National Technical University of Athens
School of Civil Engineering
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Cell Phone Use and Traffic Characteristics

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Background

- The use of cell phones is blamed for increased risk of provoking or failing to avoid a road accident.
  - Road accident risk is from 2.5 to 4 times higher when using a cell phone while driving.
  - Young drivers and male drivers are at particular high risk when using a cell phone while driving.
  - The effect is attributed to the distraction of driver's attention.

- Drivers may attempt to compensate for this by adapting their speed.
  - Speed reduction is expected to be higher in more complex (e.g. urban) settings.
  - Older drivers and females are associated with higher speed reduction when using a cell phone while driving.

- Related results on vehicle headways are rather contradictory.

- Most existing studies used driving simulator or stated preference data, i.e. the effects are seldom explored in real traffic conditions.

Objectives

The objective of this paper is to extend existing research on the effect of using a cell phone while driving on traffic speed and headways.

- The effect of several factors, on traffic speed and headways is analyzed.
  - Cell phone use
  - Driver age and gender
  - Vehicle type
  - Vehicle speed

Methods

- A roadside survey is carried out in actual traffic conditions in an appropriate setting in Athens, Greece.
  - a very low drivers compliance is observed, combined with a lack of systematic police enforcement of the use of cell phones.
- Linear regression models are developed in order to examine the effect of various parameters on traffic speed and headways.
  - Speeds and headways are considered continuous normally distributed response variables.
- Variable elasticities are estimated.
  - the point elasticity (e_i) for each driver (i) is calculated as follows, and the overall elasticity (e) is the average of (e_i) in the sample:

$$e_i = (\Delta Y_i / \Delta X_i)(X_i / Y_i) = \beta_i (X_i / Y_i)$$

- Sensitivity analysis is carried out

Data collection

- Traffic data were recorded on a four-lane urban arterial segment near the National Technical University of Athens Campus, in Athens, Greece.

- A video camera was used for the measurement of vehicle arrivals and headways
  - Vehicle headways were measured as the time difference of the front of a vehicle passing from a specific cross-section and of the vehicle ahead of it. This was achieved by means of detailed analysis of the video recordings.
- A speed gun was used for the measurement of vehicle speeds.
- Measurements concerned vehicles traveling along the right and the middle lanes, on typical weekdays and during off-peak hours
- Driver's age group and gender, as well as the vehicle type and cell phone use were also recorded.

- In total, 3,048 consecutive vehicles were captured during the roadside survey.

Variables and values

- Vehicle speed (v)
- Driver gender (gender)
- Driver age group (18-25, 25-55, >55)
- Use of cell phone (yes / no)
- Headway (Hw)
- Headspace (Hs), i.e. headways expressed in distance by multiplying the vehicle speed with the time headway.
- The absolute difference in the speed of each vehicle from the vehicle ahead (dv)
- The absolute difference in headway of each vehicle from the headway of the vehicle ahead (dhw).

- The last two variables capture the fact that vehicle headways are largely affected by traffic conditions (free flow or congestion), resulting in dependences between speed and headway of a given vehicle and those of the vehicle ahead.

Modelling vehicle speeds and headspaces (1/5)

- **Parameter estimates and fit**

	Vehicle speed (V)			Headspace (Hs)		
Variable	**β**	**t-test**	**p-value**	**β**	**t-test**	**p-value**
Constant	51.490	118.897	0.000	-8.666	-1.738	0.082
Taxi	0.692	1.914	0.055	-	-	-
Gender	-0.688	-2.537	0.011	-	-	-
Age 18-25	0.441	1.642	0.100	-	-	-
Age 25-55	-	-	-	7.299	1.386	0.166
Age >55	-1.503	-3.828	0.000	-	-	-
Cell phone use	-0.726	-1.849	0.064	-28.824	-3.271	0.001
Speed difference dv	-	-	-	7.134	16.995	0.000
Headways difference dHw	-	-	-	7.174	46.108	0.000
R^2	0.45			0.47		

- Headspace was proved to be a more efficient dependent variable than headways
- A variable is considered to be statistically significant at a 90% confidence interval, when its t-value is higher than 1.64 and consequently its p-value is lower than 0.100.

Modelling vehicle speeds and headspaces (2/5)

- **Analysis of parameter estimates**

- Some of the variables that were significant in the speed model were not found to be significant in the headspace model (e.g. gender, taxi), and vice versa (e.g. difference in headways).
- Interactions between variables were tested, but were not found to add explanatory power to the model.

- Male drivers, young drivers (18-25 years) and taxi drivers travel at increased speeds, whereas older drivers (>55 years) travel at reduced speeds.
- The use of a cell phone while driving results in reduced speeds for all drivers.
- Cell phone use is significantly associated with reduced headspaces.
- Increased speed and headway differences between consecutive vehicles result in increased headspaces as well.

Modelling vehicle speeds and headspaces (3/5)

- **Variable elasticities**

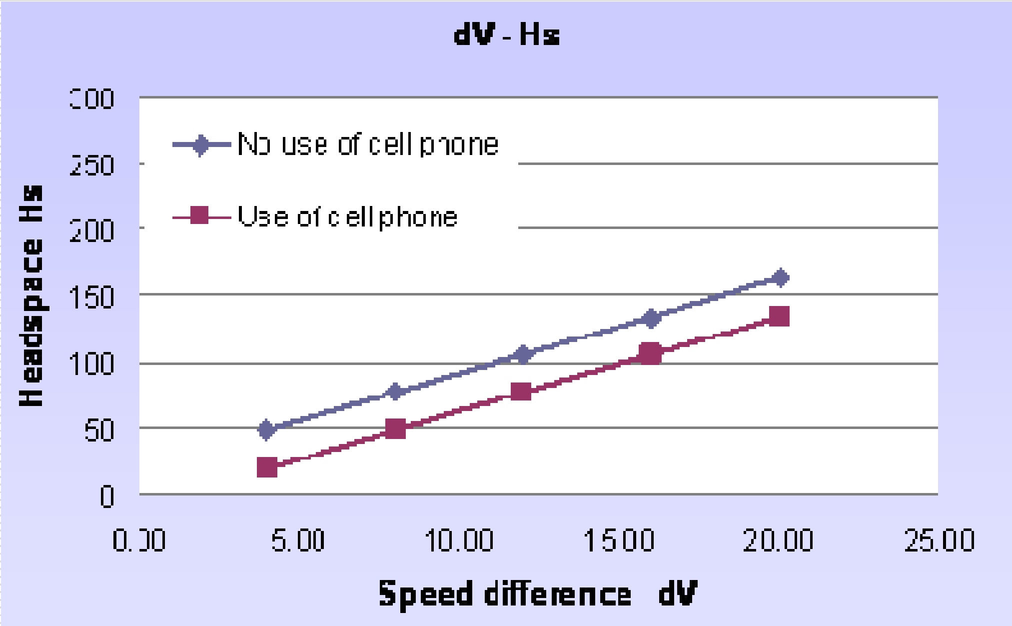
	Vehicle speed (V)			Headspace (Hs)		
Variable	**β**	**e**	**e***	**β**	**e**	**e***
Taxi	0.692	0.002	1.130	-	-	-
Gender	-0.688	0.003	2.340	-	-	-
Age 18-25	0.441	0.002	1.680	-	-	-
Age 25-55	-	-	-	7.299	0.147	1.630
Age >55	-1.503	0.003	2.180	-	-	-
Cell phone use	-0.726	0.001	1.000	-28.824	0.090	1.000
Speed difference dv	-	-	-	7.134	0.878	9.730
Headways difference dHw	-	-	-	7.174	1.287	14.260

- (e*) is a normalization of the estimated elasticities in relation to the lowest one

- Vehicle speeds are largely affected by driver age and gender, and less affected by the use of cell phone.
- Headspaces are mostly affected by the differences in speeds and in headways from the vehicle ahead, due to the obvious correlation between the three traffic measures.
- Headspace elasticity to age is also considerable, whereas the use of cell phone presents the lowest elasticity.

Modelling vehicle speeds and headspaces (4/5)

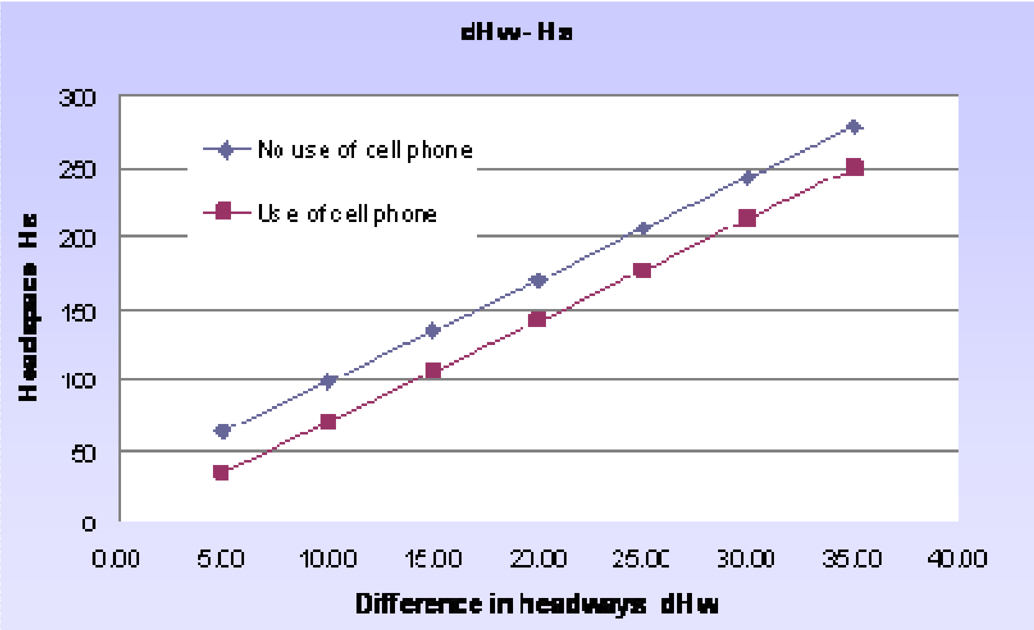
- **Sensitivity analysis** of headspaces to the difference in speeds for drivers using or not using a cell phone while driving (under constant difference in headways).



- Headspaces increase with the difference in vehicle speeds for all drivers.
- Drivers using their cell phones have smaller headspaces regardless of the difference in speeds with the vehicle ahead.
- These general patterns are not affected by age effects.

Modelling vehicle speeds and headspaces (5/5)

- **Sensitivity analysis** of headspaces to the difference in headways for drivers using or not using a cell phone while driving (under constant difference in speed)



- Headspaces generally increase with the difference in headways between consecutive vehicles.
- Drivers using their cell phone have systematically lower headspaces, regardless of the difference in headways.

Conclusions

- The results suggest that the use of cell phone brings a decrease of vehicle speeds.
  - Drivers reduce their speeds to compensate for the increased requirements for cognitive and motor effort coming from the use of a cell phone while driving.
  - Young drivers and males (18-25 years old) drive at increased speeds, regardless of the use of cell phone.
- The use of cell phone while driving also reduces vehicle headspaces.
  - The driver is distracted by the cell phone conversation, failing to keep the appropriate distance from the vehicle ahead.
  - Middle aged drivers (25-55 years old) are associated with increased headspaces, possibly resulting from a combination of more driving experience and better skills.

- A reduction of vehicle speed might be associated with a benefit in terms of road safety, given that most cases lower speeds correspond to lower accident risk and accident severity.
- In this case, however, this reduction in speed is just another aspect of driver distraction when using a cell phone, and consequently accident risk increases.

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