How to Avoid Collisions between Cyclists and Motorists in Urban Areas

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Fine Arts in Industrial Design

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5/8/2019
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Thesis Title
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Submitted in partial fulfillment of the requirements for the
degree of Master of Fine Arts
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How to Avoid Collisions between Cyclists and Motorists in Urban Areas

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Abstract

Using a bicycle as a means of transportation is becoming more common in cities. Protecting the safety of cyclists in complex urban environments is important.

This paper discuses user research, collisions analysis, and environment. Then, the article expounds by providing the different perspectives of cyclists and motorists. Analysing the accidents of bicycles, how to effectively avoid collisions will significantly solve the safety problems of cyclists. In terms of solutions, this paper considers theoretical methods and existing products available. It then recommends a visibility system and proposes a visibility system to enhance visibility and avoid unpredictable behaviour. The whole system makes cyclists conspicuous to reduce the collisions between cyclists and motorists.

Key Words:

Bicycle safety, Urban areas, Visibility system, Cyclists, Motorists

1. Introduction

Bicycles have a unique position in many modes of transportation. How to improve the safety of bikes that are most susceptible to all vehicles is the most critical issue. In recent years, urban bicycles' use has steadily risen, and more
and more people choose to use it for transportation, physical fitness, sightseeing, and environmental protection. The most significant safety hazard comes from the road because of the motor vehicle-bicycle conflict. Motor vehicles' mixed traffic conditions, and the same road is used by bicycles at the same time[1]. In every traffic accident, cyclists face more severe injuries than motorists. In 2015 in the United States, more than 1,000 cyclists failed, and there were nearly 467,000 bicycle-related wounds [2]. With these conflicts between cyclists and motor-vehicle drivers come property damage and disease burden, even death. Information from 2010 shows disastrous and non-fatal crash-related wounds to cyclists caused lifetime medical losses and productivity costs of $10 billion[3]. Therefore, how to improve the safety of bicycles driving on urban roads and avoid collisions is an urgent problem.

On the road, the cyclist is neither pedestrians nor motor-vehicles, but somehow between in pedestrians and motor vehicles. They would take up the pedestrians’ space or cars’ space. Therefore, under the complex urban traffic conditions, collisions between cyclists and motorists are apparent. Bicyclist casualties caused millions of deaths and disabilities every year. This article analyzes the reasons for the collision between the rider and the driver. For cyclists, the question is how to make the driver pay attention to whether the cyclist is day or night. According to Kwan, Mapstone, Räsänen, and Summala, the most common accident is that the driver failed to yield notice the cyclist [3][4]. So for the driver, the problem is how to focus on the rider and make the right response to the rider's unpredictable behavior. Therefore, to predict cyclists’ behavior on the road is vital for drivers to avoid collisions with cyclists. Among the factors to make cyclers’ behaviors predictable, visibility plays a vital role in helping bicyclers and motorists communicate well. Meanwhile, a practical approach to reducing the knowledge difference on the profile of cyclists can help to avoid collisions between cyclists and motorists. How to improve visibility and how to make it convey more information is the focus of this paper.

2. Design Research

Cycling in the city can make people healthy and relieve stress, so cycling is becoming more and more popular in the city. However, due to urban traffic planning, the conflict between the rider and the driver has become more intense.
For understand these conflicts, this survey will delve into the existing traffic planning or bicycle safety factors in the urban environment, including user research (users behavior and perception), use of environmental research and product research, and in-depth analysis.

2.1 Cyclists’ and motorists’ behaviors

For cyclists, they often use bicycle bells or yell and communicate with pedestrians. But for drivers, they use car lights, car horns or yelling to interact with others. Since the rider has no lights and the bell has a limited effect in the closed state of the window, the behavior of the rider on the road is often demonized by the driver. In response to this news, the Gulf region submitted a report on the opinions between the passenger and the driver in a public forum[5].

More people suppose that car drivers are cyclists' victims since bicyclists much put themselves and other way users at danger. Most bicyclists are thought to be irresponsible and do not take in the road law. A large number of people believe that bicyclists ought not to be permitted to drive on the road since they pose a risk to themselves and others.

Therefore, the driver may not consider the rider to be part of the road user. The different behavioral habits between the passenger and the driver make it difficult for most drivers to predict the behavior of the rider. Therefore, an effective way for drivers to predict the action of the rider can help them improve the situation.

2.2 Environment background

As the urban population increases, the transportation infrastructure is also increasing. However, according to the Urban Traffic Modeling System (UTMS), the transportation plan is a road layout based on the characteristics of the building, as shown in Figure 1, while the road space for bicycles or walking is generally narrow. Suppose pedestrians and cyclists stay in those tight spaces on the road. Moreover, in the United States, where the car dominates, most of the infrastructure is designed for vehicles, for example, the most massive streets in the parking area and driving area, leading to clashes between cyclists and drivers in urban areas. According to Dianhai Wang, Tianjun Feng and Chunyan Liang[6], due to the reduced road safety of motor vehicles - bicycle conflicts under mixed traffic conditions, car and car conditional bicycles use the same road at the same time, resulting in a ride between the rider and the rider. More crashes occurred Motorists. At the same time, more traffic lights and more traffic lights will cause more potential collisions.
Crossroads due to increased demand for drivers and infrastructure. To alleviate these
In conflict, many roads and streets have added more bicycle infrastructure (Figure 2).
These infrastructures only cover areas that have a slight impact on reducing collisions. It yet needs to discover a more expeditious means for the driver and rider to communicate to work out terrible road conditions' trouble in urban areas.

2.3 The cycling crashes in the urban environment

Some 10 million permanent disabilities and over a million deaths are accounted for by road traffic crash a year worldwide(Murray and Lopez, 1996)[7]. Bicyclists get self-reported near-miss crashes' most meaning part, substantially more unusual than that of motorists and comparable to that of walkers [8]. Cyclists visibility is a vital factor for exploring solutions to reduce the collisions between cyclists and motorists.

Bicyclists are reckoned to be among the most vulnerable of all way users. In addition to the urban areas, research suggests that bicyclist deaths occur because of the complex road environment and traffic congestion, which all make cyclists give up cycling in high numbers. According to the study, the crossing crashes comprise about 5/6 of the total number of accidents[3]. Amy J. Schramm, A.Narelle L. Haworth, and Rakotonirainy stated the unmarried most frequent crash kind was the vehicle that failed to give way in crossing pathway smashes, at 21.7%.Nancy L.Nihan class incidents and Yinhai Wang entailing motor-vehicle and bicycles into three kinds: head-on Motor vehicle-related crashes, left-turn motor vehicle-related conflicts, and right-turn motor vehicle-related crashes. The inaugural
type happens typically while a motorist goes away from bend or a driver correctly at a crossing and gets close to a cyclist from the right side, which results in the hit on a bike's side. It is tough for drivers to detect cyclists with peripheral vision. In the left-turn condition, drivers have a difficult time seeing bicyclists using edge. The sight obstacle makes drivers challenging to see cyclists under this situation. And the right-turn crash scenarios, a bicyclist can be hit by a motorist turning right in front of them because cyclists next to them in the same direction cannot be noticed easily.

2.4 The Bicycle Visibility factor for bicycles and motor-vehicles’ collisions

During the crash, complex road situations, users’ behaviors, interaction ways, and road law all attributed to motorist-cyclist collisions. In particular, under Jorgensen and Herslund, a share of smashes between bicyclists and vehicles have been placed as "Looked-but-failed-to-see" smashes, which puts defects forward in driver attention actions\(^9\) (as proposed by Brown, 2005). In the examination carried out by Lacherez, Wood, Marszalek, and King, 19% of 184 cyclists reported not applying bike lights at the time of the car crash, and solely reflective clothing was being worn by 34%. Exclusively two participants (of 184) nominated cyclist visibility as the accident's reason: 61% ascribed the smash-up to driver inattention\(^10\). Motorists cannot always pay enough attention to the surrounding environment resulting in failing to notice cyclists.

Cyclists visibility can help motorists to notice and predict cyclists’ actions. The visibility was disgraced further through low-light circumstances under the examination by Sivak and Owens\(^11\), who discovered that 78.8% of all disastrous crashes that involved vulnerable road users happened throughout low-light circumstances. Night-time that cycles are more life-threatening than cycling in daylight, with 40% of bicyclist casualties occurring at night in spite of a great deal more down exposure rates than in the daytime\(^12\). Besides the likely hazards of invisibility of bicyclists, the figure of days off work that followed a bike smash-up wound was discovered to be considerably depressed among bicyclists reporting that they at all times wore eminent visibility clothing\(^13\) (Thornley et al.). Pushing up cyclists' visibility thus is particularly critical under low-light circumstances.

2.5 Solutions for reducing bicycle-vehicle crashes
There have some directions explored to establish the initial concepts of the resolution; One is how to make cyclists more visible for motorists and help them to reduce understanding differences about regarding cyclist visibility. Another focuses on the road plan, which is to ensure cyclists to have enough space to turn at the sections when needed. Compared with redesigning the current road situation in urban areas, improving cyclist visibility is an economical cost solution. In terms of cyclists’ visibility, many factors are affecting the feasibility of the solution.

Conspicuity of bicyclists would be influenced by the object contrast, extent, motion, illumination, background 'clutter' and route environment, the same the driver's cognitive method and his/her reactions in acknowledgment and detection[^14]. Plenty of tests were carried out to evaluate the answers for improving visibility of the bicyclists and help drivers to detect and recognize cyclists. Studies are concentrating on cutting bicycle-vehicle crashes down from different perspectives. J.C. Wüst and J.P. Schepers did research the road factors, and they discovered the incident chance is diminished at crossings where the bicycle racecourse methods are deflected between 2 and 5m that is Away from the main carriageway[^15]. Yen-Bor Lin, Chung-Ping Young suggested a bike detection algorithm and a geometrical model of bike for a single side-view picture to help to show the bicycle motion[^16]. They wished to discover bicyclists to improve transport systems’ safety.

Moreover, the study has demonstrated that visibility aids' augmented consumption may amend drivers' power to identify bicyclists and that the strength of drivers to respond in time is more respectable while walkers or bicyclists apply for visibility assistance. As regards solutions, many types of research pay attention to catch motorists’ visual attention through improving the cyclists’ conspicuity. Visual attention is thought to function as a two-stage method. Generally, visual attention can treat information about in parallel and then focus on the specific area[^17]. Great visual attention firstly replies to contrasts in light and color, then to the cultural and emotional value of a particular color under a study article researchers from the University of Barcelona on the saliency (or visible pop-out result) of color. The most natural products are reflective materials, fluorescent clothing, static and flashing lights.

2.6 Visible products The reflective materials and light
To make cyclists more noticeable, a bunch of bright things about facilities or clothing is available on the market. Among these productions, fluorescent clothing every bit more visible than reflective clothing during the day, and the contrary at night, those were even somewhat alike\[18\]. And because of a day's different lights, clear visibility assistances likewise have got different effects. In the daytime, fluorescent clothing is helpful visibility assistance as it changes light's wavelength in the ultraviolet scope (which is in unusual saturation in the sunshine) to more retentive, visible wavelengths, thus giving rise to total growth in shown visible light \[19\] (Joint Technical Committee SF/4, 1999). At the same time, the biological motion was explored to make cyclists more visible for motorists.

Based on the exam executed by Stacy A Balk, Richard A Tyrrelló, conspicuity is maximal when people are both shifting and wearing retroreflective remedies highlighting the shape of their Participants' reply, and dead body distances were maximum for the pregnant biological-motion configuration and continued to be amazingly retentive while reflective markers' handy subsets were positioned on wrists and ankles of the walker (Figure 3) \[20\]. Figure 4 shows a comparison between the reflective material and the luminescent material in the vehicle from the perspective of the driver. Tests have shown that the impact of the content has been significantly improved, especially in the blind spot of sight, which makes the target more visible.

Figure 3 The five clothing configurations

(a) black; (b) vest; (c) ankles; (d) ankles+wrists, A+W; (e) full biological motion.
Figure 4 Six kinds of observations in the car and the comparison of materials and lighting materials
3. Conclusions

Lights are playing an essential role in our daily life. When we mention the emergency lights, stop signs and error reminders, we all associate those things with red. And many types of research all show red is the most effective at attracting our attention.

Usually, motor-vehicles drivers used to interact with cyclists using lights on the road. Every light on the car has several modes which can help others to notice them and predict their movements for cyclists. The visibility assistants that were applied most frequently were back bike lights and the front line, with 83% and 90% of respondents that indicates that they forever use these. Though it is usual for bicyclists to take rear lights and the front line in the low-light surroundings, it is still heavy to partake of the equal insight of lights' significance for bicyclists and motorists. Based on visibility using Joanne M. Wood, assistance test, Philippe F. Lacherez, Ralph P. Marszalek, Mark J. King, bicyclists valued themselves as substantially more visible while applying bike lights than did the drivers. Currently, more new researches are exploring how to make a cyclist more conspicuous for drivers. Many new products are installed on a pedal, handlebars, and wheels, which can catch people’s attention easily by making the bike look bigger visually (Figure 5) [21].

Figure 5
Six kinds of observations in the car and the comparison of materials and lighting materials
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