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Spatial issues revisited: The role of shared transportation modes☆

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ABSTRACT

This paper investigates the mechanisms through which shared modes help reduce major spatial issues related to mobility in urban areas, namely road congestion and rivalry of use for parking spaces. In this article, I use gross space consumption estimations for different transportation modes as a basis and integrate the service provided by the modes. Results indicate that in terms of time-space consumption and service provided shared modes are intermediate modes between private modes and mass transit. Therefore, shared modes constitute key components of a comprehensive and efficient transportation system in urban areas. The present analysis provides guidance for local transportation authorities.

1. Introduction

"Transport is characterized by certain specific features. The first of these specific characteristics is the role of space."(McFadden, 2011). Spatial issues related to mobility refer to the space consumed by transportation modes. According to estimations provided by mapping softwares such as BDCarto and Corine Land Cover, space allocated to mobility amounts to 5–25% of French city centers (CERTU, 2007) and represents 1.2% of the territory, among which 92% is allocated to private road transportation (CERTU, 1998).

In France, as in most developed and developing countries, space allocated to mobility is rapidly increasing over time. This evolution is closely associated with the development of settlement areas, which are urbanized spaces. Fig. 1 shows the share of artificial space at NUTS 3 level[1] in France in 2006 and the upward trend towards urbanization. Several factors have been contributing to land artificialization. First, population increase has forced existing settlement areas to be extended. Second, the per capita housing floor area has been extended (from 31 m^2 in 1984 to 40 m^2 in 2006 in France) (INSEE, 2006). Third, and probably most importantly as regards the research question of this article, the growth in space results from the development of road facilities and car use. The latter requires more per capita space than alternative transportation modes. As such, it facilitates the change from compact development to urban sprawl. In addition, factors contributing to the increase in car use (income growth, car ownership, demographics effects) also contribute to urban sprawl (Bonnel and Pochet, 2002). Mangin (2004) reveals that in the last 40 years in France, settlement space has been multiplied by a factor 4 to 5, while density has been halved.

Conversely, the urban structure (functional mix, density, transportation system) influences the total settlement space consumption, and thus the space consumed by traffic facilities. Large floor area and low densities generate additional land artificialization, but also more car-dependent commuting patterns, which in turn requires large space consumptions. In Fig. 2, Apel (2000) draws a correlation between transportation modes and the per person space consumed for mobility. Compared with cities where people mainly use bicycles or public transportation, car-dependent cities allocate a larger share of urbanized space to mobility, and the per person space consumed is more than six times larger.

The creation of artificial land has a cost for society. First, the joint increase in both car use and artificial surfaces rises environmental externalities, in particular air pollution due to car use, and loss of biodiversity, ecosystem fragmentation and lower resilience due to irreversibility of land use changes. Second, the opportunity cost of the space dedicated to mobility is particularly relevant when a change in land use occurs (Anas et al., 1997). The opportunity cost corresponds to the value of the forgone best alternative, i.e., the value of a unit of surface allocated to another use. According to the authors, taking into account

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[1] NUTS stands for Nomenclature of Territorial Units for Statistics.

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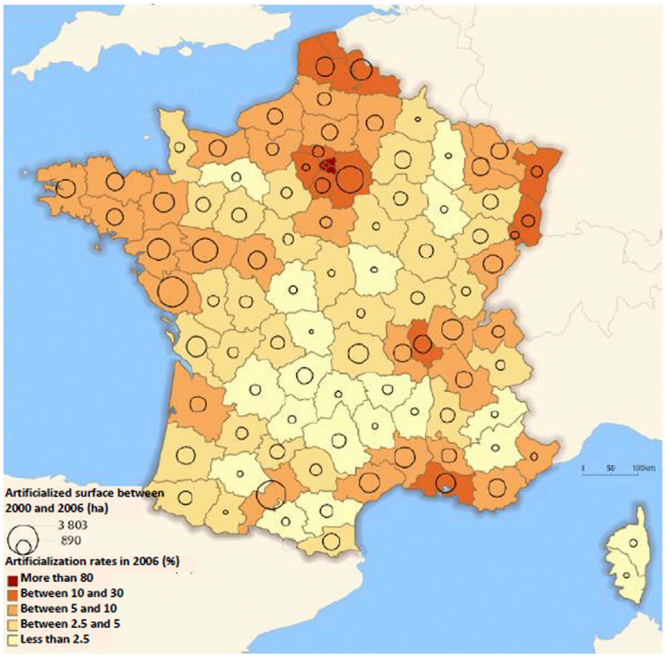

Fig. 1. Land artificialization in France, an upward trend.
Source: UE-SOeS, CORINE Land Cover, 2006.

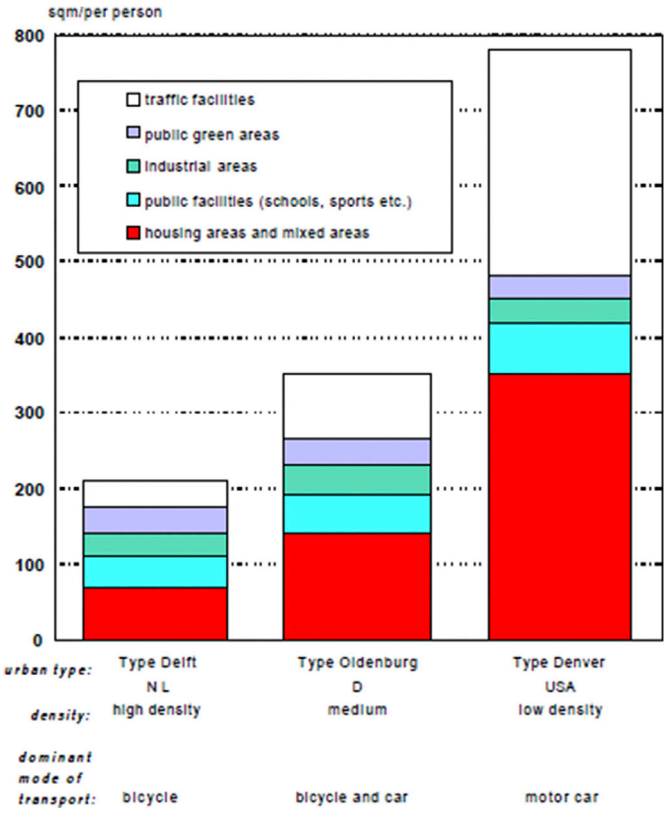

Fig. 2. Relation between settlement space and transportation modes.
Source: Apel, 2000.

the opportunity cost of space dedicated to mobility would increase by half the cost of infrastructures. Overlooking these costs results in an excess supply of space-consuming transportation infrastructures at the expense of space-saving ones or of management strategies of existing infrastructures (Woudsma et al., 2006). This is especially true in urban areas since the opportunity cost of space is high and the land value is affected by the accessibility of its localization (Lee, 1992; Vickrey, 1997).

Spatial issues related to mobility are exacerbated in urban areas. Road congestion and rivalry of use for parking spaces are major issues regularly at the heart of local transportation policies. They have been dealt with through various approaches. Alternative modes, such as mass transit, bicycles and walking, have been fostered as a solution against road congestion and rivalry of use. However, private cars remain the leading transportation mode in most developed countries.[2] For instance, in France, 65% of trips and 83% of total distances are made by car. Walking trips account for 22% of all trips, and public transportation for 8% - these two modes are on a decreasing trend.

This article explores one possible reason for the relatively limited success of modal shift policies, namely the fact that transportation modes are assumed to offer similar services, origin-to-destination trips. More precisely, I propose to overcome this limit investigating the services provided to the user by transportation modes. Spatial issues are then analyzed in the light of the space consumed by modes per unit of service provided. I question the modes to be fostered when spatial issues are taken into account, and when the size of the city (or its structure, in particular population density) is considered. Shared modes, namely vehicle-sharing and self-service vehicles, are considered and their role in a complex transportation system is highlighted. The contribution of this paper is twofold. First, I explore the mechanisms at work for shared modes to help reduce road congestion and rivalry of use for parking spaces, compared to private modes. Second, I highlight the fact that services provided to users vary depending on the transportation mode. Therefore, gross comparisons in terms of time-space consumptions between modes (Marchand, 1993) are oversimplifying. I suggest to put these gross estimations into perspective accounting for additional services provided by transportation modes. Refined measures of time-space consumptions are presented. When the service provided is accounted for, the gap between mass transit and private cars is reduced. More importantly, the results show that car-sharing and self-service cars constitute relevant alternatives to private cars in terms of time-space consumption per unit of service provided.

The analysis provides guidelines for decision-makers since it clearly indicates orders of magnitude for time-space consumptions from various transportation modes. The occupancy rate of vehicles, and thus tacitly population density, is also considered in the analysis. It allows different policies for high-density and lower-density areas to be suggested. The study reveals that shared modes help reduce spatial issues related to mobility in urban areas and as such constitute key components of a comprehensive and efficient transportation system. Furthermore, I mention the limits of the present organization for shared modes. More precisely, the need for increased institutionalization is highlighted for car-sharing, and network expansion required for self-service vehicles. Finally, spatial issues are discussed jointly with environmental issues, namely air pollution, since they have common origins and similar remedies. Therefore, considering the space allocated to different transportation modes will reinforce local policies supporting low-carbon modes.

The article is organized as follows. Section 2 provides a brief theoretical background on road congestion and parking issues, and investigates the role of shared modes as regards the aforementioned issues. Then, in Section 3, the concept of time-space consumption from

[2] There exist some exceptions: in Paris and its suburbs, France, private cars are used for around 43% of trips and for 12% of trips when only the city of Paris is considered (CGDD, 2010). Similarly, other large cities in Europe and Asia, more rarely in North America, rely mainly on alternative modes and exhibit low modal shares for private cars: 21% in Barcelona, 28% in Vienna, 38% in London, 12% in Tokyo, 20% in Shanghai, and 43% in Singapore (Singapore Land Transport Authority Academy, 2014).