



Department of Transportation
Planning and Engineering,
NTUA



Department of Neurology, Psychiatry
and Social Medicine, UoA
Department of Psychology, UoA

Cognition, Behaviour and Driving

26 June 2015, Athens
Amphitheater NIMTS

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The effect of driver distraction on driving performance



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Objective

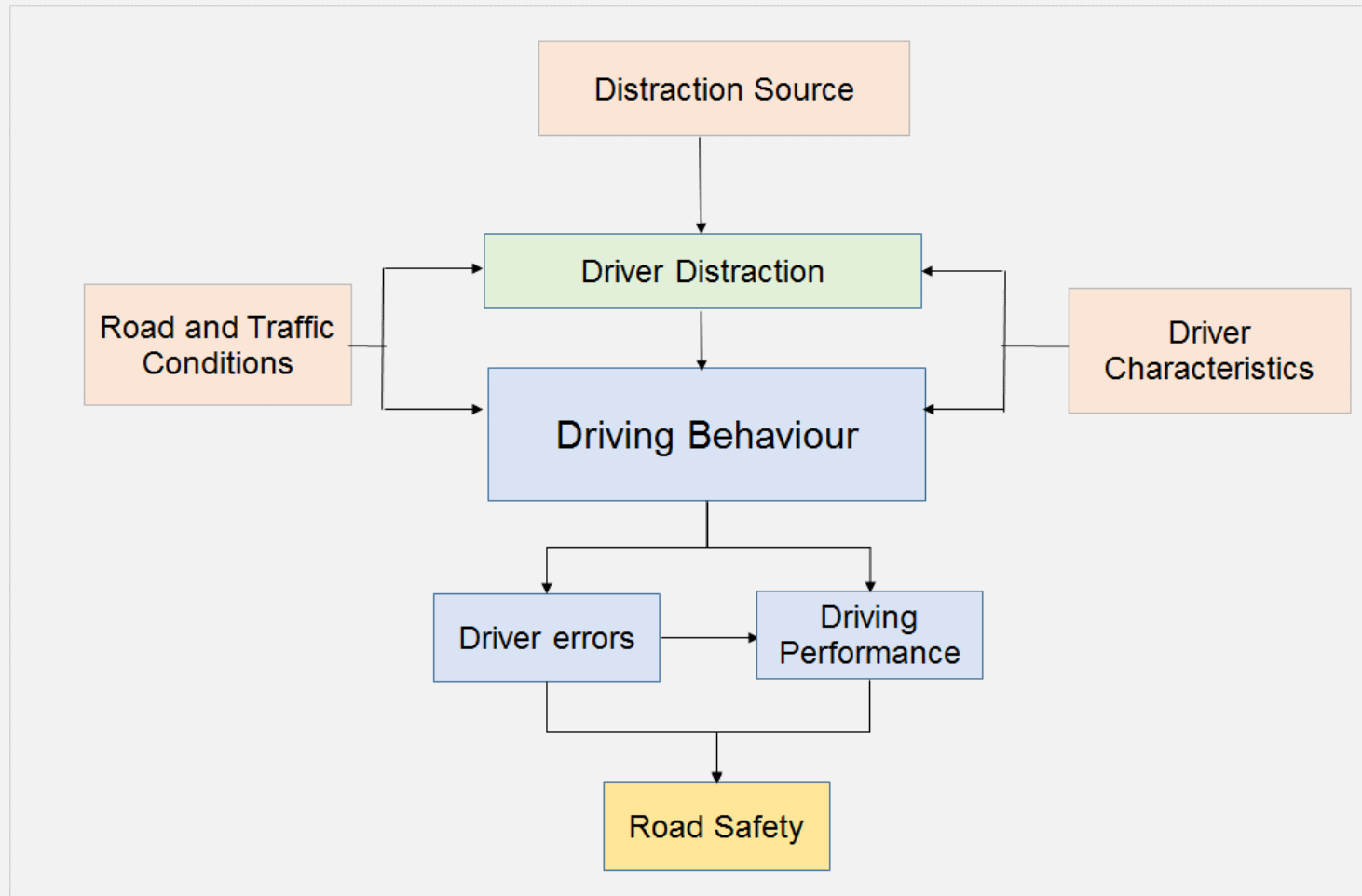
To estimate the effect of distraction, driver as well as road and traffic characteristics directly on driving performance

Methodological steps

1. Conceptual framework for the analysis of driver distraction
2. Methodological review regarding driving performance measures and statistical analysis techniques
3. Development of an innovative statistical analysis methodology
4. Application of a Structural Equation Model



The methodological framework of causes and impacts of **driver distraction** is the following:



Two targeted literature reviews took place in order to investigate:

- the key **driving performance measures** examined in driver distraction research
- the **statistical analyses** implemented in the scientific field of driver distraction

Authors	year	Driving-related Outcomes								Statistical Analyses				
		speed	lane position	reaction time	perception / situation	headway	accident probability	eye glance	acceleration / deceleration	Descriptive statistics	One way ANOVA	Two way ANOVA	Repeated measures ANOVA	Latent analysis
1 Laberge et.al	2004	•	•											
2 Drews et.al	2008	•	•											
3 Charlton	2009	•												
4 Yannis et.al	2011	•	•	•										
5 Hunton andRose	2005													
6 Horbery et al	2006	•												
7 Reed-Jones et	2008	•												
8 Yannis et al	2011	•	•	•										
9 Rakauskas et al	2004	•	•											
10 Kass et al	2007													
11 Bruyas et al	2009													
12 Reimer et al	2010	•			•									
13 Schlehofer et al	2010								•					
14 Ma and Kaber	2005	•	•			•								
15 Beeder and Kas	2006	•	•	•										
16 McKnight and Mc	1993				•									
17 White et al	2010													
18 Maciej et al	2011													
19 Noy et al	2004	•												
20 Donmez et al	2006													
21 Donmez et al	2008	•	•			•		•	•					
22 Liang et al	2010		•		•									
23 Fofanova et al	2011	•												
24 Muhrer et al	2011	•												
25 Metz et al	2011													
26 Kaber et al	2012													
27 Zhang et al	2012	•												
28 Hatfield et al	2008	•	•		•			•						
29 Chisholm et al	2008		•		•									
30 Garay-Vega et al	2010								•					
31 Young et al	2012	•	•											
32 Hughes et al	2012	•	•											
33 Jamson et al	2005													
34 Donmez et al	2007	•							•					
35 Reyes et al	2008			•					•					
36 Jamson et al	2010	•	•											
37 Benedetto et al	2011			•										
38 Birrell et al	2011	•				•			•					
39 Terry et al	2008			•		•								
40 Young et al	2009		•											
41 Bendak et al	2010	•												
42 Edquist et al	2011		•											
43 Rakauskas et al	2008								•					
44 Young et al	2008	•	•											
45 Harrison et al	2011	•												



- Driver distraction is a **multidimensional phenomenon** which means that no single driving performance measure can capture all effects of distraction
- The selection of the specific measures should be guided by the nature of the task examined as well as the specific **research questions**
- **More than half** of the examined studies perform repeated measures regression models
- **Latent model** analysis and especially structural equation models have never been implemented in the scientific field of driver distraction.

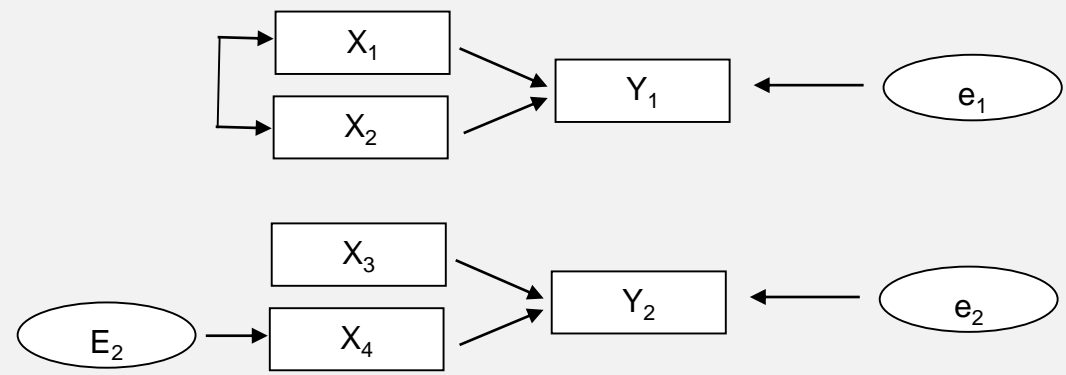
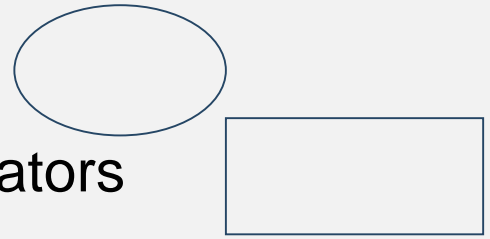


- Structural Equation Modeling is a very general, powerful **multivariate analysis** technique that includes several analysis methods
- SEM involves the evaluation of two models:
- **Measurement Model**
 - The part of the model that relates indicators to latent factors
 - The measurement model is the factor analytic part of SEM
- **Path model**
 - This is the part of the model that relates variable or factors to one another (prediction)
 - If no factors are in the model then only path model exists



Theoretical background – path diagram

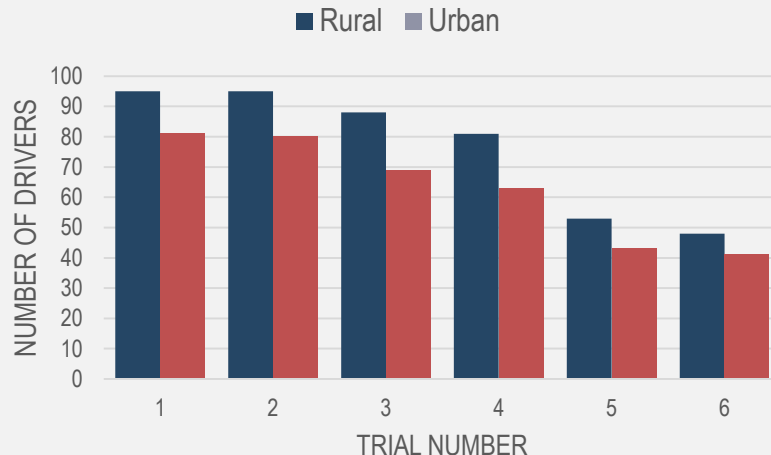
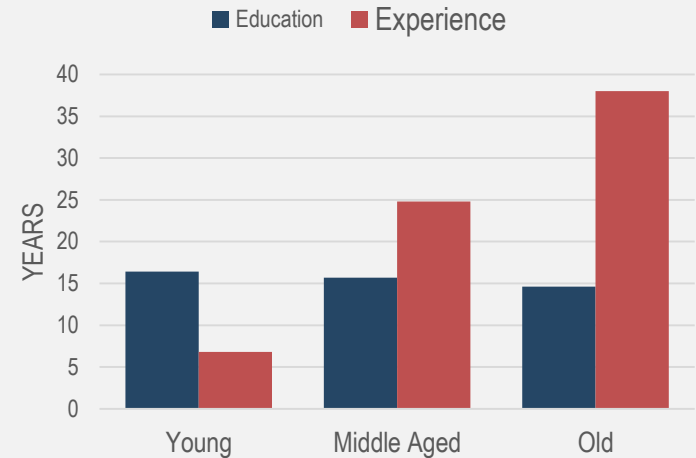
- Latent variables, factors, constructs
- Observed variables, measures, indicators
- Single-headed arrow \rightarrow
 - This is prediction
 - Regression Coefficient or factor loading
- Double headed arrow \leftrightarrow
 - This is correlation
- Missing Paths
 - Hypothesized absence of relationship
 - Can also set path to zero



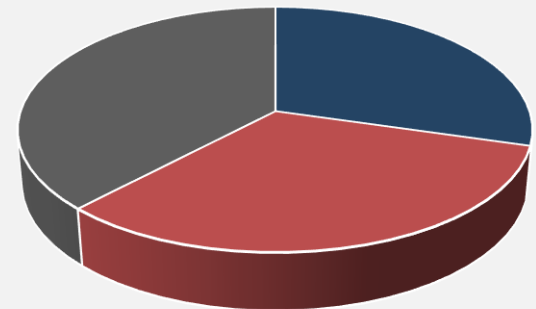
Sample characteristics

The sample of the analysis consists of **95 participants**

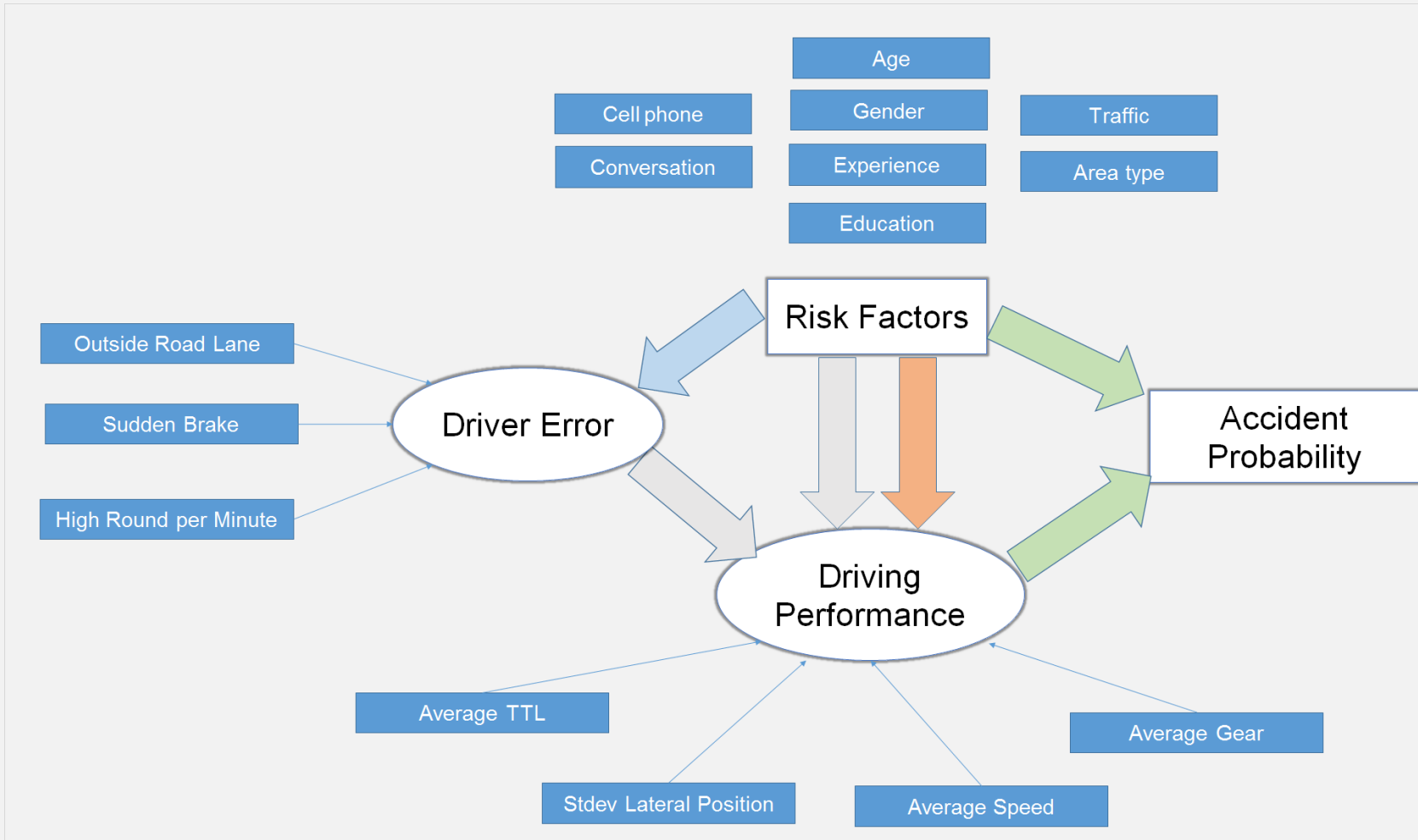
- 28 young drivers aged 18-34 years old
- 31 were middle aged drivers aged 35-54 years old
- 36 older driver aged 55-75 years old



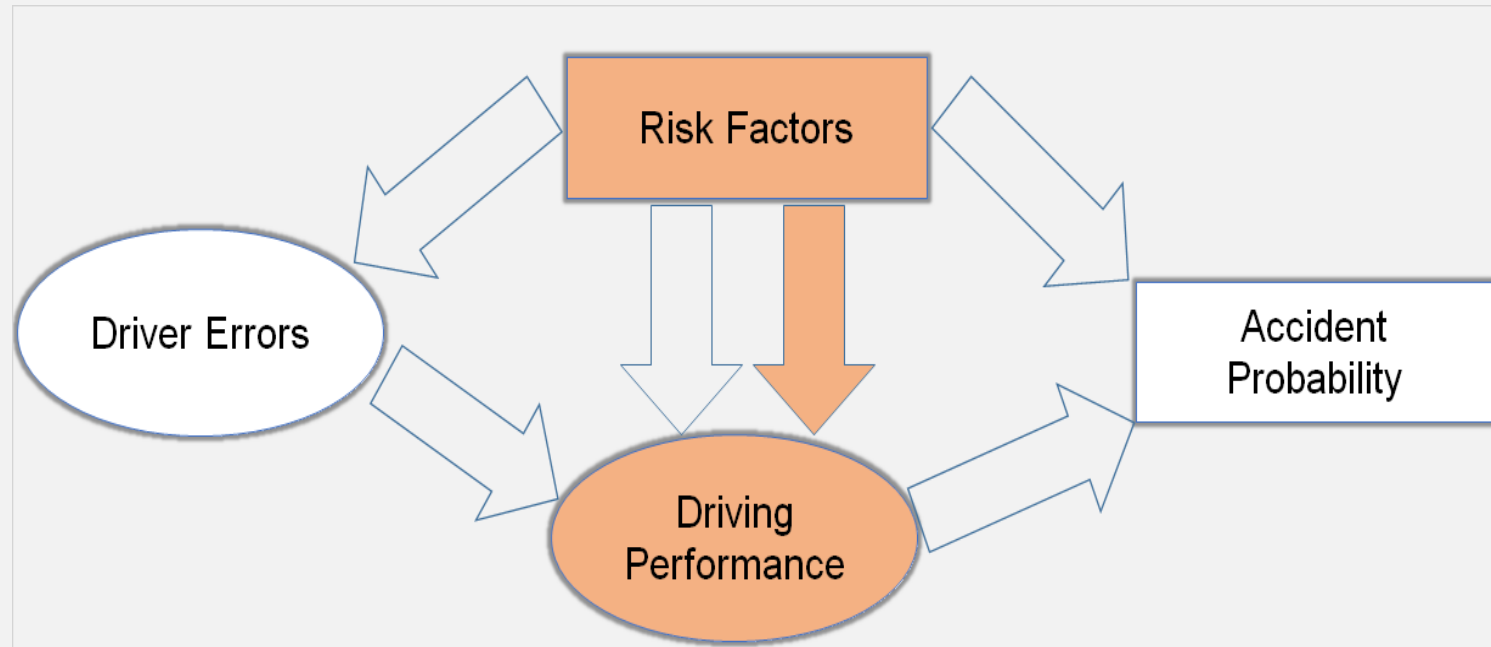
■ Young ■ Middle Aged ■ Old



Latent analysis overview



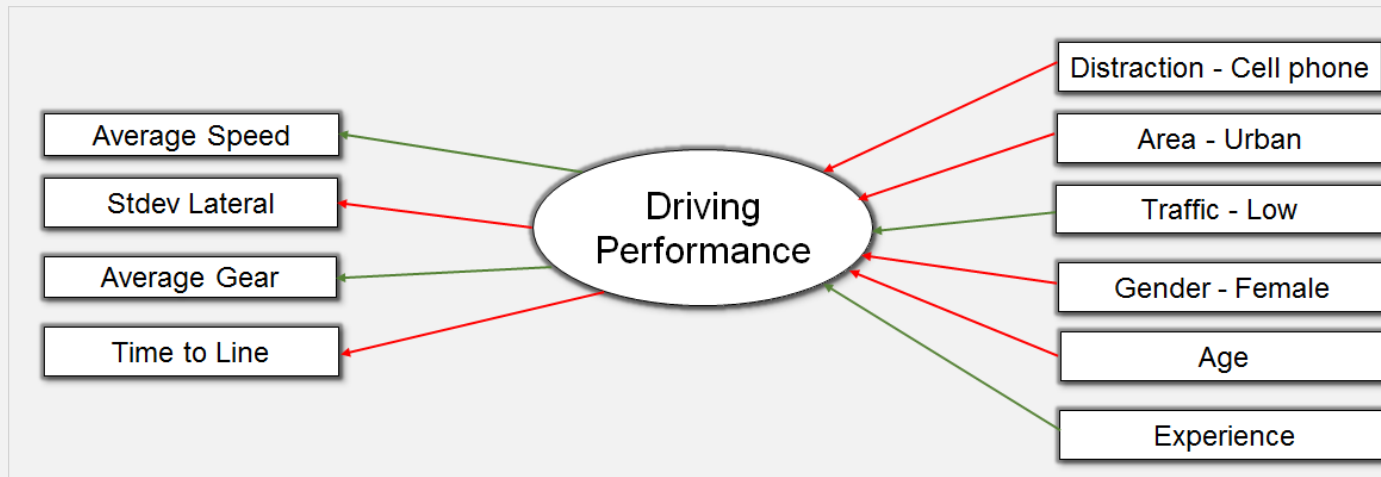
- The latent variable reflects the underlying **driving performance** and the objective is the quantification of the impact of distraction, driver characteristics as well as road and traffic environment on driving performance



SEM on driving performance (2/3)

Latent Variable	Est.	Std.err	t value.	P(> z)
Driving Performance				
Average Speed	1,000	-	-	-
Stdev Lateral Position	-0,085	0,004	-23,909	0.000
Average Gear	0,048	0,002	21,887	0.000
Time to Line Crossing	-0,109	0,005	-19,972	0.000
Regressions				
Driving Performance				
Distraction – Cell phone	-1,099	0,342	-3,213	0.001
Area – Urban	-15,596	0,467	-33,410	0.000
Traffic – Low	1,123	0,285	3,943	0.000
Gender – Female	-1,154	0,303	-3,802	0.000
Age	-0,155	0,027	-5,755	0.000
Experience	0,083	0,032	2,630	0.009
Summary statistics				
Minimum Function Test	305,74			
Degrees of freedom	20			
Goodness of fit				
SRMR	0,065			
RMSEA	0,159			
CFI	0,879			
TLI	0,819			



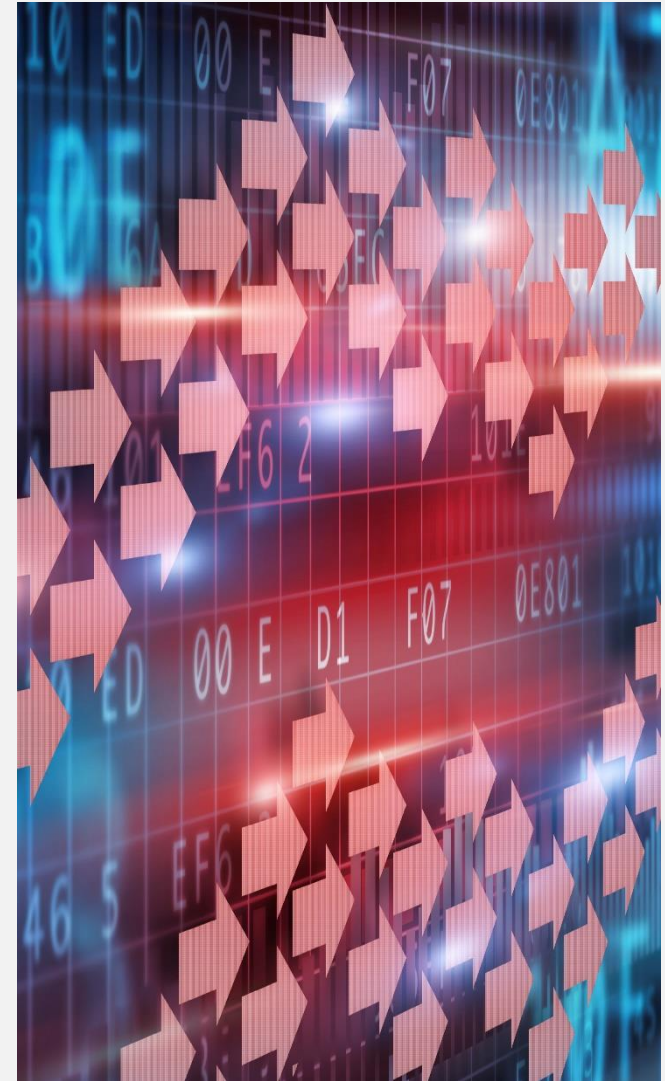


- The effect of cell phone on driving performance is negative
- Conversation with the passenger was not found to have a statistically significant effect
- Age, gender and experience have a significant impact on the model
- In urban areas driving performance was negatively affected

- **Latent analysis** through structural equation models is implemented for the first time in the field of driving performance and traffic safety
- The present analysis allowed an important scientific step forward from piecemeal analyses to a **sound combined analysis** of the interrelationship between risk factors, driving performance, driver error and accident probability
- A latent variable was created reflecting the underlying **driving performance** of the participants



- Results regarding the effect of **driver distraction** indicate the different effect on driving performance between cell phone use and conversation with the passenger
- **Driver characteristics** play the most crucial role in driving performance (Gender, Age, experience)
- Driving performance is worst in urban areas and high traffic conditions probably due to the complex **driving environment**





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