

REPORT

Evaluation +Light Line Bodegraven

Behavioural observation and analysis of opportunities,
threats and application options

Client: Bodegraven-Reeuwijk Municipal Authority

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1 INTRODUCTION

An accident involving an inattentive cyclist has given rise to a debate within the municipal authority on the safety of (bicycle) crossings. The accident happened because the cyclist was distracted by his phone. This incident raised questions within the Bodegraven-Reeuwijk Municipal Authority about the safety of pedestrians and cyclist who use their smartphone in traffic. The Bodegraven-Reeuwijk Municipal Authority has asked HIG Traffic Systems to come up with ideas for awareness-raising solutions for vulnerable, pedestrian and cyclist who, among other things, use their smartphone in traffic. In consultation with the Municipal Authority, this company proposed to incorporate the +Light Line into the paving at traffic light-controlled junctions. This +Light Line is an additional indication to the standard pedestrian crossing light, and its intended purpose is to alert pedestrians (including smartphone users) whether crossing the road is possible or not. The Bodegraven-Reeuwijk Municipal Authority has decided to implement this proposal as a pilot and to evaluate this pilot. In the evaluation, we analysed the influence of the +Light Line on road safety. The document before you is the report on this evaluation.

In this first chapter, we look at what the +Light Line is, its location and the public opinion as well as interim developments. The chapter concludes with a brief explanation of how our evaluation is built up.

1.1 The +Light Line

Figure 1-1 shows the +Light Line, which consists of a LED-illuminated strip that is connected to the traffic lights. The goal of the +Light Line is to improve safety for vulnerable crossing traffic users by making use of today's technical developments.

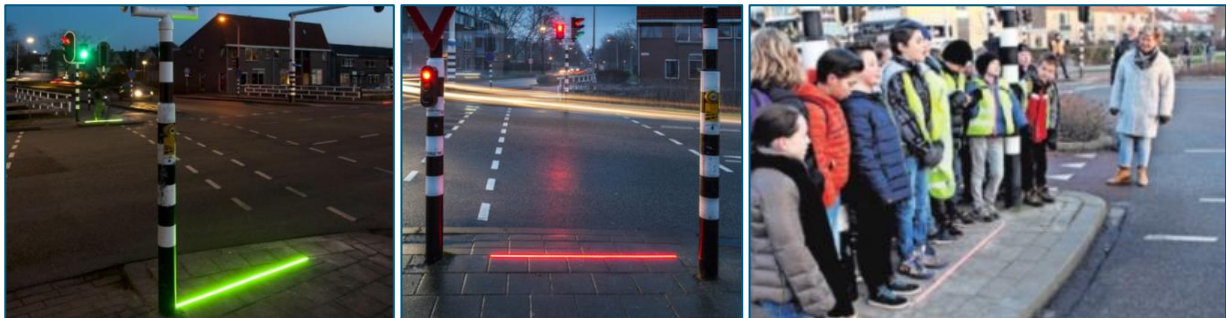


Figure 1-1: +Light Line in Bodegraven

1.2 Pilot Location

The pilot location is the Vrije Nesse / Cortenhoeve – Goudseweg junction (Figure 1-1). This junction was chosen because it concerns a traffic light-controlled junction where a reasonably high number of pedestrians cross. The Goudseweg is an important connecting road for Bodegraven towards the N11. The junction is also widely used by pedestrians and cyclists, since it is near several primary schools (see Figure 1-2): Public Primary School 't Vogelnest, Primary Schools de Goede Herder, Speel en Werkhoeve, Willibrord Miland and the Prinses Beatrix school). It is also near a sports hall, De Sporthoeve. Figure 1-3 indicates where at the junctions the +Light Lines are located.

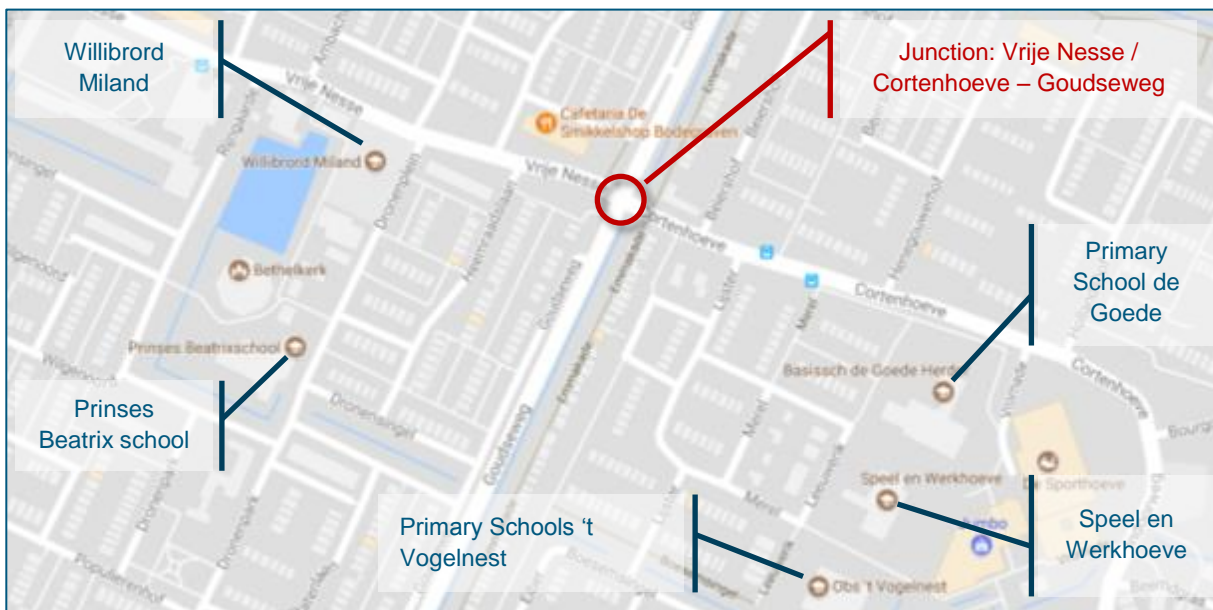


Figure 1-2: Facilities in the vicinity of the Vrije Nesse – Goudseweg junction.

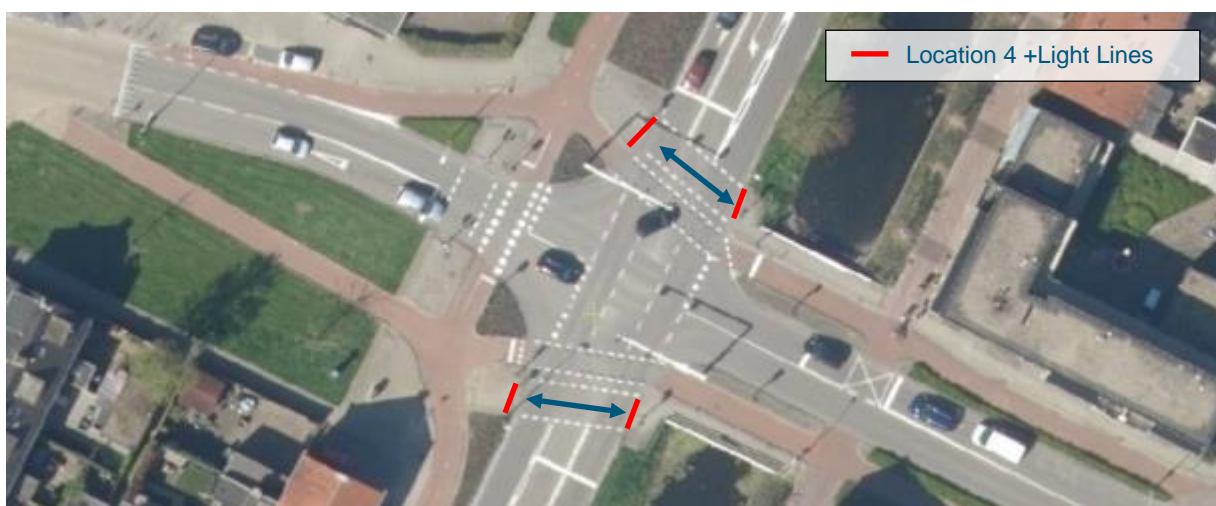


Figure 1-3: Crossing location +Light Lines.

1.3 Interim Developments

The first version of the +Light Line was installed at the junction on 14 February 2017. The application and appearance of the +Light Line has provoked numerous reactions from inside and outside Bodegraven, nationally and internationally. With regard to the influence of the +Light Line on road safety, two perspectives became apparent: those who oppose the system believe that the +Light Line sends a clear signal that smartphone usage in traffic is acceptable, thus rewarding or even encouraging unsafe traffic behaviour. Those in favour indicate that the smartphone in traffic is simply today's reality, and therefore we must strive for the safest possible use thereof. According to this point of view, a development like the +Light Line can contribute to this.

These comments have also resulted in various adjustments to the +Light Line compared to the first trial version of February 2017.

The following adjustments have been made to the final product version:

- In the first version, both the red and the green lights were shown just like with the standard pedestrian crossing lights. However, for people who are colour blind, the distinction between red and green is nil and thus poorly recognisable. Therefore, the decision has been made to show only the red light in the basic variant. As a result, the +Light Line only has an alerting / warning function.
- The light output proved too low during the day and too high at night. Therefore, the light intensity at night was reduced to prevent a blinding effect (glare). The +Light Line is equipped with a dimming control to adapt to current weather conditions.

1.4 Structure of the evaluation

In the evaluation, we analysed the influence of the +Light Line on road safety. To understand this, we conducted a literature study, an on-site observation and organised an internal discussion session. A traffic control technology specialist, a traffic psychologist and traffic safety experts contribute to the evaluation.

First, pedestrian accidents and smartphone usage, solutions to prevent these accidents and the role and function of the +Light Line were analysed successively. Then a behavioural observation was conducted at the +Light Line in Bodegraven-Reeuwijk. Based on the analysis and observation, conclusions were drawn and recommendations made.

2 SMARTPHONE USAGE IN TRAFFIC: BAN OR FACILITATE?

The application of the +Light Line cannot be seen separately from the discussion about smartphone usage in traffic. In this chapter, we will review this discussion and the developments. We will focus on the road safety issue (2.1), the current directions in which solutions are sought (2.2) and what this means for the application of the +Light Line (2.3).

2.1 Pedestrian accidents and smartphone usage

The number of pedestrian movements as part of a chain (before and after transport in cars and public transport) is rising (Information and Technology Centre for Transport and Infrastructure (KpVV), 2016). In other words, walking becomes an increasingly important mode of transport. Pedestrians are the most vulnerable road users because they lack a protective "layer", while also the difference in mass between the colliding parties plays a role (Institute for Road Safety Research (SWOV), 2012). The consequences of an accident are more serious for pedestrians. According to Dekra (2016), 22% of fatal accidents in the European Union include a pedestrian. Most accidents with pedestrians occur while crossing the road. Therefore, safe and clear crossover facilities are vital for their safety (Dutch Traffic Safety Association (VVN), 2017). Well-known examples of additional traffic safety measures at junctions with traffic lights are ticking audible traffic signals and waiting time predictors.

In 2015 and 2016, the number of traffic casualties in the Netherlands increased again after years of decline. One possible reason for this is the growing use of smartphones. The smartphone zombie, also known as "smombie", has become a permanent feature in the roads. A study conducted by the SWOV (2017) shows that smartphone usage leads to distraction. This distraction while crossing the road results in careless crossing, a longer crossing time, crossing while a vehicle approaches, not crossing in a straight line and more equilibrium disturbances. This increases the risk of an accident. Distraction seems to be commonplace among cyclists and pedestrians. In 2015, Dutch newspaper *Algemeen Dagblad* published that tram drivers from the Hague Public Transport Company HTM had to take intervening action 40 times per ride in order to prevent an accident (AD, 2015). In the Netherlands, it has been agreed that we will no longer accept victims due to the unsafe use of smartphones in traffic (Position paper, 2017).

2.2 Directions for Solutions

Given the risk of smartphone usage in traffic, we are looking hard for solutions. These solutions can be divided into three groups: reducing smartphone usage, making smartphone usage safe, and using smartphones as a means of improving traffic safety.

Reducing Smartphone Usage

There are several measures to reduce the use of smartphones: a ban, education and information, or a combination of technology and behavioural influence (SWOV, 2017).

The first measure (ban) is currently being pursued, with a bill to ban smartphone usage on bicycles. In Denmark, Germany and Austria, for example, hand-held calling on a bicycle is already prohibited. A ban on using the phone while walking virtually does not exist. The only exception is Honolulu (Hawaii), where it is forbidden for pedestrians to cross the road while looking at their phone. In Stockholm, traffic signs are used to warn "smombies" for the risks of smartphone usage while walking (Figure 2-1).



Figure 2-1: In the Swedish capital of Stockholm, traffic signs are used to warn “smombies” for the risks of smartphone usage while walking.

In the Netherlands, a ban on smartphone usage for pedestrians seems unlikely in the short term. As far as the banning of smartphone usage in traffic is concerned, it should also be mentioned that this is only credible and therefore effective if properly enforced.

Another way of reducing the use of the smartphones while participating in traffic is through education and influencing behaviour. Various campaigns and programmes aimed at motorists and cyclists have been rolled for this purpose. For instance, the government has developed the bicycle mode app in collaboration with other parties. This app allows cyclists to accumulate points by not using their telephones while on their bicycle. This aims to discourage the use of smartphones while riding a bike. Such programmes are not known for pedestrians.

Safe Smartphone Usage

Another point of view is that smartphone usage among pedestrians cannot be stopped, and we must therefore strive to make it as safe as possible. Several measures have been developed in recent years to achieve this. For instance, measures have been taken to reduce the negative impact of smartphone usage on pedestrians. An example thereof are the smartphone strips in a Chinese city. The footpath is divided into two strips: one for the people with, and one for the people without the smartphone in their hands. This separates the fast walkers from the slow walkers preventing them (hopefully) from colliding with each other. Although this was intended as a playful stunt, smartphone-friendly footpaths have been made available in the Belgian city of Antwerp, sporting the phrase 'Text Walking Lane'. Furthermore, after a series of accidents, traffic lights were installed in the ground at a tramway crossing in Germany in 2015. These aim to alert “smombies” to passing trams. A +Light Line has also been installed at a pedestrian crossing across the tramway tracks at the Vlaamse Poort in Brussels (Figure 2-2).

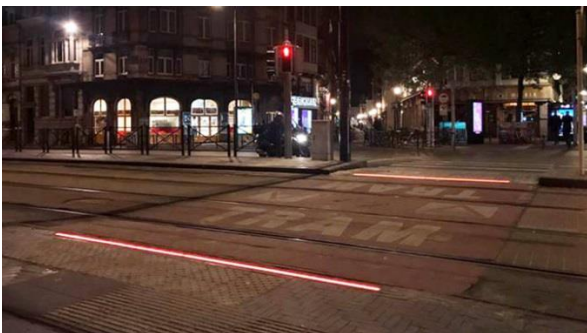


Figure 2-2: Application of a +Light Line at a pedestrian crossing across the tramway tracks at the Vlaamse Poort in Brussels

Smartphone usage as a means

Solutions are also being sought in the direction of actively using smartphone usage as a means to improve road safety. In September 2017, for instance, 40 companies have signed the "Safe smartphone usage in traffic" covenant, including VVN, Cycling Federation, ANWB and Royal HaskoningDHV (Position

Paper, 2017). This means: no social media and SMS / WhatsApp in traffic, but using smartphone services that promote safety, such as a traffic jam warning system and safe route guidance. Applications that are developed from Talking Traffic¹ are in line with this. Together with decentralised governments and businesses, the Ministry of Infrastructure and the Environment will invest 90 million euros in 2020 in this Partnership. These are used to deploy smart mobility developments that promote road safety and traffic flow, for example, by facilitating communication between traffic lights and road users through smartphones.

2.3 Role and Function of the +Light Line

In the previous section, we have seen that there are three general directions in which solutions can be sought to reduce the negative impact of smartphone usage. So far, there is no consensus on the best strategy. Therefore, different measures exist side by side.

The +Light Line fits the solution of: making smartphone usage in traffic as safe as possible. The idea behind this is that it is inevitable that road users will use smartphones. Since the target group concerns pedestrians, this is a realistic assumption. A high percentage of pedestrians uses smartphones and prohibiting this does not seem realistic. Even if the ban only applies to crossing the roads, it is difficult to enforce. If we accept smartphone usage of pedestrians, investigating additional measures like the +Light Line is a logical next step. The +Light Line can help to alert distracted people to the task of crossing the road. People who have trouble seeing the traffic lights can also benefit, for example, older pedestrians using walkers, whose look is generally directed downwards. The red line may "provoke" crossing pedestrians to take up a safe position, ensuring these vulnerable road users don't stand too close to the road. The extent to which these effects occur can be tested during a pilot.

Examples of existing support measures at pedestrian crossings are ticking audible traffic signals and waiting time predictors. Their purpose is not to assume the function of the traffic lights, but to provide additional support where required by the situation. This must also be the starting point for the application of the +Light Line.

There is also another side to the coin. Applications such as the +Light Line may send a signal that using a smartphone while crossing the road is acceptable. The use of smartphones may be realistic, however, facilitating it on a large scale may contribute to shifting the norm further towards acceptance. On the one hand, the application of the +Light Line can help make people aware of the dangers of using their smartphone when crossing the road. On the other hand, it may undermine efforts to reduce the use of smartphones, such as the current educational programmes and campaigns. The widespread implementation of additional measures may further cause people to pay less attention. They get used to being assisted. This getting used is undesirable, because safely crossing the road requires the pedestrian to look up before walking onto the road. For example, in case of system failure (traffic light failure or defective lamp) or unexpected traffic situations (a motorist fails to stop at a red light), it is essential they look themselves.

The +Light Line can help to alert distracted pedestrians to the crossing task, however, the uncontrolled broad rolling out of these and similar measures involves risks. To minimise the risks, it is paramount that "paying attention yourself" when crossing the road remains the norm, and this should be the message. The +Light Line should then be considered a tool that can offer some support in situations that require this.

¹ *Talking Traffic is a partnership between regions, companies and the Ministry of Infrastructure and the Environment in which agreements are made about sharing information to enable further developments in the field of SMART mobility.*

2.4 Points of Attention arising from Legal Aspects in the Netherlands

The Dutch Traffic Lights Regulation, which is part of the Road Traffic Act (1994), lays down provisions regarding the application, dimensions and appearance of pedestrian traffic lights. Article 74 of the Regulation states that pedestrian traffic lights comprise lights with an equal lens diameter of approximately 200 mm, that the green and the red light show a pedestrian symbol and that the post holding the pedestrian traffic light for the pedestrian crossing the road is located at the end of the pedestrian crossing. The +Light Line can therefore not be used to replace a traffic light, since the +Light Line does not meet the provision regarding its appearance. As a result, the +Light Line does not have a legal status.

Based on the current Traffic Lights Regulation, the +Light Line can only play a supporting role to the regular traffic lights. In order to continue to comply with the current Road Traffic Act, the +Light Line must be switched off when the pedestrian traffic light is not in service.

3 RESULTS OF THE BEHAVIOURAL OBSERVATION

In the previous chapter, we discussed the effect of the +Light Line from the theoretical perspective. To get an idea of what really happens at the junction, an observation was conducted. This chapter describes the results of this observation.

The observation took place on Tuesday 5 September between half-past seven and half-past nine in the morning. During this period, a total of 33 pedestrians crossed the road at the +Light Line (from both sides). Most of these persons crossed the road between 8 and 8:30 and were probably on their way to one of the nearby primary schools.

All persons waited for the green light before crossing. Everyone was clearly aware of being at a junction that is controlled by traffic lights: pedestrians looked around or ahead when approaching the junction, stopped on time and pressed the button. Once the traffic light turned green, the pedestrians looked ahead and/or both ways before crossing the road. No one showed any visible distraction.

As far as the viewing direction of the crossing pedestrians was concerned, we noted that nobody consciously looked at the +Light Line. It must be said that because of the daylight, the +Light Line was not very noticeable. The pedestrians used the traffic light on the other side to determine whether it was on green or red.

The position of pedestrians while waiting does seem to be influenced by the +Light Line. This is a strong suspicion, but it cannot be demonstrated because no observation of the previous situation was conducted. In any event, it could be observed that people usually position themselves behind the +Light Line while waiting. This means that this known psychological effect of lines (people unconsciously prefer not to cross) also occurs at this junction. In this case, the effect may be enhanced because the line is illuminated. This effect is desirable because it means that people keep a safe distance to the road. However, the line is not continuous at the pilot location, resulting in some people positioning themselves next to the +Light Line at the exit while waiting. During the observation, this particularly applied to people with prams and for one person with a walker. From that position, the +Light Line is outside the field of view of the person crossing the road, thus eliminating the possible effect of the +Light Line.

Three persons crossed the road with a mobile phone in their hands. They were looking at their phones while walking on the sidewalk, however, upon approaching the junction, they focused their attention on the task of crossing the road. While waiting, their attention was once again drawn to their phones. Once the traffic light turned green, they first took plenty of time to look both ways before crossing the road. They did not look at their phones while crossing the road. In other words, this did not really concern "smombies".

During a later observation in the dark, it became apparent that at night, the junction really stands out because of the +Light Line. This increases the visibility of waiting pedestrians for motorists.

Considering all findings, it is difficult to determine the effect of the +Light Line based on this observation. The presence of the target group, smombies, pedestrians with walkers and pedestrians in general, is limited and the situation (clear crossing, quiet, clear transition from sidewalk to road) does not provoke the problematic behaviour the +Light Line primarily focuses on. The pilot's starting point was, however, to contribute to road safety for schoolchildren. What is clear from the observation is that the +Light Line can potentially ensure that pedestrians wait at a safe distance from the road.

4 CONCLUSION

In Chapters 2 and 3 we have analysed the (potential) effect of the +Light Line on road safety from the theoretical perspective, current developments and the observation. We have seen that pedestrians are vulnerable road users. They are more likely to be involved in (serious) accidents and this risk is highest when crossing the road. The use of smartphones in traffic increases the risk of accidents and causes pedestrians to exhibit more unsafe behaviour while crossing the road. In general, there are three directions in which solutions can be sought: reducing smartphone usage, making smartphone usage safe, and using smartphones as a means of improving traffic safety. So far, there is no consensus on the best strategy.

The +Light Line fits the solution which assumes that the use of smartphones is inevitable and that we should strive to make it as safe as possible. Based on this starting point, the +Light Line can help to alert distracted people to the task of crossing the street. The risk, however, is that by facilitating the use of smartphones, people will use their phones more often and pay less attention. In addition, these types of applications undermine current measures aimed at reducing smartphone usage in traffic. To minimise the risks, it is paramount that "paying attention yourself" when crossing the street remains the norm, and this should be the message. The +Light Line should only be a tool at those locations where the situation requires it.

In addition to this theoretical reasoning, we observed the behaviour of pedestrians at the pilot location. The presence of the target group to which the +Light Line could add value was limited and neither does the situation provoke problem behaviour. What did become clear from the observation is that the +Light Line can potentially ensure that pedestrians wait at a safe distance from the road. Should the +Light Line eventually be used more often, some functional requirements and legal aspects regarding pedestrian traffic lights should be taken into account.

All things considered, it is difficult to make hard statements about the effect of the +Light Line on road safety based on this evaluation. Given the many influencing factors, the long-term effect of the +Light Line on road safety is too comprehensive to be determined within this evaluation. The outcome of the social discussion about either banning or facilitating the use of smartphones in traffic has a significant impact on the application options of the +Light Line. This issue will undoubtedly be discussed and examined extensively in the coming years.

The fact that smartphone usage in traffic is very common is sufficient reason to also give the facilitation measures a fair chance and to evaluate them properly. By conducting this pilot, the Bodegraven-Reeuwijk Municipal Authority has taken the initiative to make a contribution to this. Although the results do not yet point in a certain direction, much knowledge has been gained about the situations in which the +Light Line can provide added value and about how this can be demonstrated. There is, therefore, sufficient potential to further investigate the application options of the +Light Line.

Possible outcomes include:

- The +Light Line alerts people to the crossing task in a timely manner, ensuring they pay closer attention.
- The +Light Line not only helps "smombies", but also road users who are in any way distracted or hindered, for example, elderly people with walkers, children, large groups of pedestrians, etc.
- Since the junction is more visible at night because of the +Light Line, waiting pedestrians are better visible and motorists take them into account.
- The +Light Line provokes people to wait behind this line. This prevents (mostly) youth from standing too close to the road while provoking (mostly) elderly people to stand closer to the road (to shorten the crossing time).

5 RECOMMENDATIONS

The current pilot location has proven insufficiently appropriate in this evaluation to answer the research questions due to the low number of pedestrians crossing over at this junction. It is important to map the effects of the +Light Line before widely rolling out this measure. We therefore recommend further evaluating the +Light Line at locations where this measure may have added value. In this concluding chapter, we will provide an analysis of application options, an opinion on a controlled further development (evaluation study of new applications) and points of attention relating to legal aspects.

Recommendation Regarding Application Options

The +Light Line can provide added value in situations where many (distracted) pedestrians cross and where the situation is unclear: busy locations with an increased safety risk for crossing pedestrians. For instance, solitary pedestrian crossings in urban areas or near public transport stops, where there is also tram traffic or bus traffic in addition to car traffic. Also, locations where the footpath transitions into the road and that have no significant height and colour difference are suitable. Without the +Light Line, they provoke pedestrians to position themselves too close to the road and even careless crossing. This is exactly where pedestrians could use a little help. The recommendation is then to ensure the +Light Line covers the full width of the crossover location. This will prevent pedestrians from positioning themselves next to the +Light Line.

In addition to a tool for pedestrian crossings, the +Light Line can, for example, also be useful to indicate along a platform that a bus, tram or train is coming. The product can also be used to indicate the check-in and check-out location for the Public Transport chip card.

Recommendation for a follow-up study

To further investigate the impact of the +Light Line on road safety requires a research design that includes measuring the effects prior to the installation of the +Light Line and afterwards. A number of criteria to be included in a follow-up study are:

- The number of times the red light is consciously ignored by pedestrians
- The number of times the red light is unconsciously (nearly) ignored by pedestrians because they are distracted
- The number of times pedestrians carry their smartphone in their hands while approaching, deciding, waiting, crossing
- The location the pedestrians wait for the traffic light (distance to the road)
- The viewing direction of the pedestrians (pedestrian traffic light or +Light Line, both or elsewhere)
- The effect on other road users / the surrounding area

We would like to emphasise that it is essential to conduct measurements before and after the installation of the +Light Line in order to determine the actual effect of the +Light Line.

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