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## Sharing is (s)caring? Interactions between buses and bicyclists on bus lanes shared with bicyclists



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### ABSTRACT

This paper presents the results of an observation study of interactions between bicyclists and buses on shared bus lanes. The aim of the paper is to analyse bicyclists' safety on bus lanes shared with bicyclists. Straight sections of two bus lanes shared with bicyclists in Belgium are observed. All interactions between bicyclists and buses over two full weeks are recorded and analysed. Additionally, the lateral position and riding speed of bicyclists that are in interaction with buses are compared with the behaviour of bicyclists that are not in interaction with buses. One of the observed bus lanes is in line with road design guidelines in a number of countries that state that a sufficiently narrow bus lane (<3.5 m) is hypothesised to be safer than a somewhat wider bus lane; the other observed bus lane is deemed too wide according to these guidelines and is hypothesised to lead to close overtaking manoeuvres.

The results show that close interactions between bicyclists and buses are relatively frequent on both types of analysed bus lanes. Close overtaking manoeuvres (a bus overtakes a bicyclist with a lateral distance less than 1 m) as well as close bicycle-following situations (a bus drives behind a bicyclist with a time gap less than 2 s) are quite common on both analysed bus lanes. The analyses could not confirm the hypothesis that a sufficiently narrow bus lane is safer than a wider bus lane. On the contrary, close interactions seem even slightly more common on the narrower bus lane. Slightly more close overtaking manoeuvres take place on the narrower bus lane, but the difference is not statistically significant. Additionally, more bicycle-following situations take place on the narrower bus lane because overtaking is more difficult. The results show that buses often maintain a close time gap in these situations. The overtaking speed of the buses is, however, significantly higher on the wider bus lane compared to the narrower one.

Moreover, the presence of a bus has an influence on the behaviour of bicyclists. Bicyclists who get overtaken by a bus ride more closely to the edge of the road than bicyclists who are not in interaction with a bus. While the road design guidelines assume that bicyclists take up a width of one meter from the edge on bus lanes shared with bicyclists, the observations show that bicyclists take up much less space while being overtaken. The presence

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of a bus does not have a significant influence on the standard deviation of the lateral position of the bicyclist. On the narrower bus lane, some findings suggest that bicyclists who are involved in an interaction with a bus ride faster than bicyclists who are not involved in an interaction with a bus.

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## 1. Introduction

Available space is often limited and may not allow for the provision of separate facilities for all road users. This is especially the case in urban areas. Allowing bicyclists to make use of bus lanes may be considered as a compromise to balance the needs of all road users. However, the safety effects of allowing bicyclists to make use of bus lanes have scarcely been investigated. Whether or not bicyclists should be allowed to make use of bus lanes is therefore a subject of debate for policy makers and traffic engineers on an international level (Agrawal, Goldman, & Hannaford, 2012).

This study makes use of semi-automated video observation software with the aim of analysing bicyclists' safety on bus lanes shared with bicyclists. A straight section of two bus lanes shared with bicyclists in Belgium have been selected for detailed analysis, and two full weeks of video footage have been analysed for each bus lane. Interactions between bicyclists and buses are analysed using surrogate safety indicators (overtaking proximity, time gap and minimum time-to-collision), and the behaviour of bicyclists who are in interaction with buses is compared with the behaviour of bicyclists who are not in interaction with buses.

## 2. Background

### 2.1. Bus lane safety and bus–bicycle accidents

While there is a significant body of literature assessing the impact of bus lanes on traffic flow (for buses as well as other traffic) and on bus punctuality, the impact of bus lanes on traffic safety has largely been overlooked (Tse, Hung, & Sumalee, 2014). A meta-analysis of the effects of bus lanes on traffic safety suggests that bus lanes generally lead to an increase in the number of injury accidents (Elvik, Høy, Vaa, & Sørensen, 2009). It is, however, unclear what types of accidents increase due to the presence of bus lanes. Moreover, only one study was found that specifically investigated the impact of bus lanes on bicycle accidents. The study found indications that an increase in bicycle accidents may take place after the implementation of a bus lane (Devenport, 1987).

A study of seven major cities in different countries shows that some allow bicyclists to share bus lanes, while others do not (Agrawal et al., 2012). This indicates that there is some disagreement on whether or not it is desirable to allow bicyclists to share bus lanes. No studies have been found that specifically examine the safety of bicyclists when sharing bus lanes.

Buses and bicycles are at the opposite ends of the spectrum in terms of size, mass and manoeuvrability; while bicycles are small, light and agile, buses are large, heavy and rigid (Austroads, 2005). Therefore, safety conflicts may arise when buses and bicycles are sharing the same space on the roadway (Baumann, Brennan, & Zeibots, 2012). An Australian study (Austroads, 2005), focusing on bus–bicycle accidents on all roads, shows that the majority (55%) of accidents between buses and bicycles takes place at intersections. For non-intersection accidents, the most frequent type of accidents are angular accidents (60% of all non-intersection accidents). Angular accidents are accidents in which at least one of the vehicles is hit at the side in the accident. These non-intersection angular accidents are mostly related to lateral movements of buses on the roadway, such as overtaking. The study also points out that of all the types of bus–bicycle accidents, angular crashes and rear-end crashes have the highest probability of resulting in a fatal outcome.

### 2.2. Subjective safety of bus–bicycle interactions

Baumann et al. (2012) performed a survey with bus drivers and bicyclists regarding bus–bicycle interactions. They concluded that the overtaking of a bicycle by a bus is considered an uncomfortable manoeuvre for both parties; 59% of bicyclists and 68% of bus drivers indicated that they feel uncomfortable while interacting with each other. This finding is indirectly confirmed by a stated preference survey on bicycle infrastructure preferences. Caulfield, Brick, and McCarthy (2012) find that bicyclists are less likely to choose routes that have a bus lane with shared use with bicyclists. The only type of infrastructure that is considered as undesirable as the shared-use bus lane is mixed traffic (i.e. no bicycle facilities present). Research also suggests that close-passing motor vehicles can create a subjective experience of being unsafe, which is a disincentive to travel by bicycle (Guthrie, Davies, & Gardner, 2001; Parkin, Wardman, & Page, 2007).

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