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An analysis of bicycle travel speed and disturbances on off-street and on-street facilities

Silvia Bernardi[a*], Federico Rupi[a]

[a]*University of Bologna, Viale Risorgimento 2, Bologna 40136, Italy*

Abstract

For transport planners and land use practitioners, many are the qualitative guidelines provided regarding the location and quality of separated bicycle facilities. When separated bicycle facilities are poorly designed or placed in less than optimum locations, their intended use is less than anticipated. An interesting element in the evaluation of bicycle facilities that have received less attention revolve around the disturbance due to the presence of other users on cyclists way. Other users consists in cyclists and pedestrians for off-street bicycle facilities, and motorized vehicles on the roadway. This study focuses on quantifying the role of disturbances encountered on separated cycling facilities, compared to disturbances from cycling mixed with traffic, assuming cyclists speed as a performance measure and analysing the cyclist speed reductions from different types of disturbances. Collecting data on three segments of Bologna's cycling network (Italy), we measured the frequency, type, and speed reduction attributed to different types of disturbances. The data collected shows that pedestrian disturbances on the separated facility are highly frequent but associated with moderate speed reductions, while disturbances in the mixed traffic environment can be relatively fewer but have more severe speed reductions. Moreover, our results suggest that design elements of separated facilities can play a role in affecting the frequency, type, and severity of disturbances. This work helps lay the foundation for outlining the existing relationship between bicycle travel speeds and non stationary disturbances.

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Keywords: cycling; bicycle speed; separated bicycle facilities; pedestrians

* Corresponding author. Tel.: +39-051-2093343.
E-mail address: silvia.bernardi9@unibo.it

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1. Overview

Depending on the context in which they operate, transport planners and land use practitioners can refer to various manuals and guidelines that classify and describe the geometric and functional features of separated bicycle facilities, and evaluate their applicability.(e.g., CROW 2007, NACTO 2012, AASHTO 2012).

In research, several efforts have focused on evaluating the effectiveness of such facilities in terms of cyclist safety and user satisfaction. Using stated preference surveys (Abraham et al. 2002, Sener et al. 2009, Stinson and Bhat 2005, Krizek and Roland 2005, Tilahun et al. 2007), revealed preference surveys (Broach et al. 2012, Menghini et Al. 2010, Hood et Al. 2011), and accident data (Lusk et al. 2011, 2013), the research base generally points at how separated facilities improve perceived safety, have some actual safety benefits, and provide a more pleasurable cycling experience.

Cyclists consider a variety of factors when choosing particular segments of routes. For many European cities, actually, the main cyclist's choice is between the use of an existing separated facility or the use of the roadway, mixing with vehicular traffic. Moreover, not every street can integrate an off-street exclusive bicycle facility, for reasons of space availability or for its use patterns. But even when a widespread cycling network is present, sometimes the design of separated bicycling facilities is poor and the impact and use of facilities is less than intended (Aultman-Hall et al. 1998, Sener et al. 2009, Tilahun et al. 2007).

There are several factors that possibly explain the decision of cycling on the roadway instead than on a bicycle facility. Socio-demographics and cyclist experience is important; more experienced cyclists often prefer to ride in the road. Knowing specific elements about the environment is also important; where facilities stop and start or where traffic volumes are low, it is often easier for cyclists to simply ride in the road (Sener et al. 2009). However key elements in designing separated bicycle facilities that have received less attention revolve around disturbances—specific obstacles in the facility that affect user satisfaction.

Disturbances may be stationary (e.g., intersections, utility poles, bollards) or non-stationary (e.g., other cyclists or pedestrians). For example, intersections that interrupt separated bicycle facilities have shown to be particularly vexing, both in terms of safety and in terms of speed. For non-stationary disturbances, little work has focused on the role of pedestrians mixing with cyclists on separated or dedicated facilities. Pedestrians slow cyclists travel speed, thereby influencing the overall utility of the choice for the cyclists who might use the facility.

The most relevant literature in this respect refers to "pedestrian hindrances." Knowing volumes and speeds of pedestrians and cyclists, Botma (1995) initially proposed a model to evaluate the number of events such as passing another cyclist or a pedestrian (or meeting, when opposite direction volumes are present) on a given section of an off-street bicycle facility. This method was later adopted and applied to different contexts (Allen et al 1998, Virkler et al. 1998, Kiyota et al 2000, Green et al. 2003, Highway Capacity Manual 2010) to demonstrate how hindrances affect functional characteristics of bicycle facilities. In these works, the frequency of passing and meeting events provide a measure of how much a cyclist is disturbed in its trip and is used to determine the level of service of a bicycle network's link.

What remains unexamined is how pedestrian presence influence cycling behaviour in different contexts. This research therefore aims to quantify the impact of disturbances along different types of cycling facilities, especially focusing on the role of pedestrians. Such impact is discussed both in terms of cyclists speed reduction and disturbance frequency. We systematically analyzed three transportation segments in Bologna (Italy) and examined cycling travel speeds along a separated bicycle facility and the adjacent roadway to specifically measure speed reductions and ascertain differences with and on-street alternative. Our results contribute to the literature by quantifying cyclist speed reductions due to pedestrians, bicycles (on separated facilities) and motorized traffic (in mixed traffic facilities). In Section 2 we describe the context of our research, the features of the three segments and the data collection process. The following Section 3 details our results, in terms of cyclists speed and disturbances effects. These results are discussed in Section 4, focusing on implications and future research needs.