem that might increase crash risk due to the degradation in driving performance during multitasking, including slower reaction time and narrowed visual scanning

- However, before extracting any reliable conclusion for the impact of driver distraction to accident risk, the issue of risk compensation should certainly be taken into account

- As more wireless communication, entertainment and driver assistance systems proliferate the vehicle market, further quantitative research for their effect on driver behaviour and accident risk is needed

# Measures against driver distraction

- Enforcement of traffic rules
  - driving and talking on the phone
  - driving under the influence of alcohol and medicines

- Driver sensitisation campaigns
  - risk associated to mobile phone use
  - risk associated to driver distraction in general

- Driver training and education
  - traffic education at school
  - re-integration courses of frequent offenders

- Creation of less demanding traffic conditions
  - interventions on infrastructure
  - interventions on traffic management

# Future research

Several open issues remain for future research:

- identify functions behind distraction activities
- focus on mobile phones use
- separate impact from the various distraction factors
- examine the combined effect of all distraction factors
- **link distraction-associated driver behaviour with accident risk**
- cross validation through experiments (driving simulator, naturalistic driving) and statistics (before-after, comparison of sections)
- ergonomic design of devices to minimise distraction
- develop universally agreed definition of driver distraction

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