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Modelling children’s mobility and school commuting: a review and key challenges for further research

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Abstract

Problem statement

Children’s mobility and school travelling are relatively underdeveloped in transport research, especially when compared with commuting to work. Despite it is often argued that a profound analysis of school-travel patterns has the potential to generate many important insights that may impact transport-system policy and management, the modelling of children mobility, is still in an early stage of development and children are often only considered as constraints to adults’ mobility. In this paper, we argue that innovative modelling frameworks that were recently developed in the field of transportation could be adapted and applied to the mobility of children in order to develop both novel scientific insights and inform the development of policies aiming at increasing active and independent mobility of children, in a broader vision of sustainability.

Research objectives

First, a synthesis of research about the determinants of school commuting and active/independent mobility of children is presented to better understand the specificities of children’s mobility and the factors to integrate in modelling frameworks. Then, a comprehensive state-of-the art of transportation modelling frameworks is provided, with a specific emphasis on safety modelling. Consequently, the knowledge with regard to route choice modelling is recapitalized. Next, the most important findings in literature with respect to the information provision of active transport itineraries are indicated. Finally, guidelines and key challenges to address in future research relating to the modelling of children’s mobility are proposed.

Determinants

Research on child and youth mobility has mainly focused on (i) the declining use of active commuting (cycling and walking), (ii) children’s independent mobility (the opportunity for children to move freely in the environment without an accompanying adult), as well as (iii) the increasing prevalence of physical inactivity and obesity among children and youth. These research studies have particularly examined correlations between personal, family, social and environmental factors and children’s active/independent commuting to and from school, mainly focusing on health and obesity. The main conclusions of these studies are that the likelihood of walking or cycling to school decreases as travel distance increases

Transport modelling frameworks

Activity-based travel demand frameworks provide an adequate behavioral basis for school transport, especially in the context of evidence suggesting that children are often accompanied by caregiver(s). Activity-based models imply a shift from aggregate to disaggregate micro-simulation models. When embedded in an agent-based framework, the spatial-temporal accuracy can be embedded in a natural way. The use of time as the integrating framework at both individual and household level reassures intra-person integrity. After all, the forecasted multi-dimensional activity-travel sequences are both consistent and feasible within the space–time constraints of the individual and temporal, spatial and institutional constraints set by the environment. Intra-household integrity is achieved by coordinating individual daily activity–travel patterns at the household level, considering task and resource allocation, joint activities and joint travel. These intra-households constraints are critical in the

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determination whether a family will conduct a parent-child joint trip. The activity patterns of household members reflect intra-household interdependencies, one of which is parent-child mutuality.

Route choice modelling

The importance of route choice modelling has been well recognized in both fields of safety and capacity assessment of road facilities. To ensure that route choice models reflect well reality, the key determinants should be incorporated in the modelling frameworks. With regard to pedestrian route choice, it should be taken into account that pedestrians move considerably more slowly than vehicles, and therefore they are more aware of and sensitive to their surroundings. Accordingly, numerous features in the physical and social environment, such as building design, signage, and streetscape affect route choice. Furthermore, various infrastructural (e.g. pavement, pedestrian crossover, landmarks and waypoints), safety-related (e.g. traffic safety, congestion, presence of school crossing guard), socio-demographic (e.g. age, gender, ethnicity), and trip and route related (e.g. travel distance, scenery, number of turns) significantly influence route choice. With respect to cycling route choice it should be noted that bicycling routes are typically longer than the shortest possible route, and that various attributes are significantly different. The following factors account for these differences: presence of dedicated cycling infrastructure (bicycle lanes and pathways), physical characteristics (e.g. hilliness, pavement condition, and street configuration), aesthetical aspects (embedment in green and aquatic areas), safety aspects (e.g. functional class of the road), land-use (e.g. residential density and land-use mix).

Information provision

With respect to the information provision, one should use a geographical information system-based planner that incorporates variables that influence choices to travel by bicycle in selecting the preferred routing. The use of geographic information systems as a framework for analysis is prevalent in many studies in this area. Examples include calibrating environmental measures related to active transport including accessibility and walkability; estimating probable routes taken or energy expended; and finally, assessing pollutant exposure along routes. In terms of the visualization of the information, providing roads and crime rate-related information in 3-D, can invoke shifts in route choices.

Research perspectives

The following perspectives to advance the research on school commuting have been identified. The first research perspective concerns the scope of the agents that is envisaged by agent-based travel demand modelling frameworks. Traditionally, these modelling frameworks only represent the behavior of adults, whereas the agents' behavior of children is at most incorporated as a constraint to the action range of the adults. The agents' behavior of children should thus be explicitly tackled by treating them as full-scale agents in the model. By explicitly taking into account household interactions, the natural hierarchy in household decision making processes will be maintained in the agent-based travel demand modelling framework. A second perspective concerns the scope of variables that should be incorporated in the modelling framework in order to surpasses the scope and extent of traditional approaches, especially by adopting a high level of multidimensionality, that allows to enhance the behavioral realism of the modelling framework. Furthermore, the explicit incorporation of information provided by end-users of the itineraries is important to develop to ensure that the modelling framework excels in terms of validation to real life case studies. The third research innovation concerns the incorporation of various route choice mechanisms in a single modelling framework. The vast of majority of current transportation modelling frameworks focuses only on car and public transport route choices, whereas choices with respect to pedestrian and cycling routes are mainly investigated from a separate perspective. Finally, developing comprehensive analyses of school-travel patterns embedded in a framework that takes into account the substitution effects between school travel and other travel episodes of children will generate many important insights that may impact transport-system policy and management.