The validity of the SAGAT-questionnaire:

An empirical study using simulated driving situations

Bachelor thesis

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Abstract

In order to develop a valid test tool for further studies about automated driving such as comparing different driver-car interfaces, an experiment investigated situation awareness of the drivers´ surrounding on three different time-periods: 1.25 sec, 1.75 sec. and 2.25 sec. Contrary to expectations, an earlier study showed reductions in situation awareness as the time period increased, which might be explained by an invalid research design. The three time-levels also got subdivided into two different situations. Situation awareness was measured by a SAGAT questionnaire right after the simulation stopped. The present study showed significant higher situation awareness at the highest time-level 2.25 sec., but no significant difference for situation.

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1. Introduction

Machines are getting more complex and automated in many regards. Consequently, human-machine interaction becomes a more central topic when it comes to engineering the latest technology. While the role of machinery is getting more active, the user´s role is getting more passive. Concerning automated cars, a passive role implies that drivers do not have to concentrate on the driving task continuously, but on a supervision task, which requires less concentration. Therefore, drivers are less involved in the actual driving task. This results for example in reductions of situation awareness. This means that drivers are less concentrated on perceiving their environment because it seems less relevant to the driver compared to drivers of non-automated cars (Endsley & Kaber, 1999). This phenomenon of not being involved in the driving task is called the ´out-of-the-loop´ performance problem. That is, automated driving facilitates secondary tasks like reading a book and writing a mail. If users would for instance be fully concentrated on a book, they may not be aware of every event happening in their environment.

Even though there are situations in which unawareness of the environment may not be problematic, there will still be situations in which the user needs to intervene actively by manually taking control over their car. Getting back the users´ attention from an ´out-of-the-loop´ status can be a challenging task for a system. Research shows that drivers who are out of the loop, take longer to process a warning signal given by the system because they need more time to recognize an event in their environment (Merat, 2009). This implies that distracted drivers who are not aware of their environment, have a longer reaction time to react to specific situations. This is particularly dangerous, because most of the situations in which automation fails are critical situations. An example of such a situation is an unexpected strongly braking car in front of the driver´s car. This requires a direct intervention to avoid an accident. A longer reaction time might be caused by participants´ failure to intervene when necessary, a human over-trust in computer controllers, operator loss of system and situation awareness, and the operator direct/manual control skill decay (Endsley & Kaber, 1997). Despite these obstacles, the system has to find its way to get the drivers´ full attention just like the driver needs to get an overview of what the system or the situation requires.

In order to achieve this, purposeful and useful interfaces need to be created. These interfaces need to take into account the former mentioned problems, such as limited situation awareness, and adaptation to the user´s abilities. To assess whether an interface realizes that goal, a method must be established with which different interfaces can be compared and

evaluated. Such a foundation must be based on measures regarding situation awareness and time that drivers need to react. Hence, it is important to find a valid measuring instrument. Therefore, the validity of the measuring instrument was a crucial point in the present research. The main focus was to assess the validity of a specific measurement tool of situation awareness.

The aim of this tool is to measure the driver´s situation awareness. Therefore, situation awareness is one of the dependent variables of this research which will be defined and explained in the following section.

1.1 Situation awareness

Endsley (1996, p. 2) defines situation awareness (SA) as: "A person´s mental model of the world around them, is central to effective decision making and control in dynamic systems." Situation awareness is of great importance when it comes to humans operating complex systems, like e.g. automobiles and airplanes. In the field of airplanes, automation is already widely integrated. Many studies have investigated pilots´ situation awareness (Endsley & Bolstad, 1994; Bolstad & Howell, 2003). Since it is only a matter of time that automated cars will be common, the importance of situation awareness in the car sector is increasing as well. Situation awareness indicates awareness of a person´s surroundings. That is why SA concerning automobiles refers to the area in and around a car, awareness of the system and the way the system and elements of the surroundings are interacting with each other (Endsley, 1996). Automated vehicles tend to have a negative influence on situation awareness (Endsley & Kaber, 1997). Through an automated car, drivers have the chance to deal with other activities than the actual driving task. Thereby they do not need to pay attention to the environment or the system most of the time, which reduces the situation awareness. Therefore, it is difficult to increase the driver´s SA again when the situation requires it. "Achieving situation awareness is one of the most challenging aspects of these operators´ jobs and is central to good decision making and performance" (Endsley, 1996, p. 2). Research has also shown that many traffic accidents are caused by human error and that 88 % of these accidents involved a problem with situation awareness (Endsley, 1994a). Since situation awareness seems to be such a crucial factor when it comes to the driver´s safety, it is important to design interfaces that have a positive influence on the driver´s situation awareness.

Situation awareness is subdivided into three different levels. These three levels are perception, comprehension and projection. The perception level concentrates on the perception of elements such as the locations and colors of other cars. Level two, comprehension, focuses on the interpretation of what the driver perceives. Level three, projection, enables the driver to make predictions concerning their own state based on what they are perceiving (Kaber &, Ma, 2007).

Together, these levels of situation awareness can be defined as "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future" (Endsley, 1988, p.97).

1.2 SAGAT

The situation awareness global assessment technique (SAGAT) is a tool that measures situation awareness in terms of three levels: perception, comprehension, and projection. For each level of situation awareness, the SAGAT poses a number of questions whereby only one of the possible answers is correct. Studies, in which the SAGAT is used as a measurement tool, usually make use of a simulator that simulates a real-life situation (e.g Endsley, Selcon, Hardiman, & Croft, 1998; Gonzalez & Wimisberg, 2007). In earlier approaches that measured pilots´ SA, questions were asked during the task itself (Endsley & Garland, 2000). This enabled the pilot to search for the needed information in the present surrounding. This way, a falsely increased SA score was measured. An advantage of measuring SAGAT while the simulation is at rest, is that participants can only report what they really perceived and kept in mind from the last seen situation. The questions itself refer to objects or events from the just presented situation (Endsley & Garland, 2000). They also differ in degrees of importance. Like already mentioned, the questions address the three levels of SA: perception, comprehension, and projection. The SAGAT was chosen for the present study because it has many benefits comparing to e.g. physiological techniques. Physiological techniques may register whether perception of elements occurred or not, but they are not able to find out how much information actually remains in memory nor if the information has been stored correctly (Endsley, 1996). SAGAT-scores in contrast provide a very detailed collection of information that can directly be compared to reality. Hence, SAGAT is a more objective method which is not dependent on a subjective evaluation because there is one right answer that is defined from the outset. According to Herrmann (1984), the fact that perception can be evaluated on

the basis of objective knowledge is a reference to validity since the answers can directly be compared to reality.

1.3 Cause of the present study

Despite the supposed objectivity of the SAGAT, an earlier study showed results against the expectations. In the previous study it was expected that the more time the participants have to react to a critical situation, the higher the situation awareness would be. For some reason though, opposite results were found. The study compared two methods for measuring situation awareness: SAGAT and SART. The aim was to investigate which method for measuring SA is better suited to compare driver-vehicle interfaces in automated cars. The study made use of a driving simulator. After respondents were brought out of the loop, they had to respond to a critical situation. The analysis focused on whether level of SA and driving performance were influenced by the criticality of the situation. In order to find this out, SA scores were evaluated by SAGAT and SART and subsequently compared. The results indicated that only the SART significantly correlated with the criticality of the situation, but not the SAGAT. This was contrary to expectations because the SAGAT is generally regarded as a more valid, reliable, and sensitive measurement tool compared to SART (Salmon, 2006). However, the results might have been caused by an invalid research design. In the previous study, the SAGAT questions did not focus on events that happened immediately before the simulation was paused. This made it possible that participants answered the questions incorrectly because their SA already faded and not because their actual SA was low (Endsley, 1995). Furthermore, the questions might have been too easy and lacked in variety which could have made the questionnaire too predictable. Furthermore, the environment was too blank which further simplified the answering of the questions. Also a blank environment does not properly reflected a real driving situation.

1.4 The present study

The presented study also used a simulator in order to simulate a driving situation. In the situation the participants were driving on a highway with an automated vehicle. Participants were brought ´out of the loop´ through a secondary task. This was important because this is to be expected when drivers are offered with automated driving functionality. This is important

to make sure that situation awareness is only measured in those critical situations, what means after the signal rang and they have to prevent an accident.

However, in order to overcome the shortcomings of the previous study, the present study used a modified research design. Hereby, attention is at first paid to the most important difference, that the SAGAT-questions applied directly to the freeze-moment and thus not to moments that were a while ago. Making the questions itself less unpredictable and more difficult was another point of difference. A point of criticism to this earlier study is that questions throughout the whole experiment may were too simple, which means that every question was too easy to be answered, no matter to which condition or level of difficulty it belonged. Another point of criticism that has to be taken into account is that the environment may were too blank. This could also have simplified answering the questions. In the revised research, attention is paid to filling in the environment with more elements and also more variation in elements. Furthermore, more variations in the conditions were added that were not followed by a SAGAT in order to break the pattern of expectations.

1.5 Research questions and hypothesis

Because of the possibly weak research design of the previous study, the question emerged whether there is significant higher situation awareness if there is a longer time period between a ´take-over-request´ (TOR) and the freeze-moment, when the research design is improved. Also in order to investigate whether in the revised research design situation awareness has a predictive value for driving performance, the question was posed whether a positive relationship can be measured between time to collision and situation awareness. Time to collision refers to the time that is left before the driver collides with the car in front of him or her after the car in front has braked. Also it was questioned whether situation awareness positively correlates with shorter reaction time.

The expectation was that the longer the time period between TOR and freeze-moment, the higher the SA. Therefore, it has been hypothesized that a positive relationship would be measurable between the time period between TOR and the freeze-moment and SAGAT. Furthermore it has been hypothesized that a higher SAGAT score correlates positively with a longer time to collision. Lastly it has been hypothesized that a higher SAGAT score correlates positively with a shorter reaction time.

2.Method

2.1 Participants

The participants consisted of 39 students and one adult, of which 27 were female and 13 were male. The mean age of the participants was 22,825 ranging from 19 till 53. Among them were five Dutch people and 35 German people. All of them had to prove that they were in possession of a driver´s license.

2.2 Apparatus

This experiment involved a driving simulator. The simulator consists of three screens with three connected beamers. The screens are positioned at a distance to the mock-up of approximately 200cm, which provides a total horizontal viewing angle of approximately 200°. Another part of the simulator is the car mock up. This mock up consists of a gas pedal, a steering wheel, a clutch and a brake. The drivers´ actions, like reaction time or time to collision, automatically got stored by the computer that is connected to the simulator system.

2.3 Task

After getting some general instructions about the experiment (see appendix), participants were instructed on their secondary task. This secondary task was a simple game with a low level of difficulty. The screen on which the secondary task was performed was located next to the driver´s seat. They could operate the display, which was a touch-screen, with an appropriate pen. With this pen, they had to keep a blue ball away from touching red balls, which were travelling over the screen from different directions. This was possible by pulling the blue ball over the screen by using the pen. Despite the low level of difficulty, the secondary task was useful in this experiment because participants needed to look at it continuously to evade the red balls. This fact simulated participants to be ´out-of-the-loop´. Participants were told that their main goal was to take over control when a sound rings out. The car was driving autonomously on the high way. When another car suddenly braked or cut in the driver´s lane, a sound rang out. After the sound rang out, the driver was required to quit the secondary task in order to take control over the car and avoid an accident. Participants were allowed to perform any action such as braking and evading, as long as they did not leave the road.

Besides that, they were told to perform as good as possible on the secondary task instead of concentrating on the environment or the driving task all the time.

Furthermore, the participants got a SAGAT-questionnaire, each consisting of three questions. The questionnaire was handed out after only some of the situations in which an over-take was required. This was to break the pattern of expectations and thereby to prevent any learn-effect.

2.4 Procedure

After welcoming the participants to the experiment, they were asked to fill in some demographic information such as gender, age, and if they possess a driver´s license.

At next, they were partly informed about the aim of the study. The participants were instructed on their actual task then. Beginning with taking place in the simulator and fitting the seat to their comfort, they were introduced to the simulator by a test run. The aim was to get them used to signals such as the ringing of a sound they had to deal with and the simulator´s operations. The ringing of the sound meant that participants had to take over control. Getting used to this signal was important to make sure that participants would not miss this signal and also to get to know what they have to do when it rings out. Since the car was starting and driving automatically, participants were advised not to get in touch with operations like the steering wheel or the brake, because otherwise automation would stop. Participants were only allowed to make use of the manual operation if an alarm-signal would ring out. It was clearly pointed out that if a sound would rang out, they needed to take over control in order to avoid a collision. Participants were further informed that they could perform any action in order to avoid the collision, such as evading another car, braking, or both of it. Automated driving was no longer given when the sound rang.

When the participants had no more questions about the instructions, the experiment started. Participants had to react to two different driving situations, divided in twelve trials in total. The first of the two situations was the so called ´Emergency-brake-situation´ (EBS). One emergency brake took place at the left side of the street, and one on the right side. These two conditions differed only concerning the side of lane; they had the same level of difficulty. In both of this EBS´s a sound rang which is a signal that a car stopped in front of them. This meant that participants were requested to take over control (TOR). The second situation was the ´Cut-in-situation´ (CIS). In this situation, a sound rang because a car cut in the lane of the

participant. Furthermore, there were three different time to freeze-moments (1.25 sec., 1.75 sec., 2.25 sec.). A freeze-moment includes the time between a take-over-request (TOR) and the moment at which the simulation was paused (frozen). The last seen situation was no longer visible at the screens; instead of it they were blanked. Combined with the two different situations, there were six out of twelve trials, in which a take-over was required and situation awareness was measured. From the remaining six trials, three trials required a over-take and three did not.

The EBS were altogether presented six times. Three out of the six times an over-take was required and questions were asked. In two trials an over take was required but no questions were asked. In one trial nothing happened furthermore. Latter trials at which no over-take was required and no questions were asked, were introduced in the design to soften the learning effect by breaking the pattern of expectations. Through this, participants were for example not able to estimate if questions would be asked or not. Also they could not be prepared to take action, because action was not always required. The CIS were also presented six times. Three out of the six times an over-take was required and questions were asked. In one trial an over-take was required but no questions were asked. In two trials nothing happened.

All in all the experiment consisted of 12 trials, from which nine times an alarm rang out and a reaction was demanded and at only six times situation awareness was measured by SAGAT. The trials were chosen randomly for each participant, to overcome the pattern of expectation. Participants were driving about 40 minutes. The time period from one condition to the next was about three minutes on average.

2.5 Dependent Measures

Situation awareness was measured by the SAGAT-questionnaire. After certain trials in which an over-take was required, participants got a SAGAT-questionnaire consisting of three questions. Each of the three questions belonged to one of the three levels of SA: perception, comprehension, and projection. For every question, three or four possible answers were given. The participants had to choose for one. The right answers were defined from the outset and were evaluated as correct or incorrect. Since participants got six questionnaires with three questions each, it was possible to get a maximum score of 18 right answers in total. The variables time to collision and reaction time were stored by the computer that was directly connected to the simulator.

3.Results

3.1. Effects of time to freeze and take over on situation awareness: In order to test the hypothesis that a higher SA correlates positively with a longer time period between TOR and the freeze-moment, a two-way-ANOVA was conducted with SAGAT as the dependent variable, and the various time-to-freeze moments (3:1.25s; 1.75; 2.25) x Situation (2:Cut-In vs. Emergency brake) as independent variables. The results showed a significant main effect for time-to-freeze [$F(1,39)= 5,717$, $p< 0,01$], but no significant effect for situation ($p>0,05$), nor a significant interaction effect ($p>0,05$). Figure 1 graphically displays the results for H1.
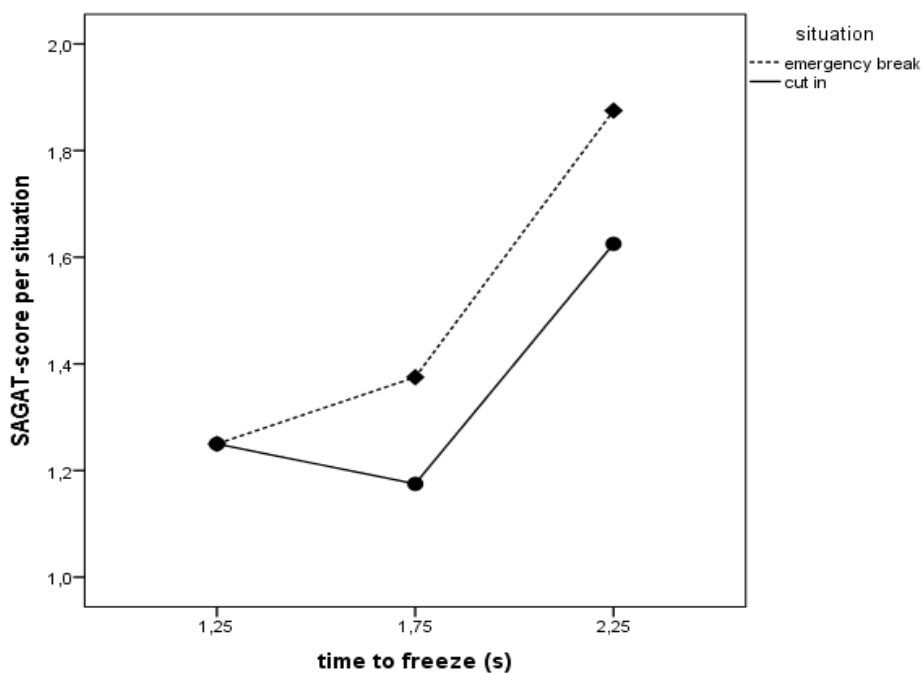

Figure 1: SAGAT scores per situation

3.2 Relationship between time to collision and SAGAT: In order to test if it is possible to measure a relationship between time to collision and situation awareness, a correlation was calculated between time to collision and SAGAT. The correlation was not significant (r= -0,096, *p*>0,05).

3.3. *Relationship between situation awareness and reaction time:* Furthermore the correlation between situation awareness and reaction time was investigated. There was also no significant relation (r= -0,093, *p*>0,05).

3.4 *Drivers´ reaction in different situations:* Frequencies were calculated for the drivers reaction (break, evade or both) for the different conditions. Table 1 shows the results per condition. Condition 1 was the emergency break (EB) situation with 1.25 sec, the second was EB with 1.75 sec, and so on. Thus the sixth condition was the cut-in situation with 2.25 sec.

Tabel 1: Amount of reactions per condition

			reaction			Total
			break	evade	both	
condition	EB 1.25	Count	10	4	19	33
		% within condition	30,3%	12,1%	57,6%	100,0%
	EB 1.75	Count	9	1	28	38
		% within condition	23,7%	2,6%	73,7%	100,0%
	EB 2.25	Count	9	3	26	38
		% within condition	23,7%	7,9%	68,4%	100,0%
	CI 1.25	Count	9	3	27	39
		% within condition	23,1%	7,7%	69,2%	100,0%
	CI 1.75	Count	7	2	27	36
		% within condition	19,4%	5,6%	75,0%	100,0%
	CI 2.25	Count	14	0	24	38
		% within condition	36,8%	0,0%	63,2%	100,0%
Total		Count	58	13	151	222
		% within condition	26,1%	5,9%	68,0%	100,0%

A chi-square test was conducted to examine if there is a significant relationship between the reaction the drivers performed and the condition. No significant results were found (χ^2=9,54, *p*>0,05)

4.Discussion

The main goal of this study was to develop a valid tool that measures situation awareness. Therefore, situation awareness was measured by SAGAT since SAGAT is known as a valid measuring instrument. It was hypothesized that situation awareness would increase as time-to-freeze also increases. This first hypothesis can clearly be confirmed. Like expected, the drivers have the highest situation awareness at the longest time-to-freeze: 2.25 sec. This could suggest a more valid research design of this experiment. Research has already shown that the person´s level of involvement in performing a task decreases if the level of automation increases (Endsley, 1999; Wiener, 1980). This means, that if a person is completely out-of-the-loop while driving in an automated car, it will take more time to interfere manually in a critical situation (Merit, 2009). Hence, it can be assumed that drivers will deliver a better performance and therefore have higher situation awareness, the more time is available to regain situation awareness. Though an earlier study showed contrary results which suggested that situation awareness would be higher when less time was available to regain it. The underlying reason for that is probably an invalid research design involving an invalid way of measuring.

In terms of differences between this research and the earlier study, the most important difference was that the SAGAT-questions applied directly to the freeze-moment and thus not to moments that were a while ago or less clearly defined. The basic idea hereby was that situation awareness is still presented intensive in mind, while SA fades away as time passes by. The SAGAT-questions itself are another point of difference. In this study they were set up more challenging because there were more elements in the driver´s surrounding. The more important it was to formulate questions unambiguously and even difficult in the different levels of criticality. Latter was important to exclude the possibility that different SA-scores could be caused by different levels of difficulty of the questions, and not by different levels of criticality. Another difference laid in the way questions were asked. Participants had to answer verbally in the previous study. This could have made them feel under pressure to give a right answer and maybe kept them from concentrating on what they saw. That is why participants in the present study got a written questionnaire. It allowed them to think about it unhurriedly. Another important point was to enrich the driver´s environment. Through this, questions got more challenging. There were for example more cars the participants had to keep an eye on. This meant, that questions were more difficult, so that they could not be answered without a deeper situation awareness. Another point that deserves attention is that results of this research do not show a consistent increase of situation awareness as time-to-

freeze increases. Instead of this, they for example do not show a difference in SA between 1.25 sec. and 1.75 sec., but a significant difference when it comes to 2.25 sec. This suggests that situation awareness may need a certain amount of time to be regained at all, in fact eventually more than 2.00 sec. Shorter time-periods may not make a difference, because they are too short anyway to regain SA.

Now that the expected results were found, one could assume that this research design is a suitable basis for further studies. Having measured a correlation between SA and time-to-freeze like in the present study, it is possible to compare the drivers´ SA in two different car-driver-interfaces or warning systems with each other. Even though this study was an appropriate way to measure situation awareness, the question about what situation awareness reveals about the actual drivers´ performance in such critical situations is still open. Apparently there is no statement yet about how much SA is needed to perform well on a certain task (Endsley, 1995). In this study, hypotheses about relations between reaction time and time to collision and SAGAT had to be rejected because they were not significant. This suggests that situation awareness says little about the actual driving performance. An explanation for this could be the fact that some participants missed their main task, which was to avoid an accident. Maybe they were too concentrated on the secondary task and paid less attention to their actual main goal. For further studies, it would be important to get participants aware of their main task. One indication for this assumption is the amount of missing reactions.

4.1 Limitations

A disadvantage of this study was for example the technical obstacle. It was not possible to program some important aspects such as traffic signs that show for example maximum speed. This would have been an interesting question concerning the driving task. For further studies it would be important to work this out so more varied questions can be asked. This would make a questionnaire more diverse and by that less predictable. This reduces the probability that participants know what they have to pay attention to because participants are able to learn this (Endsley, 1995). Furthermore, concerning the questions itself, there should always be an answer like "No idea". By this it is possible to prevent that people guess the right answer even though they do not know.

Another important point is that the secondary task that is intended to distract the drivers before hearing a sound was not measured or controlled very well. Although participants were told not to look in the environment and keep playing the game until the

sound arises, they had the chance to do so. Through this it was possible for them to check out the environment before the critical situation arises. Thus, this allows the fact that SA was not only measured in critical situations, as it actually was intended. This calls the validity of this research design into question.

A last drawback was the formation of the sample. Almost two thirds of the participants were female which decreases the generalization of the results.

5.Conclusion

The first hypothesis claiming that a higher SAGAT-score correlates positively with a longer time period between TOR and the freeze-moment can be confirmed. Figure one shows a significant main effect for the longest time to freeze. This means that situation awareness is significant higher at 2.25 second to freeze independent of the situation. Thus, it can be concluded that situation awareness increases in that situation compared to 1.25 and 1.75 seconds to freeze. The second hypothesis must be rejected. There was no significant correlation found, which means that there is no relationship between time to collision and situation awareness. It can be concluded that situation awareness, thus SAGAT, does not predict driving performance concerning time to collision. The third hypothesis had to be rejected as well. There was no significant correlation found, which means that there is no relationship between reaction time and situation awareness. It can be concluded that situation awareness as measured by SAGAT does not predict driving performance concerning reaction time.

Also the frequencies of reactions were tested. If there would have been a reaction that occurred significantly more often when SA was high, a correlation between this specific reaction and situation awareness could have been brought into context. This would have meant that situation awareness could for example always have been higher when participants decided to evade and lower when participants decided to break. In this case, one could have assumed that evading another car allows the driver to get higher situation awareness than breaking. This could have suggested that evading another car requires more SA, for example because the driver needs to look around if there is room to evade. To test if there was a significant difference between the reactions, a chi-square test was conducted. There were no significant results found, meaning that there is no reaction that could be brought into context with situation awareness.

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7. Appendixes

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1. Situation awareness global assessment technique (SAGAT)
2. Instruction
3. Demographic questions
4. Informed consent

Appendix 1

Ik ga nu een aantal vragen stellen en die hebben betrekking op het moment dat de simulatie werd bevroren, d.w.z. het witte scherm verscheen

Vragenlijst:

1.

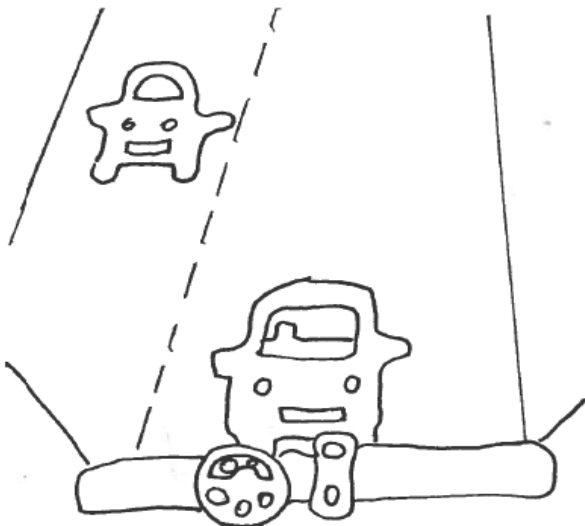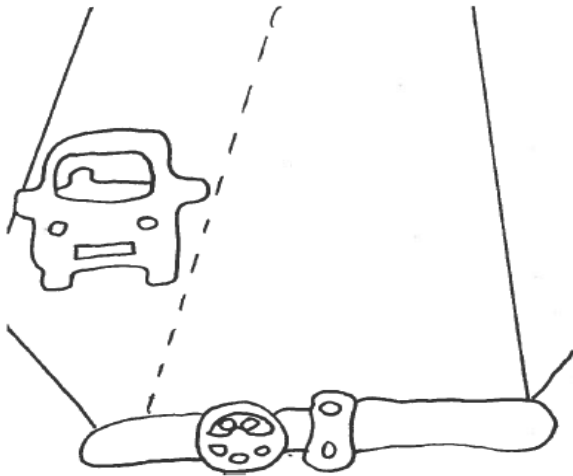1. Wat was de oorzaak om weer de controle over te moeten nemen?

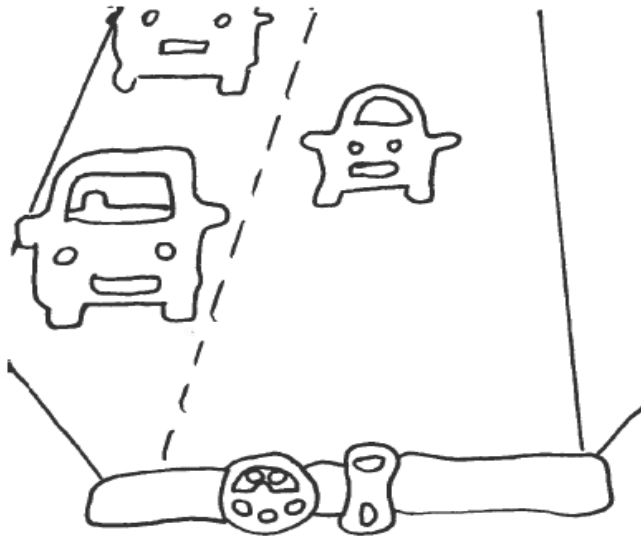A: De auto voor mij voegde ineens in

B: De auto voor mij heeft ineens geremd

C: In mijn auto trad een systeemfout op.

D: Geen idee

2. Welk van de volgende situaties geeft de situatie waarin u zich voorafgaand aan het pauzeren van de simulatie bevond, het beste weer?

3. Het voertuig dat achter u was op het moment dat de simulatie werd stopgezet; welke type was dat?

A:Personenbusje

B:Stationwagen

C: Kleine auto

D: Terreinauto/ SUV

2.

1. Het voertuig dat achter u was op het moment dat de simulatie werd stopgezet; welke type was dat?

A:Personenbusje

B:Stationwagen

C: Kleine auto

D: Terreinauto/ SUV

2. Gebruikte de rijder voor u het knipperlicht?

A: Ja

B: Nee

C:Weet ik niet

3. Stel dat de simulatie niet gestopt was, denkt u dat u het ongeluk zou hebben vermeden?

A: Ja, door te remmen

B: Ja, door naar rechts uit te wijken

C: Ja, door naar links uit te wijken

D: Nee

3

1. Gebruikte de rijder voor u het knipperlicht?

A: Ja

B: Nee

C:Weet ik niet

2. Het voertuig dat achter u was op het moment dat de simulatie werd stopgezet; welke type was dat?

A:Personenbusje

B:Stationwagen

C: Kleine auto

D: Terreinauto/ SUV

3. Stel dat de simulatie niet gestopt was, denkt u dat u het ongeluk zou hebben vermeden?

A: Ja, door te remmen

B: Ja, door naar rechts uit te wijken

C: Ja, door naar links uit te wijken

D: Nee

4.

1. Wat was de oorzaak om weer de controle over te moeten nemen?

A: De auto voor mij voegde ineens in

B: De auto voor mij heeft ineens geremd

C: In mijn auto trad een systeemfout op.

D: Geen idee

2.Welke type auto was voor u op het moment dat de simulatie stopte?

A: Kleine auto

B: (Personen)busje

C: Terreinauto/ SUV

D: Stationwagen

3. Stel dat de simulatie niet gestopt was, denkt u dat u het ongeluk zou hebben vermeden?

A: Ja, door te remmen

B: Ja, door naar rechts uit te wijken

C: Ja, door naar links uit te wijken

D: Nee

5.

1. Denkt u dat er voldoende ruimte was om uit te kunnen wijken?

A: Ja, maar alleen naar de rechter kant

B: Ja, maar alleen naar de linker kant

C: Ja, naar beide kanten

D: Nee

2.Op welke baan bevond de auto zich die veroorzaakte dat er ingegrepen moest worden?

A: Rechts

B: Links

C: Midden

D: Weet ik niet

3.Op welke rijbaan bent u gereden?
A: Op de linker
B: Op de rechter
C: Weet ik niet

6.

1. Het voertuig dat achter u was op het moment dat de simulatie werd stopgezet; welke type was dat?

A:Personenbusje
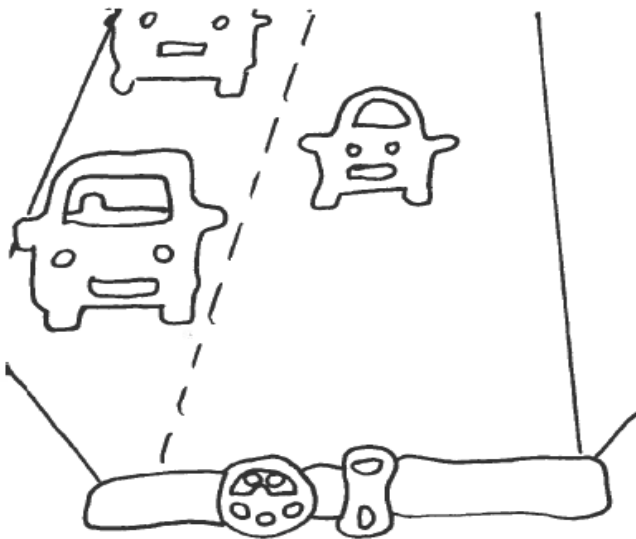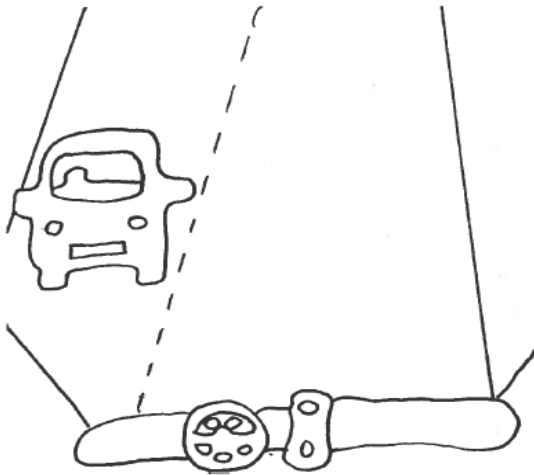
B:Stationwagen

C: Kleine auto

D: Terreinauto/ SUV
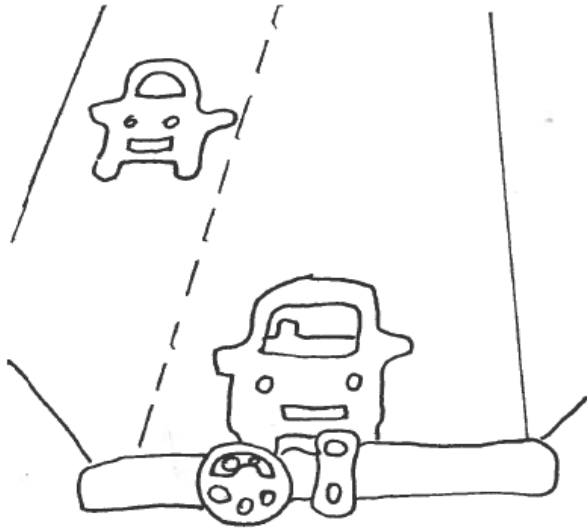
2. Gebruikte de rijder voor u het knipperlicht?

A: Ja

B: Nee

C:Weet ik niet

3. Welk van de volgende situaties geeft de situatie waarin u zich voorafgaand aan het pauzeren van de simulatie bevond, het beste weer?

Appendix 2

Beste proefpersoon,

Welkom bij dit experiment.

Vóór begin van het experiment wordt U eerst gevraagd om uw demografische gegevens in de vragenlijst in te vullen.

Dit experiment zal ongeveer één uur duren. U gaat gedurende het hele experiment in de rijsimulator zitten. Deze simuleert verschillende situaties op de snelweg, waarbij de auto vanzelf rijdt.

Soms wordt er een waarschuiwingssignaal afgespeelt, wat zou kunnen betekenen dat de automatische controle van de auto uitvalt en een overname nodig is. In dat geval is het de bedoeling om een ongeluk te vermijden. Hierbij is elke handeling toegestaan, zolang U maar op de baan blijvt.

Op sommige momenten wordt de simulatie op stop gezet. Dan is het de bedoeling om drie vragen te beantwoorden.

Tijdens het rijden wordt U bezig gehouden met een secondaire taak. Deze wordt U voor begin van het experiment door de onderzoeker uitgelegd.

Hartelijk bedankt voor uw deelname!

Appendix 3

Demografische gegevens

Leeftijd:

Geslacht:

Nationaliteit:

Rijbewijs:

Appendix 4

<div style="border: 2px solid black; padding: 10px;">

GEÏNFORMEERDE TOESTEMMING
</div>

Ik, …………………………………………………………….. (*naam proefpersoon*)

Stem toe mee te doen aan een onderzoek dat uitgevoerd wordt door

Jana Uhrmeister

Ik ben me ervan bewust dat deelname aan dit onderzoek geheel vrijwillig is. Ik kan mijn medewerking op elk tijdstip stopzetten en de gegevens verkregen uit dit onderzoek terugkrijgen, laten verwijderen uit de database, of laten vernietigen.

De volgende punten zijn aan mij uitgelegd:

1. Het doel van dit onderzoek is het bewustzijn van de omgeving tijdens kritische situaties te meten.
   Deelname aan dit onderzoek zal meer inzicht geven omtrent een validere afname van de SAGAT.

2. Er zal mij gevraagd worden om in een rijsimulator te gaan zitten en enkele handelingen uit te voeren om een ongeluk te vermijden.
   Het hele onderzoek zal ongeveer 90 minuten duren. Aan het einde van het onderzoek zal de onderzoeker uitleggen waar het onderzoek over ging.

3. Er behoort geen stress of ongemak voort te vloeien uit deelname aan dit onderzoek.
4. De gegevens verkregen uit dit onderzoek zullen anoniem verwerkt worden en kunnen daarom niet bekend gemaakt worden op een individueel identificeerbare manier.
5. De onderzoeker zal alle verdere vragen over dit onderzoek beantwoorden, nu of gedurende het verdere verloop van het onderzoek.

Handtekening onderzoeker: …………………………………………   Datum: …………………..

Handtekening proefpersoon: ……………………………………   Datum: …………………..