



Yielding behavior and traffic conflicts at cyclist crossing facilities on channelized right-turn lanes

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ABSTRACT

Channelized right-turn lanes (CRTLs) improve traffic flow efficiency, enabling right-turning drivers to bypass traffic lights at signalised intersections (for right-hand drive countries). Many CRTLs provide crossing facilities for pedestrians and cyclists. Previous studies examining the safety performance of CRTLs indicate that they increase overall safety levels but hint that safety issues regarding vulnerable road users exist. This study investigated these issues through site-based observations of yielding behavior and evaluated the effect of the priority rule on cyclists' safety in two CRTL designs. Four locations in Belgium were selected for video observations: two where the priority rule favoured cyclists and two where motorists had priority.

With regard to yielding, four types of crossing behavior were identified and defined. Independent of the priority rule, cyclists crossed the conflict zone first in most interactions without taking the initiative to cross first. Underlying reasons for motorists willingly giving away their right-of-way could not be determined, but possible courtesy or fear of inflicting injuries at vulnerable road users might be at hand. A safety evaluation was performed using two traffic conflict indicators (TTC_{min} and the TA value). High correlations between the two indicators were found ($r^2 > 0.83$), but no conclusions about the safest priority rule for cyclists could be drawn. The results hinted, however, that locations with motorist priority and cyclists crossings from right to left (from the driver's point of view) yields the highest proportion of safety critical events.

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1. Introduction

Several right-turn treatments exist to improve traffic flow efficiency at signalised intersections. Examples include exclusive right-turn lanes, right-turn-on-red rules and channelized right-turn lanes (CRTLs) (AASHTO, 2011). CRTLs offer drivers a more comfortable right-turn movement by allowing them to bypass traffic lights and stop only when it is really necessary. In many cases, CRTLs include crossing facilities for cyclists as well, but their design varies between intersections. In general, two types of cyclist crossings at CRTLs can be distinguished: one where cyclist crossings are located at the entrance and the exit of the CRTL and another where the cyclist crossing is located at the centre of the CRTL (Fig. 1).

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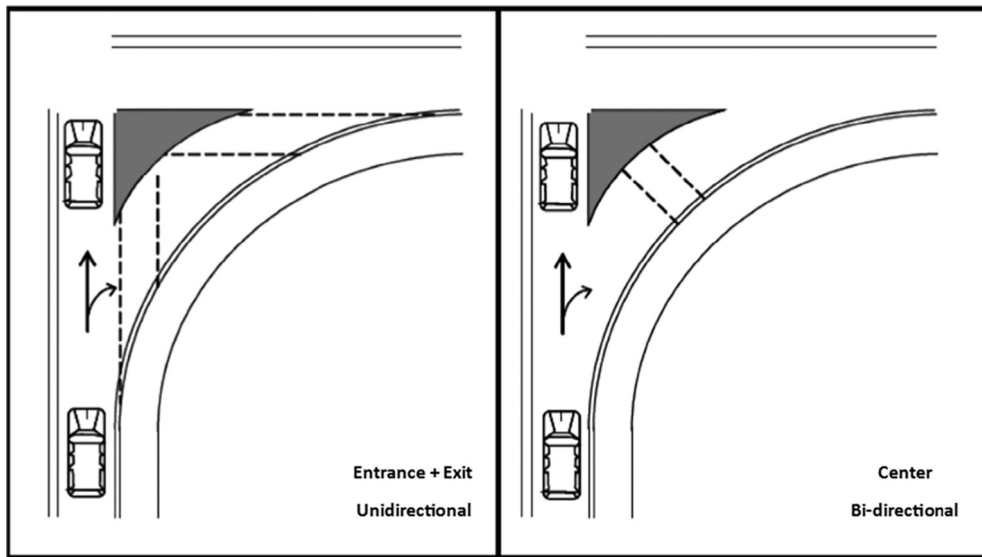


Fig. 1. The two configurations for accommodating vulnerable road users on CRTLs (modified from Potts et al., 2011).

The main difference between the two configurations is that when there are crossings at both the entrance and exit, these are usually unidirectional, while a crossing facility at the centre of the turning lane allows cyclists and mopeds to cross in both directions. CTRL design guidelines and regulations in Flanders are not clear as to which configuration should be used in which situations, and rules are lacking regarding how priority rules in centre-crossing designs should be applied by road designers. As a result, there is no uniformity in CTRL design and this creates varying, unclear and possibly unsafe situations for cyclists and motorists. To our knowledge, no international literature has investigated the influence of priority rules on yielding behavior and cyclists' safety at cyclist crossings at CRTLs. Therefore, and on request of the Flemish Road Agency, this study investigates the yielding process between drivers and cyclists and provides insights into the safety issues that occur at the centre-crossing design CTRL, including an evaluation of the effects of the priority ruling at hand.

Many transportation agencies perceive CRTLs to improve traffic safety levels (Potts, Bauer, Torbic, & Ringert, 2013), but quantitative data supporting this statement is limited. Most studies investigating the safety performance of CRTLs have focused on motorists and on the comparison of different right-turn treatments. For example, Dixon, Hibbard, and Nyman (1999) compared intersections with shared through lanes (one lane accommodating traffic both going straight and turning right) and right-turn lanes with and without raised islands in Georgia (USA) and found that the presence of traffic islands decreased the number of right-angle crashes. A similar study in Texas (USA) concluded that shared through lanes experienced fewer crashes than right-turn lanes (Fitzpatrick, Schneider, & Park, 2006). A Belgian study evaluated 1295 crashes at 87 signalised intersections and concluded that intersections with CRTLs have fewer accidents (Polders, Daniels, Hermans, Brijs, & Wets, 2015). However, an increase in the number of rear-end collisions was found; this was attributed to yielding behavior towards vulnerable road users and searching behavior for finding an appropriate gap to merge into the traffic stream. Autey, Sayed, and Zaki (2012) compared two types of CTRL designs in Canada and concluded, based on traffic conflict observations, that sharper turning angles at the convergence point may result in more potentially dangerous situations.

Although several studies suggest that conflicts between motorists and vulnerable road users may occur, scientific research focusing on cyclists' and pedestrians' safety issues at CRTLs is limited. Several researchers hinted that drivers focus mainly on motorists driving on the road that they are about to merge into rather than on the potential presence of pedestrians and cyclists (Potts et al., 2011; Potts et al., 2013; Fitzpatrick et al., 2006; Polders et al., 2015). In these cases, drivers may see approaching vulnerable road users but are unable to detect them, succumbing to the "looked-but-failed-to-see" error (Herslund and Jørgensen, 2003). Additional problems occur on bidirectional crossings, because drivers might not expect cyclists to arrive from their right-hand side. Potts et al. (2013) compared conventional right-turn lanes, shared through lanes and CRTLs and found that conventional right-turn lanes experienced 70–80% more pedestrian crashes; however, no differences were found between the other two right-turn treatment types. Sayed, Zaki, and Autey (2013) conducted a video observation study in Canada that investigated both motorists' and cyclists' safety and found that cyclists' safety was mostly threatened by motorists ignoring yield signs and blocking the cyclist crossing facility. However, no study could be found that specifically looked into the effect of different priority rules at cyclist crossing facilities at CRTLs. Therefore, this study further investigated cyclists' safety issues at these crossing facilities.

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