Evaluation of Factors Influencing the Usage of Child Car Seats for Nursery School Travel

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- Child passengers of motorized vehicles are exposed to a significant risk of crash-related injuries and fatalities [1].
- In Greece, the fatality rate of child passengers accounts for **55% of deaths** from known causes in the age group [2].
- One effective measure towards reducing child-related death and the severity of the injuries is the child restraint systems (CRS) use in vehicles.
- In the case of Greece, **the CRS compliance rates are relatively low** [3], as an observational study revealed that only 57% of drivers use a child restraint [4].



Introduction - Child Car Seats



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Introduction - CRS & Booster Seat Use

- Various factors may influence the use/misuse of the CRS in vehicles, e.g., the parent's knowledge of road safety and the impact of CRS on children's safety [5].
- The frequency of CRS usage is linked to the *driver's socioeconomic status (SES) and family size* [6].
- Parental hazard perceptions associated with trip types may influence the CRS usage, i.e., parents may identify certain trip types to be safer and thus, change the usual pattern of restraint use [7].





- School travel research has shown childcare and child chauffeuring as household activities that lead to a higher probability of commuting during peak hours [8].
- The **environmental factors** (e.g., distance to the school) or **personal factors** (e.g., work-related issues of parents) can affect the parents' travel choices and school travel behaviors [9].
- The *built environment characteristics* may be **less influential** than the *attitudes and psychosocial parameters* when the distance to the school is shorter [10].
- Children traveling by vehicle to school **are less likely** to be restrained than those traveling for other purposes [11].



- This study aims to **identify the factors linked with the child's car seat usage** for the daily **trip to nursery school**.
- This paper examines whether the factors affecting CRS and booster seat use in other studies worldwide also apply in **Athens, Greece**, and whether there are area-specific factors.
- Specific attention is given to **socioeconomic factors** to determine road safety behavior and car seat use.
- The identified parameters can be practical **to drive policies for the increased use of the CRS**.



Data Collection – Target Groups

- Parents having at least one child **attending the municipality nursery school**.
- The target age group was defined as **children between nine months to five years old**.

The following main elements were specified to examine through the collected data:

- > The family travel patterns
- > The trip characteristics of nursery schools
- > The child-parent interactions
- > The traffic safety climate
- > The family structure and SES



Data Collection – Questionnaire Design

- Three main sections were allocated to the questions regarding:
 - Travel to and from nursery schools
 - Child-parent interactions and traffic safety
 - Parent demographics (including SES information)
- In Addition, the questionnaire comprised **a general section** where parents provided information about:
 - > The number of children in the family
 - Children demographic data
 - > The children's nursery schools



- The selected municipalities have different socioeconomic characteristics.
- These areas have differences regarding the built environment and the road network types.



Fig. 1. The occupational structure of Athens. Source: [12]





Methodology – Recruitment

- The survey was disseminated among a total of 24 participating schools.
- The distribution and collection of the questionnaires took place in **2014**.
- There was **no financial incentive** for participation in the study.
- The complete and usable data were collected for **734 children** attending the nursery schools.





- Most children attending the municipality nursery schools were between **3 and 5 years old**.
- This age group is particularly interesting as many children graduate from forward-facing CRS to booster seats.



Fig. 2. Demographic characteristics of parents and respondents' children.



Methodology – Overview of the Data

The income distribution and percentage of parents follow the expected pattern.



Fig. 3. Data of respondents (parents) in each area.



Methodology – Overview of the Data



Fig. 4. Statistics of key variables extracted from the collected data.



Model Estimation & Results – GLM

- Initially, a generalized linear model (GLM) was formulated to capture the degree of child car seat use.
- The GLM allows building a linear relationship between the response (Y: degree of child car seat use) and predictors (e.g., $x_1, x_2, ..., x_i$), even though their underlying relationship is not linear.

$$Y = \alpha + \beta_1 x_1 + \dots + \beta_i x_i$$

• The *parameters influencing the usage of child car seats* were extracted from the questionnaire and participants' responses.



GLM estimation results:

Parameter	Estimated value	t-value
Intercept	0.169	1.411*
Pedestrian path length/area	2.464	3.644
Motorway length/area	1.509	2.429
Driver gender: male/female	0.075	1.945*
No. of children in car >2	-0.207	-3.245
Child gender dummy: female	-0.076	-2.292
Child age	-0.044	-2.084
Father tertiary education dummy	0.058	1.612*
Family size dummy: couple with one child	0.083	2.098
Use of driver seat belt: frequently	0.499	8.227
Use of driver seat belt: always	0.598	9.311
Parent involved in traffic crashes dummy	0.060	1.797*
Null deviance	91.93	(512 d.o.f)
Residual deviance	68.778	(501 d.o.f)
AIC	451.02	

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Note: * Insignificant at the 95% confidence interval





Model Estimation & Results - SEM

- In the next step, a structural equation modeling (SEM) approach was applied to approximate the safety perception of the participants and quantify it as a latent variable.
- In this research, the latent variable 'traffic safety climate' was constructed by four indicators:
 - ➤ Father's tertiary education,
 - ➢ High use of driver seat belt as a binary dummy variable
 - > The stated perception of the parents regarding their children's safety using the current transport characteristics,
 - \succ The (un)safety perception of the parents regarding the route for commuting on foot.



SEM estimation results:

	Estimate	Std. Err.
Latent variables		
Traffic safety climate	=~	
Father tertiary education dummy	1	
Use of driver seat belt: frequently or always	2.248	2.699
Safety level of children commute	2.446	2.536
Unsafe traffic to walk dummy	-0.802	-1.889
Regression		
Use of child car seat	~	
Traffic safety climate	2.903	2.733
Pedestrian path length/area	2.573	3.984
Motorway length/area	1.674	2.829
Child gender dummy: female	-0.064	-1.940
Child age	-0.048	-2.255
Driver gender: male and female	0.082	2.120
Family size dummy: couple with one child	0.103	2.610
Measures of Goodness of fit	Value	
RMSEA	0.059	
SRMR	0.039	
CFI	0.75	



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Model Estimation & Results - SEM

Path diagram for the estimated SEM:



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Limitations & Recommendations

- In such surveys, participants are more likely to be female, married, and have higher annual incomes [5].
- There are **differences between self-reported data and observational data**, regarding CRS use.
- Self-selection bias in the study is likely to have resulted in **the overrepresentation of more compliant parents**.
- The **proper use of CRS** was not within the scope of the study.
- The study took place in Athens during **the national economic crisis**, there is an additional interest in further exploring the effect of the crisis on the use of CRS systems.



- The study aims to understand the parameters that influence the use of car seats for the daily trip to nursery school.
- The research presents a methodological approach for **quantifying factors influencing the use of child car seats**.
- The concept of traffic safety culture is explicitly modeled using a latent variable and used as an explanatory variable in a SEM that captures the factors affecting child car seat use.
- The results obtained from these models can be used to **drive policy decisions** quantitatively.



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