Multi-Dimensions Motivational Factors in Autonomous Driving

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Abstract

The autonomous cars are predicted to be an optimized driver and would only have one motivation that is purely based on mobility. On the other hand, the human drivers might have more than one motivational factor when they are driving the car. Unexpected motivational factors or driving goals could suddenly occur during the driving and would usually change the way one is driving. In autonomous driving, where human has no longer control over the driving decision, the consequence of sudden occurrence of motivational factors would be the temptation to take over the automation or else one will experience mental discomfort. In this position paper, we are trying to set up an experiment to investigate how the unexpected motivational factors could tempt the driver to take over the automation from the autonomous car.

Author Keywords

Autonomous driving; motivational factors; take over

ACM Classification Keywords

H.1.2 User/Machine Systems - Human factors; I.2.9 Robotics - Autonomous vehicles

Introduction

In National Highway Traffic Safety Administration (NHTSA) Level 3 and 4, autonomous car is projected to

take over the automation either partially or completely or in other words replacing the human driver in driving the car. On the other hand, according to [1] and [2], human driver drives a car in a satisficing manner where motives and emotions are the strong driven factors. Furthermore, during the driving, the human driver will tend to achieve the "targeted feeling" or "best feeling" depending on the situation and motivation. Meanwhile, autonomous car is projected to drive in an optimized manner where depending on the situations; the car will choose the suitable speed, distance between cars, fuel consumption while maintaining the physical comfort of the driver, abiding the traffic laws and driving safely. The difference in driving styles (satisficing vs. optimized) is predicted to cause mental discomfort especially when sudden motivational factors arise during the autonomous driving mode where human driver, either assertive or defensive type of river, has no control over the automation.

Hypothesis

There are two hypotheses to be tested in this experiment:

a) Assertive human drivers have higher tendency to take over automation when a motivational factor occurs compare to defensive human drivers

b) Take over time is the shortest when "seeking for thrill" motive takes place rather than when "in pressure" or "in hurry"

Aims and Objectives

The objective of this experiment is to study the influence of motivational factors on a two type of human drivers (assertive and defensive) in autonomous driving mode. Three scenarios regarding motivational factors (hurry, pressure and thrill) in driving will be investigated.

a) To determine the temptation of the driver to take over the automation when sudden motivational factor occurred, in order to experience mental comfort

b) To determine how long one will take over the automation once the motivational factor occurs

c) To determine if the degradation of automation is required when motivational factor occurs

Theories

Differences in driving styles
According to [1] and [3], driving is determined by motivational factors and it is a process of maintaining a state of mental comfort or known as "comfort zone". In addition, "comfort zone" could be different to a different driver and every driver wants to acquire that particular "target feeling" or "the best feeling" when they are behind the steering wheel [2].

As revealed by the study done by Continental in 2015, consumers has shown that emotions are more powerful than reasons when it comes to driving a car [4].

Different driving styles (optimized vs. satisficing) and different motivations (one-dimensional vs. multi-dimensional) between autonomous car and human driver would therefore create conflicts such as temptation to take over the automation. In addition, the mismatch between driving styles and motivations would cause mental discomfort or intrusion of "comfort zone" for the human driver.

Take over

Take-over could be divided into two (2) situations:

a) Forced or involuntary take-over which comes down a situation when autonomous system would be failed soon (reaching the boundaries of AC as mentioned by [5]) or already has failed.

b) Voluntary take-over is done by the human driver because of the needs to take over the control to fulfil psychological and emotional needs.

Motivational Factor

Mobility, to get from one place to another, is one of the main motivations of why human drives a car [1]. In addition, some drivers do have other motivational factors such as to get the "targeted feelings" in driving for example, pleasure, sensation, secure and so on [2]. [1] also states that mobility and other motivational factors at the beginning of the trip will influence the decisions and chosen speed of the entire trip. However, motivational factors or goals could suddenly occur during the trip and these motives could arise from within the traffic (infrastructures, other drivers) or from outside the traffic (a phone call, a sudden realization) and hence largely influence the decisions along the trip [3].

There are three motivational factors that we are interested which are "seeking for thrill", "in pressure" and "in hurry". These three factors are chosen because they are associated with "thrill" dimension in which we used to sort the type of drivers (either assertive or defensive).

Proposed Methods

There are two proposed methods:

a) Method 1 is proposed by using the driving simulator

b) Method 2 is proposed using City Car Driving software

Proposed scenarios

There are two parts in this experiment, in the first part the participants will have to answer a set of survey to determine the type of driving styles (either defensive or assertive based on "thrill" dimension). In the second part, the participants will undergo the simulation study in autonomous driving mode from location A to destination B. There are four scenarios in which the participant will have to encounter.

a) Scenario 1 (served as baseline) – driving autonomously from A to B as shown in **Error! Reference source not found.**.

Figure 1 : Scenario 1

b) Scenario 2, 3 and 4 – driving autonomously from A to B with the implementation of motivational factor as shown in **Error! Reference source not found.**.
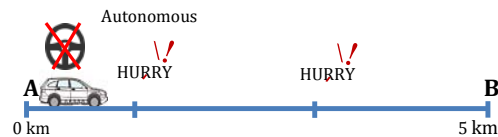
Figure 2 : Scenario 2, 3 and 4

Automation Take Over
In the experiment, the participants will be provided with a button which function is to indicate the automation take over process from the car. The participant can push the button at any time after the motivational factor has been presented and the time taken (from when the motivational factor was presented and the button was pushed) will be recorded.

In addition, in this experiment, a biofeedback signal is proposed to be implemented in order to get a continuous and instantaneous monitoring of the participants.

Acknowledgements

References

[1]   H. Summala, "Towards understanding motivational and emotional factors in driver behaviour: Comfort through satisficing," in *Modelling Driver Behaviour in Automotive Environments: Critical Issues in Driver Interactions with Intelligent Transport Systems*, 2007, pp. 189–207.

[2]   T. Vaa, "Modelling driver behaviour on basis of emotions and feelings: Intelligent transport systems and behavioural adaptations," in *Modelling Driver Behaviour in Automotive Environments: Critical Issues in Driver Interactions with Intelligent Transport Systems*, 2007, pp. 208–232.

[3]   R. Näätänen and H. Summala, "A model for the role of motivational factors in drivers' decision-making∗," *Model. Driv. Behav. Automot. Environ. Crit. Issues Driv. Interact. with Intell. Transp. Syst.*, vol. 6, no. 3–4, pp. 243–261, 1974.

[4]   Continental, "Driving beyond 2020 – Reason or Emotion ? Questions to Answer," 2015.

[5]   C. Gold, D. Dambock, L. Lorenz, and K. Bengler, "'Take over!' How long does it take to get the driver back into the loop?," *Proc. Hum. Factors Ergon. Soc. Annu. Meet.*, vol. 57, no. 1, pp. 1938–1942, Sep. 2013.