Empirical Evidence on the Role of Bikesharing in Reducing Car Use

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Extended Abstract

Background

Taking advantage of new technological improvements and the promotion of cycling as an alternative to car use in urban areas, in the last decade, bike sharing systems (BSS) have seen an explosive growth especially in China, Europe and North America (Demaio, 2009; Shaheen, Guzman and Zhang, 2010; Fishman, Washington and Haworth, 2013; Fishman, 2016; Shaheen and Chan, 2016).

There are several reported benefits associated with BSS, ranging from reduced congestion and CO₂ emissions, public health improvements, increased mobility options, increased accessibility, normalization and promotion of cycling, complement to public transport (PT), local economies enhancement, reductions on travel times, leisure and social equity, etc. (Demaio, 2009; Shaheen, Guzman and Zhang, 2010; Fishman, Washington and Haworth, 2013; Fishman, 2016). However, it seems that a significant part of those benefits is dependent on the bikesharing’s ability of inducing modal shifts from motorized modes of transport, especially car. Environmental benefits, which are mainly related to reductions on CO₂ and other air pollutants, are dependent on bikesharing substituting trips from motorized modes of transport. While the main health benefit from bikesharing, which is the increase on physical activity levels (Rojas-Rueda et al., 2011; Rabl and de Nazelle, 2012; Woodcock et al., 2014; Otero, Nieuwenhuijsen and Rojas-Rueda, 2018), is also intrinsically connected with the BSS’s ability in inducing modal shifts from sedentary modes of transport (Rojas-Rueda et al., 2011; Fishman, Washington and Haworth, 2014b; Otero, Nieuwenhuijsen and Rojas-Rueda, 2018).

Research Aim and Methods

Thus, the aim of this study is to explore the ability of bikesharing in inducing modal shifts, specifically from car users. As such, the study synthetizes the available evidence on the modal shifts dynamics reported from bikesharing systems across the world, assessing the expected outcomes on travel behaviour of implementing a BSS. Furthermore, the study also explores the explanatory factors for those reported modal shifts and which could further enhance the bikesharing’s capability of reducing car use.

To accomplish this, the study looked at peer-reviewed literature through consulting the scientific databases of Scopus and Web of Science, complementing those findings with analyses of grey literature namely government reports from the UK and USA.

The study then identifies the current research gaps where further research is needed, pointing to future directions that could be followed to answer those shortfalls. Consequently, this research aims at providing further clarify on the BSS ability and potential in effectively reducing car use.
Main Findings

The available literature on modal shifts towards BSS indicates that most substituted trips derive from sustainable modes of transport, mainly PT and walking, with only a small part shifting from car use. From systems in Europe (Midgley, 2011; Fishman, Washington and Haworth, 2014a; Murphy and Usher, 2015), to China (Yang et al., 2015), Australia (Fishman, Washington and Haworth, 2014a) and North America (Buck et al., 2013; Fuller et al., 2013; Fishman, Washington and Haworth, 2014a), all studies systematically report modest car replacement rates. However, there is a high variability on the range of car substitution rates, from systems only capturing a small percentage of car users like London with only 2% (Transport for London, 2011; Fishman, Washington and Haworth, 2014a) to systems with much higher modal shifts around 20% like the BSS of Dublin (Murphy and Usher, 2015), Minnesota or Brisbane (Fishman, Washington and Haworth, 2014a). (Fishman, Washington and Haworth, 2014a) suggests that more car dependent cities lead to higher car replacing rates, Cities such as Minnesota and Brisbane that have car modal shares above 70% also reported high car replacement rates (respectively 19% and 21%), whereas cities like London with much less car modal share (36%) reported residual car modal shifts (2%) (Fishman, Washington and Haworth, 2014a).

This reduction in car use, even if small, should not be disregarded as modal shift from car use has been shown to be particularly difficult, with most available initiatives aimed at it revealing modest results (Ogilvie et al., 2004). Moreover, most of these systems are concentrated in the city centres, which tend to have lower car modal shares (Murphy and Usher, 2015), therefore a possible expansion to more peripheral areas could lead to better outcomes. In addition, new innovations such as dockless systems and e-bikes could have potential different impacts on modal shifts due to their different features comparing with the traditional systems (more accessibility and more range, for instance) (Campbell et al., 2016), but have not been properly investigated. Furthermore, the mobility patterns of BSS users are complex, with evidence revealing that even the most frequent users only use bikesharing on a small part of their travel routines (Buck et al., 2013; Fishman, 2016; Raux, Zoubir and Geyik, 2017; Wielinski, Trépanier and Morency, 2017).

The main method employed by the literature to assess bikesharing’s influence on travel behaviour and modal shift is the deployment of surveys (Buck et al., 2013; Fuller et al., 2013; Shaheen, Martin and Cohen, 2013; Fishman, Washington and Haworth, 2014a; Murphy and Usher, 2015). However, to fully assess the impact of bikesharing, the surveys need to include not only all BSS users (which includes registered and casual members), but also non-users as the introduction of these systems could also influence broad travel behaviours at the city level (Fuller et al., 2013) by, for instance, normalizing cycling use (Goodman, Green and Woodcock, 2014). Furthermore, both the frequency of the trips being replaced as well as usage patterns among users are of paramount importance to fully quantify the environmental and health gains of bikesharing (Ricci, 2015). Due to the vast amount of resources needed to deploy such city level surveys, some scholars complement survey data with the BSS’s datasets as most systems provide data on trips’ Origin-Destination and duration, allowing more accurate results (Fishman, Washington and Haworth, 2014a). Other techniques such as modelling (Li et al., 2015; Campbell et al., 2016; Lu et al., 2018) and proxies (Pelechrinis, Li and Qian, 2016; Wang and Zhou, 2017; Hamilton and Wichman, 2018) are also being employed and can provide additional insights on travel behaviour, although they are more useful as supportive tools as they do not provide actual results on modal shift, but only indirect evidence (either by estimations or by inferences).

Notwithstanding the modest evidence on effective modal shift from car to cycling among BSS users, the literature reveals several bikesharing’s characteristics that could induce further reductions on car use. Factors such as users regarding bikesharing as the most convenient (Fishman, Washington and Haworth, 2013; Ricci, 2015; Fishman, 2016) and fastest mode of transport (Transport for London, 2011; bikeplus, 2017a, 2017b; Comouk, 2018), combined with
travel data revealing bikesharing to be as fast or faster than cars in dense urban areas (Jensen et al., 2010; Faghih-Imani et al., 2017), suggest that BSS can be competitive and attractive to car users. Furthermore, the possible combination of bikesharing with public transport could provide synergetic relations between the two modes, reinforcing their competitiveness against car. From increasing PT’s catchment areas, reducing overcrowding in saturated services, as well as reducing overall travel times, bikesharing could therefore provide additional support for PT use (Jäppinen, Toivonen and Salonen, 2013; Shaheen, Martin and Cohen, 2013; Martin and Shaheen, 2014).

Finally, with environmental and health concerns gaining relevance among the population (Fishman et al., 2014; Nikitas, Wallgren and Rexfelt, 2015), appealing to bikesharing’s sustainability, could also lead to an increase in usage, with (Ma et al., 2018) suggesting awareness campaigns contrasting the BSS advantages with private cars as a possible path for inducing modal shift. Nevertheless, further research is needed to analyse the strength of these and other factors that could potentiate higher car substitution rates.

Thus, bikesharing can potentially induce modal shifts from car in two ways. Firstly, by directly substituting car trips by cycling trips in short distances, and in addition to bikesharing trips, the BSS could also induce shifts to private bikes through normalizing cycling use (Goodman, Green and Woodcock, 2014). Secondly, by complementing public transport networks, either by acting as a first and last mile connector or by alleviating congested systems, potentially attracting new users (Martin and Shaheen, 2014; Campbell and Brakewood, 2017).

Subsequently, and bearing in mind the significant benefits of reducing car use, quantifying the modal shift dynamics of bikesharing including its citywide impacts, alongside with increasing the BSS’s performance on inducing modal shift from car users are amongst the main challenges for researchers, as well as for operators and public authorities.

**Future Research**
Based on these findings, as future work the authors will study the bikesharing’s ability of replacing car trips, assessing modal shifts dynamics of BSS in operation (including the new hybrid bikesharing system implemented in Lisbon, entitled Gira, and constituted by electric and conventional shared bikes). With those results, the authors will then test for causal relationships between the observed modal shifts and possible BSS’s advantages against car use, namely the bikesharing’s convenience (translated in reduction of travel times), its ability in increasing the catchment areas of public transport, as well as environmental and health concerns. Preliminary results of these analyses will also be presented.

**References**


