# Individual users' perception of signalised intersections


## Bas van der Bijl

***Graduation Date:***
*December 16, 2010*

***Graduation committee:***
*Prof. E.C. van Berkum*
*Dr. J. Bie*
*J.D. Vreeswijk, MSc. (Peek Traffic)*

***Organisation:***
*Peek Traffic*



Knowledge of the users' perception of signalised intersections is important to increase the acceptance of a system. A good traffic light controller not only optimizes its control to the objectives of the road authorities, but also takes the user acceptance into account. A low acceptance might result in red light or speed violations and route alterations.
The perceived waiting time (PWT) is an indicator for the users' perception. The PWT is a measurement of how long car drivers experience their waiting time at a traffic light. Besides the actual waiting time, other factors (e.g. the number of stops or green waves) influence the PWT. Knowing the PWT in the design process is useful to increase the user acceptance of the final system. Therefore it is necessary to evaluate the PWT a priori of implementing a system. This evaluation can be performed using simulation studies.

The main objective of this study is to find a model that describes the PWT of car drivers. A literature review resulted in ten factors with various levels of influence on the waiting time perception at signalised intersections. The most important factors are the actual waiting time, the number of stops in the queue, the unused green time of conflicting traffic and green waves between adjacent intersections.
An online video survey among 159 respondents is conducted to retrieve the influence of each factor on the PWT. Respondents were shown a number of movies filmed from the drivers' perspective of a vehicle passing a signalised intersection in Den Bosch or Helmond, and after each movie the respondents were asked to estimate their waiting times and indicate if they perceive their waiting time acceptable or not.
The results of the survey are used to calibrate models for the PWT and for the user acceptance. Using these models, it is possible to estimate how car drivers experience their waiting time before a traffic light.

Both models are validated with a real-world experiment. Both in Den Bosch and Helmond, two car drivers were asked for their PWT and UA while they were driving a route over a number of signalised intersections. Together the subjects analyzed 37 situations, resulting in a positive validation of both models. Although the models are retrieved from an online video survey, they are a good prediction of the real-world PWT and UA.

A second objective was to evaluate the perceived waiting time in the traffic simulator Vissim. Using the COM-Interface, an external application is used to retrieve vehicle data from Vissim, calculate the PWT and UA for each vehicle and visualize the PWT by colouring the vehicles in the simulation.

The third objective of this study was to evaluate the differences in the users' perception of different traffic light control systems and configurations. In simulation the network controller Utopia is compared the solitaire controlled intersections, and different configurations of Utopia are compared with each other.
In the solitaire controlled scenario, the user acceptance is higher compared to the Utopia-scenario. Due to the network

optimization of Utopia, left turning vehicles and vehicles on the side roads have to wait longer, resulting in more unacceptable perceived waiting times. Alternative configurations of Utopia also have some influence of the user acceptance. More coordination on the main road, for example, results in a higher acceptance of the main road and a lower acceptance on the side roads.

In conclusion, the perceived waiting time is a good indicator for the users' perception of signalised intersections. A lower average PWT results in a higher user acceptance of a traffic light control system. According the model, the following requirements can be set to increase the users' perception of a system:

- Prevent short and long waiting times. Due to the quadratic nature of the model, both short and long waiting times are overestimated while average waiting times are perceived as they are.
- Multiple stops in the queue result in lower perceived waiting times, which impacts the user acceptance of traffic lights.
- If there is a red wave between two adjacent intersections, a short stop at the second results in an increase of the PWT, while a long stop decreases the perceived PWT.