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Bike sharing: A review of evidence on impacts and processes of implementation and operation

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ABSTRACT

Despite the popularity of bike sharing, there is a lack of evidence on existing schemes and whether they achieved their objectives. This paper is concerned with identifying and critically interpreting the available evidence on bike sharing to date, on both impacts and processes of implementation and operation. The existing evidence suggests that bike sharing can increase cycling levels but needs complementary pro-cycling measures and wider support to sustainable urban mobility to thrive. Whilst predominantly enabling commuting, bike sharing allows users to undertake other key economic, social and leisure activities. Benefits include improved health, increased transport choice and convenience, reduced travel times and costs, and improved travel experience. These benefits are unequally distributed, since users are typically male, younger and in more advantaged socio-economic positions than average. There is no evidence that bike sharing significantly reduces traffic congestion, carbon emissions and pollution. From a process perspective, bike sharing can be delivered through multiple governance models. A key challenge to operation is network rebalancing, while facilitating factors include partnership working and inclusive scheme promotion. The paper suggests directions for future research and concludes that high-quality monitoring impact/process data, systematically and consistently collected, as well as innovative and inclusive evaluation methods are needed.

1. Introduction

This paper is concerned with identifying and critically interpreting the available evidence on bike sharing to date, on both impacts and processes of implementation and operation. The aim is twofold. First, the paper seeks to determine evidence gaps and limitations that need further investigation. Secondly, by drawing on the evidence review, it attempts to identify the enabling conditions for the occurrence and transferability of beneficial impacts and positive implementation and operation processes. By critically reviewing and reflecting on the available evidence on both impacts and processes, rather than on impacts alone as other existing reviews have done, this paper advances the current body of knowledge on bike sharing and contributes to the ongoing academic and policy discourse on this increasingly popular cycling measure.

Bike sharing involves the provision of a pool of bicycles across a network of strategically positioned 'bike sharing stations', typically distributed in an urban area, which can be accessed by different types of users (i.e., registered members or occasional/casual users) for short-term rentals allowing point-to-point journeys. Bike sharing is often named in different ways according to the geographical area of application, e.g., 'cycle hire' in the UK, 'public bicycle' in China and 'bicycle sharing' in North America (ITDP, 2013).

Bike sharing schemes (BSSs) have existed for almost fifty years but only in the last decade have they significantly grown in prevalence and popularity to include over 800 cities across the world and a global fleet exceeding 900,000 bicycles (Meddin, 2015). In their historical development BSSs have progressed through so-called 'generations' (see Beroud & Anaya, 2012 and DeMaio, 2009 for a detailed historical analysis). Modern 3rd generation BSSs share a few key features (Anaya & Castro, 2012; ITDP, 2013; OBIS, 2011; TDG & PBIC, 2012):

- The bicycles can be checked-in and out through the use of a personal 'smart card' using radio-frequency identification (RFI) technology, or a 'key'. Most modern systems are largely automated in this respect;
- Each bike sharing station, i.e., the station where bikes can be checked in and out of their docking points, can be equipped with terminals, also termed 'kiosks', where users can get information on the scheme, view the local and overall station network map, communicate with customer service, and in some cases make the payment for use;
- Wireless communication technology, e.g., general packet radio service (GPRS), allows real-time monitoring of occupancy rates at each station. If the bicycles are equipped with global positioning system (GPS), their movement through the network can be monitored.
- BSSs incentivise short-term rental hence maximise the number of times each bicycle is used, by allowing users to have, typically, the first 30 min free of charge (within their specific subscription for which they are charged upfront) and then increasing the charges

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rather substantially after that period. In this sense bike sharing is very different from a bike rental service: the former is about using the shared bikes to make short-term point-to-point journeys, the latter involves the renting, and private use, of a bicycle for a given amount of time. Users are generally required to provide credit or debit card details, which serve both as a deposit, as well as payment for registration and usage fees.

According to policy documents and various grey and academic literatures, BSSs are expected to contribute to a number of different objectives, including:

- To reduce single occupancy car journeys and ease traffic congestion;
- To reduce CO_2 emissions and to improve air quality by reducing other pollutant emissions from motorised traffic;
- To improve public health and increase levels of physical activity;
- To increase cycling levels, and help normalise and promote cycling (for example, by removing barriers associated with bike ownership, e.g., concerns about theft and parking);
- To improve accessibility and support flexible mobility, through enhanced transport choices and opportunities for multi-modality and inter-modality (for example, by acting as a 'first' or 'last mile' solution in connection with public transport);
- To improve road safety, in particular for cyclists;
- To enhance the image and liveability of cities and to support local economies and tourism.

The review of evidence provided here sheds light on whether, and to what extent, the aforementioned effects of bike sharing have been assessed, and with what results. The rest of the paper is organised as follows. Section 2 provides a critical overview of the increasing number of information sources and growing body of knowledge about bike sharing, and explains the rationale for the evidence review on which the present paper is based. Sections 3 and 4 summarise the evidence on users, usage and impacts of bike sharing, and discuss the results' significance and limitations. Section 5 provides a summary of the evidence around managing the business of bike sharing from a process evaluation perspective, in particular in terms of drivers, barriers and lessons learnt. Section 6 concludes the paper by discussing how the evidence presented here can be helpful in enhancing and transferring positive results in terms of impacts and processes of implementations to other contexts, and identifies key areas that merit further investigation.

2. Sources of information and evidence on bike sharing: an overview

Reflecting the rapid growth of bike sharing especially in the past ten years, a number of very different sources of information and evidence about bike sharing have appeared. These include:

- Guidelines and manuals for bike sharing operation, such as the handbook developed by the EU-funded OBIS project (OBIS, 2011) and two planning guides to bike share implementation, one focused on the U.S. context and experience (TDG & PBIC, 2012), and the second on the global experience to date (ITDP, 2013). Other important analyses of existing systems include an overview of Spanish BSSs by Anaya and Castro (2012), in Spanish but with a short summary of recommendations in English; and an analysis of BSS implementation and operation governance with particular attention to French and Spanish schemes (Beroud & Anaya, 2012). Relevant platforms for sharing results and good practice also comprise international conferences such as the European Cyclists' Federation's Velocity conferences and the European Transport Conference series.
- Websites, comprising both those offering general information on bike sharing and those set up by BSS operators and/or projects, which sometimes include scheme-specific data on operational/financial performance and customers' profile and satisfaction. Well-known examples amongst the former category are: The Bike-sharing Blog,[1] Mobiped[2] and Suprageography[3] (in particular the Bike Sharing Map section) which keep track of all the BSSs across the globe and act as points of contact and reference for stakeholders involved in BSSs and, more broadly, anyone interested in this cycling measure. Amongst the BSS operators that make performance data and/or reports readily available in the public domain are: Capital Bikeshare,[4] Washington DC; Nice Ride Minnesota[5]; and Barclays Cycle Hire,[6] London. Other schemes may supply performance data and reports on request, including tender documents and contracts of operation.
- Reports and scholarly publications, including peer-reviewed journal articles, exploring one or more aspects and/or effects of bike sharing and focusing on one specific scheme or a range of schemes for which data are available. Most of these publications have appeared in the past five years, suggesting that this is still an emerging but potentially prolific area of research.

The review of evidence for this paper draws on a literature search aimed at identifying studies that met two requirements. First, these studies needed to provide some form of evaluation, assessment or appraisal of existing BSSs, involving the collection and/or generation of data on issues such as usage, impacts, and processes of implementation and operation. Second, the studies needed to be supported by well-explained and robust conceptual and methodological approaches.

The search was carried out by the author through a variety of scholarly databases and internet engines, and using a combination of keywords connected with bike sharing, evidence, impacts and evaluation (only documents in English were considered). Several considerations can be made in relation to the availability, relevance and significance of the range of the available evidence identified on this cycling measure.

First, it must be noted that although bike sharing has recently started to attract attention from commentators around the globe, including academic researchers, independent and peer-reviewed in-depth evaluations of existing schemes are not readily and publicly available. No single BSS (of a sufficient scale[7]) appears to have been fully and independently evaluated along an extensive range of impact and process dimensions (for an overview of different impact evaluation approaches, see Hills & Junge, 2010; for process evaluation, see Bloor & Wood, 2006). More frequently, the existing studies look at one particular aspect or a set of characteristics of one or more schemes, with different methodological approaches. As a result, the available evidence is somehow patchy and does not easily lend itself to comparative analysis. However, the increasing availability of usage/performance data such as origin–destination journeys and station occupancy, often through explicit 'open data' policies, has stimulated the growth of academic literature on BSSs and has the potential to enable better comparative assessment of schemes (O'Brien, Cheshire, & Batty, 2014).

Secondly, the evidence available on bike sharing does not generally offer a clear understanding of the specific objectives that a particular scheme had sought to achieve. This makes it difficult to assess whether, and to what extent, a scheme has been 'successful'. This is particularly relevant when interpreting the results of academic studies of specific BSSs, which often reflect the authors' own research objectives and line of academic inquiry, rather than provide an evaluation of the scheme's success against its original objectives.

[1] http://bike-sharing.blogspot.co.uk/.
[2] http://www.mobiped.com/vls_public-bicycles_bike-sharing_en.html.
[3] http://oobrien.com/bikesharemap/.
[4] https://www.capitalbikeshare.com/.
[5] https://www.niceridemn.org/.
[6] http://www.tfl.gov.uk/info-for/open-data-users/our-feeds. It must be noted that during the writing of this paper there was a change of sponsorship to the London scheme, which is now called 'Santander Cycles'.
[7] The author contributed to an in-depth impact and process evaluation of a bike sharing demonstration scheme in Bath, U.K., co-funded by the CIVITAS Plus Renaissance project, 2008–2012. The evaluation report is to be published by the European Commission.