I am the Greatest Driver in the World!

-Does self-awareness of driving ability affect traffic safety behaviour?

Master's report 30 credits, written by

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Abstract

This simulator study aims to investigate if there is a relationship between self-awareness of driving ability and traffic safety behaviour. Self-awareness in this study is accurate self-evaluation of one's abilities. By letting 97 participants (55-75 years old) drive the simulator and answering the Driver Skill Inventory (DSI; Warner et al., 2013) as well as the Multidimensional locus of control (T-loc; Özkan & Lajunen, 2005). A measure of self-awareness was computed using the residuals from regression line. Furthermore, this measure could show if a participant over-estimated or under-estimated their ability. Four self-awareness measures were made. The self-awareness measures were compared to traffic safety behaviour. Three different traffic safety measures were computed using specific events in the simulator scenario. The self-awareness measures were grouped into three groups; under-estimators, good self-awareness and over-estimators. These groups were then compared to each other with respect to traffic safety. A multivariate ANOVA was made to test for differences between the self-awareness groups but no significant main difference was found. The results showed no difference in traffic safety behaviour given the different levels of self-awareness. Furthermore, this could be a result of the old age of the sample group as self-awareness may only be relevant in a learning context. The conclusion of the study is that the analysis shows that there is no difference between over-estimators and under-estimators of driving ability, at least not in experienced older drivers.

Keywords: Human factors, Driving Ability, Self-awareness, Traffic Safety Behaviour, Simulator study, Self-assessment, DSI, Traffic locus of control, Over-estimation

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List of definitions

Metacognition - knowledge about ones own knowledge (cf. Brown, 1978)

Self-awareness (Self-a) – How accurate one's self-assessment is.

Traffic safety behaviour (TS) - Avoiding accidents and dangerous situations as well as having good marginal for avoiding them.

Driver skill inventory-questionnaire (DSI) - The DSI consists of eleven items targeting perceptual motor skills and nine items targeting safety skills in traffic. The Swedish version of the DSI questionnaire used can be seen in the appendix. (Warner et al., 2013)

The multidimensional locus of control (T-loc) – This is a questionnaire that asks if the driver him/herself or other drivers are more likely to cause an accident (Özkan & Lajunen, 2005).

The Goal Driver Education matrix (GDE-matrix) –The GDE-matrix is a definition of what is needed for a good driver education (Hattaka et al., 2002).

1 Introduction

Everyday there are car accidents and each time you go for a drive you are taking a risk of being a part of an accident that is caused by you or someone else on the road. However, what is the difference between people that are subject to accidents and people who are not? It could be argue that it is the control of the vehicle and the understanding of the traffic legislation, which would probably be correct to some extent. According to the Swedish ministry for traffic, traffic safety is dependent on several factors. It could be either dependent on contextual factors, for example, weather conditions or internal cognitive problems such as reaction time or alertness as well as how a driver can plan and cooperate with other drivers (Trafikverket.se, 2014). However, in this study the focus lies on the driver in the context of other drivers. Specifically, the study will investigate how metacognitive ability affect traffic safety behaviour of the individual as well as in the context of other drivers. Metacognition is knowledge about ones own knowledge (cf. Brown, 1978). How does metacognition affect driving ability and as this study will investigate - how does self-awareness of driving ability affect traffic safety behaviour? In this study self-awareness is defined as the ability to know ones own weaknesses/strengths and limitations (Bandura & Cervone, 1983; Lundqvist & Alinder, 2007).

Metacognitive skills have been shown to be very important for reaching expert level in a skill (Kolb, 1984; Mezirow, 1990). Therefore, it should be equally important for reaching a safe driving skill level; not only in driver education but also in the continuous improvement the driver receives whilst driving (Hattaka et al., 2002). In a previous student thesis by the author (Sommarström, 2015) the relationship between self-awareness and traffic safety was investigated. The results pointed to self-awareness having no effect on traffic safety behaviour. This relationship will be investigated further in this study. Furthermore, the study will investigate how one's perspective on oneself and other drivers might affect traffic safety. In other words, if a driver over-estimates his or hers driving ability, would that estimation have a negative effect on traffic safety behaviour.

1.1 Traffic safety behaviour

Traffic safety behaviour in this paper refers to avoiding accidents and dangerous situations as well as having good marginal for avoiding them. Svensson (1998) analysed data from 1991 in Finland and the US. These data showed that the average driver is involved in one accident every 7,5 years or once every 150 000 km. Furthermore, near incidents happens once every month or once every 2000 km for the average according to the same statistics. If a driver would exceed this statistic then that would make that driver more liable to be involved in more accidents since that driver would be an outlier. Likewise, if a driver were involved in fewer accidents than the average, it would make the driver safer than the average. Using these statistics the safety of a driver could be calculated. Furthermore, through measuring how a person acts in certain situations in a vehicle or in a simulator this could give an estimate of a person's traffic safety behaviour; this is how traffic safety behaviour is tested in this study.

1.2 Self-awareness

When people have been asked to rate how good their driving abilities are compared to the rest of the population there is a tendency towards over-estimation. Furthermore, it has been shown in several studies that people tend to be better at driving then 60% of the population which, of course, is not possible since it would mean that there is a skewed normal distribution of driving skill in drivers (Amado et al., 2014; Groeger & Grande, 1996; Stapleton, Connolly & O'neil, 2012; Svenson, 1981). This suggests that people are driving beyond their ability. However, these results are under some scrutiny since the term "average driver" may be seen as negative and therefore affect the drivers' rating of themselves (Groeger & Grande, 1996). Furthermore, this might have been a problem in reliability of the questionnaire used; people will interpret the scale on a questionnaire differently compared to others even though they might mean the same thing. In this study the Multidimensional locus of control questionnaire (T-loc; Özkan & Lajunen, 2005) will be used to assess self-awareness which will allow the researcher to see whether the participant think him/herself worse or better than other drivers.

In a series of studies by Kruger and Dunning (1999) self-assessment versus actual performance was investigated. A pattern was found that participants who were very good at a skill under-estimated their ability, or rather, their score at the testing. For participants who were incompetent in a skill it was found that they over-estimated their ability vastly. This result was explained by two different biases. Participants who under-estimated their skill suffered from the false-consensus bias – if I am this good my peers are equal or better. The over-estimators were credited to the over-confidence bias – over-confidence in ones abilities. This led to the conclusion that the more knowledge you have in a skill, the worse you think you have performed. In other words, people who are incompetent are only incompetent because they do not have the knowledge to remedy their own incompetence (Kruger & Dunning, 1999).

The work by Kruger and Dunning tested several different skills and implied a relation between self-assessment and the knowledge of the specific skill. The more knowledgeable a participant was the less the participant over-estimated him/herself. This might be a similar aspect of self-awareness that should be noted (i.e. different self-awareness for different skills). Would the results from this study be true for the driving context too? In a previous work by Sommarström (2015) it was shown that there was no noticeable effect between ones self-awareness and the exhibited traffic safety behaviour. However, this result could be the effect of a comparison to the wrong kind of self-awareness? Furthermore, if there were several different kinds of self-awareness there would be no practical difference between self-assessment and self-awareness. This will be further explained later in this report on the basis of the results.

In an attempt to classify what good driver education is, the Goal Driver Education matrix was created (GDE-matrix, Hattaka et al., 2002). The GDE-matrix points out that there are three different important aspects, or goals, of good driver education. These are "Knowledge and skills" (e.g. Knowledge about traffic legislation and the cognitive and motoric skills to drive), "Risk-increasing factors" (e.g. Knowledge about potential risks in traffic) and lastly "Self-evaluation" (e.g. learning from mistakes to better oneself) (Hattaka et al., 2002; Peräaho, Keskinen & Hatakka, 2003). Self-awareness is in the context of this study how accurate self-evaluation is in traffic, which is in line with the previous definition that self-awareness would be to know one's strengths/weaknesses as well as limitations. Therefore, self-awareness might only be important for learning a new skill and improving it. This might be why good self-awareness does not automatically entail traffic safety behaviour, which was shown in the previous work by Sommarström (2015).

There are some previous studies that have been working on self-awareness as a measure. These have been on-road studies where the participant has to rate how well the driving went and then compare this to an objective assessment by a driving instructor (Lundqvist & Alinder, 2007; Mallon, 2006). From the comparison a self-awareness measure could be made. These studies found that drivers who over-estimated their driving performance were more likely to fail on an actual driving test. In a previous work by Sommarström (2015) a similar measure was made but instead of an on-road exam a simulator was used. Performance was compared to the participants rating of their driving ability. The questionnaire used to assess participants' self-assessed driving ability was the Driver skill inventory-questionnaire (DSI; Warner et al., 2013). The DSI consists of eleven items targeting perceptual motor skills and nine items targeting safety skills in traffic. The Swedish version of the DSI questionnaire used can be seen in the appendix.

As mentioned earlier and as a compliment to the DSI this study will use the T-loc-questionnaire (Özkan & Lajunen, 2005). The T-loc asks questions regarding what is more probable to cause accidents in traffic. Furthermore, the reason for using this as a compliment for the DSI is that the T-loc might lead to an assessment that is more suitable comparison to traffic safety behaviour. The Swedish version of the T-loc questionnaire used can be seen in the appendix.

1.3 The driving task[1]

A driver with great "Knowledge and skill" is not necessarily a better or safer driver. A driver that is more skilled and knows it the driver might increase the task difficulty (Hattaka et al, 2002; Evans, 1991; Näätänen & Sumala, 1974). With higher technical skill it is more likely that the driver would take more chances of, for example, overtaking in heavy traffic and/or focusing on more secondary tasks, which would lead to more risk for the driver, instead of less risk (Evans, 1991). This would be in line with the risk homeostasis theory, which states that every person has a risk target level that they try to work towards (Hoyes, Stanton & Taylor, 1996). However, this would still affect a driver with good self-awareness. This is only to point out that increasing technical skill would not affect traffic safety behaviour in general. More experience of driving before acquiring a license has shown a decrease in traffic accidents involving novice drivers. However, it is argued that this is not because the novice has an increased technical ability but rather that the driver becomes more aware of the risks of driving and learns to handle situations that could lead to accidents (Gregersen et al, 2000; Hattaka et al, 2002). Furthermore, this would be in line with the GDE-matrix, which states that "Risk-increasing factors" are one of the three factors of driver education.

In the GDE-matrix self-evaluation is an important aspect of driving because it regulates the other factors of driving education. Self-evaluation is also the main factor that is important to continuously as a driver after he/she has gotten the driver's license. Furthermore, it is shown that metacognitive skills are important for achieving an expert level of a skill. However, a driver needs to know the limits of his or hers skill in order to improve them (Hattaka et al., 2002). Furthermore, since car driving is essentially a self-paced action, where the driver decides risk factors such as speed and distance to next vehicle, good self-awareness would effectively lead to avoidance of risky situations and accidents (Bailey, 2009; Hatakka et al., 2002; Näätänen & Sumala, 1974).

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[1] Parts of this text are similar to previous student work by author (Sommarström, 2015).

Performance in traffic could loosely be divided in to three categories. These would be the three levels of performance (i.e. strategic, tactical and operational) according to Michon (1979). The strategic level would be how the driver plans the trip before driving. Tactical performance regards the planning of actions, which are executed at the operational level. Hence, the tactical level requires knowledge and awareness of ones own ability on the operational level (Lundqvist & Alinder, 2007; Michon, 1979). If this is correct, different accidents could be divided in to these three categories even though some accidents are the result of a combination of several levels. If a pedestrian would suddenly walk out onto the road an accident can be avoided with adequate reaction time, which would correspond to the operational level. However, the driver might have been able to slow down the car and be ready to break if the driver suspects that someone would suddenly walk out onto the road, this would correspond to the tactical level. Here the categories become quite indistinct since it is difficult to place the accident into a specific category. Thus, it should be reasonable to assume that accidents can be caused more or less by inadequate self-awareness but perhaps not solely because of it. Accidents on the strategic level would refer to bad planning of the journey, such as driving at night or having to drive faster because of a time constraint. Thus, a line must be drawn on which accidents to focus on and understand which accidents are caused by inadequate self-awareness and which are caused by inadequate reaction time or other factors.

The Swedish statistics of accidents from 2013 (Transportstyrelsen.se, 2014) list the most usual car accident types and their frequency. Five of the most frequent car accidents are accidents with pedestrians or bike/moped, accidents where two cars meet, accidents where one car drives in to another car from the rear and accidents where a single car crashes. An analysis of the reason for the accidents from this papers point of view would be that accidents where a single car crashes or when a car drives in to the rear of another car would be caused by lacking self-awareness on he tactical level. For example, if the driver has too little space to the car in front or that the driver drives to fast and looses control of the vehicle. The other accidents would more likely be the cause of mistakes at the strategic level (e.g. Driving while tired). Accidents where you meet a car or hit a pedestrian or bike/moped could be caused by both lacking self-awareness and inadequate reaction time. In some cases the driver may be able to plan ahead to avoid the accident but in some cases a car, bike or moped will suddenly just loose control and drive in to the wrong lane or similar.

1.4 Self-awareness and perspective on other drivers

The traffic context is dependent on cooperation between vehicles and humans. A driver and a car that are working towards a shared goal can be seen as a cognitive system (Hollnagel & Woods, 2005). Traffic situations with several cars could therefore be seen as joint cognitive systems. For a joint cognitive system to work there would have to be some sort of communication between system entities. This communication could be built up through joint activities and common ground between the agents in the system (i.e. the cars in the traffic) (Clark, 1996). Common ground is the shared knowledge and beliefs between two or more people (Clark, 1996). Joint activities are activities where several agents share a public goal and on some level work towards it. Furthermore, each agent would have his or hers own private goal (Clark, 1996). In the traffic context the public goal might be to avoid accidents. A private goal could be for each driver to arrive at a certain destination and/or within a specific time frame. In this example the private goal would be dependent upon the public goal to be completed (Clark, 1996).

In the traffic context the smallest part of communication would be signals (Clark, 1996). A signal from a car could be, for example, sounding the horn, head nods, hand gestures or blinking with your lights or slowing down before a zebra crossing to let pedestrians know that they can pass safely. The interpretation of these signals depends upon the common ground between the drivers/pedestrians (Clark, 1996). More experienced drivers would therefore lead to a broader common ground between system entities, which should lead to fewer accidents caused by miscommunication in traffic. If a driver adequately communicate his/hers intentions other drivers will understand the driver if common ground is achieved. However, if the driver over-estimates what the other drivers understand or violates established signal patterns, it could lead to accidents. Furthermore, an over estimation of the traffic situations could be the result of the driver failing to comprehend potentially risky situations which could result in an accident. For example, if two drivers would meet in a four-way intersection with stop signs in every direction. The drivers would have to be capable of signalling to each other about who drives first. Of course, this is done by using the indicators, but suppose two of the cars are signalling to go straight across (i.e. forgets to indicate direction). This could potentially lead to a situation where one driver drives across at the same time as the other driver turns right into the car – if both the drives would have misinterpreted signals given by each other. For this reason self-awareness could be an important factor in a traffic situation in conjunction with other drivers and not only individually; a driver with good self-awareness would be less likely to assume common ground with other drivers where there is none (Clark, 1996). However, a driver with a good self-awareness would not only rely on signals but also on experience which could mitigate the bad communication and avoid potential accidents. In this study this will be tested by investigating how the belief of one's own skill compares to the belief of other drivers' skill is related with traffic safety behaviour.

1.5 Operationalization[2]

As mentioned earlier, this study will measure self-awareness using the DSI (Warner et al., 2013). However, only selected DSI-items will be used to measure driver's estimation of their driving ability and comparing those with their actual ability in a simulator. For example, one DSI-item is; "Conforming to the speed limits?". The participant answers if this is a weak or a strong ability on a scale from one to five, one being definitely weak and five being definitely strong. In the simulator this exact question will be tested with an event or stretch in the

[2] Parts of this text are similar to previous student work by author. (Sommarström, 2015)

scenario and then compared to the self-assessment from the DSI. This will give an estimation of how much the drivers own idea of his or hers ability differs from ability in the simulator. Furthermore, this is similar to other studies where drivers have had to rate themselves after a drive with an instructor as well as getting rated by the instructor. The self-assessment and the instructor's assessment would then be compared to each other (Lundqvist & Alinder, 2007; Mallon, 2006). The comparison between assessment and performance will be repeated for five of the DSI-items that are possible to measure in the scenario. As mentioned earlier the DSI was split in two parts - perceptual motor skills and safety skills. Theoretically, the items that tests perceptual motor skills should be related and vice versa. Therefor, the five different self-awareness measures were split into two groups – perceptual motor skills and safety skills.

Another way of measuring self-awareness in traffic is to use the T-loc, which contains a list of 17 items regarding to what accidents can be credited to in traffic (Özkan & Lajunen, 2005). For example, "Are accidents caused by faults in *my* driving ability" and "Are accidents caused by faults in *others'* driving ability". As with the DSI-questionnaire the T-loc has sub-categories. These are "Self", "Fate", "Other drivers" and "Vehicle and environment". In this study only "Self" and "Other drivers" will be used. The reason to use this questionnaire would be because it asks questions related to accidents rather than weak and strong aspects of the participants driving behaviour as in the DSI-questionnaire. This might therefore be a better questionnaire to calculate self-awareness from when it is related to traffic safety measures.

The self-awareness measurement in the T-loc will be calculated in the same way as the self-awareness measurement from the DSI. The T-loc assessment will be compared to actual performance in the simulator where each T-loc item is compared to a corresponding situation in the simulator. For example, one question in the T-loc is about if the participant often drives above the speed limit. This is tested in a specific event in the simulator to see how well the participant can stay below or on the speed limit. Then the comparison between the participant's self-assessment and the actual performance in traffic safety is tested.

Using the T-loc, it is possible to see how the participant rates her/him-self compared to the rest of the population. For example, five paired questions are built up according to the following structure: First question, "Deficits in my driving ability" and the second, "Deficits in others driving ability". From this it is possible to get a delta-value (i.e. difference between the two answers) to see if the participant rates others in the same or a similar way or if the participant thinks her/him-self much better or worse than other drivers. Using the T-loc in this manner takes away the reliability problem of many questionnaires where the researcher does not know how the participant has interpreted the question. Using this method a participant who has answered 2 on the scale can be the same as another participant who answered 4 if both participants have given similar answers when compared to the rest of the population, in other word if the delta-value between the two items is the same for both participants. This will be done with the five pairs of items in the T-loc and when these are added together it will give an overall value of locus of control (i.e. Who is/are responsible for accidents) for each participant.

Traffic safety behaviour will be measured in the simulator using different measurements of performance. However, there is no research that specifically states how traffic safety behaviour should be measured. Therefore, this will be done using several different events in the scenario. For each event it was decided theoretically what was a safe behaviour in the given situation. For example, merging in traffic was deemed safe if the participant held a high time to collision (TTC) to the cars in the front and behind (Lee, 1976). TTC measures the time in seconds to when both cars will collide. The calculation needs to account for both the cars speed and trajectory and calculates the time to the point they will collide. Hence, if two cars are driving along side each other and their trajectory never intersects the TTC-value will be infinite but if one car changes its course so that the trajectories intersect there will be a TTC measure in seconds. Two different events and several distances of the scenario were used to capture different aspects of safe driving behaviour. For example, the different events involved distance in time to a ball rolling over the road and reaction time to a girl walking out onto the road from in front of a bus. Furthermore, several distances were used to capture aspects such as speed keeping in different settings and speed limits of the scenario. It should also be noted that even though the same measurements might be used to create the self-awareness variables and the traffic safety variables, different distances and places of the scenario was used so that no variance overlaps between the self-awareness variable and the traffic safety variables. In the method part of this study a more specific description of the different variables (i.e. Self-awareness with T-loc and DSI, Traffic safety variables) will be described.

1.6 Research Questions

In the previous work by the author (Sommarström, 2015) it was noted that the two self-awareness variables of the sub-categories of the DSI were not correlated. It is the hypothesis that this effect will remain with comparison to the new self-awareness measures since these are measuring different skills. This will cast light upon whether self-awareness is more similar to the self-assessment as proposed by Kruger and Dunning (1999) and that there might not be a general measure for self-awareness to be assessed.

In addition to the previous research question, it is of interest to see if the T-loc self-awareness variable can predict traffic safety behaviour. The reason for investigating this is because the T-loc questionnaire is about accidents and traffic safety rather then strong and weak driving ability, which the DSI is about. Furthermore, in the previous work by the author an effect between the DSI self-awareness variable and the traffic safety variable could not be found. A comparison between T-loc self-awareness variables and traffic safety behaviour is therefore of interest to further investigating the previous results.
This study will also see if participants who are good drivers (i.e. exhibit safe traffic behaviour) tend to under-estimate themselves compared to others or not and if bad drivers tend to over-estimate themselves compared to others. Both of

these questions will be answered by grouping the self-awareness measures in different categories based on how accurate participants have assessed themselves, then comparing this to how safe the different groups performed in the simulator.

It is also of interest to see whether participants who think themselves better than other drivers tend to exhibit more unsafe traffic behaviour. This comparison will be made using the summed delta values from the T-loc questionnaire and comparing these to traffic safety variables.

1.7 Hypothesis

Given the research questions the following hypotheses are made:

1.7.1 Hypothesis 1

Because of the differences between what the DSI and the T-loc questionnaire tests there will be no correlation between all the self-awareness measures, given their different sub-category in the T-loc and the DSI.

1.7.2 Hypothesis 2

Because of the similarities in context between the items in the T-loc questionnaire and traffic safety the self-awareness measures made from the T-loc questionnaire this will be able to predict traffic safety behaviour.

1.7.3 Hypothesis 3

Participants who over-estimate themselves compared to the rest of the population will exhibit less traffic safe behaviour than participants who under-estimate themselves.

1.7.4 Hypothesis 4

Participants who think that other drivers are worse than him/herself as measured by the T-loc will exhibit less traffic safe behaviour both by themselves and in context with other drivers.

2 Method[3]

2.1 Participants

98 participants completed the questionnaires and drove the simulator. The sample consisted of 33% women and 67% men. Participants were between 55 and 75 years with a mean age of 64.6 (*SD* = 5.8). Participants that did not finish the simulator scenario or any of the questionnaires were excluded from the data. 20 participants did not finish the simulator scenario due to simulator sickness or other reason for cancelation. Due to a problem with recording the data in the simulator there was only 27 full recordings of data from the simulator and the rest of the recordings only contain the last part of the simulator scenario. The variables were however adapted to this problem so that most of the analysis use data from all the participants.

The requirements for a participant to be contacted were that their age should be between 55 and 75, this was chosen due to constraints from the main project for this data set. They should have a normal field of vision and as well as driving at least 1500 kilometres per year. These requirements were used because the sample group were made to correspond with a test group from another study. Participants were contacted via mail through the Swedish vehicle registry. From a list of possible participants a randomized sample of participants were selected. All participants lived in the Linköping area in Sweden. The participants received 500 SEK for participating even if they did not complete the test.

2.2 Questionnaires

The driver skill inventory (DSI) was used to rate self-awareness (Warner et al., 2013). The DSI consists of eleven items relating to perceptual control skills such as car control and nine items relating to safety skills. The participant answers each question with the participant's weakest and strongest sides in mind. Each

[3] Previous student work by the author uses a similar method and therefore some parts are similar to the original unpublished student work. (Sommarström, 2015)

item is constituted by a question and a five-point scale where 1 is "definitely weak" and 5 is "definitely strong".

The participants answered the T-loc about what the likeliness of something causing an accident is and their perspective on contextual factors affecting potentially dangerous situations (i.e. what factors in traffic are responsible for accidents) (Özkan & Lajunen, 2005). This questionnaire consisted of seventeen items, which were rated on a five-point scale, 1 being "not at all likely" and 5 being "definitely likely".

After driving the simulator the participants answered a questionnaire with questions regarding driving experience of the simulator and their traffic experience. Furthermore, participants answered a questionnaire regarding their involvement in traffic accidents in the last three years. This questionnaire was however rejected from the analysis since it was noticed that almost none of the participants answered more than zero accidents on the questions. Furthermore, one of the questions that related to near-incidents was interpreted differently by many participants and therefore could not be analysed for within group.

2.3 Simulator

The simulator that was used in the study is the "Simulator III" at VTI in Linköping. It is a motion-based simulator that can simulate lateral and longitudinal forces. The simulator uses a vibration table under the chassis to simulate contact with the road and provide a more realistic driving experience. The graphics are PC-based and uses six projectors to create a 120-degree frontal view and three smaller screens for the rear-view mirrors. The simulator can be used with either manual or automatic gearbox. In this study the automatic gearbox was used. The simulator can be seen on the picture below.

Figure 1 – The "Simulator III" at VTI Linköping

2.4 Procedure

When contacting participants via mail they were given the DSI and the T-loc questionnaire. Participants answered these at home and then handed them in to the researcher before driving the simulator. The test took approximately 90 minutes and consisted of driving two simulator scenarios. After the scenarios were finished the participants answered one questionnaire about accident-involvement and one questionnaire about the simulator in general.

Before driving the scenarios participants were given seven minutes of practice in the simulator. During this time participants could ask the researcher questions, which they were told not to do during the test scenarios. Participants then drove the first scenario of two.

2.4.1 Scenario 1

The purpose of this scenario was to test the participant's driving ability and driving safety skills. The scenario consisted of a two-lane rural road, a four-lane highway and finally driving in an urban environment. During each stretch the participants were faced with potentially dangerous events, for example, merging in heavy traffic or having to emergency-break before "hard-to-see" pedestrians' walking/running out onto the road. These events were scattered throughout the different settings and environments of the scenario. The scenario lasted for 50 minutes. Once the participants had completed the scenario, they stopped the car and got ready for scenario 2. How the scenario looked for the driver can be seen in the three sample pictures of the scenario below.

Figure 2 – An example of rural driving in the simulator.

Figure 3 – An example of driving on highway in the simulator.

Figure 4 – An example of city driving in the simulator.

2.4.2 Scenario 2

The purpose of this scenario was to test the participant's reaction time to visual stimuli. Participants fitted themselves with two clickers, one on each index finger. The participants had received instructions on how to use and attach the clickers before starting the first scenario. During the scenario, if the simulator screen showed a blue/white road sign the participant was instructed to click the left index finger clicker. If the screen showed a red/yellow sign they were to click the right index finger clicker. The scenario lasted for 7 minutes. This data could then be analysed according to signal detection theory to see the ratio between true hits/misses and false hits/misses (Solso, 1988). For a further explanation of a similar test see Jenssen (2003).

After the participants were finished driving they filled in a questionnaire about the simulator as well as the questionnaire about their accident involvement the last three years.

2.5 Analysis

2.5.1 Experimental Design

The four different hypotheses use four different experimental designs and will be presented below.

2.5.1.1 Design 1

The first hypothesis has a within group design where the different measures for self-awareness from the DSI and the T-loc are analysed for correlations.

2.5.1.2 Design 2

The second hypothesis has a between group design. The independent variable is the different groups of the self-awareness measure (Self-A measure). The four T-loc Self-A measures are each grouped into three groups depending on what value the participant exhibits. These groups are under-estimators, good self-awareness and over-estimators. Under-estimators are classes as the mean value plus half the standard deviation of the self-awareness measure, over-estimation was the mean value minus half the standard deviation and finally good self-awareness was classed as the values between the under and over estimators. The dependent variable for this hypothesis is traffic safety behaviour; this variable is defined later in the measures section of the method.

2.5.1.3 Design 3

As with hypothesis 2, hypothesis 3 also has a between group design where the independent variable is the groupings of self-awareness and the dependent variable is the same traffic safety measures as the previous hypothesis 2. However, the groupings of self-awareness are different in this design. Here there are only two groups of self-awareness and those are over- and under-estimators. Over-estimators are defined as everything below the mean value and under-estimators are defined as everything above the mean-value.

2.5.1.4 Design 4

Hypothesis four has a between group design where the two groupings of T-loc delta are the independent variable. This grouping is made using frequency tables of the distribution. The distribution was grouped into three roughly equal sized groups. Group 1 = participant assesses him/herself similar to his assessment of other drivers, Group 2 = the participant assesses him/herself as safer that other drivers, Group 3 = the participants assesses him/herself as much safer than the other drivers. The dependent variable of this hypothesis is traffic safety behaviour as defined in a later part of the method.

2.5.2 Simulator measures

To measure how a participant has performed in the simulator each event in the scenario needs different measures. The reason for using different measures and not a single one is that each unique measure gives different aspects of the driving behaviour of the participant. The measures used in the study are the following: Time to collision (TTC), Time head way (THW), two different measures of Speed-keeping and reaction time. These will be explained in more detail below.

- TTC, as mentioned earlier, measures the time until the participant's car and another car will collide, given the speed and trajectory of both vehicles. The minimum TTC a participant reached was the TTC-measure for that event. (Lee, 1976)

- THW measures the time until the next vehicle if the vehicle in front would suddenly stop, this does not take trajectory or speed of the other vehicle into account. As with the TTC-measure the THW also only uses the minimum value for an event. TTC can be said to measure cooperation in traffic and THW measures the safe behaviour of the individual in the traffic context.

- Speed-keeping in this study measures the variance of the speed during a period of time.

- Reaction time is measured in milliseconds between the time it takes for a participant to react to an object after it becomes visible (i.e. pedestrian walking out from behind a bus).

- Speed-exceed is a ratio between how many times the participants is driving below and above the speed limit.

Speed-keeping and reaction time will have an inverse value compared to the others since all values need to be the higher the better or vice versa to be able to compare to each other. This does not affect variance at all.

2.5.3 Calculating Self-awareness and Traffic Safety Behaviour measures

In the design the independent variable was self-awareness (Self-A) and the dependent variable was traffic safety behaviour (TS). To measure Self-A specific DSI items were compared with the participant's actual performance in the simulator. For example, one of the items in the DSI is "Conforming to the speed limits" where the participants answered a number between one and five (one being definitely bad and five being definitely good). Self-A was then calculated using the residual values from a linear equation between a specific DSI item and its simulator counterpart. This method of using residuals is illustrated with the graph below. The linear equation is the optimal Self-A compared to the normal distribution of all the participants and the difference between the line and the participants' actual answer and performance is the Self-A measure.

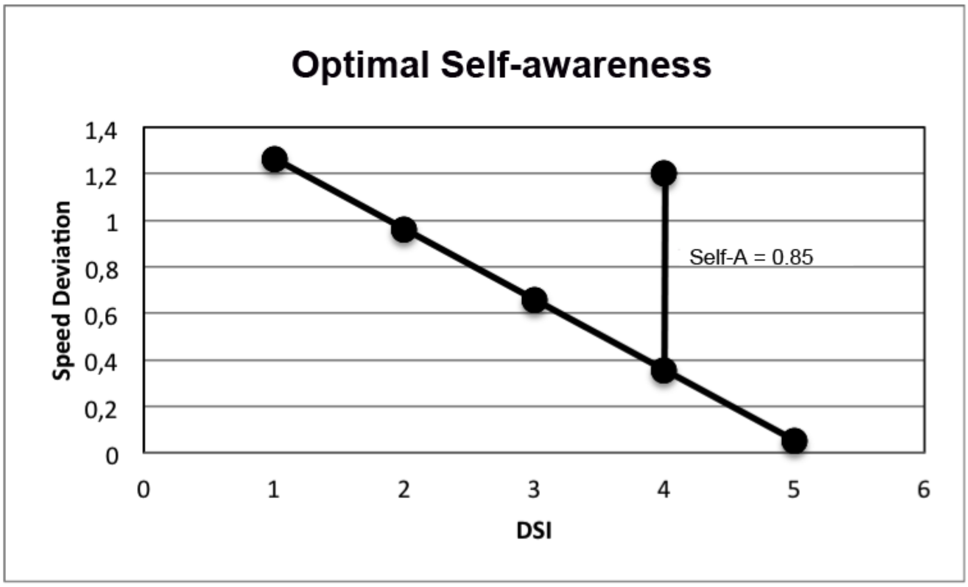

Figure 5 – The regression line is the optimal Self-A given a specific DSI answer. If a participant answers a four on the DSI and shows a speed deviation of 1.2 the true Self-A for the participant would be 0.8475, the

difference between the actual and the optimal Self-A (i.e. the residual). It should be noted that this is only an example and not actual data.

Five variables for Self-A were created from DSI items 1 (i.e."Fluent driving"), 5 (i.e. "Predicting traffic situations ahead"), 7 (i.e."Fluent lane-changing in heavy traffic"), 11 (i.e. "Keeping a sufficient following distance") and 16 (i.e. "Conforming to the speed limits"). These items were compared to suitable simulator measures that reflected on the nature of the item. The residuals were calculated for each DSI-item. These five Self-A measures were then unified using the categories of the DSI, which reduced self-awareness to two variables; "Traffic safety skills" (DSI 1, 5 and 7) and "Perceptual motor skills" (DSI 11 and 16). In the table below the different measures used for each DSI item is presented.

DSI item	Simulator measure
DSI 1 - Fluent driving (Traffic safety skills)	TTC, Lane-keeping, Speed keeping
DSI 5 - Predicting traffic situations ahead (Traffic safety skills)	Reaction time to breaking before a pedestrian walking/running out onto the road.
DSI 7 - Fluent lane-changing in heavy traffic (Traffic safety skills)	TTC
DSI 11 - Keeping a sufficient following distance (Perceptual motor skills)	THW
DSI 16 - Conforming to the speed limits (Perceptual motor skills)	Speed keeping

Table 1 – A table over what measures was used for each used DSI item

The Self-A from the T-loc variable was computed in the same manner as the Self-A from the DSI. This was done because one of the hypothesis entails a comparison between both different Self-A measures. The specific items used in the T-loc were the following: T-loc item 2 (i.e. "My own risk-taking"), 7 (i.e. "I often drive with too high speed"), 9 (i.e. "I drive to close to the car in front") and 16 (i.e. "My own dangerous over-taking"). As with the DSI questionnaire the T-loc consist of sub-categories that groups the different items. These are "Self", "Other drivers", "Fate" and "Vehicle and environment". The chosen items for the Self-A measures are only from the "self" category, they will however be compared to corresponding items in the category "Other drivers". The following table shows what measure is used for each T-loc item.

T-loc item	Simulator measure
T-loc 2 ("My own risk-taking")	TTC
T-loc 7 ("I often drive with too high speed")	Speed-exceed
T-loc 9 (. "I drive to close too the car in front")	THW
T-loc 16 ("My own dangerous over-taking")	THW TTC to the car behind

Table 2 – A table over what measures were used for each T-loc item.

As mentioned earlier a delta-value was computed between five pairs of items in the T-loc. In the table below the items used are shown sorted into their corresponding pair.

T-loc item	Question
T-loc 1 T-loc 3	"Shortcomings in my driving skills" "Shortcomings in other drivers' driving skills"
T-loc 2 T-loc 4	"My own risk-taking" "Other drivers' risk-taking"
T-loc 7 T-loc 8	"I often drive with too high speed" "Other drivers drive often with to high speeds"
T-loc 9 T-loc 10	"I drive to close too the car in front" "Other drivers drive too close to my car"
T-loc 16	"My own dangerous overtaking"

T-loc 15	"Other drivers' dangerous overtaking"

Table 3 – Table over the items in the T-loc used to create the delta values, sorted into their correct pair.

Two different values using the delta-values were created. The first variable summed up the differences between the two items in each pair. For example, if answer were: T-loc 1 = 1 and 3 =3, the value for that participant would be -2 (i.e. 1-3 = -2). Each participant has five of these values, which are summed together to create the variable. Furthermore, this variable could see if a participant were more prone to assess him/herself as safer or less safe than the rest of the population.

The second variable that was created used the mean value between the answers in each pair and summed these up. Using our example from previously, this value would instead be 2 instead of -2. This value can show what the participants perspective on what causes accidents, since a T-loc 1 = 1 would suggest that the participants think it is impossible for him/her to be the cause of an accident, a value of T-loc 1 > 1 would instead give a small probability of it. These variables were then split into three groups each depending on the frequencies of the values with the distribution in mind so that each group had roughly the same amount of participants.

The Traffic safety variable (TS-variable) was measured using specific events in the scenario. For each event different measures were chosen depending on what was deemed as safe traffic behaviour in that specific event. For example, one event consisted of keeping a safe following distance to the car in front; in this case distance to the car ahead was measured in seconds with regard to the participants own speed (i.e. THW). For other events in the scenario measurements such as speed keeping and reaction time were measured depending on what was relevant and traffic safe for that event. The different traffic safety measures summed up to three different TS variables with different measures between them. The following table shows what simulator measure was used for each of the three variables/events.

TS - variable	Simulator measure
TS 1 (Reaction time to a girl walking out onto the road from behind a bus)	Reaction time
TS 2 (Four different sections where speed-keeping was measured)	Speed-keeping
TS 3 (A ball rolling over the road)	THW

Table 4 - A table over what measures were used for each TS variable and what events they are derived from.

Some of these measures are such as the reaction time and speed-keeping have an inversed relationship to THW. Because of this both of these variables were inversed before analysis.

2.5.4 Statistical tests

To test for normality both Shapiro-Wilk and Kolmogorov-Smirnov were used.

2.5.4.1 Design 1

Pearson's correlation coefficient was used to test the correlation between the Self-A measures of the DSI and T-loc.

2.5.4.2 Design 2,3,4

A main MANOVA was made to test for main effects between the groupings (See the experimental design for each hypothesis) of the independent variables (the T-loc Self-A measures) and the dependent variables (TS-variables). If one MANOVA was significant pairwise comparisons were made using Bonferroni correction to see where the effects were.

In hypothesis 2 a linear regression is used to see if Self-A could predict traffic safety behaviour. To do this, Self-A was computed into an absolute value.

3 Results

3.1 Hypothesis 1

Because of the differences between what the DSI and the T-loc questionnaire tests there will be no correlation between all the Self-A measures, given their different sub-category in the T-loc and the DSI.

Below are the descriptive data for the DSI Self-A measures. These are normally distributed as tested with Kolmogorov-Smirnov.

Self-A-Measure DSI	N	Min. Value	Max. Value	Mean (SD)
Perceptual motor skills	20	-1.02	1.81	0.063 (0.68)
Safety skills	24	-0.94	1.43	0.006 (0.575)

Table 5 – Descriptive statistics of the Self-A measures from the DSI.

Below are the descriptive data for the T-loc Self-A measures. These are also tested for normality of distribution. The measures that are not normally distributed are marked with an asterisk (i.e. "*"). The closer to zero this value is the more self-aware the participant is. Negative value suggests over-estimation and positive value suggests under-estimation.

Self-A-Measure T-loc	N	Min. Value	Max. Value	Mean (SD)
T-loc 2	77	-5.97	6.22	-0.954 (2.18)
T-loc 7*	79	-26.33	9.38	-11.21 (7.93)
T-loc 9	77	-3.54	2.31	-0.65 (1.37)
T-loc 16	21	-0.93	0.58	-0.15 (0.39)

Table 6 – Descriptive statistics of the Self-A measures from the T-loc.

Results showed that there were no correlation between any of the Self-A variables from the T-loc and the DSI, $p > 0.05$. There was however one significant effect but this was disregarded to possible shared variance. Below is a correlation-matrix of the test. Significant correlations are marked with an asterisk (i.e. "*")

Self-A-Measure	DSI - Perceptual motor (Sig.)	DSI - Safety skills (Sig.)
T-loc 2	$r = 0.07$ $p = 0.80$	$r = 0.24$ $p = 0.28$
T-loc 7	$r = 0.07$ $p = 0.78$	$r = 0.37$ $p = 0.93$
T-loc 9	$r = -0.03$ $p = 0.91$	$r = 0.54$* $p = 0.01$
T-loc 16	$r = -0.10$ $p = 0.70$	$r = 0.426$ $p = 0.06$

Table 7 – Table of the p-values and correlation coefficients of the correlation test between the DSI and the T-loc Self-A – measures.

3.2 Hypothesis 2

Because of the similarities in context between the items in the T-loc questionnaire and traffic safety the Self-A measures made from the T-loc questionnaire this will be able to predict traffic safety behaviour.

Below are the descriptive data for the TS measures. These are also tested for normality of distribution. The measures that are not normally distributed are marked with an asterisk (i.e. "*").

Traffic Safety measure no.	N	Min. Value	Max. Value	Mean (SD)
TS 1*	79	-2260	-20	-620 (502.19)
TS 2	79	-2.32	-0.52	-1.20 (0.33)
TS 3*	79	0.001	5.17	0.67 (1.17)

Table 8 – Descriptive data for traffic safety behaviour measures.

The Self-A variable from the T-loc was grouped into three groups for each variable: Under-estimation, over-estimation and good Self-A. "Under-estimation" was defined as the mean plus half the standard deviation of Self-A. "Over-estimation" was defined as the mean minus the half the standard deviation of Self-A. "Good Self-A" was the values in between these extremes. This was done since the variables for Self-A ranged from, for example -5.97 to +6.22 where the perfect Self-A would be the mean value or close to the mean value. The mean value in the normally distributed Self-A measures should be zero or close to zero. However, because all Self-A measures are not normally distributed it was deemed more accurate to use the mean instead of a value of zero as the groups would be uneven otherwise.

Using a the Pearson correlation coefficient it could be seen that the groupings were correlated between the different groups, $p<0.05$. With the exception of the correlation between T-loc 7 and T-loc 16, $p = 0.096$. This suggests that participants that over-estimates or under-estimates in one item, does a similar estimation in other items of the T-loc. Below is the correlation matrix of the T-loc Self-A-measures. Significant correlations are marked with an asterisk (i.e. "*")

Self-A-Measure	T-loc 2	T-loc 7	T-loc 9	T-loc 16
T-loc 2	-	r =0.51* p = 0.00	r =0.46* p = 0.00	r =0.36 p = 0.10
T-loc 7	r =0.51* p = 0.0	-	r =0.46* p = 0.00	r =0.24 p = 0.29
T-loc 9	r =0.46* p = 0.0	r =0.46* p = 0.00	-	r =0.54* p = 0.12
T-loc 16	r =0.36 p =0.10	r =0.24 p = 0.29	r =0.54* p = 0.12	-

Table 9 – Correlation matrix of the p-values and correlation coefficients of the Self-A-measure of T-loc.

A first analysis was made using a multivariate ANOVA. One significant main effect was found between the T-loc 7 Self-A-variable and TS 2, $p < 0.05$. Using one One-way ANOVA:s the different groups of the T-loc 7 Self-A-variable were compared to each other with respect to traffic safety behaviour. As with the previous study by Sommarström (2015) there were no significant main effects between the different groups of Self-A, p > 0.2.

To investigate if Self-A could predict traffic safety behaviour an absolute values was made for each of the variables. Doing this it is possible to see if a continuous variable with more definition can predict TS better. Linear regressions were made between the four absolute Self-A variables and the TS-variables. No significant effect was observed in any of the tests, $p > 0.05$.

3.3 Hypothesis 3

Participants who over-estimate themselves compared to the rest of the population will exhibit less traffic safe behaviour than participants who under-estimate themselves.

For this test the T-loc Self-A variable were grouped into two groups, under-estimators and over-estimators. If the Self-A variable is above the mean it is an under-estimator and vice versa.

A first analysis was made using a multivariate ANOVA. One significant main effect was found between the Self-A-variable for T-loc 16 and TS 2. A one-way ANOVAS:s were made between the grouping of each the T-loc 16-variable and the TS-variables. A significant effect between the T-loc 16 Self-A-variable and TS 2, $p < 0.05$, $F(1,19) = 6.2$, $\omega = 0.654$. This effect pointed towards that over-estimators were less traffic safe than under-estimators. No other significant effects were noted between T-loc 16 Self-A-variables and the TS-variables.

3.4 Hypothesis 4

Participants who think that other drivers are worse than him/herself will exhibit less traffic safe behaviour both by themselves and in context with other drivers.

For this analysis the difference between the T-loc items and their corresponding item was used, this will be called the delta value as explained previously in the design. For this test a regression analysis was used between the delta of the T-loc in four cases and the fourth traffic safety measure. The fourth traffic safety measure is made from the same simulator measures as one of the T-loc Self-A measures. This was done since the traffic safety measures used previously do not take cooperation in traffic into account. The descriptive statistics for the new traffic safety measure, the two T-loc variables as described in the method are shown in the table below. The first T-loc delta variable is "Delta T-loc Sum" and second is "Delta T-loc absolute Mean). The measures that are not normally distributed are marked with an asterisk (i.e. "*").

Measure	N	Min. Value	Max. Value	Mean (SD)
Delta T-loc Sum	73	-19	0	-8.63(3.93)
Delta T-loc Absolute Mean*	75	9.50	25	15.99 (2.73)
TS 4	77	1.29	6.99	3.39 (1.01)

Table 10 – Descriptive statistics over the T-loc delta values and the fourth traffic safety measure.

The two T-loc delta variables were each grouped into three groups splitting the participants according to the frequencies of the values so that the three groups were equal in size. The three groups were: 1 = The participant assesses him/herself similar to the other drivers, 2 = The participant assesses him/herself as safer than the rest of the population, 3 = The participant assesses him/herself as very much safer than the population.

A multivariate ANOVA was made between the two different groupings of the T-loc delta values and the four traffic safety measures. The three first TS-variables (i.e. TS 1, TS 2, TS 3) test for traffic safety in a context where the driver is alone on the road, the fourth measure measures traffic safety in a cooperative context (i.e. an overtaking in this case). There was one significant main effect in the MANOVA this was between T-loc Sum variable and the TS 3 – variable (i.e. "Distance in time to a ball rolling over the road), $p < 0.05$, $F(2, 69) = 4.58$, $\omega = 0.76$. Using a Bonferroni pairwise comparison it could be shown that this effect was between grouping 1 and 3 of the T-loc Sum variable. When this effect was plotted it could be seen that participant who exhibited a less traffic safe behaviour were the participants who were under-estimators, in other words opposite to the hypothesis. No other significant differences were found in the MANOVA.

Even though the ANOVA is said to be robust against non-normality of the data (Schmider et al., 2010) the author advocates scepticism to an actual effect were the TS 3-variable is present. This because the distribution of the variable exhibits a ground-effect where a large part of the values are very low. This is relevant for effects in all hypotheses where this variable is present.

4 Discussion

This discussion is split in two main parts. These are two separate discussions about the results and the method. The discussion will end with a brief summary of the study as a whole.

4.1 Results discussion

The first hypothesis investigates if there are any correlations between the different self-awareness measures and their sub-groups. The results showed that there was no correlation between the different Self-A-measures. This suggests that there is no general measure for self-awareness to be assessed, at least not in this manner. This gives further validation to the previous study by Sommarström (2015). If this were to be the case there would not be practical difference with accurate self-assessment as proposed by Kruger and Dunning (1999) and the self-awareness proposed in this study. Kruger and Dunning suggested that good self-assessment is an effect of how knowledgeable a person is in a subject. Since self-awareness measures that are different for each skill would not be any different from self-assessments that are different for each skill. However, it should be noted that the results could be a product of the method used to acquire this data. For example, if the sample group had been younger the self-awareness measure might have looked different due to an increased variance in the data. However, this will be further inquired later in the method discussion.

According to the results for hypothesis two there were no effects between the three groupings of self-awareness and traffic safety. However, when grouped into over and under-estimators there were a couple of significant differences in the third hypothesis (see results). Both of these effect showed that under-estimators exhibited significantly better traffic safety behaviour. These results are in line with the studies made by Kruger and Dunning where people who are unskilled often over-estimate their ability and people who are skilled often under-estimate their ability. This effect could however not be replicated in the results for hypothesis two that had a higher definition of estimations. Even though there was an effect, it was only a fraction of the tests made. There might be several reasons to why this effect was not noted in the other comparisons and some of them will be mentioned in the method discussion. However, it is the belief by the author that this can be a result of the experience of the sample group. Since all of the drivers are very experienced this might give the self-awareness variables a larger variance than it should have. For example, if the test had a broader age group with younger participants as well, the variance may have looked very different. Furthermore, it might be that self-awareness only is important in the beginning of the learning process, which would be a reason to have a younger age group or comparing self-awareness between groups in a learning situation for novice drivers. Furthermore, it would be interesting to see if novice drivers with good self-awareness would acquire more knowledge or learn faster as a function of good self-awareness.

In the fourth hypothesis there is one significant effect between the third traffic safety variable and the different groupings of T-loc delta. This effect is completely opposite to the hypothesis and it shows an opposite relation to the effect in the third hypothesis. Even though this effect should be under much scrutiny because of the sample distribution of the traffic safety variable this effect is very interesting. It is interesting because the effect in hypothesis three also involves the same traffic safety variable. This would suggest that people who are unsafe drivers and over-estimate themselves also over-estimates themselves compared to the rest of the population but drive safer because of that, two effects that say completely opposite things. This can either show invalidity in the effects that may or may not be caused by the distribution, or it can point towards some unreliability in what the measures of self-awareness and T-loc delta actually measures

4.2 Method discussion

In the previous studies that had used self-awareness as a measure for predicting traffic safety there was a much younger sample group in both studies (Lundqvist & Alinder, 2007; Mallon, 2006). It might be the case that the sample group in this study is too old. Since older drivers are, in most cases, much more experienced than younger drivers. Furthermore, this could lead to a difference among the participants due to the method used for calculating self-awareness. It might be that all participants in the sample are very good drivers and that the self-awareness measure show a difference where there should be none. To remedy this problem with age of the sample group a replication study would be needed where the sample group needs to be broader.

The method of calculating the self-awareness measure seems in theory to be a valid way of assessing self-awareness. However, this method might need many constraints in order to be a valid measurement. For example, as mentioned earlier, in order to theoretically avoid un-reliable measurements and skewed variance the sample group needs to be younger so that there really is a difference between over and under-estimation of performance. Furthermore, a problem with this method is that it is only anchored in theories of what self-awareness might be and not in empirical evidence. In the study by Lundqvist & Alinder (2007) they used an on-road assessment by an expert that could then easily be compared to the participants' own assessment. Using this method instead takes away the problem of only having a theoretically based measure.

A problem that is similar to the issue with the self-awareness measurement is the traffic safety measurements. Here the traffic safety measurements are, as earlier, only grounded in a belief about what is safe in different context. Even if the type of measurements used (e.g. Speed-keeping, THW, TTC) would be reliable there is the issue of knowing if this is measured in an adequate way in the simulator. The author has not found any research relating to what traffic safety behaviour is and how to measure it in a simulator. Furthermore, as an effect of this it is very difficult to know how to interpret that different traffic safety measure are not correlated. However, it is probably that they measure different aspects of traffic safety but the researcher does not know if the non-correlation depends on the un-reliability of the measure or on different types of traffic safety.

In the introduction self-awareness was connected with the risk homeostasis theory. The theory says that no matter how many security systems there is in a car the driver will adapt their driving to their risk-level so it would mitigate the effect of the security systems. If self-awareness would affect the level of risk in the simulator scenario this might not reflected in they way traffic safety behaviour is measured. The scenario does measure traffic safety on both the operational level and the tactical level if Michon's (1979) classification is used. Furthermore, in the introduction it is hypothesized the self-awareness would mainly affect traffic safety and accidents on the tactical level of performance (i.e. planning that is executed on the operational level). However, it might be that the situations are not correct for capturing this kind of difference.

One of the better ways to measure traffic safety might be to have actual statistics from insurance companies and from that make one test group and one control group to see if people with high accident statistics would exhibit less self-aware behaviour. Data of accident history was gathered but it was too few data point for an analysis.

Some remarks to the reliability of the DSI and the T-loc questionnaire should be mentioned. A usual reliability problem with questionnaire is that the researcher has no chance to know whether the participants have interpreted the questionnaire in the same way. However, this is a very good thing about the T-loc questionnaire since it has both questions about oneself as well as other drivers. It could be argued that results could depend upon a different in the interpretation between the participants. For the self-awareness measure made from the DSI questionnaire this was one of the points raised as a reliability problem. In this study the same manner of calculation for the self-awareness measures were repeated which would possibly lead to the same reliability problem with the DSI. In order to investigate this new self-awareness measures were made from the delta-values between self and other drivers. This would mitigate the possible problems of misinterpretation. After analysis the results produced were still in line with the analysis of the original self-awareness measures.

4.3 Concluding remarks

The analysis of the study showed that there was only significant effects in hypothesis one, that the different measurements for self-awareness (e.g. DSI and T-loc) are not correlated with each other. This could suggest that the different self-awareness measures are aspects of self-awareness. However, it could suggest that there is no general measure for self-awareness and that there are only self-assessments on different skills.

The study shows that self-awareness does not affect affect traffic safety behaviour in older/experienced drivers. However, it is the author’s belief that self-awareness might not be relevant for an older and/or experienced population and that it might only make a significant different in a younger population that are still improving their driving ability. These results suggest that over and under-estimation of driving ability does not matter when it comes to traffic safety behaviour in older drivers.

Recommendations for future research are that the study is repeated with a broader age group. This would show if there are differences for younger people if self-awareness affects traffic safety and also further investigate if over and under-estimation in older people does not affect traffic safety. Furthermore, it is of interest to investigate other possibilities of measuring self-awareness that might be more robust and not so reliable on good variance in data.

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6 Appendix

6.1 DSI

The Swedish version of the DSI questionnaire used in this study.

Fylls i av försöksledaren:

FP_________ Datum__________

Vilka är de starka respektive svaga sidorna i din körning?

Det finns många skillnader mellan förare, speciellt i hur vi hanterar olika moment när vi kör bil. Vi har alla våra starka och svaga sidor. Markera dina starka respektive svaga sidor genom att fylla i lämpligt svarsalternativ.

Svarsalternativen är:
1 = Definitivt svag 2 = Svag 3 = Varken svag eller stark 4 = Stark 5 = Definitivt stark

		1	2	3	4	5
1.	Flyt i körningen	O	O	O	O	O
2.	Upptäcka faror i trafiken	O	O	O	O	O
3.	Köra bakom en långsam bil utan att bli otålig	O	O	O	O	O
4.	Manövrera bilen genom en sladd	O	O	O	O	O
5.	Förutse trafiksituationer längre fram	O	O	O	O	O
6.	Veta hur du ska bete dig i en viss trafik situation	O	O	O	O	O
7.	Smidigt körfältsbyte i tät trafik	O	O	O	O	O
8.	Uppträda och fatta bestämda beslut	O	O	O	O	O
9.	Behålla lugnet i irriterande situationer	O	O	O	O	O
10.	Ha fordonet under kontroll	O	O	O	O	O
11.	Hålla tillräckligt stort avstånd till framförvarande	O	O	O	O	O
12.	Anpassa din hastighet beroende på förhållandena	O	O	O	O	O
13.	Starta i brant uppförsbacke	O	O	O	O	O
14.	Omkörning	O	O	O	O	O
15.	"Ge upp" lagliga rättigheter när detta är nödvändigt	O	O	O	O	O
16.	Hålla hastighetsbegränsningarna	O	O	O	O	O
17.	Undvika onödiga risker	O	O	O	O	O
18.	Lugnt tolerera andra förares misstag	O	O	O	O	O
19.	Noga följa trafikljusen	O	O	O	O	O
20.	Fickparkera i en trång parkeringsficka	O	O	O	O	O

6.2 T-loc

The Swedish version of the T-loc questionnaire used in this study.

Fylls i av försöksledaren:

FP_________ Datum_________

OLYCKSORSAKER

Olyckor kan orsakas av en eller flera olika faktorer, antingen på grund av den egna eller andras körstil samt trafikmiljön. Tänk på din egen körstil och trafikmiljö, skatta sedan hur möjligt du anser att de olika faktorerna nedan skulle kunna orsaka en olycka. Markera ditt svar med ett kryss på skalan mellan ”Inte alls möjligt” och ”Definitivt möjligt”.

D		Inte alls möjligt				Definitivt möjligt
1	Brister i min körförmåga	O	O	O	O	O
2	Min egen risktagning	O	O	O	O	O
3	Brister i andra förares körförmåga	O	O	O	O	O
4	Andra förares risktagning	O	O	O	O	O
5	Otur	O	O	O	O	O
6	Farliga vägar	O	O	O	O	O
7	Jag kör ofta för fort	O	O	O	O	O
8	Andra förare kör ofta för fort	O	O	O	O	O
9	Jag kör för nära bilen framför	O	O	O	O	O
10	Andra förare håller för kort avstånd till min bil	O	O	O	O	O
11	Ödet	O	O	O	O	O
12	Dåligt väder eller ljusförhållanden	O	O	O	O	O
13	Mekaniskt fel på bilen	O	O	O	O	O
14	Andra förare kör trots att de har druckit alkohol	O	O	O	O	O
15	Andra förares farliga omkörningar	O	O	O	O	O
16	Mina egna farliga omkörningar	O	O	O	O	O
17	Tillfälligheter	O	O	O	O	O