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Special

Characteristics of nighttime crossing accidents in areas feature without pedestrian crossings



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Introduction

In recent years, there have been many pedestrian accidents in Japan. To address this, authorities have strengthened the crackdown on violations of Article 38 of the Road Traffic Act, which states "Pedestrians' and Cyclists' Right of Way at Pedestrian and Bicycle Crossings"¹). However, a survey conducted by the Japan Automobile Federation found that the national average for the rate of drivers temporarily stopping at pedestrian crossings without traffic signals² is only 45.1%, and it is reported that half of the drivers still do not temporarily stop for the pedestrians crossing a pedestrian crossing, which has become a social problem. While "accidents that occur when pedestrians are crossing the road" have received attention to the extent that it has become a social problem, considering the severity of the damage caused, shouldn't the accidents occurring in areas without pedestrian crossings also receive attention and countermeasures be taken to prevent such accidents from happening?

Therefore, in this paper, we specifically focus on accidents occurring while crossing the road in areas without pedestrian crossings and will examine the results of accident analysis from both the driver and pedestrian perspectives.

2 Characteristics of pedestrian-vehicle accidents

Pedestrian-vehicle accidents that occur "at night," when the "passenger car is moving straight on," and when the "pedestrian is crossing an area without a pedestrian crossing" require attention

The Cabinet Office of Japan published the White Paper on Traffic Safety 2023³), which reported that in terms of the number of casualties by condition in 2022, the number of fatalities while walking was the highest at 955 people (36.7%), and the number of seriously injured while walking was 6,582 people (25.3%). These figures indicate that a significantly high number of pedestrians are involved in accidents, leading to fatalities and serious injuries.

Examining in detail the type of accidents in pedestrian-vehicle accidents, we found that approximately 60% of these accidents happen when pedestrians are crossing the road (total number of pedestrians crossing at pedestrian crossings, crossing areas without pedestrian crossings, etc.), indicating that this is a highly dangerous type of accident. Accordingly, we will take a closer look at the characteristics of accidents limited to pedestrian crossing accidents. Firstly, in 2022, approximately 70% of the primary parties — the party with a higher percentage of fault — in pedestrian crossing accidents were passenger cars, as shown in Figure 1. This suggests that the cars we typically drive are responsible for most accidents involving pedestrians crossing the road. Going forward, we will focus solely on the data related to passenger cars.



Figure 1. Percentage of pedestrian-vehicle crossing accidents by primary party type (2022) (In that order, the label shows the number of accidents and their percentage.)

Next, we will examine the behavior of the primary party passenger car during a crossing accident in the direction of travel. Figure 2 illustrates the trend in the number of casualty accidents that occurred when the primary party passenger cars were moving straight on and turning right. As the figure shows, since 2014, the number of accidents caused by passenger cars turning right has exceeded the number of accidents caused by those moving straight on but has remained at the same level. Here, the ratio of serious accidents in relation to the total number of accidents is defined as follows:

Ratio of fatal and serious injury accidents =

(Number of fatal and serious injury accidents in a specific accident type) (Total number of casualty accidents in a specific accident type)

Further, when considering accidents that occur during the day or night, the numbers for both crossing a pedestrian crossing and crossing an area without a pedestrian crossing are higher than for other categories when a passenger car is moving straight on at night. Also, crossing an area without a pedestrian crossing shows a significantly higher ratio of fatal and serious injury accidents when compared to other categories, suggesting that it is an especially dangerous type of accident (Figure 3). Regarding right-turn accidents, it is likely that the car slowed down or stopped before making a right turn and then collided with a pedestrian, resulting in only a slight injury due to its relatively low speed. On the other hand, when the car was moving straight on, it traveled at a higher speed than when making a right turn, which is considered to have resulted in a serious injury or fatal accident.







Figure 3. Ratio of fatal and serious injury accidents by type of primary party passenger car behavior (2022)

Speed at the time of collision and accident location

What is the speed of the primary party passenger car at the time of the collision? Hereafter, we will focus on the behavior of passenger cars when moving straight on and the type of accident that occurs while crossing a road in areas without pedestrian crossings. Figure 4 shows the results of an analysis of the Danger Perception Speed - the car speed at which the driver perceived danger - by the passenger cars involved at the time of the accident. The graph shows the cumulative percentage of slight injury accidents and fatal and serious injury accidents during the day and night. The curve line is closer to the right at night than during the day and for fatal and serious injury accidents, indicating that the danger perception speed of the cars involved tends to be higher. Since there is a possibility that some response may be taken after the driver recognizes the danger, the danger perception speed is considered to be close to, if not the collision speed. As mentioned earlier, since the speed of the concerned passenger cars is higher in fatal and serious injury accidents at night, the damage caused by collisions with pedestrians is likely to be severe.



Figure 4. Danger perception speed of primary party and cumulative percentage of accidents for primary party passenger cars moving straight on in an area without a pedestrian crossing (Total for 2018 to 2022)

Why do collisions occur when passenger cars travel at such high speeds? When we examine the locations where accidents happen while a passenger car is moving straight on and a pedestrian is crossing an area without a pedestrian crossing, we notice that many accidents occur at "non-signalized intersections" and on "uninterrupted road sections and deemed uninterrupted road sections*" (Figure 5).



Figure 5. Presence of traffic signals and road configuration at accident locations when the primary party passenger car was moving straight on and the pedestrian was crossing an area without a pedestrian crossing (Total for 2018 to 2022) * Based on Road Traffic Accident Statistics, road configurations are classified as "uninterrupted road sections," "intersections," and "near intersections." However, when we analyzed vehicle behavior and danger perception speeds of crossing accidents that occurred at non-signalized intersections with narrow streets and near intersections, we found that the trends were similar to those on "uninterrupted road sections. Therefore, we considered the situation to be similar to driving on uninterrupted road sections from the perspective of driving behavior and defined intersections where the width of the intersecting road is less than 5.5m as "deemed uninterrupted road sections" within near intersections where the width of the road on which vehicles are passing is 5.5m or more.

A passenger car traveling on a straight road without traffic signals collides with pedestrians without slowing down, typically because of its high speed. But why does the car fail to slow down? Also, why were the pedestrians crossing the road when a car approached at a certain speed? Let us look at the causes of accidents for passenger cars and pedestrians separately.

3 Human factors of passenger cars (drivers)

Figure 6 shows the comparison results of human factors of drivers during day and night in crossing accidents involving primary party passenger cars moving straight on in areas without a pedestrian crossing, using macro data from all over Japan. While it is observed that drivers tend to detect pedestrians late, both during the day and night, there is a higher proportion of delay in detection for drivers at night as compared to during the day. Details reveal that the rates of intrinsic failure to pay attention forward (e.g., absent-minded driving) and extrinsic failure to pay attention forward (e.g., distracted driving) increased by approximately 10 points or more respectively, at night. This implies that drivers who drive at night without paying attention to the road ahead are delayed in detecting pedestrians and, as a result, collide with pedestrians without slowing down enough.



Figure 6. Crossing accidents for primary party passenger cars moving straight on in areas without a pedestrian crossing- Human factors of primary party passenger cars (Total for 2018 to 2022)

To investigate the reasons behind drivers failing to pay attention forward on the road, we analyzed interviews with the parties from the in-depth case studies (microdata) conducted by our center in the Tsukuba area. Our findings indicated that drivers, at the moment of the accident, experienced the following emotions. (Numbers in parentheses indicate the analysis results of 85 pedestrian crossing accidents caused by cars moving straight on at night. *Multiple cases may apply.)

- I let my guard down because there was less traffic at night. (5)
- I was preoccupied with thoughts about my personal life and work. (11)
- Normally, I do not find pedestrians on this familiar road, so I assumed there were none this time as well. (18)
- I was staring off into the distance without any particular thought. (19)
- I looked away to take the luggage inside the car, thinking there was no danger, and became distracted by something outside the car. (50)

When driving straight on, the task can become monotonous, causing drivers to lose concentration and engage in other activities. This is especially true at night when drivers may have more distracting thoughts and less attentiveness. On familiar roads, drivers may be less attentive to pedestrians due to their experiences, leading to the assumption that "it is usually fine," causing a delay in detecting pedestrians. In particular, since there are no diamond road markings in areas without a pedestrian crossing, drivers may find it difficult to predict whether "pedestrians may be present." Moreover, at non-signalized intersections with narrow streets and in their vicinity, the driving behavior of drivers is similar to driving on uninterrupted road sections, making it difficult to notice pedestrians crossing the street. This may be one of the reasons for the delay in detecting pedestrians. Also, it is essential to be aware that at night, drivers can easily get distracted by the headlights of oncoming cars or shop illumination in the dark or let their guard down because of less traffic at night.

4 Human factors of pedestrians

Next, we will examine the human factors of pedestrians using macrodata. Figure 7 shows the number of accidents by human factors during the day and night. In addition, as a result of statistical analysis to determine whether the environmental factors of day and night are related to human factors of pedestrians, the four items marked with ** in the figure were found to be significantly more prevalent at night than during the day. The following factors were found to be more likely to cause accidents at night than during the day: (1) insufficient confirmation of safety factors, (2) incorrect perception of the car's speed, (3) other judgment errors, and (4) poor health condition. (Note that the order of items has no statistical significance.)

In the aforementioned cases (1) and (2), despite confirming the safety factors, an accident occurred when the pedestrians started crossing either because the safety confirmation was insufficient or due to their misunderstanding of the situation.

As for (3) other judgment errors, it is difficult to identify the specific error in judgment, as it covers a range of judgment errors, but there was undoubtedly some error in judgment.

Drinking alcohol falls under the category of (4) poor health condition. Pedestrians should be particularly cautious while crossing the road after consuming alcohol.

At night, it can be challenging for pedestrians to perceive a car's shape and size. In such a situation, they depend on the brightness and size of headlights to estimate the distance, speed, and arrival time of the approaching car. Based on this information, they decide whether or not to cross the road. However, there is a possibility of making an error in this process, which can result in a dangerous crossing. During the night, fewer cues are available about a car's movements compared to the daytime, making it more difficult to predict its motion. Therefore, if you notice a passenger car approaching you, it is essential to ensure that it has slowed down or stopped before crossing the road. If a pedestrian crossing is nearby, it is advisable to use it.



Figure 7. Crossing accidents for primary party passenger cars moving straight on in areas without a pedestrian crossing- Human factors of secondary party pedestrians (Total for 2018 to 2022)

When it comes to errors in judgment, we can consider the following possibility: At night, the cells in the human eye adapt to darkness, allowing us to see objects even in low light conditions. However, in exchange for being able to see objects even in the slightest amount of light, our sensitivity to glare* also increases. This makes it easier for pedestrians to feel "dazzled" when they see an oncoming car. This feeling can lead them to assume that if the lights are bright, the car will notice them and slow down, allowing them to cross the road. However, when a pedestrian starts crossing with this assumption, the driver may not actually see the pedestrian and could end up colliding with them. Therefore, in this case, as well, it is essential to observe the behavior of passenger cars carefully before attempting to cross the road.

* Glare is defined as a "dazzling" light that causes discomfort and makes it difficult for a person to see things clearly.

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5 Conclusion

Based on the analysis results, the following findings were revealed:

- a) Many pedestrian-vehicle accidents occur when a vehicle is "moving straight on" and "a pedestrian is crossing the road in an area without a pedestrian crossing." The serious accident rate for such accidents is higher at night compared to other crossing accidents.
- b) In nighttime crossing accidents in areas without a pedestrian crossing, when a primary party passenger car is moving straight on, the car's danger perception speed is high.
- c) In particular, many accidents occur on uninterrupted road sections without traffic signals. The microdata analysis shows that the cause of delay in detecting the crossing pedestrians is often drivers driving absent-mindedly or getting distracted by monotonous driving operations.
- d) Human error by pedestrians occurs at night when they misjudge whether or not to cross the road due to insufficient confirmation of safety factors, such as "misperceiving the car speed" or "insufficient confirmation of safety factors." This often leads to a possibility of collision with a vehicle while crossing the road, as estimated from macrodata and statistical accident analysis.
- e) There are many other accidents at night where other judgment errors or the influence of alcohol are the contributing factors.

In this paper, we have analyzed accidents caused by pedestrians crossing at areas without pedestrian crossings, considering the time of day and night. We believe it is important to focus on the following points to reduce accidents at night.

Accidents that occur at night while crossing an area without a pedestrian crossing are believed to be caused by a delay in the driver's ability to spot pedestrians, resulting in collisions without the vehicle slowing down enough. Even on a monotonous road, drivers should remain attentive to the road ahead and to pedestrians on the side of the road who are about to cross. Drivers should be particularly cautious about lowering safety awareness on familiar roads.

When crossing a road, pedestrians should be cautious and check for approaching vehicles. They should wait until the vehicle has slowed down and stopped before starting to cross. Wearing reflective materials is an effective measure for pedestrians, as it helps drivers detect their presence and movements quickly⁴.

This paper highlights the significance of being well-informed about accidents for pedestrians and drivers who participate in traffic scenes, thinking of preventative measures on their own, and taking action to avoid accidents. We have created this comprehensive guide to emphasize the need for repeated and thorough efforts to achieve this goal and ensure that this content is clearly communicated to those new to the traffic scene. We hope these activities will reduce the number of traffic accidents, even by one.

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Reference materials:

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- Cabinet Office webpage: "White Paper on Traffic Safety in Japan 2023" https://www8.cao.go.jp/koutu/taisaku/index-t.html
- A) National Police Agency webpage: "Reflective materials and lights Lights save lives at dusk and night"

https://www.npa.go.jp/bureau/traffic/anzen/reflector.html

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