Accident Analysis and Prevention xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

Can cycling safety be improved by opening *all* unidirectional cycle paths for cycle traffic in both directions? A theoretical examination of available literature and data

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ARTICLE INFO

Article history:
Received 8 December 2015
Received in revised form 13 May 2016
Accepted 18 May 2016
Available online xxx

Keywords:
Cycling
Cycling safety
Bidirectional cycle paths
Contra-flow cycling

ABSTRACT

Many studies have found bicycle-motor vehicle crashes to be more likely on bidirectional cycle paths than on unidirectional cycle paths because drivers do not expect cyclists riding at the right side of the road. In this paper we discuss the hypothesis that opening *all* unidirectional cycle paths for cycle traffic in both directions prevent this lack of expectancy and accordingly improves cycling safety. A new national standard requires careful consideration because a reversal is difficult once cyclists are used to their new freedom of route choice. We therefore explored the hypothesis using available data, research, and theories. The results show that of the length of cycle paths along distributor roads in the Netherlands, 72% is bidirectional. If drivers would become used to cyclists riding at the left side of the road, this result raises the question of why bidirectional cycle paths in the Netherlands still have a poor safety record compared to unidirectional cycle paths. Moreover, our exploration suggested that bidirectional cycle paths have additional safety problems. It increases the complexity of unsignalized intersections because drivers have to scan more directions in a short period of time. Moreover, there are some indications that the likelihood of frontal crashes between cyclists increases. We reject the hypothesis that opening all unidirectional cycle paths for cycle traffic in both directions will improve cycle safety. We recommend more attention for mitigating measures given the widespread application of bidirectional cycle paths in the Netherlands.

1. Introduction

Over recent decades, the Netherlands has established a reputation as one of the safest countries in which to cycle, on a per distance travelled basis (Schepers et al., 2015). Although unrivalled in both cycling participation and safety, bicycle use on bidirectional, segregated paths has been shown to carry an elevated risk when compared to cycling on unidirectional paths. This paper sets out to determine whether the safety of cycling in the Netherlands would be improved by adopting a policy of making all cycle paths bidirectional. Thereby, this study focuses on a system level while previous research, described in the following, was done at a location level such as a crossing.

Bicyclists travelling against the direction of traffic on unidirectional cycle paths are 4–6 times as likely to sustain bicycle-motor vehicle crashes at intersections as compared to those travelling with the direction of traffic (Schepers and Voorham, 2010; Wachtel and Lewiston, 1994). Even though legal and indicated to drivers by traffic signs, the likelihood of bicycle-motor vehicle crashes at intersections with bidirectional cycle paths is found to be higher than at intersections with unidirectional paths (Schepers et al., 2011; Vandenbulcke et al., 2014) (see Fig. 1). These elevated risks have been explained by drivers' expectations and related visual scanning strategies at intersections. Drivers entering a distributor road from a minor road have difficulties in detecting cyclists from the right (in case of right-hand driving) (Räsänen and Summala, 1998), see the sketch in Fig. 2. Summala et al. (Summala et al., 1996) found that drivers turning right scanned the right leg of the T-intersection less frequently and later than those turning left. Their explanation is that drivers turning right focus their attention on cars from the left because those coming from the right pose no threat to them.

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http://dx.doi.org/10.1016/j.aap.2016.05.018
0001-4575/

Fig. 1. Unsignalized intersection with bidirectional cycle paths at both sides of the distributor road.

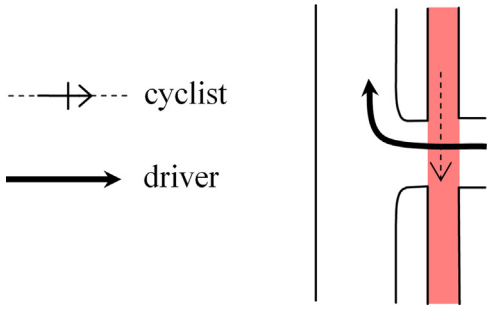

Fig. 2. Sketch of an encounter between a driver entering a distributor road from a minor road and a cyclist coming from the right (riding on the left side of the road).

Van Haeften (2010) found similar results in Groningen which has a bicycle modal share as high as 50%, one of the highest in the world (Ligtermoet, 2009).

Because of the elevated risks at intersections, the Dutch Design Manual for Bicycle Traffic (CROW, 2007) cautions against application of bidirectional bicycle paths unless it strongly reduces cyclists' need to cross distributor roads and avoid potential large shares of illegal contraflow cycling. Most bicycle-motor vehicle crashes in urban areas in the Netherlands occur at unsignalised intersections of distributor roads (Schepers and Voorham, 2010). Per passing cyclist, the number of bicycle-motor vehicle crashes is about two times as high while crossing a distributor road compared to while crossing a minor road at an unsignalised intersection. However, since the number of minor roads is high, there are about two times as many bicycle-motor vehicle crashes while crossing a minor road as compared to while crossing a distributor road (Schepers et al., 2011; Schepers and Voorham, 2010). Because of the high frequency of the former crash type and its increased likelihood at bidirectional cycle paths, a net safety improvement through bidirectional cycle paths is expected to be rare (CROW, 2007).

The lack of expectancy of cyclists from the right for cars entering from a minor road seems to be the main problem of bidirectional cycle paths (Summala et al., 1996). It has been suggested that this expectancy problem is related to a lack of uniformity. Some paths are unidirectional and others are bidirectional. It can therefore be hypothesized that cycling safety can be improved by allowing contraflow cycling on *all* unidirectional cycle paths. A few Dutch cities like Breda already decided to convert unidirectional cycle paths into bidirectional bicycle paths (Gemeente Breda, 2007).

Uniform allowance of contraflow cycling on *all* unidirectional cycle paths in a number sufficiently large jurisdictions (i.e. provinces in the Netherlands) with other jurisdictions serving as control areas would be ideal from a research perspective to inform a before-after study. However, such research and or new national standard containing this new policy requires careful consideration because a reversal is difficult once cyclists are used to their new freedom of route choice. This paper explores the hypothesis that cycling safety can be improved by converting all unidirectional cycle paths into bidirectional cycle paths in the Netherlands using available data, research, and theories. We did so by considering the development of illegal contraflow cycling on unidirectional cycle paths (Section 2), the presence of bidirectional and unidirectional cycle paths (Section 3), a discussion of alternative theories for the aforementioned expectancy theory to judge the safety of bidirectional cycle paths (Section 4), and consideration of other crash types that may be affected next to the aforementioned bicycle-motor vehicle crashes at intersections (Section 5). The results are summarised and discussed in Section 6.

2. Is contraflow cycling increasing on unidirectional cycle paths?

Currently available data suggest that contraflow cycling on unidirectional paths is substantial but constant. This is important because increased contraflow cycling could potentially cause safety levels at unidirectional cycle paths to decrease to a level comparable to bidirectional paths because of the high risk of cyclists riding against the direction of traffic on unidirectional paths (Schepers and Voorham, 2010; Wachtel and Lewiston, 1994). The earliest study we found about contra-flow cycling was conducted in 1994 by Van Minnen and Braimaister (1994). Of the 1314 cyclists counted at unidirectional cycle paths around roundabouts, 4% were cycling against the direction of traffic. A count of 23,652 cyclists completed in 2014 yielded 2% (Methorst and Schepers, 2015). Three locations in the study by Methorst and Schepers (2015) were also examined using conflict observations in 2012 (De Goede et al., 2013). The share at these locations remained stable at 3%.

The share of contraflow varied between locations and over time, e.g. between 2% and 13% in the study by Van Minnen and Braimaister (1994) and between 0% and 9% at locations reported by Methorst and Schepers (2015). The lowest share was found at the location with the highest volume of cyclists (over 2000 cyclists per hour during the countings). Similarly, Methorst and Schepers (2015) found a share below 2% on weekdays and above 3% in the weekend (with countings at all locations taken together). High volumes of cyclists appear to correlate with reduced contra-flow cycling, probably due to less space remaining available.

3. To what degree are bidirectional cycle paths applied in the Netherlands?

The Dutch Cyclists' Union recently finalized an online route planner covering the whole country (Fietsersbond, 2014). Whether cycle paths are open for cycle traffic in one or two directions is essential information for route planning and is therefore recorded in the underlying database. Based on this database, Zeegers and Kamminga (2014) estimated that the Netherlands:

- Has some 15,900 km of bicycle paths along roads (standalone bicycle paths are excluded) of which 11,400 km (72%) are bidirectional paths
- The share of bidirectional bicycle paths amounts to 62% within city limits and 79% outside city limits
- Road sections (between intersections) of unidirectional cycle paths within city limits have an average length of 52 m versus 107 m for bidirectional cycle paths

Please cite this article in press as: Methorst, R., et al., Can cycling safety be improved by opening *all* unidirectional cycle paths for cycle traffic in both directions? A theoretical examination of available literature and data. Accid. Anal. Prev. (2016), http://dx.doi.org/10.1016/j.aap.2016.05.018