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Master's thesis

Measuring explicit and implicit aggressive attitudes in drivers.
A new approach to novice driver education

Supervisor :
prof. dr. Kris BRIJS

Co-supervisor :
dr. Veerle ROSS

Nora Reinolsmann

*Thesis presented in fulfillment of the requirements for the degree of Master of
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PREFACE

This master thesis represents the findings of the research investigation on explicit and implicit measures of aggressive attitudes in young novice drivers and male drivers, completed by Nora Reinolmann, Master's student of Transportation Sciences (Traffic Safety), under the supervision of Veerle Ross.

Young novice drivers are still over-represented in fatal road accidents, despite the successful accomplishment of recent driving training. Especially, aggressive driving behavior is a frequently observed phenomenon that is prevalent among young novice drivers until 24 years and continues to prevail among male drivers. Aggressive driving has to be counteracted since it can have life-threatening consequences for all road users. The motivation for this research is to understand aggression types among drivers and to identify the drivers with aggressive attitudes already during the learning phase.

Special thanks are dedicated to Veerle Ross for supporting me throughout the research and writing process of this Master thesis as well as Kris Brijs and Ellen Jongen for their helpful comments along the way. I have learned a lot during the past years of my studies at Hasselt University and with this final work I aim for a Master's degree in Transportation Sciences.

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EXECUTIVE SUMMARY

The master thesis focused on explicit and implicit measures of aggressive attitudes in drivers. Aggressive driving behavior is a frequently observed phenomenon that is prevalent among young novice drivers until 24 years and continues to prevail among male drivers. Aggressive driving can have life-threatening consequences since the drivers endanger themselves and others on the road. Thus, aggressive driving represents a serious problem for traffic safety and requires more research to understand the mechanisms of aggression with regard to driving. Moreover, explicit and implicit attitude measures can help to identify and counteract traffic-related aggressive attitudes already during the learning phase. The thesis consists of two chapters that present two independent papers with different aims, scopes, and target groups. Nevertheless, the results of both papers create an overall understanding of the incremental value of explicit and implicit measures of aggression types for better interventions in novice driver education.

The **first chapter** of this thesis is about the “predictability of explicit and implicit measures of reactive and proactive aggression in angry male drivers”. The aim of this study was to investigate the aggression types that lead to driving anger in male drivers while paying attention to the predictive contribution of explicit and implicit measures of aggression types. Driving anger is described as the propensity to become angry while driving, which often leads to aggressive driving behavior on the road. The literature review pointed out that aggressive driving behavior is mainly observed among angry male drivers, but not angry female drivers. Besides, the concept of age as a moderator of aggression and driving anger was discussed. Chapter one is completely based on secondary data that was provided by a previous study on angry drivers. Therefore, no data collection was necessary in the framework of chapter one. Data of explicit and implicit measures of proactive and reactive aggression were already available by means of survey responses and reaction times (measured by the Single-Target Implicit Associations Test (ST-IAT) and the Emotional Stroop Task (E-Stroop)). The primary goal of this chapter was to conduct a specified data analysis in order to gain new insights from the data. The implicit measures of reactive and proactive aggression were added to explicit measures of reactive and proactive aggression in a hierarchical regression analysis to assess their unique contribution with regard to driving anger. Moreover, a simple slope analysis was conducted to investigate the direction of a significant interaction of proactive aggression by age that predicts driving anger. The results of the data analysis were presented in this chapter. It was found that reactive aggression is a main predictor of driving anger in male drivers while age has no main effect on driving anger. However, age is moderating the relationship between low proactive aggression and driving anger in the case of young age. This means that reactive aggression predicts driving anger independent of age, whereas low proactive aggression is associated with driving anger in young males. Also, the combination of explicit and implicit measures of aggression improved the predictability of driving anger among male drivers. The implications of these findings were discussed.

In the **second chapter**, special attention was paid to implicit measures of aggression in order to identify traffic-related aggression in young novice drivers. The literature review of chapter two showed that young novice drivers until 25 years do not only lack experience, but they are also in a developmental phase of life that forwards aggressive and risk taking behavior. It has found that implicit tests can be helpful in situations where questionnaires are affected by social desirability and a lack of self awareness. The application of implicit tests in the traffic context is proposed, since young novice drivers lack the experience to know how they would react in certain traffic situations. Both, the Single-Target Implicit Association Test (ST-IAT) and the Emotional Stroop Task (E-Stroop) are not yet available in a traffic-specific format. Thus, the aim of chapter two was to design and build new implicit tests that are applied to the traffic context in order to collect data on aggressive attitudes in young novice drivers. A traffic-related ST-IAT and E-Stroop were developed based on an additional literature review on the validation of implicit stimuli. In a pretest phase, traffic-related stimuli were collected and tested by means of word evaluation tests, word frequency tests, word length assessment and Dutch language frequencies from the CELEX corpus. The selection procedure of traffic-related stimuli for the new version of the implicit tests was explained, followed by a discussion of the pretests. Afterwards, the overall research methodology was presented and the research sample and instruments that were used in the data collection procedure are explained. Questionnaires on particular personality traits that are associated with aggressive driving behavior and young age (e.g., sensation seeking, impulsivity and fearlessness) were also included in the methodology. In total, four implicit computer tasks (two traffic-related and two general implicit tests) and the explicit questionnaires that measure aggression (Buss-Perry Aggression Questionnaire, Reactive & Proactive Aggression Questionnaire), personality traits (Arnett Inventory of Sensation Seeking, Barratt's Impulsiveness Questionnaire, Multidimensional Personality Questionnaire: harm avoidance, The Stimulating and Instrumental Risk Questionnaire, Driving Anger Scale) and driving behavior (Multidimensional Driving Style Inventory, Manchester Driving Behavior Questionnaire, Driving Anger Expression Inventory) were applied. The procedure of the experimental testing was demonstrated and the possible limitations of the new implicit tests were discussed in detail. Finally, the implications and research questions for further research were presented in the last section. The statistical analysis of the collected data to answer these questions fell out of the scope of chapter two.

THESIS OUTLINE

Taken together, the master thesis consists of four parts:

1. General introduction and problem statement regarding aggressive driving
2. Chapter 1) Empirical data analysis of variables that predict driving anger in male drivers
3. Chapter 2) Development of traffic-related implicit tests that capture an aggressive traffic-related attitude in young novice drivers
4. General conclusion about the implications of research results from both chapters

1. General Introduction

In the general introduction, the problem of aggressive driving for traffic safety is highlighted. Facts and figures related to reported aggressive driving behaviors among different age and gender groups are presented. Besides, the high number of traffic accidents involving young novice drivers is highlighted as an alarming fact that needs to be counteracted. Interventions that focus on the reduction of risky circumstance for young novice drivers are considered to be less efficient. Therefore, explicit and implicit attitude measures were proposed to measure traffic-related aggression in novice drivers. This approach can be valuable to novice driver education in order to identify aggressive young novice drivers already in the learning phase and to respond to their individual needs for attitude change.

2. Chapter one

Chapter one is based on secondary data of a previous study about angry drivers and investigates the aggression related aspects of driving anger. The research in chapter one is written as a stand-alone article in order to be published separately from the master thesis. The motivation to include this paper as chapter one in the thesis is to conduct a comprehensive data analysis and to present new insights from available data that have not been considered yet. The literature review highlighted that aggressive driving behavior is especially a problem among angry male drivers, but not angry female drivers. The impact of aggression types is explained and age as a possible moderator is identified for the analysis. Based on the literature review, the following research questions were formulated:

- Is reactive, proactive or a combination of both aggression types a good predictor of driving anger?
- Do implicit measures of reactive/proactive aggression improve the predictive power of the model?
- Is there an interaction between reactive/proactive aggression and the moderator age that affects the prediction of driving anger?

Sequentially, the methodology and instruments were discussed and a statistical analysis was conducted with available data of driving anger, sample demographics as well as explicit and implicit measures of reactive and proactive aggression in male drivers. Afterwards, the results were presented and the research questions were answered. Finally, a discussion was written indicating the implications of research. The chapter ends with the formulation of limitations of this study.

The first chapter describes in detail:

- Problem discovery by conduction of a literature review and formulation of research questions
- Development of the methodology: identification of the research design and the target Group
 - use of secondary data that is based on appropriate research instruments
- Statistical data analysis
- Discussion of results
- Formulation of limitations and recommendations

3. Chapter two

The second chapter of this thesis aims to build upon the insights in explicit and implicit measures of aggression types in drivers and goes into more detail about implicit attitudes measures. Explicit and implicit attitudes have to be related to specific attitude objects in order to draw conclusions about traffic-specific behavior. Whereas a number of questionnaires related to driving behavior are available for data collection, are implicit tests not yet available for the traffic context. Therefore, new implicit tests that measure traffic-related aggression were proposed for the data collection in chapter two. The chapter starts with the problem statement regarding aggressive attitudes in young novice drivers. Relevant research concepts are introduced and a literature review on aggression, personality traits as well as on explicit and implicit attitude measures is provided. A review on the validity of implicit stimuli is conducted in order to design and develop traffic-related implicit tests. The traffic-related stimuli were selected and pre-test word analyses were conducted in order to determine the final set of traffic-related stimuli for the new implicit tests. After the description of the pretests, the research methodology is visualized by means of a chart that shows the relations between aggression, personality traits, explicit and implicit measures of attitudes and aggressive driving behavior. Sequentially, all materials used for the data collection were presented and the data collection procedure was explained. The final analysis regarding the effectiveness of the new developed implicit instruments as well as the analysis of research questions that can be answered with the collected data fell out of the scope of chapter two. The theoretical and practical implications of the new implicit tests as well as possible limitations were discussed, but further analysis will be addressed in future research.

The second chapter describes in detail:

- Problem discovery by conducting a literature review and formulating the aim of research:
The development of new required research instruments
 - Methodology : identification of stimuli pretest, appropriate pretest instruments
 - Pretest data collection
 - Pretest data analysis for finalization of instrument
- Overall methodology: definition of the research design, the target group and the
- research instruments
- Data collection (primary data)
- Formulation of implications and limitations of the data collection procedure

4. General conclusion

At the end of the two chapters, a general conclusion is provided that summarizes the main findings and implications of the master thesis. The research implications for intervention programs that aim to target proactive and reactive aggression types in young novice drivers are discussed. Specifically, the importance of tailored interventions strategies that focus on developmental differences is highlighted. The general conclusion ends with recommendations for further research that focus on explicit and implicit intervention combinations when addressing aggression types in young novice drivers.

Furthermore, a list of all references that were used throughout the thesis is provided. The thesis concludes with some annexes that provide an overview of the means, standard deviations, word lengths indicators and frequencies of the Celex corpus for the final selection of traffic-related implicit stimuli that were designed in chapter two.

GENERAL INTRODUCTION

Aggressive driving behavior contributes to a substantial proportion to fatal road accidents and is perceived as a serious threat to traffic safety (AAA Foundation for Traffic Safety, 2016). Self-reported aggressive driving behavior among 2705 drivers in the United States showed that young novice drivers of 19-24 years were most likely to report trying to block another vehicle from changing lanes and bumping or ramming another vehicle. In contrast, the drivers of older age groups reported to act out the majority of other aggressive driving behaviors (e.g., to tailgate, yell, honk, gesture, cut off and to confront other drivers). Male drivers were more likely than female drivers to report each of the aggressive driving behaviors presented in Table 1, and were more likely to act out the most extreme aggressive behaviors (AAA Foundation for Traffic Safety, 2016). The findings of the survey of the AAA Foundation for Traffic Safety in 2014 can be summarized as follows: “Nearly nine out of ten drivers perceived aggressive drivers to be a serious threat to their personal safety” (AAA Foundation for Traffic Safety, 2016 p.7). This is based on two problem statements that were revealed from the survey:

- More than half of the drivers reported that ‘driving anger’ became a bigger problem than three years earlier (AAA Foundation for Traffic Safety, 2016).
- Nearly two in three perceived that ‘aggressive and careless drivers’ were a bigger problem relative to three years before (AAA Foundation for Traffic Safety, 2016).

TABLE 1: Aggressive driving behaviors reported by driver demographic (AAA Foundation for Traffic Safety, 2016)

			Tailgate	Yell	Honk	Gesture	Block from changing lanes	Cut off	Confront	Bump/ram
		<i>N</i>	<i>%, weighted</i>							
Driver age	All drivers	2,705	50.8	46.6	44.5	32.5	24.2	11.9	3.7	2.8
	16-18	514	48.5	40.5	34.4	26.2	12.0	9.2	2.1	3.4
	19-24	111	45.5	51.8	43.5	39.8	28.0	14.8	4.4	4.4
	25-39	452	66.7	51.9	53.6	42.8	27.5	16.8	6.2	4.3
	40-59	1,017	51.2	50.2	46.7	33.4	26.3	12.2	3.4	2.5
	60-74	478	38.9	40.1	37.4	23.2	19.3	7.3	2.0	1.0
	75+	133	35.6	24.1	26.6	14.6	17.9	5.0	2.4	2.8
Driver sex	Male	1,335	55.5	49.5	49.0	40.0	28.6	15.5	5.7	4.3
	Female	1,370	46.1	43.7	39.9	25.0	19.8	8.3	1.8	1.3

Whether a driver decides to engage in angry or aggressive driving behavior can depend on situational factors (e.g., time pressure, anonymity) and psychological factors (e.g., emotional arousal, outcome evaluations)(O’Brien, 2011). Especially, the psychological factors have been found to be associated with intended and deliberate aggressive driving. The first chapter aims to focus on the problem of angry drivers that is described as ‘driving anger’ in the literature and is highlighted by the survey of the AAA Foundation for Traffic Safety (2016). Angry and aggressive driving is especially a problem among male

drivers across different age groups. The questions arise what kind of aggression type is characteristic for driving anger in male drivers and whether angry drivers among different ages are more or less affected by driving anger? Available data from a previous research will be analyzed to provide answers.

The second problem identified by AAA Foundation for Traffic Safety (2016) is described as ‘aggressive and careless drivers’ that are perceived as a threat to traffic safety. Researchers found out that especially young novice male drivers systematically tend to overestimate their driving ability and underestimate the risks of driving (De Craen, Twisk, Hagenzieker, Elffers, & Brookhuis, 2011; Scott-Parker, Hyde, Watson, & King, 2013). The survey of the AAA Foundation for Traffic Safety (2016) showed that young drivers till 24 years are more likely to block another vehicle from changing lanes and bump or ram another vehicle by purpose. Generally, most road crashes (90-95%) are the result of inappropriate human driving behavior (Constantinou, Panayiotou, Konstantinou, Loutsiou-Ladd, & Kapardis, 2011). The driving task is a very complex process that requires high cognitive capacity, especially for young novice drivers. The young drivers group is still in the learning phase and driving expertise is not yet accessible via the automatic cognition route (Keating, 2007). Insights in neurophysiologic sciences provide evidence that the frontal part of the brain (prefrontal cortex) is not fully developed until the age of 25. This part of the brain is associated with controlled reasoning, decision making and the inhibition of impulses (Constantinou et al., 2011). It is agreed upon that the deficits in self regulation and risk assessment are major drawbacks in the driving behavior of adolescents (DeWall, Baumeister, Stillman, & Gailliot, 2007; Keating, 2007). The number of deaths in this age category remains still above that of the general population (see figure 1) (IRTAD & Belgian Road Safety Institute, 2014).

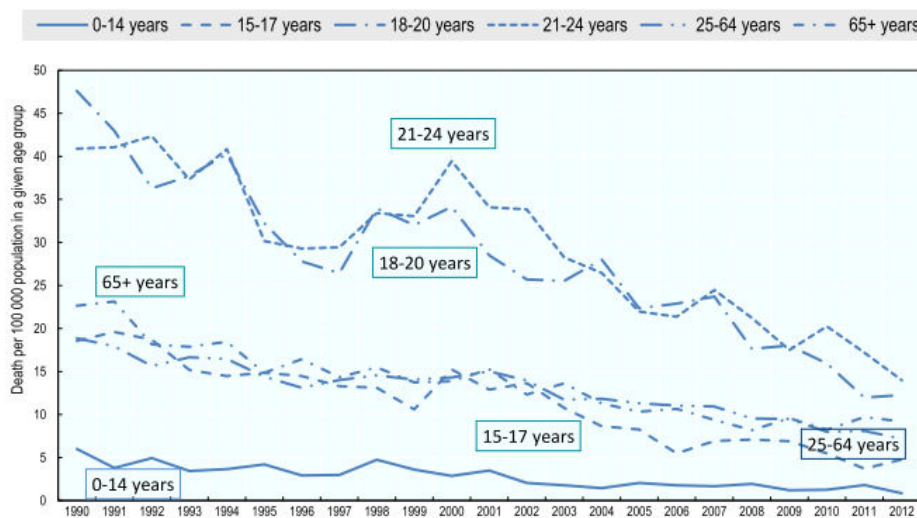


FIGURE 1: Road death rates per age group, 1990-2012 (IRTAD & Belgian Road Safety Institute, 2014)

The young novice driver group until 24 years is at the highest risk of being involved in road traffic accidents with a fatality rate twice as high as that of the general population (IRTAD & Belgian Road Safety Institute, 2014). In the past decades, there has been a substantial decrease in fatal road accident among young novice drivers (18-24 years) due to increased standards in driving education. However,

young novice drivers are still more likely to get injured or die in traffic accidents, due to their tendency to drive in an aggressive or risky manner (Constantinou et al., 2011). Driver education programs that are based on a multiphase approach e.g., the Graduated Driving Licensing (GDL) are evolving, but accidents remain high in number during the first two years after obtaining a license. Besides the training of knowledge and driving skills, the GDL program addresses external influences that are associated with risk taking behavior (e.g., night time driving and driving with peers) and promotes parental involvement during the period of probationary license (Mayhew & Simpson, 2002). Still, driving behavior does not necessarily become safer as the individual advances his/her driving skills (Demir, Demir, & Özkan, 2016). Driver behavior is defined as the driving style and acts of the individual that he/she purposefully chooses and that reflects the personality, attitudes and motives of the individual (Demir, Demir, & Özkan, 2016). The attitudes and personality of the individual young novice drivers are not taken into account yet in driving education, although attitudes (individual belief and evaluations) constitute an important explanatory component of behavior (see: theory of planned behavior (Ajzen, 1991)). The unchanged high numbers of accidents involving young novice drivers with aggressive driving behavior indicates that aggression and a positive attitude towards aggressive driving behavior can be a relevant explanation. Therefore, it is important to identify aggressive drivers already in the learning phase through the inclusion of attitude and trait measurements in the driving curriculum. It is aimed to investigate in more detail on explicit and implicit attitude measures that predict aggressive driving-related attitudes among young novice drivers in a reliable way. In particular, general and traffic-specific implicit measures of aggression will be discussed in chapter two in order to collect data that help identifying young novice drivers with aggressive attitudes. Sequentially, aggressive young novice drivers can be targeted through additional interventions in driver education in order to counteract the aggressive attitude.

To summarize, both chapters in this thesis deal with the question whether adding implicit and explicit measures of aggression types might be better predictors of the intention to engage in several types of aggressive and angry driving (Hatfield, Fernandes, Faunce, & Job, 2008). Moreover, chapter two further contributes with the development of new implicit tests that measure traffic-related aggression in young novice drivers. The new implicit tools might improve the identification of young novice drivers with aggressive or safe traffic-related attitudes. Based on this, effective intervention strategies can be designed that target reactive and proactive aggression in young novice drivers.

CHAPTER 1

THE PREDICTABILITY OF EXPLICIT AND IMPLICIT MEASURES OF REACTIVE AND PROACTIVE AGGRESSION IN ANGRY MALE DRIVERS

1. INTRODUCTION

Driving anger is an increasingly discussed phenomenon in the literature because it leads to more aggressive driving behavior, less speed limit compliance, and increased driving errors (Biaassoni, Balzarotti, Giamporcaro, & Ciceri, 2016; Zhang, Chan, & Zhang, 2015). These behaviors can have life threatening consequences because they expose the driver to more crash-related conditions that increase the risk of serious and fatal road accidents (Stephens & Sullman, 2014).

The Driving Anger Scale (DAS) has been developed by Deffenbacher et al. (1994) to measure an individual's propensity to become angry across a number of driving situations and has been applied in several studies. The results have demonstrated that "male drivers do not need to be emotionally irritated to behave aggressively" (Björklund, 2007, p. 1076). The results of the research indicated that woman usually feel more irritation than men for progress impeded and other drivers' reckless driving. However, men are acting out aggressive driving behavior "more often than women to reckless driving and others' direct hostility" (Björklund, 2007, p. 1076). Angry male drivers also engage more often in aggressive traffic violations (Laapotti, Keskinen, Hatakka, & Katila, 2001). Female drivers do more efforts to control their anger and often commit driving errors when angry. In contrast, angry male drivers display aggressive and risky driving behavior (Zhang et al., 2015). This indicates that driving anger has different implications for male and female drivers. The fact that angry male drivers engage in aggressive driving behavior that endangers themselves and others is a big problem in terms of traffic safety. The literature points out that anger in males leads to more perceived control and therefore to more optimistic risk appraisals (Lerner & Keltner, 2001). This means that angry drivers are prone to underestimate risky situations and change their behavior in a maladaptive and aggressive way. Male drivers that experience anger are also more confident when engaging in aggressive driving behavior because males are prone to underestimate the dangers of a possible harmful situation (Laapotti et al., 2001) and overestimate their own driving skills (Scott-Parker et al., 2013).

The relationship between male driving anger and aggressive driving behavior indicates that aggression in males might play an important role in the explanation why driving anger is enacted in an aggressive way. Theories about aggression made a distinction between emotionally driven aggression which is temporarily based on feelings of frustration and anger, and instrumental aggression which refers to unemotional and goal-oriented harm in anticipation of self-serving outcomes (Myers et al., 2010; Brugman et al., 2015). In the literature it is often referred to proactive and reactive aggression when describing instrumental and emotional types of aggression (Cui, Colasante, Malti, Ribeaud, & Eisner, 2016). The proactive use of aggression has the aim to put others in a situation where they are not able to hinder someone from attaining a goal (e.g., overcoming obstacles and avoiding delays). Proactive aggression is not dependent on physiological arousals or provocation to act out aggressive behavior because the use of aggression is calculated to achieve a target. This type of aggression is based on

positive outcome expectancies regarding aggressive behavior that manifests the attitude. In contrary, reactive aggression is triggered by feelings of anger and frustration when provoked by others. The reactive type of aggression always needs physiological arousals to be activated and leads to a temporal increased focus on competition and self-defense (Brugman et al., 2015). Moreover, Lobbestael et al. (2016) highlights that reactive (and not proactive) aggression is associated with biases in information processing which leads to increased misinterpretation and misperceptions (Lobbestael, Cousijn, & Brugman, 2016). The perceived provocation on the road can then easily lead to driving anger and aggressive behaviors as a possible result.

The research of Cui et al. (2016) claims that proactive and reactive types of aggression tend to co-occur within the same person. Developmental researchers have already studied the overlap of reactive and proactive aggression (Cui et al., 2016). Adolescents with persistent, high levels of both reactive (hot-headed or emotional) and proactive (cold-blooded or instrumental) aggression showed high levels of risk taking (Cui et al., 2016). Also impulsive tendencies to engage in aggressive behavior have been associated with both, reactive and proactive aggressions. But proactively aggressive drivers may be more adapting at regulating immediate, aggressive impulses (Cui et al., 2016). This highlights that the relationship between reactive and proactive aggression might be more complex than expected and that it is not clear yet whether reactive aggression alone or a combination of reactive and proactive aggression are predictors of driving anger in male drivers.

Driving anger occurs predominantly among young drivers and decreases with age (Björklund, 2008; Forward, 2009). Age seems to play an interesting role, since it is not clear yet whether older drivers are more prone to driving anger compared to young drivers. It is often stated that the brain of adolescents under 25 years is not fully developed yet and social cognitive processing of information is more likely to be impaired, which leads to increased misperceptions and hostile interpretations (Keating, 2007). Moreover, young drivers miss experience with frustrating traffic situations. Lajunen and Parker (2001) have found that driving anger might actually decline over time as drivers learn to cope with emotions in frustrating situations (Lajunen & Parker, 2001). Therefore, we anticipate that age would moderate the association between reactive aggression and driving anger, such that the positive association between these variables would decrease with age.

2. IMPLICIT AND EXPLICIT MEASURES OF AGGRESSION

Driving anger leads to arousal based negative emotions that can occur in several traffic situations. Driving anger is therefore highly linked with the interpretation of situational cues. Many drivers are often not aware about their tendency to become angry behind the wheel when being asked directly. This is because they are not aware about their disposition for driving anger. Furthermore, angry and aggressive driving are socially undesirable behaviors that are disapproved by the society. Therefore, drivers would rather not admit that they can become angry in certain traffic situations (Lajunen & Summala, 2003).

Common methods to identify the conscious and unconscious beliefs about one's disposition for aggression are explicit and implicit attitude measures. On one hand, explicit measures are usually based on self-report questionnaires that motivate the participant to think actively about his/her attitudes towards aggression and the tendency to become angry while driving (Richetin & Richardson, 2008). An explicit measure is gained through self-report answers that are based on controlled cognitive processes (Bluemke & Friese, 2012). Explicit self-report measures have proven to be good predictors of conscious beliefs and behavior (Richetin & Richardson, 2008). However, explicit measures on sensitive topics like aggression can often lead to socially desirable responding, because participants either lack self-awareness regarding specific attitude objects (e.g., driving anger) or don't want to admit that they reacted aggressively in certain situations (Lajunen & Summala, 2003).

In contrast, an implicit measure is gained through automatic internal processes via the affective route and can provide information about the attitudes. The affective route represents the unconscious attitude and can be measured through behavior. Well-known methods are implicit tests that measure affective Go/No-Go associations and reaction times (Nosek, & Banaji, 2001). Self-deception and attentional biases towards aggressive stimuli can easily be detected with implicit measures (Perugini, Richetin, & Zogmaister, 2010). The advantage of implicit tests is that they measure beliefs and attentional biases in situations where participants are not aware about their attitude due to a lack of introspective access or if they prefer to report consciously accessible representations of aggression (Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005; Richetin & Richardson, 2008). Brugman et al. (2015) used the Emotional Stroop Task (E-Stroop) to measure reactive aggression and the Single Target Implicit Association Test (ST-IAT) to measure proactive aggression in an implicit way. It was concluded that reactive aggression is associated with sensitivity to aggressive stimuli from the environment (e.g. aggressive-emotional words), whereas proactive aggression is based on a strong association between the self and aggression while having low sensitivity to aggressive-emotional stimuli from an external source. In both implicit tests, emotionally primed stimuli are applied in implicit computer tasks using e-prime software to activate hidden attitudes in an automatic way.

3. AIM AND RESEARCH QUESTIONS

To the best of our knowledge, the constructs of proactive and reactive aggression have not been investigated in relation to trait driving anger yet. While there has been a lot of research on driving behavior as an outcome measure of driving anger, less attention has been paid to the predictors of driving anger itself (Deffenbacher, Filetti, Richards, Lynch, & Oetting, 2003; Deffenbacher, Kemper, & Richards, 2007). Moreover, the role of aggression types and age is not very clear yet when it comes to driving anger. More research is needed on driving anger and the aggression types that predict the phenomenon of the angry male driver. Therefore, this paper aims to investigate the influence of reactive and proactive aggression types on driving anger and the joint effects that are related to driving anger in male drivers (Fitzmaurice, 2000). Possible interactions between aggression and maturation in terms of age are investigated to see whether the relationship between aggression and driving anger is moderated. The moderator has a regulating function that determines the relationship between aggression types and driving anger. Interactions effects are tested to expose the predictive effects of aggression on driving anger in male drivers.

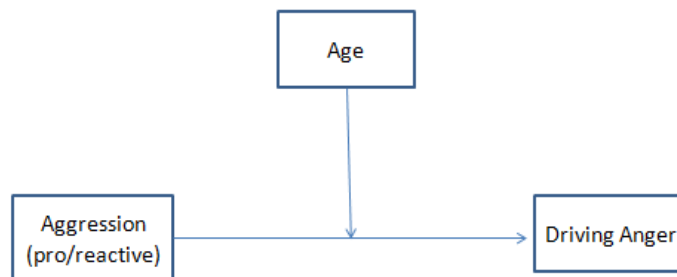


FIGURE 2: Conceptual Model of the moderated relationship

The following research questions will be answered:

1. Are reactive, proactive or a combination of both aggression types good predictors of driving anger?
2. Do implicit measures of reactive/proactive aggression improve the predictive power of the model?
3. Is there an interaction between reactive/proactive aggression and a moderator that affect the prediction of driving anger?

4. METHODOLOGY

4.1. PARTICIPANTS

Males between 18 and 45 years were recruited for this research. The participants were required to own a driver's license for at least one year and to drive on a regular basis (every week). The recruiting process included circular emails from university staff, social media and personal networks. A number of 50 respondents agreed to participate in the experiment on a voluntary basis. However, data components of 8 respondents were incomplete and had to be removed from the analysis. The final research sample consisted of 42 male participants.

4.2. MATERIALS

Driving Anger Scale

The propensity to become angry while driving is measured using the 14-item short form of the DAS (Deffenbacher et al., 1994). Items describe potentially anger provoking scenarios that might occur while someone is driving. Respondents rate each item as to the degree to which the situation would anger them using a five-point Likert scale (1 = "not at all" to 5 = "very much"). The situations describe either the progress of the participant was impeded or reckless driving reduced the safety. However, the focus lays on the anger, caused by another driver's blame. Only two items from the original DAS (Deffenbacher et al., 1994) deal with a potential anger-provoking event that cannot be labeled to another driver (traffic jam and construction site)(Roidl, Frehse, & Höger, 2014).

Reactive-Proactive Aggression Questionnaire (RPAQ)

The questionnaire RPAQ was applied to distinguish between reactive and proactive forms of aggression. Participants were asked to rate each of the items (e.g. "Yelled at others when they have annoyed you", "Had fights with others to show who was on top") by putting a circle around 0 (never), 1 (sometimes), or 2 (often). The questionnaire consists of 23 items: 11 items are used to measure reactive aggression, and 12 items are used to measure proactive aggression (Raine et al., 2006).

ST-IAT (proactive aggression)

An idiographic version of Single-Target Implicit Association Task (ST-IAT) was used as an implicit measure to predict proactive aggression. The procedure was based on 5 blocks and consisted of three binary categorization tasks that were combined in a manner that was either compatible or incompatible with the measured attributes. The target category was "I" (for example: participant's first name, last name and etc.), and the attribute categories were "aggressive" (with aggressive verbs such as abuse, attack, etc.) and "peaceful" (with peaceful verbs such as cooperate, contribute and others). In total, the task comprises 138 trials (Brugman et al., 2015).

E-Stroop (reactive aggression)

The Emotional Stroop Task (E-Stroop) was used to measure an attentional bias for aggressive stimuli, to gain an implicit measure of reactive aggression. Participants had to color name neutral, negative, positive, and aggression-related words that were written in four colors (red, yellow, green, and blue) and presented on a computer screen. It was required to press as quickly as possible the correct response keys on a keyboard to indicate the color of the word. The E-Stroop consists of four blocks of 20 words and one test block. The task has 88 total trials. Delays in reaction times are expected to represent emotional interference (Brugman et al., 2015).

4.3. PROCEDURE

The experiment consists of two components. Participants that agreed to participate in the experiment received online questionnaires one week prior to their appointments. Each participant had to fill in the RPAQ questionnaire on reactive and proactive aggression and answered questions related to driving anger and demographics. The actual experiment was conducted one week later at IMOB in Diepenbeek where the participants had to complete two computer tasks that measured their reaction times. The measures of the ST-IAT served as indicators of implicit proactive aggression whereas the E-Stroop was applied to measure implicit reactive aggression in participants (Brugman et al., 2015). The participants were not informed about the true goal of the study and received a reimbursement of 20 euro as gift vouchers. The overall experiment was approved by the ethical committee of Hasselt University.

4.4. STATISTICAL ANALYSIS

The data was analyzed with SPSS 20. Descriptive statistics were applied to get an overview of the data and to check for missing value. The identified missing values were replaced with the average score for this variable to complete the dataset. Moreover, VIF tests were used to check for multicollinearity. The multicollinearity test revealed that correlation among variables is indeed a problem. Due to the fact that there is a strong collinearity effect between the variables that measure the same construct, it was advised to center the variables before conducting the analysis. The advantage of the variable centering method is that centered predictors tend to be more stable, and estimates from these models can be treated as more or less independent of each other (Field, 2005). Therefore all independent variables are transformed to Z- or centered scores. Therefore, the implicit and explicit measures of proactive and reactive aggression types could be analyzed together.

A Pearson correlation analysis has been conducted to investigate on the linear relationship between driving anger and other variables. The Pearson's correlation coefficient (r) indicates whether there is a positive (+1), negative (-1) or zero covariance (0) between the dependent and independent variable. A one-side test is conducted because aggression is expected to be associated with an increase in driving

anger in male drivers. It will be tested whether there are significant correlations between variables at a 95% confidence level (Field, 2005).

Finally, a stepwise hierarchical regression analysis was carried out to determine the contribution of each explanatory variable, including implicit and explicit measures of aggression, towards driving anger. Interactions between aggression types and age were added in order to find out whether these interactions would significantly increase the overall predictive power of the model. In a first step, age, and the explicit measures of proactive and reactive aggression (RPAQ) are entered as main effects into the regression model to predict driving anger. In a second step, the implicit measures of proactive and reactive aggression (ST-IAT and E-Stroop) were added in a enter procedure to see whether implicit measures improve the predictive power of the model. In a third step, the interactions between all explanatory variables including interactions with age were applied in a forward procedure to test their significance at $\alpha=0.05$.

To test the prediction that age moderates the relationship between aggression and driving anger, a simple slope analysis was conducted using Hayes' PROCESS macro in SPSS (Hayes, 2013). The interaction model was bias-corrected at 95% confidence intervals with 1000 bootstrapped samples. Confidence intervals that do not contain zero indicate a significant effect. Continuous predictors were mean-centered prior to analysis. In addition, RPQ reactive aggression and the implicit measures ST-IAT and E-Stroop were included as covariate to evaluate the unique association of proactive aggression by age.

5. RESULTS

5.1. VARIABLES AND CORRELATIONS

Six variables were entered into the Pearson correlation. The one-tailed Pearson correlation revealed that there is a strong correlation between driving anger and the explicit measure of reactive aggression. This means that an increase in reactive aggression (RPQ) does strongly correlate with an increase in driving anger. Also, the implicit measure of reactive aggression, measured by the E-Stroop, is significantly related to driving anger. The E-Stroop measures an implicit attentional bias towards aggressive stimuli. Higher scores do also correlate with increasing driving anger. Age has no correlation with driving anger. Besides, there is a significant correlation between the explicit measure of RPQ proactive aggression and driving anger which is interesting and requires further analysis by means of a regression analysis.

TABLE 2: Pearson Correlations with Driving Anger

Variables entered into Pearson Correlation

1	Driving Anger Scale	1.000
2	Age	-.037
3	RPQReactive aggression	.557**
4	RPQProactive aggression	.244**
5	E-Stroop	.285**
6	ST-IAT	-.181

**Significant at $p < 0.05$

5.2. REGRESSION

The hierarchical regression analysis yielded three models for driving anger (Table 2). The first model includes the explicit measures of aggression types, the second model adds the implicit measures of aggression types and the third model also keeps the significant interactions with age in the model. As a result, model 3 has the most explanatory power with more than 50% ($R^2 = 0.504$) of the variance explained by the variables included in the model. To confirm model validity, independence of residuals was analyzed. The Durbin–Watson $D = 2.559 > 2$ confirmed that there is no autocorrelation of residuals. Therefore, the regression coefficients appear to be correct. Furthermore, the collinearity between the variables is very low, which is the result of variable centering and reflected by low values of VIF (Pérez Fuentes, Molero Jurado, Carrión Martínez, Mercader Rubio, & Gázquez, 2016).

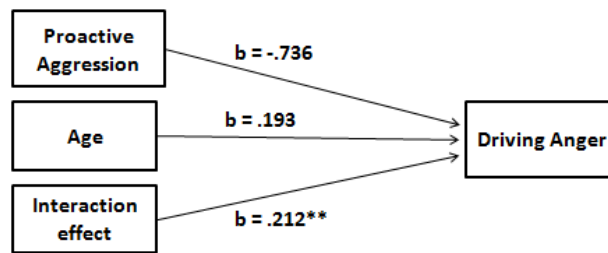
TABLE 3: Regression Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change	Durbin-Watson
						F Change	df1	df2		
1	.584a	.341	.289	5.838	.341	6.565	3	38	.001	
2	.668b	.446	.369	5.500	.105	3.403	2	36	.044	
3	.710c	.504	.419	5.278	.058	4.088	1	35	.051	2.559

TABLE 4: Regression Model Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		Collinearity Statistics		
		B	Std. Error	Beta	t	p-value	Tolerance	VIF
3	(Constant)	32.507	.823		39.476	.000		
	Age	.193	.140	.181	1.379	.089	.820	1.219
	RPQReactive	1.713	.366	.779	4.684	.000**	.513	1.951
	RPQProactive	-.736	.698	-.171	-1.056	.149	.540	1.853
	ST-IAT	-4.792	2.418	-.250	-1.982	.028**	.890	1.123
	E-Stroop	.031	.018	.218	1.764	.043**	.925	1.081
	RPQProactive*Age	.212	.105	.279	2.022	.026**	.742	1.347

Dependent Variable: Driving Anger Scale, ** significant at p value < 0.05



* *Significant at p value < 0.05

FIGURE 3: Interaction effect on driving anger

The regression coefficients of the hierarchical regression with driving anger revealed that explicit reactive aggression (RPQ), implicit reactive aggression (E-Stroop), and the implicit measure of proactive aggression (ST-IAT) are significantly associated with driving anger. Especially, RPQ reactive aggression is the strongest predictor of driving anger. Moreover, the interaction term proactive aggression (RPQ) by age yields explanatory weight in the model, although its main effects are not significant. The listed variables are associated with driving anger on a confidence level of 95%. The interaction of proactive aggression (RPQ) by age indicates that values of proactive aggression (RPQ) and age were crossing each other in different conditions while predicting driving anger. Therefore, the significant interaction requires more attentions and will be further analyzed by means of simple slope analysis. The simple slope analysis follows the procedure of Hayes and is conducted with the Hayes' PROCESS plug in for SPSS (Hayes, 2012).

5.3. SIMPLE SLOPE ANALYSIS

The initial regression analysis shows that the interaction RPQ proactive*age is significant. Therefore, proactive aggression by age was analyzed using simple slope analysis. Also, RPQ reactive aggression, ST-IAT (implicit proactive aggression) and E-Stroop (implicit reactive aggression) were added as covariates. The interaction model in table 5 shows that RPQ reactive aggression and the interaction proactive aggression by age are significant predictors at a confidence level of 95%. The main effects of the interaction term are not significant. The next step is to tease the significant moderator relationship apart. It is of interest how variations in the moderator (age) alter the relationship between proactive aggression and driving anger.

The simple slope analysis showed that the simple R-square increase due to the interaction is significant at an alpha level of 0.05. In addition, reactive aggression remains as a significant covariate in the interaction model. More than 50% of the variations ($R^2=0.504$) can be explained by the model shown in table 5.

TABLE 5: Interaction Model Coefficients

	Coefficients	Std. Error	t	P-value	LLCI	ULCI
constant	32.507	.902	36.021	.000	30.675	34.339
Age	.193	.135	1.427	.162	-.081	.467
RPQProactive	-.736	.588	-1.253	.218	-1.929	.456
interaction	.212	.100	2.124	.041**	.009	.415
RPQReactive	1.713	.407	4.211	.000**	.887	2.538
ST-IAT	-4.792	2.816	-1.702	.098	-10.509	.925
E-Stroop	.031	.021	1.488	.146	-.011	.074

** Significant at p value < 0.05

The significant interaction requires further attention, because the moderator (age) is a continuous variable and therefore, it is necessary to vary between low, average and high values of age. Based on this, it is necessary to create three conditional regressions line which are based on high, average or low values of age and the standard deviations of proactive aggression (RPQ) to predict values of driving anger. Basically, the continuous variable is sorted into a categorical variable by forcing variation across the moderator. This will give three values of Y (driving anger) for each of the regressions. Testing the slopes at 1 standard deviation above and below the mean is very common. However, these values are typically arbitrary, meaning the simple slope test has a very specific (and not very useful) interpretation. Jeremy Dawson (2014) advises choosing values of the moderator that are more theoretically meaningful (but still represent high and low values), so this can be interpreted in a more meaningful way (Dawson, 2014). The simple slope analysis was conducted using the PROCESS plug for SPSS. The specific standard deviations of the variables were provided by the PROCESS slope analysis. RPQ proactive aggression has a standard deviation of ± 1.609 from the mean and the moderator age has a standard deviation of ± 6.515 .

Table 6 indicates that the conditional effect of proactive aggression on driving anger is only significant at low values of the moderator. The conditional effect of proactive aggression on driving anger at values of the moderator age provides the following conclusions: At a low level of age, every unit of RPQ proactive aggression leads to a decrease of -2.118 units in driving anger. This means that driving anger is only associated with young age and very low levels of RPQ proactive aggression.

TABLE 6: Conditional effect of X on Y at values of the moderator (age)

Age	Value	Effect	Std. Error	t	p-value	LLCI	ULCI
Low	-6.515	-2.118	.948	-2.235	.032**	-4.042	-.194
Average	.000	-.736	.588	-1.253	.218	-1.929	.456
High	6.515	.646	.799	.808	.425	-.977	2.268

* *Significant at p value < 0.05

The graphic in figure 4 shows the slope of proactive aggression vs. driving anger compared at different conditions of age. The slope is visualized to understand the direction of the interaction between proactive aggression and age. Low age and low proactive aggression are associated with driving anger above the general cross-over values (constant: 32.507 units) of proactive aggression and age. This means that the interaction at condition of young age and low proactive aggression is positively associated with driving anger, whereas other conditions of proactive aggression will decrease the relationship. Therefore, it can be concluded that young drivers with low proactive aggression are high in driving anger. This is in line with the findings that high levels of reactive aggression, and not proactive aggression, are significantly related to an increase in driving anger.

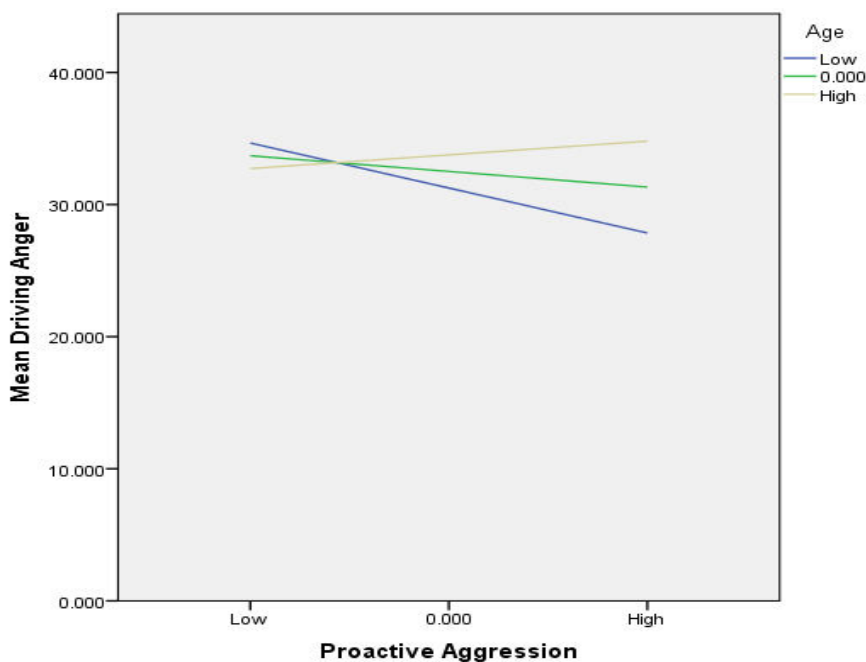


FIGURE 4: Simple slope direction of interaction

To summarize, the regression analysis showed that explicit reactive aggression and the implicit measures of reactive and proactive aggression (E-Stroop and ST-IAT) are significantly related with driving anger at a confidence level of 95%. This shows that measures of explicit and implicit aggression types improve the predictive power of the model. Also, the interaction proactive aggression (RPQ) by age has been found significant. The simple slope analysis revealed that the interaction at conditions of low proactive aggression and young age are significantly associated with driving anger at a confidence level of 95%. Other levels of age or an increase in proactive aggression do not predict driving anger anymore. Therefore, the interaction effect reflects the extent to which proactive aggression by age is contributing to driving anger. Besides, the explicit measure of reactive aggression remained a significant covariate in the interaction model.

6. CONCLUSION

Angry male drivers are likely to engage in aggressive driving behavior that endangers themselves and others in traffic. Therefore, the goal of this study was to analyze the effect of implicit and explicit measures of reactive and proactive aggression on driving anger in male drivers. The propensity to become angry while driving has been assessed by the DAS (Deffenbacher, Oetting, & Lynch, 1994; Deffenbacher et al., 2003). The relationship between male driving anger and aggression types has been analyzed, while accounting for joint effects with age.

1. Are reactive, proactive or a combination of both aggression types good predictors of driving anger?

A combination of proactive and reactive aggression improved the explanatory power of the regression model. More than 50% of the variations ($R_2 = 0.504$) were explained by measures of reactive and proactive aggression (including a significant interaction with age). Explicit proactive aggression (RPQ) was not significant as previously expected. This is logical considering the fact that proactive aggression is not associated with negative arousals and frustration inherent to driving anger (White & Turner, 2014). Therefore, reactive aggression represents a better predictor of driving anger. Interestingly, the implicit measure of proactive aggression was negatively associated with driving anger, whereas a significant interaction of explicit proactive aggression by age was positively associated with driving anger. Further analysis of the interaction yielded more detailed results. Reactive aggression and low proactive aggression by low age were significant predictors of driving anger. This indicates that aggression as an overall construct might be less distinguishable in young male drivers compared to angry male drivers in general. Our data highlighted that reactive aggression is the best predictor for driving anger in the general angry male driver population. However, when it comes to young male drivers, a combination of reactive aggression and low levels of proactive aggression were better predictors of driving anger.

2. Do implicit measures of reactive/proactive aggression improve the predictive power of the model?

It can be stated that the implicit measures of reactive and proactive aggression improved the predictive power of the model from 34% (only explicit measures) to almost 45% (explicit and implicit measures) of all variations explained. This change in power is considerably high and can be attributed to the individual contribution of implicit measures. The implicit and explicit measures of reactive aggression were significantly associated with driving anger in males, whereas the implicit measure of proactive aggression was significantly decreasing driving anger at a confidence level of 95%.

3. Is there an interaction between reactive/proactive aggression and a moderator that affect the prediction of driving anger?

It is found that there is a significant interaction effect of proactive aggression by age that affects the prediction of driving anger (see figure 4). We could not find any direct effects of age on driving anger. However, the interaction effect was significant predicting driving anger under the condition of low age and low levels of proactive aggression. This means that young age is moderating a relationship between low proactive aggression and driving anger that would not be present without the interaction effect. We can conclude that age is not moderating reactive aggression while predicting driving anger. Several

studies confirm that a hostile attribution bias which represents an implicit measure of reactive aggression, is linked to aggression in several populations and across different ages (Oostermeijer, Nieuwenhuijzen, van de Ven, Popma, & Jansen, 2016). However, we also found that age is a moderator of low proactive aggression in young males that predict driving anger.

7. DISCUSSION

The results of this study showed that reactive aggression and low proactive aggression at young age were positive predictors of driving anger in male drivers. These findings are supported by Cui et al. (2016) who suggest that proactive aggression is likely to be simultaneously present with reactive aggression, whereas reactive aggression is not present at certain levels of proactive aggression anymore (Cui et al., 2016). Cui et al. (2016) collected data from a sample consisting of mid-aged school children and young adolescents. Their research addressed the development of distinct aggression subtypes at young age. They identified four trajectory groups among young adolescents with high, moderate and low reactive aggression and three trajectory groups among young adolescents with high, moderate and low levels of proactive aggression. Reactive aggression of the high reactive group remained consistently stable during adolescence, whereas proactive aggression among the high proactive group, decreased during adolescence (Cui et al., 2016). Moreover, it was found that most of the young participants who showed proactive aggression usually also showed reactive aggression (Cui et al., 2016). These findings are in line with our results that reactive aggression among angry male drivers is consistently present disregarding age, while proactive aggression was only available among the young age group. Low levels of proactive aggression were not significantly related anymore to driving anger in mature male drivers.

Besides, research showed that drivers with high reactive aggression are considered to have problems in both regulatory and moral reasoning (Cui et al., 2016). On one hand, there is low sympathy or inability to acknowledge the wrongfulness of one's own aggressive behaviors. On the other hand, deficits in self-regulation which go along with persistent reactive aggression lead to increased arousal and driving anger when observing threatening or reckless behaviors of others. This indicates that male drivers don't perceive driving anger as undesirable in situations that are considered a threat for traffic safety. It has been highlighted that drivers that get angry about reckless driving behavior would act out aggression in order to teach the other driver a lesson in traffic safety. This shows that drivers high in driving anger are actually willing to violate traffic rules in order to release negative arousals and to punish the aggressive driving behavior of a fellow driver (Björklund, 2008; Lajunen & Parker, 2001). Furthermore, proactive aggression at young age has also been associated with low levels of moral reasoning if the outcome of aggressive driving is considered to be rewarding (Cui et al., 2016). This means that young males are less concerned with the moral beliefs of good and bad behavior for traffic safety, if the outcome of aggressive driving is perceived to be positive. Therefore, young male drivers might be more willing to accept risk as a possible outcome for obtaining the reward. Examples from the literature show that young novice drivers reported less anger at other drivers' violations compared to older age groups (Björklund, 2008). Björklund (2007) explains that young novice drivers have a higher tendency to

speeding which indicates that “drivers who drive fast themselves do not become irritated and do not behave aggressively when they see other drivers drive fast, run a red light or a stop sign, or weave in and out of traffic to pass quicker” (Björklund, 2008 p. 1076). The positive outcome expectancies of speeding could be mirrored in our findings that proactive aggression negatively related to driving anger. Still, young males do not necessarily tolerate avoidable risk-taking. It has been found that younger drivers reported more anger than older drivers at progress impeded and direct hostility (Björklund, 2008). Therefore, our results are in line with the fact that reactive aggression is present in all drivers that experience driving anger independent of age. Nevertheless, does driving anger in young males always come along with the instrumental evaluation of traffic scenarios that are presented in the DAS.

Conclusively, this study made an interesting discovery while applying explicit and implicit measures of reactive and proactive aggression to predict driving anger in male drivers of different ages. It can be summarized that aggression as a whole construct seems to play an important role in predicting driving anger in young male drivers, whereas only reactive aggression is a significant predictor for all age groups. The results of this paper imply that aggression type assessments in angry male drivers have to be tailored. Specifically, intervention strategies should focus on developmental differences between angry male drivers.

8. LIMITATIONS AND RECOMMENDATIONS

This research was based on explicit and implicit measures of aggression types that predict driving anger in male drivers across different ages. Possible limitations are the small sample size and the number of variables (including interactions) that were aimed to be studied in this research. A higher sample size might have led to other significances for the main effects. Also the age range between 18 to 45 years is only representative for a portion of the male driver population. Generalizations on the whole population of angry male drivers might be limited, since aggressive driving behavior among male drivers is considered to be a problem until the age of 59 years (see table 1) (AAA Foundation for Traffic Safety, 2016). In the current study, no drivers older than 45 years were included in the male sample. Nevertheless, the data provided valuable insights.

The self-reports of driving anger and aggression might be affected by social desirability and impression management (Mauss, Evers, Wilhelm, & Gross, 2006). No driver social desirability scale has been applied to detect social desirable responding which might have affected the responses. However, the risk of social desirable responses is less likely for measures of driving anger than for self-reported driving behaviors and accidents. Most research indicates that social desirability does not influence personality test scores and that social desirability is only a minor issue in measures of personality traits (Dahlen, Edwards, Tubré, Zyphur, & Warren, 2012).

Another limitation is the use of secondary data in this research. The authors have not been involved in the data collection phase. Thus, no absolute certainty about the accuracy of the data can be guaranteed.

Unreported information or data coding mistakes might interfere with the results. However, this limitation is considered to be small since the source of data is well known.

Finally, more research on interaction effects is needed. Therefore, future studies should apply additional measures of aggression related traits (e.g., impulsivity and sensation seeking) and cognitive control abilities to investigate interaction effects with proactive and reactive aggression while predicting driving anger or driving behaviors.

CHAPTER 2

HOW TO IDENTIFY TRAFFIC-RELATED AGGRESSION IN YOUNG NOVICE DRIVERS? - APPLICATION OF IMPLICIT ATTITUDES MEASURES IN THE TRAFFIC CONTEXT

1. INTRODUCTION

The unchanged high number of accidents involving young novice drivers with aggressive driving behavior indicates that aggression and a positive attitude towards aggressive driving can be a relevant explanation. The attitudes and personality of the individual young novice drivers are not taken into account yet in driving education, although attitudes (individual belief and evaluations) constitute an important explanatory component of behavior (see: theory of planned behavior (Ajzen, 1991)). There is a common agreement that aggressive drivers should be already identified in the learning phase through the inclusion of attitude and trait measurements in the driving curriculum (Roman, Poulter, Barker, Mckenna, & Rowe, 2015; Rowe et al., 2013; Ulleberg, 2001).

Information processing and decision making in young novice drivers is based on two systems: implicit-automatic, and explicit- deliberate (Hofmann et al., 2005). Explicit-deliberate processing is based on thoughtful reasoning and the evaluation of appropriate and social desirable behavior (Hofmann et al., 2005). Implicit-automatic processing leads to spontaneous and affective impulses that are mainly released under time pressure and reveal the true motivation for certain behaviors. These uncontrolled and unconscious reactions (while driving) do often reflect traces of automatic attitudes and individual personality traits that reflect the motivation to engage in aggressive or safe driving. Furthermore, it was found that explicit and implicit attitudes have to be related to specific attitude objects in order to draw conclusions about situation-specific behavior (Ajzen & Fishbein 2005). Whereas a number of traffic-related questionnaires on aggressive driving behavior are available for measures of explicit attitudes, are implicit tests not yet available for the traffic context. Therefore, new implicit tests that measure traffic-related aggression need to be developed. Young novice drivers develop their personal driving style within the first two years after licensing. During this time, they are at elevated risk of being involved in serious or fatal road accidents when engaging in aggressive or risky driving behavior (Roman et al., 2015). Implicit stimuli have to be translated into the traffic context to measure the implicit attitude towards aggressive driving behavior and provoking situations among young novice drivers. This requires specific design considerations as well as detailed insights in implicit attitude measures and biases towards aggressive driving.

Besides, the literature review revealed that there is a correlation between personality traits of young novice drivers who frequently engage in aggressive driving behavior and the positive attitude towards traffic violations (Constantinou et al., 2011). These traits are: 1. impulsivity 2. sensation seeking and 3. fearlessness. Impulsivity is a personality trait that is strongly related to low inhibitory control and reflects the inability to control impulses and arousals (Jongen, Brijs, Komlos, Brijs, & Wets, 2011a). Sensation seeking describes the excitement for new sensations, which go along with low self control to

stay with boring and monotonous tasks (Steinberg et al., 2008). Tests have shown that young novice drivers have higher scores in impulsivity and sensation seeking compared to older drivers (Arnett, 1994; Steinberg et al., 2008). These traits are associated with a 'lack of concern for others', and 'careless violations'. But also fearlessness is highlighted as an important character trait that leads to "deliberate, self-serving rule violations and frequent traffic offences" among young novice drivers (Panayiotou, 2015, p. 117). Fearlessness is a trait that is characterized by low levels of anxiety and more optimistic risk appraisals (Panayiotou, 2015).

Within the literature, two types of aggression are introduced that constitute important predictors why to engage in aggressive behaviors (Brugman et al., 2015). It was pointed out that proactive aggression is related to intended rule violations, whereas reactive aggression is an evoked response towards aversive situations that result in spontaneous rule violations. These two types of aggression represent distinct motivations to become aggressive (Brugman et al., 2015; Lobbestael et al., 2016). Reactive aggression is usually described as impulsive and emotionally-driven aggression expressed in response to threatening stimuli, whereas proactive aggression is defined as more controlled aggression motivated towards obtaining specific rewards and goals. Translated in the traffic context this means that proactive aggression is related to intended traffic violations in order to gain time advantages and rewards, whereas reactive aggression is an anger-evoked response towards aversive and goal-blocking traffic situations (Cima, Raine, Meesters, & Popma, 2013).

2. AGGRESSION

Aggression is a very complex concept that is usually described as the intention to harm others in a physical or verbal way (Myers, Abell, Kolstad, & Sani, 2010). Other definitions strengthen the relationship between competition, and goal-related aggression that is rooted in evolutionary and social learning theories to gain power within a group. Aggressiveness and sensitivity to provocation varies among both males and females due to differences in personality and temperament. Especially the testosterone hormone has a mediating effect between aggression and dominating behavior. This means that testosterone is facilitating dominance and aggressiveness, whereas at the same time dominating and defeating behavior increases the level of testosterone (Myers et al. 2010). This reinforcing process leads to increased susceptibility towards aggressive behavior, if people were already involved in similar behavior before.

Although aggression is present in males and females, the factors that lead to behavioral enactment of aggression are different (Myers et al. 2010). Social learning and personal resources (physical strength, social power, dependency, etc.) have a major influence on how aggression is handled and expressed. Due to differences in males and females, males are more prone to physical aggression and impulsive actions, whereas females more often engage in verbal and relational aggression (manipulative behavior) (Rappaport & Thomas, 2004). Moreover, these differences are facilitated by social learning from society. Enacted aggression pays off for men in society (Myers et al. 2010), whereas females seek to show

aggression in other ways, due to perceived higher costs of direct aggression (e.g. lack of physical strength and awareness of social desirability in society).

2.1. EMOTIONAL VS. INSTRUMENTAL AGGRESSION

Further theories have made a distinction between emotionally driven aggression which is temporarily based on feelings of frustration and anger, and instrumental aggression which is rooted in the personality and attitude (Myers et al., 2010; Brugman et al., 2015). Emotional aggression is based on negative emotional arousals that trigger aggression. The Frustration-aggression theory states that frustration always leads to some form of aggression, because frustration arises if anything is blocking a person from attaining a goal (Berkowitz, 1989). Figure 5 shows two routes of psychological processing, if a goal is blocked and cannot be attained. The first path demonstrates that aversive experiences (e.g. impeded traffic) evoke feelings of frustration, anger and emotional arousal. Whether aggression or some other response occurs in order to relieve the negative arousal depends on what consequences the individual has learned to expect (Myers et al., 2010). The second path is based on the evaluation of rewards and costs. This path does not require emotional arousal, because an internal evaluation of the anticipated consequences is activated. The evaluation is based on positive/negative beliefs regarding the outcome of aggression. If the outcome of aggression is evaluated as positive, the attitude towards aggressive behavior will be positive, which leads to an aggressive response in that situation. However, the response will be different, if rewards and costs of aggression are evaluated as negative, due to expected punishment of aggressive behavior. Therefore, other responses might be activated (for instance, constructive problem solving, resignation or repression of feelings etc.). Shinar (1998) uses the term 'displaced aggression' when aggression cannot be expressed because of cultural norms or enforcement. Both routes of emotional and instrumental aggression can be activated at the same time (Shinar, 1998).

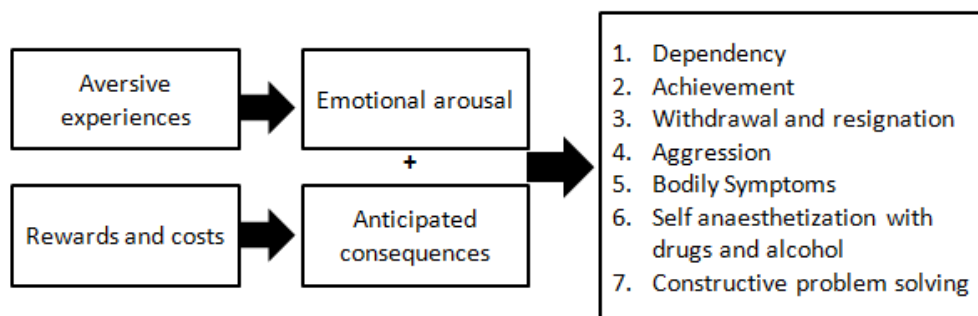


FIGURE 5: “Psychological mechanisms of aggression” (Myers et al. 2010)

2.2. PROACTIVE VS. REACTIVE AGGRESSION

The proactive use of aggression has the aim to put others in a situation where they are not able to hinder someone from attaining a goal. Proactive aggressive people do not need physiological arousal or provocation to act out the aggressive behavior. This type of aggression is based on positive outcome expectancies regarding aggressive behavior. Proactive aggression is, therefore, considered an instrumental mean to obtain specific rewards and to establish social dominance (Rappaport & Thomas, 2004).

In contrary, reactive aggression is triggered by feelings of anger and frustration when provoked by others. The reactive type of aggression always needs physiological arousals to be activated and is based on high impulsivity and low inhibitory control. Therefore, an emotional arousal or provocation leads to a temporal increased focus on competition and defense of the self (Brugman et al., 2015). It is claimed that “testosterone is specifically related to provoked aggression, but not unprovoked aggression, in adolescents” (Rappaport & Thomas, 2004, p. 264). Moreover, provocation can happen more easily at a younger age, because the brain of adolescents is not fully developed yet and therefore social cognitive processing of information is more likely to be impaired which leads to increased misinterpretation and misperceptions (Keating, 2007). At the same time, cognitive control is outweighed through strong impulsive reactions towards the experienced threat, which is in particular the case in young males with high levels of testosterone (Rappaport & Thomas 2004). A high level of physiologic arousal can either lead to the activation of an aggressive or anxious response “fight-or-flight” (Rappaport & Thomas 2004). The aggressive response is a defensive reaction in adolescents with a reactive aggression type. This type of aggression can be controlled for with experience and maturation through age (Rappaport & Thomas 2004). In contrary, proactive aggressive males hold strong positive outcome expectancies from aggressive behavior that manifests the attitude. Therefore, it is less likely that aggressive persons are motivated to control for proactive aggression when getting older (Rappaport & Thomas, 2004).

Table 7 shows high similarities between emotional and reactive aggression as well as between instrumental and proactive aggression. All definitions focus on the underlying motivation of aggression. Reactive and proactive aggressions are more comprehensive and point at general social functions like ‘defending the self’ and ‘imposing power on others’. Therefore, they can generally be considered as character traits. In the following sections, it will always be referred to reactive and proactive aggression.

TABLE 7: Differences and similarities between types of aggression (Rappaport & Thomas, 2004)

Type of Aggression	Definition	Similarities & Differences
Emotional aggression	Based on aversive experiences that evoke emotional arousals. They are cognitive cues to action to relief the tension	<ul style="list-style-type: none"> • Based on provocation • Relieving emotional tension and anger.
Reactive aggression	Emotional arousal or perceived provocation lead to a temporal increased focus on competition and aggression.	<ul style="list-style-type: none"> • Based on provocation • Relieving emotional tension • Defending the self concept from attack/ perceived threat • Considered as trait type
Instrumental aggression	A positive evaluation of the anticipated benefits, justify the instrumental means to attain the goal	<ul style="list-style-type: none"> • The perceived benefits of consequences (reward) outweigh the costs • No provocation is needed
Proactive aggression	Obtaining the rewards by means of established dominance on others. Proactive elimination of obstacles.	<ul style="list-style-type: none"> • Only sensitive for rewards, not for costs • No provocation is needed • Imposing power on others • Considered as trait type

3. RELATED PERSONALITY TRAITS

Certain personality traits are associated with aggression in young novice drivers. These character traits complement aggression types and will be investigated in more detail to understand their contribution towards aggression.

3.1. SENSATION SEEKING

According to Zuckerman (1994), Sensation Seeking “is a trait defined by the seeking of varied, novel, complex, and intense sensations and experiences and the willingness to take physical, social, legal, and financial risks for the sake of such experiences” (Zuckerman 1994, p. 27). A common characteristic is “the optimistic tendency to approach novel stimuli and explore the environment” ((Zuckerman 1994, p. 384). This means that young novice drivers with a high sensation seeking profile tend to have an optimism bias and are not avoiding new or dangerous stimuli. Moreover, research has shown that all kinds of emotional arousals are activating the same brain region and that anger and the positive emotions of joy and pleasure are related to the same risky approach behavior (Lobbestael et al., 2016). Zuckerman (1994) proposed four dimensions on the scale of sensation seeking: Thrill and Adventure Seeking, Experience Seeking, Boredom Susceptibility and Disinhibition (which is related to low inhibitory control). At the same time, Arnett (1994) proposed his own Inventory of Sensation Seeking (AISS). He highlighted that only two components of sensation seeking are the most relevant to measure sensation

seeking. These are novelty and intensity. The new scale has been validated by his studies, indicating that the AISS is more strongly related to risky behavior than Zuckerman's Sensation Seeking Scale (SSS) among adolescents. This is remarkable; because Arnett's new scale contains no explicit items related to risk behavior (in contrast to the Zuckerman's SSS). Moreover, the new scale was also found to be significantly correlated with Aggression (Arnett, 1994). This leads to the conclusion that the Arnett Inventory of Sensation Seeking is very useful for this research.

3.2. FEARLESSNESS (LOW LEVEL OF HARM AVOIDANCE)

Fearlessness is a variable that has recently been introduced in research papers on young novice drivers (Le Bas, Hughes, & Stout, 2015; Panayiotou, 2015). Fearlessness is related to low levels of harm avoidance in young novice drivers and is opposed to fear and anxiety (high levels of harm avoidance). Fearlessness and anxiety are opposing personality traits that influence cognition and decision making. Drivers that are fearless are not afraid of possible harm that can be the result of thrilling and dangerous actions. White, Grover and De Wit (2006) investigated that the trait fearlessness is correlated with the trait aggression. He found that individuals who were relatively insensitive to threat (i.e., those who are high in trait fearlessness) are less prone to stress and have a "predisposition toward fearless thrill seeking and aggression" (White, Grover, & de Wit, 2006 p.129). These results are also confirmed by Panayiotou (2015), who found that fearlessness is associated with violations of traffic laws. In contrast, anxiety and fear have been found to relate especially to errors and lapses (Wong, Mahar, & Titchener, 2014). The individuals with a high anxiety trait are very sensitive to threat which results in a tendency towards harm avoidance due to higher levels of experienced stress. This means that these individuals prefer safe and cooperating maneuvers over dangerous and aggressive maneuvers (Gulliver & Begg, 2007). Drivers who are high in trait fearlessness are less likely to be affected by anxious thoughts and do not evaluate their driving behavior in terms of harmful consequences. Therefore, fearlessness will be considered as a variable in aggressive driving.

3.3. IMPULSIVITY

Impulsivity is defined as a lack of ability to delay the performance of a behavior and to think about future consequences (Patton, Stanford, & Barratt, 1995). Therefore, impulsivity is strongly related to low inhibitory control (Jongen, Brijs, Komlos, Brijs, & Wets, 2011b), which describes the tendency to not consider alternatives and outcomes before making a decision (Whiteside & Lynam, 2001). Furthermore, it affects the ability to concentrate on one task despite "competing temptations" (Whiteside & Lynam, 2001 p.671). These temptations can be stimuli from the environment that lead to physical arousals affecting spontaneous behavior. It takes a lot of self control to restrain impulsive reactions. Therefore, aggressive impulses are likely to happen at a younger age when the capacities of self control are immature (Steinberg, 2008) and in situations, where the self-regulatory capacity is depleted (e.g., stress) (DeWall et al., 2007). Furthermore, impulsivity is a character trait that facilitates aggressive driving without the intention to engage in aggressive driving behavior. Forward (2008) stated that the traffic context plays an important role for non-intenders of violations. She explains that facilitating situations that make it hard to avoid violation (e.g. emotional arousals), and situations that make it very easy to violate (time pressure etc.), favor impulsive reactions that overrun cognitive control (Forward, 2009).

Thus, impulsivity is a personality trait that determines the level of susceptibility to 'external opportunities' and emotional arousals.

4. ATTITUDES

The attitude is strongly linked to perceptions and beliefs regarding the outcome of behavior. It can be divided into instrumental and affective attitudes towards aggression (Elliott & Thomson, 2010). The instrumental attitude towards aggression describes the belief that aggressive behavior can lead to positive consequences (e.g., 'I will save time and get a better position on the road at the expense of others'). In contrast, the affective attitude towards aggression is an emotional evaluation of the outcome in terms of positive or negative feelings (e.g., 'I feel better to express my anger if another driver is annoying me'). In both examples, the attitude serves different functions. Katz (1960) suggested that attitudes perform several functions that can be classified in four dimensions. Firstly, the utilitarian/instrumental function of attitudes allows people to maximize the chances of receiving rewards and to minimize negative social outcomes. Therefore, the attitude towards aggressive behavior would depend on the likelihood whether the behavior is punished or rewarded. Secondly, attitudes have a knowledge function that provides a sense of structure and order. They help people to explain and understand the world based on common knowledge and evaluation of objects in terms of safe or dangerous, good or bad. Thirdly, the ego-defensive function is a defense mechanism to protect the ego/self from anxiety and any external threat. Fourthly, the value-expressive function allows people to express and reinforce those attitudes that represent their self identity and central values. This function helps to create and preserve a unique image of the self that is recognized by others (Katz, 1960; Myers et al., 2010).

In order to understand individual beliefs and attitudes towards aggressive driving behavior, it is necessary to take the research of Ajzen & Fishbein (2005) and Olson & Stone (2005) into account. Their research demonstrated that attitudes have an ambivalent influence on behavior and are influenced by behavior in return. Ajzen and Fishbein formulated the theory of 'evaluative inconsistency' to point out that attitudes are "predictors of behavior only for certain individuals and in certain situations" (Ajzen & Fishbein 2005, p. 182). Perugini and Leone (2009) highlighted the fact that there is a difference between the explicit moral attitudes and actual behaviors. It was found that people's statements about their personal morals are rather "hypothetical moral evaluations, that could not predict actual behaviors" (Perugini & Leone, 2009, p.752). This shows that general attitudes might influence the evaluation of general behavior, but that driving in specific traffic situations reflects a more situation-specific attitude of the evaluation of aggressive driving. There is a general agreement that the attitude always needs to be related to a specific attitude object and that the attitude is based on a composition of several evaluations that affect driving behavior (Ajzen, 1991; Fishbein, 2014; Icek Ajzen, 2002). This has implications on the theoretical level of how to measure attitudes.

4.1. EXPLICIT ATTITUDE MEASURES

Explicit attitudes are defined as attitudes that are available on a conscious level, are deliberately formed and easy to self-report (Perugini, 2005; Richetin & Richardson, 2008). A good way to measure explicit attitudes is observation and self reporting through the use of questionnaires and attitude scales. Although self-reporting seems to be mostly accurate, it has to be assumed that the participants are highly self-aware and honest. However, it can be the case that a) participants might not be aware about their attitude due to a lack of introspective access or b) participants prefer to report consciously accessible representations of aggression and adopt a socially desirable attitude (Hofmann et al., 2005; Richetin & Richardson, 2008).

Self-reports are useful tools to gain specific information about a personal characteristics and thoughts and beliefs. However it has often been reported that sensitive or very personal questions lead to “lower response rates, item non-response and misreports” (Böckenholt, 2014). It is expected that those phenomena will also be observed during explicit tests in driving schools. Firstly, there might be resistance of young novice drivers to answer explicit aggression related questionnaires in driving schools due to fear of stigmatization (Greenwald & Banaji, 1995). Secondly, the young novice drivers will rather not report a positive attitude towards aggressive driving, because they are aware that aggressive driving is socially undesirable behavior. Thirdly, young novice drivers do not have enough experience and simply do not yet know how they would react in an unfamiliar adverse traffic situation.

To promote truthful responses in explicit tests, the privacy of the participants has to be adequately protected and answers on sensitive characteristics will not be exposed to others (Wu & Tang, 2014). Moreover, the measurements of explicit attitudes should be based on Likert scales, evaluative and trait ratings as well as thermometer-like scales that measure feelings towards attitude objects (Hofmann, 2005). This provides the respondents with the possibility to indicate types of preferences. Furthermore, research on sensitive questionnaires has indicated that the order of the items and questionnaires can affect the answers of the participants. It is proposed that insensitive and general questionnaires should be presented first to avoid reactance in participants (Standing & Shearson, 2010). Moreover, a possible learning effect can be addressed by randomizing the order of the questionnaires for the different respondents (Standing & Shearson, 2010; Wu & Tang, 2014). After all, explicit measures have proven to be good predictors of conscious beliefs and behavior if reactance and biases are addressed (Richetin & Richardson, 2008). However, explicit measures on sensitive topics like aggression can often lead to socially desirable responding, because participants tend to present themselves in a positive light and don't want to admit that they reacted aggressively in certain traffic situations (Lajunen & Summala, 2003). Therefore, explicit tests should be accounted for social desirability when measuring explicit attitudes.

4.2. IMPLICIT ATTITUDE MEASURES

Implicit attitudes are involuntarily formed, typically unknown to the participant and are therefore, measured on the unconscious level. Greenwald and Banaji (1995) defined implicit attitudes as "introspectively unidentified (or inaccurately identified) traces of past experience that mediate

favorable or unfavorable feeling, thought, or action toward social objects" (Greenwald & Banaji, 1995 p.8). The most common technique to measure implicit attitudes is based on reaction times that reveal automatic associations of attributes with predefined categories. Variants of the Implicit Association Test and the Emotional Stroop Task have been identified as useful tools to measure automatic associations in participants that reveal the implicit attitude.

The Implicit Association Test

The Implicit Association Test (IAT) was developed and published by Greenwald, McGhee, & Schwartz (1998) as a scientific tool to measure the relative strength of cognitive associations in people. The IAT has the advantage that it provides direct access to people's attitudinal unconscious and reveals automatic associations between two contrasted target categories (e.g., self versus others) and two bipolar attribute categories (e.g., harmful versus harmless) (Richetin & Richardson, 2008). If two concepts are highly associated (e.g., self and harmful or others-harmless), the classification task will be easier and the participants will respond faster during the IAT.

The IAT can provide results on socially unpopular topics (e.g., aggression) if explicit measurements are unattractive. This is practical in situations where participants are not able to communicate their attitude due to lack of insights or because they prefer to not express those attitudes in front of an examiner. However, there has been some controversy whether the IAT is really measuring attitudes or other constructs such as salience of attributes (Rothermund & Wentura, 2004) and/or cultural knowledge (Olson & Fazio, 2004). It has been recognized that the reference perspective is misleading in the traditional IAT which made it difficult for participants to decide whether the stimuli should be categorized from the "perspective of the self, the culture, or the researcher" (Han, Czellar, Olson, & Fazio, 2010, p.288). Furthermore, it is important that the stimuli used in the IAT describe a concept as good as possible to facilitate automatic responses (Fazio & Olson, 2003). The disadvantage of the general IAT is that the categories are too general. The category 'self' has to be linked with attributes like good/bad, pleasant/unpleasant. However, these attributes are often too vague and broad to be properly associated with the self-identity. Han et al. (2010) stressed the fact that the IAT is too open for interpretation and that "unclear wording, the implications of a preceding set of questions, or an unexpected natural event cast a different light on the matter at hand" leading to different interpretations of one stimuli (Han et al. 2010, p.286). This means that a reference perspective and a reference situation are necessary to avoid ambiguity of stimuli and to enhance the specificity of IAT measures.

Although there is the possibility to design an implicit picture-based computer task, only the idiomatic implicit task, which is based on word stimuli, is conducted in this research. The literature on implicit association tests has found that "IATs using pictures as target exemplars seem to produce systematically smaller IAT scores than IATs employing words as targets" (Meissner & Rothermund, 2015, p.741). Other papers provide evidence that pictures are less used in implicit tests, because they do not fit the assumptions of time sensitive Go/No-Go associations. Decoding and processing the content of a picture asks more time from a participant compared to the exposure to words representing distinctive categories like black/white or old/young (Meissner & Rothermund, 2015). Although pictures lead to

stronger and more affective experiences in participants, the information on pictures is also more complex. Therefore, pictures evoke significantly slower reaction times and activate less extreme attitudes when compared to IATs using categorical words as stimuli (Weldon & Jackson-barrett, 1993).

Brugman et al. (2015) used the Single-Target Implicit Association Task (ST-IAT) in their research to measure the automatic association only between the self concept and one target category. By excluding the second target category “other”, the measurement is more related to the participant without comparing him/herself with others. Therefore, the ST-IAT is very useful to relate the presented stimuli to the self. It has been found that a stronger self-aggression association predicted higher scores on proactive aggressive behavior (Brugman et al., 2015).

The Emotional Stroop Task

The Emotional Stroop Task is a color naming task that is designed by Stroop in 1935 and further developed during the last decades (Brugman et al. 2015). Participants are faced with stimuli that are presented in a variety of colors and are asked to name the color of the word as quickly as possible while ignoring the meaning of the word. The difference between the original Color Stroop Task and the Emotional Stroop Task is that the Color Stroop Task uses color words printed in colors, whereas the Emotional Stroop Task uses words with some emotional connotation, such as threatening words, printed in colors (Larsen, Mercer, & Balota, 2006). The emotional Stroop is based on the assumptions that specific social groups (e.g. aggressive youngsters) that are prone to aggressive behavior show an automatic attentional bias for aggressive words when confronted with a variety of words. The participants are expected to name the color of neutral words quicker than naming the colors from a meaningful list of words (e.g. negative, positive, aggressive). It has been found that participants are often slower to name the color of a word if the meaning of the word is not associated with the meaning of the color (Larsen et al., 2006). The concerns are driven by the attitude and can be measured through hesitations. The delays in reaction time are an indicator of the strength of automatic associations with the word. This is based on a cognitive conflict between the automaticity of word-reading and color matching (Smith & Waterman, 2005).

Implicit tests like the Emotional Stroop Task can measure the attentional biases towards emotional stimuli e.g. aggressive words (Brugman et al., 2014). The literature states that individuals with particular psychological traits display an attentional bias toward specific stimuli or cues (Xu et al., 2014) which reflects the automatic motivational state of an individual. The implicit motivation leads to a selective bias in attention and also affects the explicit perceptions of an individual (Xu et al., 2014). Wilkowski and Robinson (2008) found evidence that “hostile biases in attention do not create hostile interpretations but rather reinforce the impact of preexisting hostile interpretations” (Wilkowski & Robinson, 2015 p.12). They highlight that a hostile interpretation bias present in a person affects the early automatic stage of information processing. In particular, aggressive individuals are more likely to interpret ambiguous information and behavior as hostile provocations. However, the presence of an attentional bias cannot be used as a measure of behavior, because the measure can only indicate that a personal meaning is ascribed to the target word. Nevertheless, the automatic accessibility of emotions which are strongly associated with aggressive or threatening words increase cognitive arousal and reinforces

aggression. The E-Stroop has been found to be a good measure of reactive aggression (Brugman et al., 2015).

4.3. EXPLICIT VS. IMPLICIT MEASURES OF ATTITUDE

Richetin and Richardson (2008) summarized in their paper that the two types of aggression (reactive/emotional and proactive/instrumental) are simultaneously linked with two systems of information processing. They state that aggression can be based on thoughtful or impulsive actions which are either driven by deliberative or automatic processes. The distinction between automatic and deliberative systems has implications for the measurements of implicit and explicit attitudes in individuals (Richetin and Richardson, 2008). Until now three main models have been identified in the literatures which are helpful to understand individual differences in evaluations of aggression (Grumm, Hein, & Fingerle, 2011). These models are summarized in the papers of Perugini (2010; 2005) and explain how implicit and explicit attitudes can interrelate with each other in different ways (Perugini, 2005; Perugini et al., 2010):

1. Additive pattern: The implicit and explicit measures of attitudes explain different portion of variance in the variable that predicts behavior.

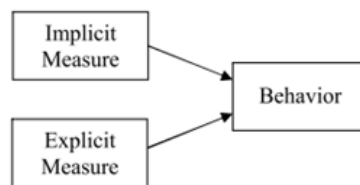


FIGURE 6: Additive pattern

2. Multiplicative pattern: The implicit and explicit attitude measures interact in influencing behavior. This pattern is reflected in an interaction term between an implicit and an explicit measure over and above their individual contributions.

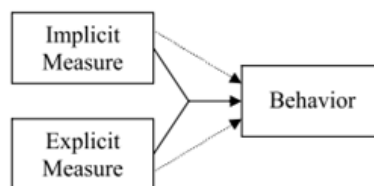


FIGURE 7: Multiplicative pattern

3. Double dissociation pattern: The implicit attitude measures predict spontaneous behavior whereas explicit attitude measured predict deliberative behavior (figure 8).

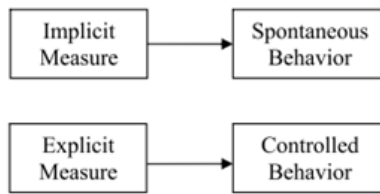


FIGURE 8: Double Dissociation Pattern

In the literature, it is highlighted that implicit test have their strength in predicting spontaneous or automatic behavior, whereas the explicit self-report better predicts controlled behavior (M. A. Olson, 2006). Within the framework of this research, it is expected that explicit and implicit measures of attitudes can be described best by the double dissociation pattern (figure 8). This means that the explicit measure can predict controlled and conscious behavior whereas the implicit measure is associated with unconscious beliefs and spontaneous behavior (Cui et al., 2016).

Grumm, Hein and Fingerle, (2011) claim that the differences between implicit and explicit attitudes in individuals are possibly explained by a developmental approach. They agree that “early developmental events may shape implicit concepts (e.g., aggressive behavior) more than explicit ones. These implicit concepts provide a foundation for future learning processes and can be regarded as an unconscious source for actions and evaluations” (Grumm et al., 2011 p.353). This means that attitudes are particularly shaped by implicit processes that increase the susceptibility towards aggressive behavior. Implicit processes are often reinforcing processes, which shape attitudes in an unintended way. But the implicit attitude does not necessarily need to lead to behavior, if counteracted by the conscious attitude and self regulation abilities (DeWall et al., 2007). The explicit attitude and coping strategies can be developed from individual experiences and learning throughout life (Smith & Waterman, 2004). The explicit measure of attitude is therefore, consciously related to behavior while the implicit measures of attitude is more related to unintended and unconscious motivations for this behavior (DeWall et al., 2007; Richetin & Richardson, 2008).

5. AIM OF THE RESEARCH

The unchanged high number of accidents involving young novice drivers with aggressive driving behavior shows that attitude and personality measures should be included in the driving curriculum to identify and address tendencies of aggressive driving among young novice drivers already in the learning phase. The aim of this study is to focus on implicit attitude measures of traffic-related aggression. Therefore, traffic-specified implicit tests need to be developed to measure traffic-related aggressive attitudes in young novice drivers. This is based on the assumption that traffic-related attitude measures predict driving behavior in a better way than general attitude measures (Ajzen & Fishbein, 2005). Emotionally primed concepts from the traffic context will be applied in two implicit tasks (ST-IAT and E-Stroop), to automatically activate object-specific attitudes in young novice drivers.

A mediated model is proposed to investigate the relationship between personality traits of young novice drivers and aggressive driving behavior. The aggression-related attitude measures are applied in an implicit and explicit way to assess their contribution. Personality traits influence the attitude and the attitude represents an explanatory component for aggressive driving behavior (theory of planned behavior by Ajzen & Fishbein, 2005). But also personality traits can be directly associated with aggressive driving behavior (see figure 9).

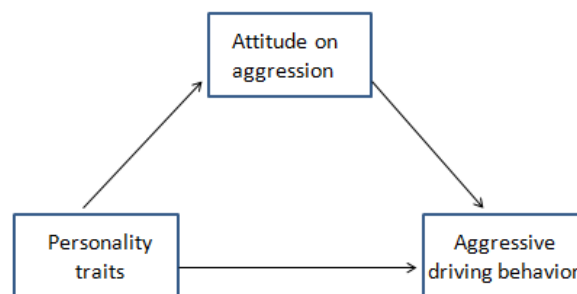


FIGURE 9: Conceptual mediation model

Several questionnaires on aggressive driving behavior are available to assess the explicit attitude on aggressive driving. However, when it comes to implicit tests, only instruments on general aggression can be applied. Therefore, it is aimed to design new implicit tests for the traffic context to identify traffic-related aggression types among young novice drivers. Traffic-related stimuli have never been designed for the E-Stroop and ST-IAT yet. Hatfield et al (2007) has already made a first contribution by applying speeding-related words in the Implicit Association Test (Hatfield, Faunce, & Job, 2007) in order to measure speeding preferences in drivers. However, our research aims at identifying implicit attitudes towards a broader range of driving acts that are considered aggressive and go beyond speeding. Therefore, stimuli related to aggressive driving acts and emotionally affecting traffic situations are designed to be applied in a traffic-related version of the ST-IAT and E-Stroop. Unfortunately, it is out of the scope of this paper to verify the individual contribution of traffic related implicit tests in comparison

to general implicit tests. Nevertheless, the design process of traffic-related stimuli is presented and the design requirements of the ST-IAT and E-Stroop are replicated in order to build new valid implicit instruments.

6. VALIDATION OF IMPLICIT STIMULI AND THEIR EFFECTS

Implicit Association Tests

Most research suggests that IAT scores provide an estimate of the strength of association between categories (e.g., aggressive and peaceful driving). However, there is an ongoing debate about whether the IAT also measures category salience, category familiarity, or valence that interfere with the strength of association (Mauss et al., 2006; Rothermund & Wentura, 2004). Therefore, implicit stimuli need to be selected carefully to guarantee that the level of salience, familiarity and valence of stimuli is identical between blocks and test trials in order to draw conclusions about evaluative differences measured by variants of the IAT. Valence, familiarity and salience are interacting concepts that affect the interpretation of stimuli. Valence describes the emotional attraction and associations of words. Familiarity is based on frequent exposure that reflects awareness and understanding of the presented words. In addition, the salience of words is reflected by the prominence and importance of stimuli in a certain context. On one hand, participants need to gain relevant information in unclear and unfamiliar situations. On the other hand, negative information is typically more salient for behavioral regulation and requires more attentional capacity than positive information. This means that faster responses are expected in trials that assigns familiar and positive words the same response key (Rothermund & Wentura, 2004).

Emotional Stroop Tasks

Research on the effects of the E-Stroop task pointed out that unfamiliar words pop out among familiar words but not vice versa (Rothermund & Wentura, 2004). These attentional effects regarding presented stimuli are called “novel popout” and “familiar sink-in” and can be explained in terms of conditioned inattention to frequently encountered stimuli. The differences in attention are the result of limited attentional capacity that is rather directed to unfamiliar stimuli that contain new information. The less familiar of two categories is thus typically more salient (Thiering, 2011). Furthermore, differences in attentional capacity have also been found between negative and positive stimuli. Negative categories automatically attract or hold attention because negative information is typically more relevant for the regulation of behavior than positive information (Rothermund & Wentura, 2004).

Furthermore, the lexical characteristics of words can also contribute to word recognition speed in implicit tests (Larsen et al., 2006). Lexical characteristics are especially important for the high number of stimuli used in the E-Stroop (20 words per category). Words in the emotion and control lists of the E-Stroop are never the same, yet the calculation of interference is done in the same way by subtracting the response times to the control words from response times to the emotional words. Since the words

in the emotion and control lists are different, it is crucial that the words are matched list-wise on lexical features that influence word recognition. If the emotional words were longer, then any slowing in reaction time to name their colors might be due to the additional visual processing time that is imposed by the more complex stimulus words (Larsen et al., 2006). In order to avoid this, several word characteristics have to be taken into account. Many lexical properties of words should be evaluated, such as word frequency, length in letters and familiarity. First, it is found that low-frequency words produce longer color-naming latencies than high-frequency words. If emotional words used in a E-Stroop study are more infrequent than the neutral control words, then estimates of interference would be higher for those words. Second, word length appears to play an important and obvious role in word recognition. In general, longer words take more time to process than shorter words. If emotional words used in the E-Stroop are longer than control words, then higher interference estimates would be expected for those words because of lexical differences (Larsen et al., 2006). A third lexical feature related to word recognition speed is orthographic neighborhood size of stimuli. This refers to the number of appearances into which a familiar word can be transformed while preserving the identity and position of the letters (Larsen et al., 2006). Words that can be applied in several context scenarios tend to produce faster response latencies because the initial meaning is faster accessible from situations that are more familiar. If emotional words used in E-Stroop tasks have smaller orthographic neighborhoods and are less familiar than the control words, then higher interference estimates would be obtained (Larsen et al., 2006).

7. PRETEST: TRAFFIC SPECIFIC IMPLICIT STIMULI

The pretest section describes all necessary steps that have to be taken into account in order to replicate valid effects of implicit tests. The collected traffic-related stimuli have been controlled for all expected aspects of interference that have been mentioned in the previous section about the validation of implicit effects. First, the participants and procedure is described followed by the materials that have been applied for pretesting stimuli. Furthermore, the results of the pretest analysis are presented. The section ends with a brief discussion of the encountered constraints of stimuli pretesting.

7.1. PRETEST: PARTICIPANTS AND PROCEDURE

A total of 45 participants aged 17-24 years have participated in the pretests. In order to collect traffic-related words that can be included in a pool of words for further evaluation, 15 students out of the 45 participated in the brainstorming sessions. The participants of the brainstorming sessions were students from the Institute of Transportations Sciences. Their input was considered valuable since these students are supposed to be familiar with a range of traffic-related words. The brainstorming papers were distributed among them and their input was sent to the author of this thesis. After the brainstorming phase, a number of additional 30 students outside the Institute of Transportation Sciences have been approached in a lecture room to conduct two pretests (word meaning evaluations and word familiarity tests) with the lists of collected traffic-related stimuli. At this time the researcher was present to provide

the students with a detailed explanation of what is expected from them. The pretest surveys were further used to calculate statistical means and standard deviations. Other criteria as word length and word use considerations were also taken into account to select the final set of stimuli. The calculations and indicators of the final stimuli lists are presented in the Appendix A-E.

7.2. PRETESTS: METHOD AND MATERIALS

7.2.1. Brainstorming and filtering

Several brainstorming sessions were initiated to collect a large number of traffic-related words with a neutral, negative, positive and aggressive meaning for the E-Stroop and peaceful and aggressive meaning for the ST-IAT. Besides, a number of 15 students were asked to think about 10 words per category based on their free association with the traffic context. Afterwards, all collected words were filtered according to three basic principles to obtain homogeneous characteristics of words:

- Exclude terms and phrases (more than one word)
- Exclude words that are connected with a hyphen or include special characters since they affect the cognitive processing speed (Bertram & Hyönä, 2013)
- No abbreviations with capital letters are allowed (e.g., GPS)

These principles were derived from several papers that published their lists of stimuli used in implicit studies (Hatfield et al., 2007; Smith & Waterman, 2004). The remaining words were stored in a database for further pretesting.

7.2.2. Word category association tests

15 out of the 30 students that did not belong to the Institute of Transportation Sciences were asked to assess the correct association of words within given neutral and emotional categories (positive, negative, aggressive and peaceful meaning in traffic). Therefore, they had to rate the affective connotation of each word by indicating whether the word belongs to one of the predefined categories or not. The accuracy of the word meaning was assessed on a Likert scale ranging from 1 (not neutral/ positive/ negative/ aggressive/ peaceful at all) to 10 (totally agree with the given category).

7.2.3. Word frequency tests

The remaining 15 out of 30 students that did not belong to the Institute of Transportation Sciences were asked to assess the frequency of the words by indicating how often they use or hear those words in a traffic context. The perceived frequency had to be marked on a Likert scale ranging from 1 (never used this word in the traffic context/ low familiarity) to 5 (very familiar/ often used in the traffic context). Thus, all traffic-related words are evaluated according to familiarity and frequent use in the Flemish language among youngsters.

7.2.4. Word length

The average length of words in each category list of the E-Stroop and ST-IAT can affect the word recognition speed (Larsen et al., 2006). Therefore, it was aimed to assess the average number of letters in each category. The word length of the traffic related stimuli and the average word length per category were counted list-wise to gain an average indicator of word length per emotional category and neutral category.

7.2.5. Celex – Lemma frequencies

Celex is a lexical database created by the Instituut voor Nederlandse Lexicografie (INL) and the Max-Planck-Institute, Nijmegen. It contains frequency data for Dutch words. Celex was made in the '80s, when electronic texts were rare. Therefore, all data are based on corpora and large amounts of text that were scanned in, automatically classified, and hand-corrected. The words in Celex are not regularly updated and still represent the state of the 80s. This means that new words and words that have not been included in the corpus at this time are likely to be missing. Nevertheless, the Celex provides a unique and comprehensive source of knowledge to study word frequencies in the Dutch language.

7.3. PRETEST: ANALYSIS AND RESULTS

The means and standard deviations of the 233 pretested words were calculated for both, the word evaluation test and the word frequency test. The selection procedure of the final set of words was defined in four steps: Firstly, there needs to be a common agreement that all words belong to a certain emotional category. Therefore, highly disputable words were removed from the lists. Secondly, words with high means in word category evaluations were kept in each list to obtain words with the highest average consent among participants. Thirdly, the Flemish youngsters need to be equally familiar with the presented words among the lists. Therefore, a selection has been made between high and low frequency words among the words that remained in the lists. Unfamiliar or exceptional words require special attention and extra processing time from the participants and had to be excluded. Fourthly, the selection of the final set of 20 words per emotional /neutral category and 6 words per ST-IAT category was done through counting letters and scanning the individual word span. This needs to be done list-wise to gain an average of the word length per category. Therefore, all word lists were controlled for an acceptable range of average word length. The Celex database was used as an additional indicator of word frequencies in the Dutch language. However, more value was attached to the sampled frequency test because it provides better insights in the word use of the target group which consists of Flemish youngsters within the age range of 18-24 years. Previous research has also shown that the Celex corpus frequencies are no powerful indicators to predict lexical processing times (Brysbaert et al., 2011ab).

Descriptive statistics of the word evaluation and frequency tests are presented in the Appendix A-E. Also, additional information on letter length and Celex frequency counts are presented in these tables for all stimuli categories that were applied in the Traffic E-Stroop and Traffic ST-IAT. Furthermore, the statistical means of the final selection of words that have been used in the E-Stroop are illustrated by

two figures that show four graphs representing the sorted characteristics of the 20 words that are selected for each category list.

Figure 10 shows the characteristics of the 20 words that have been evaluated according to their highest rating of neutral, negative, positive and aggressive meaning in traffic. The Likert scale indicates that neutral words have received the highest approval, whereas there is a less strong consent about emotional words. Participants were asked how much they agree with the aggressive meaning of the traffic-related words. Words being labeled as “aggressive” do not get higher scores than 7.6 evaluation points whereas words being labeled as neutral already start at 9.13 evaluation points. Moreover, there is much variability in the evaluation of aggressive and negative meaning words, whereas neutral and positive words display more evaluative stability.

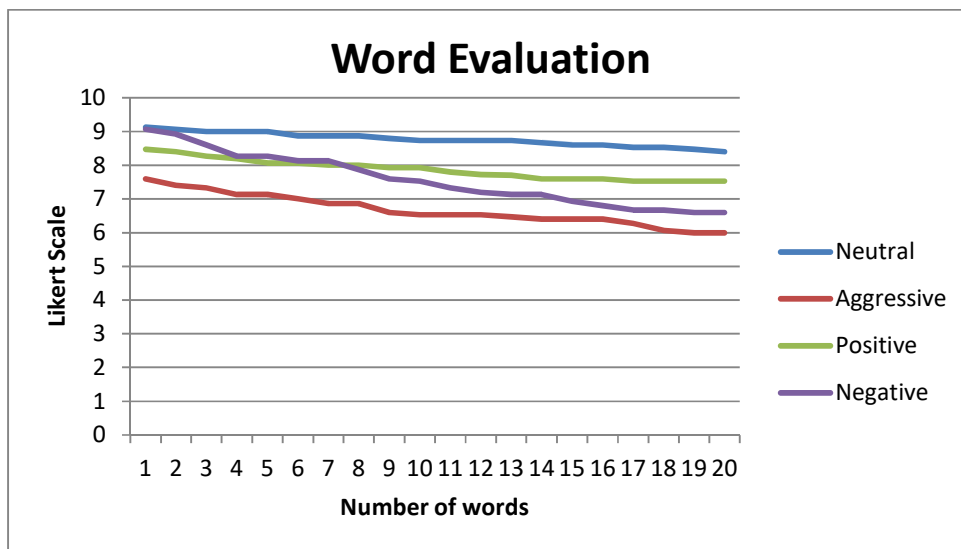


FIGURE 10: Visualization of the strength of association between words and ascribed meaning per category

Figure 11 displays the frequency and familiarity scores of traffic-related words per category. It is obvious that aggressive words are less frequently used than neutral, positive and negative words. Moreover, the frequency scale shows that there is an overall decreasing trend in word familiarity at increasing numbers of words. This might indicate that general concept words such as “safe”, “drunk” and “irritate” (high in orthographic neighborhood size) might be more frequently used than more traffic-specific words. These concept words are associated with evaluation words outside of the traffic context and are therefore, expected to be more familiar. It is likely that traffic-specific words are less familiar and less frequently used, especially if the participants were not involved in traffic scenarios on a regular basis.

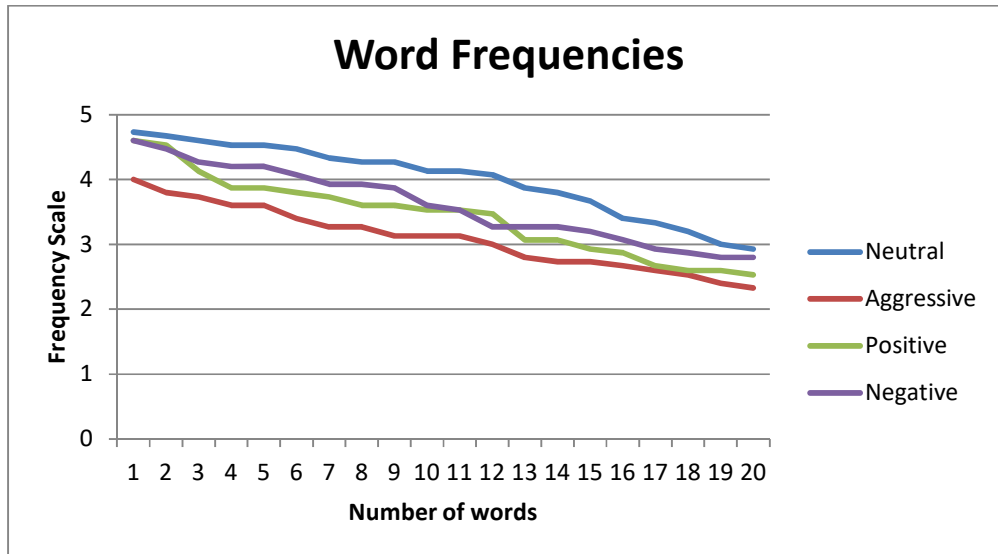


FIGURE 11: Visualization of the perceived frequency of words in each category

In addition, letter length counts were conducted for the general and traffic-related implicit stimuli. The results are listed below and indicate that traffic-related words are on average 3.5 letters longer than the general stimuli. This needs to be taken into consideration when comparing the effects between the E-Stroop and Traffic E-Stroop. Nevertheless, the internal ratio between the category lists is very much comparable. Moreover, the traffic-related stimuli lists succeeded in having the lowest letter counts for aggressive words and the highest letter counts for neutral traffic-related stimuli. In contrast, the general stimuli used in the original E-Stroop in the study of Brugman et al., (2015) showed that neutral words are on average shorter than aggressive words. This has been one of the main concerns in the literature due to possible interference with the effect score, when mean reaction times to aggressive words are compared with mean reaction times to neutral words.

The letter counts of the **general stimuli** in the E-Stroop (Brugman et al., 2015):

- The neutral Dutch words have an average word length of 5.85
- The aggressive Dutch words have an average word length of 6.05
- The negative Dutch words have an average word length of 5.95
- The positive Dutch words have an average word length of 6.3

The letter counts of the **traffic-specific stimuli** in the Traffic E-Stroop:

- The neutral Dutch words have an average word length of 9.55
- The aggressive Dutch words have an average word length of 9.15
- The negative Dutch words have an average word length of 9.55
- The positive Dutch words have an average word length of 9.35

7.4. PRETEST: DISCUSSION

The pretests showed high variations in word meaning and frequency evaluations among participants. Possible explanations for this are several context cues that are provided during the pretests and that are likely to affect the information processing of participants in different ways. It is expected that the word evaluations were influenced by value cues, functional cues, equivalence cues, class membership cues and spatial-conditional cues (Steinberg, 1987). First, it was asked to assess the words regarding their affective connotation and emotions that the word arouses. However, the spatial conditional cues in this task have been activated by the instruction to consider all presented words only in the traffic context. This might increase the likelihood that affective arousals from frequently encountered situations are transferred to the driving context. Nevertheless, the equivalence cues presented as the labels “aggressive”, “negative”, “positive”, “peaceful” and “neutral” provide information about the personal meaning of the word in contrast to the meaning of the label. Class membership cues are now likely to evolve which means that the purpose and function of the presented word is interpreted according to one or more classes to which the word can belong (racing = positive, racing= aggressive or police=negative, police=positive)(Steinberg, 1987).

Implicit tests have the aim to measure evaluative differences. However, in order to be effective it is necessary that people of the same language community know the general ascribed meaning of a word. Implicit stimuli are usually derived from a commonly agreed pool of words that have a clear meaning (Thiering, 2011). Traffic-related words are expected to be more affected by discourse-specific language that is shaped by identity and group membership. Thiering (2011) explained that people living in different environments typically differ with regard to self-views, with regard to experience and learning, and—because of selective exposure—also with regard to the salience and familiarity of categories (Thiering, 2011). These findings are an attempt to reflect on the observed variations in pretest scores for traffic-related words.

8. RESEARCH METHODOLOGY

The components of this research are visualized in figure 12, which provides an overview of the identified personality traits (distal factors) that shape the attitude (proximal factor) of young novice drivers towards aggressive driving behavior. Explicit and implicit attitudes are presented in a general and traffic-specific format and are predictors of general and traffic-related aggression that influences the intention to engage in aggressive driving.

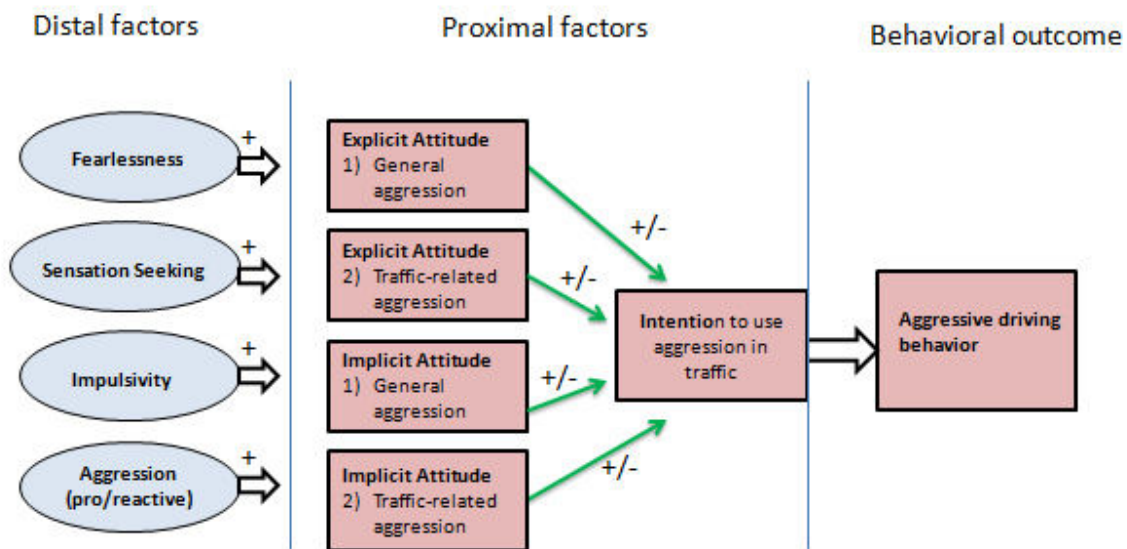


FIGURE 12: Conceptual model of the relationship between traits, attitudes and behavioral outcome

The sample of participants is described in the research methodology, followed by an explanation of the explicit questionnaires that measure aggression (Buss-Perry Aggression Questionnaire, Reactive & Proactive Aggression Questionnaire), and personality traits (Arnett Inventory of Sensation Seeking, Barratt's Impulsiveness Questionnaire, Multidimensional Personality Questionnaire: harm avoidance, The Stimulating and Instrumental Risk Questionnaire, Driving Anger Scale). Moreover, several questionnaires on driving behavior (Multidimensional Driving Style Inventory, Manchester Driving Behavior Questionnaire, Driving Anger Expression Inventory) are applied to gain measures of the dependent variable.

Afterwards, the four implicit computer tasks are introduced. On one hand, the measures of two general implicit tests (ST-IAT and E-Stroop) are described and the implicit stimuli are presented. On the other hand, the measures of two traffic-related implicit tests (Traffic ST-IAT and Traffic E-Stroop) are described and the respective implicit stimuli are also presented.

8.1. PARTICIPANTS

60 young novice drivers around the campus area of Diepenbeek and Hasselt were recruited via posters, flyers, circular emails, social media and the personal network, youth houses and driving schools. The age of the participants ranged from 18 till 24 years since young drivers up to the age of 24 are highly represented in the high -risk group of traffic fatalities (IRTAD 2013 Annual Report from OECD/ITF 2013).

The minimum requirement was to have completed at least 20 hours of driving exercise at driving schools or to have a driving experience of 60 hours in accompanied driving. Participants that own a Belgian or European drivers license for longer than two years were also invited to the experiments. They were asked in particular to state the date of obtaining their driver license in order to account for differences in driving experience with less experienced young novice drivers. A number of 60 young drivers made an appointment via an online tool (Doodle) to participate in the experimental tests. However, the total number of participants was reduced to 53 because 7 test persons didn't come to their appointments. The tests were conducted within four weeks from November 28th till December 23rd 2016. The final sample consists of a total of 53 participants.

8.2. MATERIALS

8.2.1. MEASURES OF AGGRESSION

Buss-Perry Aggression Questionnaire

The Buss-Perry Aggression Questionnaire (BPAQ) has been developed in 1992 and is still a popular questionnaire to investigate on several types of aggression (Bryant & Smith, 2001). Four dimensions are used in the questionnaire indicating physical aggression, verbal aggression, anger and hostility. These four dimensions can measure instrumental, affective and cognitive components of aggression. Instrumental aggression is described by means of physical and verbal aggression. Anger belongs to an affective aggression component that is based on physiological arousals that puts the individual in state to act out aggressive behavior. Hostility is related with the cognitive component in aggression, for example antipathy and opposition. A six-point Likert scale is used to respond to the 29 items of the BPAQ. The participants can be categorized according to their preferences for and against aggression (Bryant & Smith, 2001).

Reactive and Proactive Aggression Questionnaire (RPQ)

The Reactive and Proactive Questionnaire (RPQ) consists of 23 items divided in two subscales to measure self reported aggressiveness (Raine et al., 2006). Twelve of the items measure proactive aggression whereas eleven items are aimed to measure reactive aggression (e.g. reacted angrily when provoked by others). The respondents can use a 1 to 5-point scale, ranging from never to almost always. An average of 3 or higher (indicating sometimes, usually or almost always true) on proactive and/or reactive statements are considered to demonstrate that type of aggression (Connor, Steingard,

Anderson, & Melloni, 2003). The advantage of a two-factor proactive–reactive structure is that proactive and reactive scale scores can be weighed to obtain a better picture on individual aggression types (Raine et al., 2006). The RPQ will be helpful to understanding individual tendencies towards proactive or reactive aggression in an explicit way and can be compared with the total aggression score from the BPAQ.

The Stimulating and Instrumental Risk Questionnaire (S&IRQ)

Stimulating risk taking is impulsive and characterized by low self-control. The individual does not focus on potential gains but aims to participate in a risky situation for the sake of pleasure and tension release. Stimulating risk taking entails domination of the emotional information processing system. It is a desire to release negative emotions and experience positive emotions that makes the individual take a risk. In contrast, instrumental risk is needed by the individual to attain an intended goal. This path does not require emotional arousal, because an internal evaluation of the anticipated outcome is activated. Therefore, it is seen as an instrumental mean to obtain specific rewards and to establish social dominance (Rappaport & Thomas, 2004). The questionnaire is answered according to five points on a scale: True=5; Rather true=4; Hard to say=3; Rather untrue=2; Untrue=1. The stimulating risk dimension includes four out of seven statements (score: min 4 - max 20) and the instrumental risk dimension includes three out of seven statements (score: min 3 - max 15) (Makarowski, 2013).

The Driver Social Desirability Scale

A driver social desirability questionnaire will be applied to account for the social desirable bias in young novice drivers when measuring aggression. The questionnaire is designed by Lajunen Corry, Summala and Hartley (1997) and consists of 12 items. Participants that insist on never deviating from the social norm are expected to answer all other questionnaires also in a social desirable way. The participants have to respond whether they agree with the items on a 7 point Likert scale (1= not true, 4=true, 7= total true). This measure will help to account for the social desirability bias in driving behavior and aggression questionnaires (Lajunen, Corry, Summala, & Hartley, 1997).

8.2.2. MEASURES OF PERSONALITY TRAITS

The Arnett Inventory of Sensation Seeking Questionnaire

The Arnett inventory of sensation seeking (AISS) is a very well related to risk taking behavior as it measures reported positive arousals when engaging in exiting behavior (e.g. dangerous driving maneuvers (Dahlen, Martin, Ragan, & Kuhlman, 2005). The AISS consists of 20 items belonging to the dimensions novelty and intensity. The items of novelty are measuring a tendency to ‘strive for new experiences’, whereas intensity is measured through the perception of the value of sensation’ (Arnett, 1994; Haynes, Miles, & Clements, 2000). The two dimensions novelty and intensity have been found to have good internal validity, although some items are correlating and could be removed from the questionnaire (Haynes et al., 2000). In this research, all items of the questionnaire were applied to measure sensation seeking as a personality trait.

The Multidimensional Personality Questionnaire: harm avoidance

The subscale 'Harm Avoidance' of the Multidimensional Personality Questionnaire (MPQ—Harm Avoidance) is used to measure fearlessness as a personal characteristic. The Multidimensional Personality Questionnaire is developed by Tellegen and Waller in 1982. The MPQ- Harm Avoidance subscale consists of 28 items. Participants have to respond to several statements relating to safe and dangerous situations. Each item has a "safe" and "unsafe" answer. The scores on safe answers are counted to represent a total score on harm avoidance. A high score indicates characteristics of harm avoidance, whereas a low score indicates fearlessness as a trait. Therefore, fearlessness (low level of harm avoidance) can be measured in young novice drivers (Le Bas et al., 2015).

Barratt Impulsiveness Scale

The Barratt Impulsiveness Scale-11 presents 30 items that focus on spontaneous reactions without considering the consequences (Lajunen & Parker, 2001). Impulsiveness is measured with scores on a 4-point Likert scale, ranging from 1 ("rarely/never") to 4 ("almost always/always"), with higher scores indicating greater impulsiveness (Dahlen et al., 2005). The scale measures the ability of self-regulation of thoughts and behavior and takes three components of impulsivity into account. One component relates to the lack of thoughtfulness by acting very quickly (motor impulsivity). The second component describes fast cognitive decision making that steers behavior (cognitive impulsivity) and the final component is related to the lack of planning and foresight, and reflects a life-style that is more focused on the present than on future (non-planning impulsivity) (Luengo, Carrillo-De-La-Peña, & Otero, 1991). The reliability and validity of the BIS-11 is checked among several papers on risk taking, driving behavior and aggression and is approved across different translations of the questionnaire (Patton et al., 1995).

The Driving Anger Scale

The driving anger scale is developed by Deffenbacher, Oetting and Lynch in 1994 and measures anger and irritation during driving. The probability to become angry while driving can be measured by a short version (14 items) and long version (33 items) of the multidimensional Driving Anger Scale. The items describe potentially anger provoking scenarios that might occur while someone is driving. The respondents rate each item on a 5-point Likert scale (1="not at all" to 5="very much") indicating how much a particular situation would anger them. The multidimensional DAS consists of six sub scales each describing an aversive situation in traffic (Deffenbacher, Oetting, & Lynch, 1994). These are:

- hostile gestures (others make an obscene gesture),
- illegal driving (others going over the speed limit),
- slow driving (slow driver does not pull over to let others by),
- discourtesy (someone cuts you off),
- police presence (e.g. officer pulls you over),
- traffic obstructions (stuck in a traffic jam)

Lajunen & Parker (2001) who investigated on the relationship between self-reported general aggressiveness, driver anger and aggressive driving noticed that the items 'police presence' and 'traffic obstruction' from the DAS are anger evoking situations that cannot be related to aggressive driving in a

reliable way. They found that these items reflect impersonal situations (e.g. encountering road constructions or a police officer) that did not evoke any anger in the sample, because the respondents didn't consider it an offensive action. Therefore, Lajunen & Parker (2001) recommended omitting 'police presence' and 'traffic obstruction' from the questionnaire. They designed a new structure based on three factors: 1. progress impeded, 2. reckless driving, and 3. direct hostility. This new scale consists of 21 items and has been introduced as the UK driving anger scale (UK DAS) (Lajunen & Parker, 2001). In this research, the original 14 item version of the Driving Anger Scale will be applied since we cannot be sure if the UK DAS is also suitable for the Belgian sample. Moreover, the total scores of the short and long DAS scales have the same loadings on the different dimensions of driving anger (Deffenbacher et al., 1994).

8.2.3. MEASURES OF DRIVING BEHAVIOR

Demographic variables, mileage and accident history

Information will be collected on age, gender and the date when young drivers have obtained their full license or alternatively, started with driving training. Moreover, the participants are asked to report their level of education and their usual monthly mileage in four categories: 1-200 km, 201-400 km, 401-600 km or 600+ km. The selected estimated monthly mileage in km will be treated as a continuous variable, representing scores of 1-4 (Rowe et al., 2013).

Manchester Driving Behavior Questionnaire: violations

The Manchester Driving Behavior Questionnaire (DBQ) is a reliable questionnaire to assess driving behavior on the road (Wåhlberg, Dorn, & Kline, 2010; Zhao et al., 2012). It measured three scales of driving behavior including 1. lapses, 2. errors, 3. normal violations and 4. aggressive violations. The respondents have to rate how often they have committed each of the 28 driving behaviors in the DBQ in the past, using a rating scale of 1 = 'never' to 6 = 'nearly all the time'. The self-reported measures of driving behavior and violations have been found to be highly related to actual driving behavior in specific driving contexts (Wong et al., 2014). The first two categories of DBQ are not relevant for this research, because mistakes and errors are not aggression-specific measures and are therefore, excluded from the final questionnaire. Instead, the 11 items that measure normal and aggressive traffic violations are assessed.

Multi-Dimensional Driving Style Inventory

The Multi-dimensional Driving Style Inventory is a reliable 44-item scale assessing four broad domains of driving styles (Taubman-Ben-Ari, Mikulincer, & Gillath, 2004). It uses a 6-point Likert scale and presents questions on high acceleration, heavy braking, close following, overtaking and aggressive maneuvers to measure reckless or hostile driving styles. Also, cooperative or anxious driving styles are assessed through a number of items (Skippon, Reed, & Robbins, 2011):

1. **Reckless and careless driving style:** deliberate violations of safe driving norms and thrill seeking while driving: high speed, illegal passing, and so on

2. **Angry and hostile driving style:** expressions of irritation, rage, and hostile attitudes and acts on the road: aggressive behavior like cursing or flashing lights at other drivers
3. **Anxious driving style:** feelings of alertness, tension and stress, lack of driving confidence goes along with ineffective relaxation activities when driving
4. **Patient and careful driving style:** planning ahead and adapt the driving style, paying attention to the road, patience, courtesy, calmness, and obedience to traffic regulations

Driving anger expression inventory (DAX)

The individual differences in anger expression while driving are usually measured with the Driving anger expression inventory (DAX) containing 49-items (Deffenbacher, Lynch, Oetting, & Swaim, 2002; Deffenbacher et al., 2007). The items describe ways in which people react when angered while driving, and the respondents have to indicate how often they reacted in a similar manner on a four-point Likert scale (1="almost never" to 4="almost always"). The DAX consists of four subscales:

1. Verbally aggressive expression (e.g., yelling, cursing, etc.),
2. Physically aggressive expression (e.g., getting out of one's car to confront another driver, starting physical fights, etc.),
3. The use of the vehicle to express anger (e.g., cutting off another driver, slowing down to frustrate another driver, etc.),
4. Adaptive/constructive expression (e.g., driving safely, trying to relax, etc.).

These DAX subscales have been validated through their relationships with driving anger and aggressive driving (Deffenbacher et al., 2002). Recent experiments using the driving anger expression inventory were conducted (Ge, Qu, Zhang, Zhao, & Zhang, 2015; Stephens & Sullman, 2014) and it is agreed upon that the DAX is a very useful tool for developing individual driving anger management strategies.

8.2.4. MEASURES OF GENERAL IMPLICIT ATTITUDES

Single Target - Implicit Association Test (proactive aggression)

The idiographic self-aggression ST-IAT is used to obtain a measure of proactive aggression by measuring the association between aggressive words and the self. The procedure consists of 5 blocks with two test blocks and three binary categorization tasks that were combined in a manner that was either compatible or incompatible with the measured attributes. The target category was "I" (for example: participant's first name, last name and etc.), and the attribute categories were "aggressive" (with aggressive verbs such as abuse, attack, etc.) and "peaceful" (with peaceful verbs such as cooperate, contribute etc.). In total, the task comprises 138 trials and lasts for 16 minutes (Brugman et al., 2015).

TABLE 8: ST-IAT: general stimuli in three categories (Brugman et al., 2015)

Peaceful	Aggressive	I
Meewerken	Aanvallen	[Voornaam]
Toevoegen	Bedreigen	[Achternaam]
Instemmen	Uitschelden	[Leeftijd]
Samenwerken	Beledigen	[Geboortedatum]
Overleggen	Mishandelen	[Woonplaats]
Praten	Vechten	[Straat]

Emotional Stroop Task (reactive aggression)

The E-Stroop was used to measure an attentional bias for aggressive stimuli, to gain an implicit measure of reactive aggression. Participants had to color name neutral, negative, positive, and aggression-related words that were written in four colors (red, yellow, green, and blue) and presented on a computer screen. It was required to press as quickly as possible the correct response keys on a keyboard to indicate the color of the word. Delays in reaction times are expected to represent emotional interference. The stimuli that were used in this task are taken from the paper of Brugman et al., (2015) and are presented in table 9. The whole color naming task lasts for 10 minutes and consists of 88 trials.

TABLE 9: E-Stroop: general stimuli in three emotional and one neutral category (Brugman et al., 2015)

Neutral meaning	Aggressive meaning	Negative meaning	Positive meaning
Mand	Woede	Eenzaam	Aardig
Sleutel	Boos	Benauwd	Leuk
Lamp	Aanval	Slecht	Slim
Telefoon	Geweld	Vies	Pret
Kat	Dolk	Angstig	Eerlijk
Kleding	Conflict	Eng	Levendig
Handdoek	Kwaad	Somber	Teder
Struik	Haat	Suf	Kalm
Trein	Ruzie	Stom	Schitterend
Keuken	Gefecht	Sloom	Rein
Oven	Vijand	Ziekte	Vrolijk
Vloer	Wraak	Angst	Blij
Bakker	Vechtpartij	Gepicker	Lach
Paraplu	Bedreiging	Pech	Tolerant
Radio	Mes	Goor	Blijdschap
Schilderij	Woest	Verloren	Vrede
Melk	Geweer	Verdrietig	Vriendschap
Boot	Viandig	Vervelend	Opgewekt
Potlood	Discussie	Bezorgd	Grappig
Laars	Moord	Gezeur	Groots

8.2.5. MEASURES OF TRAFFIC-SPECIFIC IMPLICIT ATTITUDES

The Traffic Specific - Single Target Implicit Association Test

The idiographic Traffic ST-IAT is used to measure the association between aggressive driving behaviors and the self by sorting traffic-related words in two corners of a computer screen. E-prime software is used and the keystrokes were provided with Right and Left indicators. The words were presented in the middle of a computer screen, belonging either to the target category or to one of the two attribute categories that are shown in the upper corners of the screen. The target category is “I” (with e.g., participant’s first name, birthday etc.), and the attribute categories are “aggressive driving” (with aggressive verbs such as “tailgate”, “honk”) and “peaceful driving” (with peaceful verbs such as “anticipate” or “wait”), see table 10. The participants had to categorize these words into the correct category as fast as possible by pushing the left or right response key on a keyboard. The Traffic ST-IAT consists of 5 blocks of which block 3 and block 5 are test blocks displaying only the label “I” in one corner of the computer screen. In the other blocks participants are additionally faced with the categories “peaceful driving” and “aggressive driving” in each of the left or right upper corners of the screen. Moreover, the label “I” is reversed so that words belonging to the self need to be categorized under the attribute category “aggressive driving” and in a next block under the category “peaceful driving”. The traffic ST-IAT followed the same procedure as the general ST-IAT and lasts for 16 minutes (Brugman et al., 2015). A positive ST-IAT effect is expected to indicate a negative attitude toward “aggressive driving” and/or a positive attitude toward “peaceful driving”, whereas a negative ST-IAT effect would indicate a positive attitude toward “aggressive driving” and/or a negative attitude toward “peaceful driving” (Hatfield et al., 2008).

TABLE 10: ST-IAT: traffic-specific stimuli in three categories

Peaceful driving	Aggressive driving	I
respecteren	aanrijden	[Voornaam]
wachten	bumberkleven	[Achternaam]
opletten	afsnijden	[Leeftijd]
anticiperen	blokkeren	[Geboortedatum]
voorsorteren	vloeken	[Woonplaats]
invoegen	claxonneren	[Straat]



FIGURE 13: Traffic ST-IAT screen view

The Traffic specific - Emotional Stroop Task

The Traffic-specific E-Stroop measures the delay times of participants to name the color of traffic-related words that were printed in different colors (red, yellow, blue and green) and presented in the center of a computer screen. E-Prime software was used and the keyboard response keys were provided with color tags. The task started with eight practice trials using neutral words, each presented in one of the four colors twice. Participants were asked to press the color labeled key that corresponded with the color of the shown word as quickly as possible. A fixation cross of 1000ms appeared in the center of the screen before each trial. A block-wise design was applied, which means that all words were presented in the same block order (respectively neutral, negative, aggressive, and positive). Each block consisted of 20 words, which were all presented once to the participant in random order. The traffic-related stimuli with an aggressive, positive, negative and neutral meaning in traffic are presented in table 11. The Traffic-E-Stroop follows the same logic as the general E-Stroop, because the participants are automatically recalling their affective attitude towards aggressive traffic-related stimuli, if the word is unexpectedly printed in an antagonistic color (Brugman et al. 2015; Smith & Waterman, 2005). To compute a traffic-specific aggressive bias score, the mean reaction time in the neutral category need to be subtracted from the mean reaction time of the aggressive category. Interference of aggressive words is reflected by a positive score.

TABLE 11: E-Stroop: traffic-specific stimuli in three emotional and one neutral category

Neutral meaning	Aggressive meaning	Negative meaning	Positive meaning
schakelen	vluchtmisdrijf	dronken	carpoolen
rotonde	afsnijden	verkeersdoden	bobben
bestuurder	roekeloos	spookrijden	opleppen
passagier	bumberkleven	ongeval	voorrang
autoradio	schelden	verkeerslachtoffer	voorzichtig
voertuig	aanrijding	alcohol	attent
voetpad	beschadigen	gewonden	voorlaten
ruitewisser	racen	bekeuring	veilig
bushalte	opgefokt	blikschade	vooruitkijken
afslag	claxonneren	flitspaal	meerijden
busstrook	machogedrag	boete	milieuvriendelijk
dienstregeling	vloeken	verkeershinder	respecteren
rijbaan	blokkeren	uitstoot	rustig
kruispunt	botsen	spitsuur	verlichting
verkeersbord	opjagen	slippen	fietshelm
richtingaanwijzer	uitdagen	stress	geduldig
autosnelweg	verblinden	wegenwerken	comfortabel
rijbewijs	overtreding	vertraging	groenlicht
voetganger	irriteren	omleiding	hoffelijk
navigatie	toeteren	tijdsdruk	opmerkzaam

9. EXPERIMENTAL PROCEDURE

Data were collected via online survey questionnaires (Qualtrics) that had to be filled in during the experimental session. In order to participate, the young drivers had to hold a valid (or preliminary) driving license. Drivers were informed that the study was voluntary, that their responses were anonymous and they will participate in a lottery after participation. All questions were in Dutch language. The translation from English was undertaken by the researcher and checked for Flemish dialect and word use by two Flemish speakers. The entire experiment took ca. 60 minutes per participant. During the first part of the experiment, the explanation of the study and the informed consent were presented to the participant. The informed consent contained information about the background of the study, the rights of the participant and the potential reimbursement through gift vouchers that are distributed via lottery. The participants had to sign this document to approve their voluntary participation. Afterwards, the participants were introduced to the four computer tasks, and received oral and written instructions and explanations in the beginning of each computer task. The implicit tasks were counterbalanced to ensure that a quarter of the participants either started with the general ST-IAT, traffic-related ST-IAT, traffic-related E-Stroop or the general E-Stroop. An individualized procedure file with randomized orders of the computer tasks and questionnaires has been prepared for each of the participants. After completion, the output files were saved in a folder.

In the second part of the research, the participants were asked to fill in 12 randomly assigned questionnaires by opening 12 Qualtrics links on a laptop. All questionnaires were submitted and automatically stored in the Qualtrics database according to the participant's number. Finally, the participants received a small gadget and were asked to leave their contact details for the lottery.

10. IMPLICATIONS AND RECOMMENDATIONS

The results of these traffic-adapted implicit tests will have scientific and practical implications. Firstly, it can be investigated whether implicit tests that are specified for the driving context will yield better results on driving-related attitudes compared to general implicit tests. Therefore, this study makes the first contribution to the development and testing of traffic-specific stimuli in the field of implicit attitude measures. Secondly, it was aimed to attain a more precise picture of proactive and reactive aggression types in young novice drivers. Both aggression types have been linked to different forms of behavioral development (Cima et al., 2013). However, little is known about the differences of proactive and reactive aggression in young novice male and female drivers. It is suggested that distinct intervention approaches are necessary to counteract aggressive driving behavior among young novice drivers with different aggression types (Lobbestael, 2016). Distinguishing dominant characteristics of reactive and proactive aggression can help to provide young novice drivers with tailored safety interventions. Thirdly, there is a research interest to investigate to what extent the proposed explicit and implicit measures do predict driving anger expressions, driving behavior, driving style and specific driving violations when controlled for gender and driving experience among young novice drivers. Although those kinds of

questions have not been answered within the framework of this master thesis, data has been collected for the analysis of these research questions.

The pretests constitute an important topic in this thesis. Based on the conducted data collection, the following research questions are proposed to be answered in a follow up study:

1. Is there a difference between the general implicit stimuli and the traffic-related implicit stimuli?
2. To what extent do explicit and implicit measures predict driving anger, driving behavior, driving style and specific driving acts when controlled for gender and monthly mileage?
3. Does proactive and reactive aggression differ for young novice male and female drivers?

The use of traffic-related implicit tests that provide reaction times for traffic-related stimuli and specific driving acts might be especially valuable in addition to driving simulation that measures driving behavior. Anger provoking and aggression rewarding driving scenarios in the driving simulator might be better associated with the traffic-related implicit tests than general implicit tests. However, more research is needed for the development of traffic-related implicit tests. The aim of this thesis was to replicate the design of idiographic implicit tests (not picture-based implicit tests) while replacing aggressive stimuli with aggressive traffic-related stimuli. No conclusions can be drawn about the effectiveness of traffic-related implicit tests above the general implicit tests and vice versa. Moreover, it might be possible that traffic-related idiographic implicit tests work better in some language communities than in others. Secondly, further research is needed about the effectiveness of the use of pictures in traffic-related implicit tests. This research decided against the use of pictures as stimuli for implicit attitudes measures based on valid reasons. However, visual aspects of pictures might be better related to the same information processing path that happens in the simulated driving environment. A third recommendation is to add a personalized component to the ST-IAT to address the issue that the ST-IAT might still measure cultural and social desirable knowledge rather than beliefs held by a person (Olson & Fazio, 2004). The primary difference between a standard ST-IAT and the personalized ST-IAT is that rather than using "peaceful" and "aggressive" category labels, it uses "I like" and "I don't like" as category labels to avoid normative implications. Additionally, the Personalized ST-IAT does not provide error feedback for an incorrect labeling response as in the standard ST-IAT. Therefore, the personalized ST-IAT has been found to be more strongly related to explicit self-report measures than the traditional ST-IAT. Generally, it is recommended to apply several variants of the IAT in order to compare attitudes measures in road safety research. Furthermore, the semantic meaning of the words must get into the cognitive system (through word recognition) in order for implicit tests to have an effect. To improve the spontaneity of word recognition and evaluation, researchers have suggested increasing the personal relevance of implicit stimuli (Stieger, Göritz, & Burger, 2010). Therefore, a fourth recommendation is to use a more 'person-centered approach' to reflect individual differences in participants. This means that individualized stimuli for each participant are used to ensure maximum relevance for the selected attribute categories. Individually-tailored stimuli (representing words that match the regional and educational background) might be more suitable in the case of aggressive driving-related stimuli.

11. LIMITATIONS

The pretests constitute an important component of this research and also constitute the strongest limitation of this study. It starts with the brainstorming session of traffic-related words that has its limitations. Many students had difficulties to come up with traffic-related words without using terms and descriptions. The selection of potential traffic-related words was already affected in the brainstorming phase because terms and abbreviations had to be excluded. The issue with single words is that they can be ambiguous which leads to high variances in the perception whether some traffic-related words belong correctly or incorrectly in one emotional category. Some traffic-related words are considered to be rather infrequent and unfamiliar, since descriptions and terms of driving behaviors are more in use.

A second limitation might be the small sample size of 15 young Flemish students for each pretest of word meaning evaluation and word frequencies. This sample is not representative for Flemish young drivers, because it cannot account for the different educational and social backgrounds as well as dialects from different Flemish and Dutch speaking regions. However, other studies (e.g., Brugman et al., 2015) did also use a similar sample sizes for pretesting implicit stimuli. Thus, our pretest sample size is comparable to other studies.

A third limitation might be that students gave biased responses in the word evaluation and frequency tests. Although participants were asked to give spontaneous responses, it is possible that students give only extreme or moderate answers. Extreme and moderacy response styles refer to the tendency for subjects to respond consistently using particular sections of the scale. The tendency to use the extreme choices on a rating scale (e.g., 1 or 10 on a 10-point scale) is identified as a extreme response bias, while the moderacy bias refers to a tendency to avoid agreeing and disagreeing and to respond neutrally (Hatfield, Faunce, & Job, 2007). Nevertheless, rating scales are generally considered to be a reliable tool.

A fourth limitation is the sample size of 53 participants that participated in the experimental sessions. Considering the large amount of variables that are aimed to be tested in this study, is a large sample population required to gain statistically significant results. However, a follow up data collection phase still possible since the statistical analysis has not been done yet to answer the research questions. A minimum of 60 participants are required and more are desirable.

A fifth limitation might be in the nature of peaceful and aggressive traffic-related stimuli that include a range of acts and behaviors. Some driving acts can sometimes be ambiguous or unclear for participants, especially if they are unexpected. The speeding-related stimuli in the IAT designed by Hatfield et al. (2008) are very consistent. In our study, a range of different words including maneuvering acts, blocking, hostile interactions and speeding is applied. This might affect reaction times in correctly categorizing stimuli. Moreover, different Dutch dialects are expected to interfere in word familiarity and evaluations since participants from different Flemish regions and the Netherlands participated in the experimental tests. Especially, the traffic context contains many ambiguous words that can hardly be completely eliminated.

GENERAL CONCLUSION

The studies in chapter one and two deliver new insights in the influence of implicit and explicit measures of reactive and proactive aggression in young novice and male drivers. This knowledge is essential in order to create effective intervention programs that focus on the right target group. Young drivers are a relevant target group, since the first few months of independent driving pose the greatest risk of collision for novice drivers (Mayhew et al., 2003). In addition, previous research has shown that individuals are highly susceptible to attitude change during late adolescence and early adulthood (Krosnick & Alwin, 1989) and that attitudes became riskier after being fully licensed (Rowe et al., 2013). Attitude measures of (traffic-related) aggression and driving behaviors can therefore, be considered a highly promising approach to identify aggressive drivers already during the learning phase and to actively counteract the aggressive attitude in young drivers. Implicit attitude measures, such as variants of the Implicit Association Test and Emotional Stroop Task, might be especially useful as they are less vulnerable to faking than explicit tests. Attendance at attitude-training courses could become a formal requirement for licensing in future and a safe driving attitude might be the basis for final licensing (Rowe et al., 2013).

Furthermore, it is suggested that distinct intervention approaches are necessary to counteract aggressive driving among young novice drivers with different aggression types (Lobbestael, 2016). Distinguishing dominant characteristics of reactive and proactive aggression can help to provide young novice drivers with tailored safety interventions that match their individual needs while taking the intrinsic motivations to engage in aggressive driving into account. Examples of tailored interventions are *anger control training and cognitive control techniques* that are considered to be effective for the reactive aggression type of driver. In contrast, interventions that introduce *highly negative and costly consequences* for aggressive driving might be an effective approach to target the attitude of proactive aggressive drivers (Brown & Parsons, 1998). Furthermore, intervention programs have also been developed based on dual process theories of implicit and explicit processing (Wiers, Gladwin, Hofmann, Salemink, & Ridderinkhof, 2013). On the one hand, there is *cognitive bias modification* (CBM) that influences and corrects maladaptive implicit processes (an implicit aggressive attitude as well as implicit attention and approach biases). On the other hand, there is *cognitive control training* (CCT) which influences explicit and cognitive processes, and therefore increases self-regulation abilities. Explicit and implicit measures of attitudes, biases and control abilities among young novice drivers represent a valuable input for the development of effective intervention strategies that aim to target both systems of information processing. The explicit and implicit measures of traffic-related aggression that are collected within the framework of this master thesis, can help to design more effective and tailored intervention packages for proactive and reactive aggression types of young novice drivers, while accounting for an appropriate balance of cognitive bias modification and cognitive control training in individuals.

Besides, the application of interactive computer tasks measuring reaction times among young novice drivers will actively involve young novice drivers in driving education and also helps them to explore and

build up self-related knowledge. This could be a reason for an increased motivation to reflect on attitudes and abilities that eventually lead to safer driving behavior.

To summarize, the findings of chapter one created more insights about aggression types that lead to driving anger in male drivers. Interestingly, low levels of proactive aggression are also present in young male drivers with a reactive type of aggression. These findings indicate that safety interventions for young male drivers with high reactive aggression should also be provided with a small component of outcome expectancy modification that reduces the perceived reward of driving anger expressions.

Furthermore, the insights of chapter two are useful for further research on the development of effective driver assessment procedures that distinguish aggressive young novice drivers from those with a safe traffic-related attitude. The developed traffic-related implicit tests can provide other researchers in the field of traffic psychology with a more traffic-specific measure of aggression in young novice drivers. These implicit measures can be directly labeled to a number of different aggressive driving acts and types of traffic-related stimuli. Therefore, it is possible to retrain approach behavior towards specific traffic-related acts and stimuli. This is valuable for intervention campaigns that aim to discourage young novice drivers from approaching specific stimuli that lead to recurring patterns of aggressive driving.

Conclusively, it is essential to identify an optimal combination of the most effective implicit and explicit measures and training sets that can detect and retrain maladaptive attitudes and lacking control abilities in aggressive young novice drivers. Tailored driving education is needed to create lifelong safe drivers.

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APPENDIX

STIMULI FOR TRAFFIC ST-IAT

Agressief rijden	Word length	Obs	Minimum	Maximum	Mean	Std. Deviation	Freq Min	Freq Max	Freq Mean	Freq Std. Deviation	Celex
aanrijden	9	15	7.00	10.00	9.53	0.92	1.00	5.00	3.27	1.10	239
bumberkleven	12	15	7.00	10.00	8.93	1.10	1.00	5.00	3.27	1.28	66
afsnijden	9	15	1.00	10.00	8.13	2.33	1.00	5.00	2.67	1.11	652
blokkeren	9	15	5.00	10.00	8.07	2.05	1.00	5.00	2.33	1.11	438
vloeken	7	15	4.00	10.00	7.67	2.26	1.00	5.00	3.40	1.30	1239
claxonneren	11	15	1.00	10.00	6.80	2.57	1.00	5.00	3.13	1.25	39
	Average 9,5										Average 446

Vreedzaam rijden	Word length	Obs	Minimum	Maximum	Mean	Std. Dev	Freq Min	Freq Max	Freq mean	Freq Std. Deviation	Celex
respecteren	11	15	1.00	10.00	8.67	2.26	1.00	5.00	3.07	1.22	630
wachten	7	15	4.00	10.00	7.87	1.68	2.00	5.00	3.20	0.86	14839
opletten	8	15	2.00	10.00	7.80	2.43	2.00	5.00	3.87	1.06	507
anticiperen	11	15	1.00	10.00	7.60	2.16	1.00	5.00	3.20	1.08	139
voorsorteren	12	15	1.00	10.00	7.13	2.56	2.00	5.00	3.67	0.98	9
invoegen	8	15	3.00	10.00	6.87	2.07	2.00	5.00	4.07	1.03	74
	Average 9,5										Average

NEUTRAL STIMULI FOR TRAFFIC E-STROOP

Neutral Stimuli	length	Obs	Minimum	Maximum	Mean	Std. Deviation	Freq Min	Freq Max	Freq Mean	Freq Std. Deviation	Celex
schakelen	9	15	6.00	10.00	9.13	1.41	3.00	5.00	4.27	0.59	883
rotonde	7	15	6.00	10.00	9.07	1.22	1.00	5.00	3.80	1.32	55
bestuurder	10	15	5.00	10.00	9.00	1.46	3.00	5.00	4.47	0.83	814
passagier	9	15	5.00	10.00	9.00	1.51	2.00	5.00	3.67	1.29	694
autoradio	9	15	7.00	10.00	9.00	1.13	1.00	5.00	2.93	1.28	39
voertuig	8	15	5.00	10.00	8.87	1.41	2.00	5.00	4.07	1.28	604
voetpad	7	15	5.00	10.00	8.87	1.41	3.00	5.00	4.13	0.83	145
ruitewisser	11	15	3.00	10.00	8.87	1.88	3.00	5.00	4.13	0.74	47
bushalte	8	15	4.00	10.00	8.80	1.74	2.00	5.00	4.27	1.22	107
afslag	6	15	6.00	10.00	8.73	1.33	2.00	5.00	3.87	1.25	79
busstrook	9	15	4.00	10.00	8.73	1.91	2.00	5.00	3.40	1.12	10
dienstregeling	14	15	5.00	10.00	8.73	1.62	1.00	5.00	3.00	1.41	52
rijbaan	7	15	5.00	10.00	8.73	1.67	1.00	5.00	3.20	1.47	58
kruispunt	9	15	5.00	10.00	8.67	1.59	4.00	5.00	4.73	0.46	287
verkeersbord	12	15	3.00	10.00	8.60	1.92	3.00	5.00	4.67	0.62	41
richtingaanwijzer	17	15	4.00	10.00	8.60	1.92	2.00	5.00	4.33	0.82	13
autosnelweg	11	15	5.00	10.00	8.53	1.64	3.00	5.00	4.53	0.64	48
rijbewijs	9	15	5.00	10.00	8.53	1.60	2.00	5.00	4.53	0.83	141
voetganger	10	15	3.00	10.00	8.47	1.92	4.00	5.00	4.60	0.51	153
navigatie	9	15	5.00	10.00	8.40	1.84	1.00	5.00	3.33	1.23	65
	Average 9.55										Average 217

NEGATIVE STIMULI FOR TRAFFIC E-STROOP

Negative Stimuli	Word length	Obs	Minimum	Maximum	Mean	Std. Deviation	Freq Min	Freq Max	Freq Mean	Freq Std. Deviation	Celex
dronken	7	15	5.00	10.00	9.07	1.39	1.00	5.00	3.60	1.06	1589
verkeersdoden	13	15	3.00	10.00	8.93	2.43	2.00	5.00	3.20	1.08	0
spookrijden	11	15	2.00	10.00	8.60	2.41	2.00	5.00	2.80	1.08	0
ongeval	7	15	1.00	10.00	8.27	2.19	2.00	5.00	4.20	0.86	323
verkeerslachtoffer	19	15	1.00	10.00	8.27	2.79	2.00	5.00	3.27	1.10	7
alcohol	7	15	1.00	10.00	8.13	2.45	2.00	5.00	3.93	0.96	1230
gewonden	8	15	1.00	10.00	8.13	2.92	2.00	5.00	3.27	0.96	0
bekeuring	9	15	3.00	10.00	7.87	2.23	1.00	5.00	3.27	1.10	35
blijkschade	10	15	3.00	10.00	7.60	2.03	2.00	5.00	2.93	0.96	6
flitspaal	9	15	1.00	10.00	7.53	2.92	3.00	5.00	4.47	0.74	6
boete	5	15	1.00	10.00	7.33	2.79	2.00	5.00	4.20	1.01	402
verkeershinder	14	15	2.00	10.00	7.20	2.57	3.00	5.00	3.93	0.80	236
uitstoot	8	15	1.00	10.00	7.13	2.42	1.00	5.00	3.53	1.19	24
spitsuur	8	15	1.00	10.00	7.13	2.90	3.00	5.00	4.60	0.63	75
slippen	7	15	1.00	10.00	6.93	2.46	2.00	5.00	3.07	0.96	136
stress	6	15	1.00	10.00	6.80	2.54	1.00	5.00	2.87	1.25	519
wegenwerken	11	15	1.00	10.00	6.67	2.16	3.00	5.00	4.27	0.70	0
vertraging	10	15	2.00	10.00	6.67	2.35	2.00	5.00	3.87	0.92	367
omleiding	9	15	1.00	10.00	6.60	2.03	2.00	5.00	4.07	0.88	11
tijdsdruk	9	15	1.00	10.00	6.60	2.56	1.00	5.00	2.80	1.37	11
	Average 9.55										Average 217

AGGRESSIVE STIMULI FOR TRAFFIC E-STROOP

Aggressive stimuli	Word length	Obs	Minimum	Maximum	Mean	Std. Deviation	Freq Min	Freq Max	Freq Mean	Freq Std. Deviation	Celex
vluchtmisdrijf	14	15	1.00	10.00	7.60	3.72	2.00	5.00	3.13	1.19	0
afsnijden	9	15	3.00	10.00	7.40	2.23	1.00	5.00	2.67	1.11	652
roekeloos	9	15	3.00	10.00	7.33	2.41	1.00	5.00	3.00	1.46	321
bumberkleven	12	15	4.00	10.00	7.13	1.81	1.00	5.00	3.27	1.28	0
schelden	8	15	1.00	10.00	7.13	2.64	1.00	5.00	3.13	1.06	659
aanrijding	10	15	1.00	10.00	7.00	3.00	3.00	5.00	3.80	0.68	35
beschadigen	11	15	2.00	10.00	6.87	2.29	1.00	4.00	2.40	1.12	371
racen	5	15	2.00	10.00	6.87	3.09	2.00	4.00	2.73	0.80	47
opgefokt	8	15	1.00	10.00	6.60	2.95	1.00	5.00	3.27	1.28	0
claxonneren	11	15	3.00	10.00	6.53	2.53	1.00	5.00	3.13	1.25	39
machogedrag	11	15	1.00	10.00	6.53	2.23	1.00	5.00	2.60	1.12	5
vloeken	7	15	2.00	10.00	6.53	2.80	1.00	5.00	3.40	1.30	1239
blokkeren	9	15	1.00	10.00	6.47	2.61	1.00	5.00	2.33	1.11	438
botsen	6	15	1.00	10.00	6.40	2.82	3.00	5.00	3.73	0.80	493
opjagen	7	15	1.00	10.00	6.40	2.95	1.00	5.00	3.60	1.30	366
uitdagen	8	15	1.00	10.00	6.40	3.00	1.00	4.00	2.53	1.06	497
verblinden	10	15	1.00	10.00	6.27	3.20	2.00	4.00	2.80	0.94	577
overtreding	11	15	1.00	10.00	6.07	3.03	2.00	5.00	4.00	0.93	552
irriteren	9	15	1.00	10.00	6.00	2.70	1.00	4.00	2.73	1.10	634
toeteren	8	15	1.00	10.00	6.00	2.80	2.00	5.00	3.60	1.06	177
	Average 9,15										Average 355

POSITIVE STIMULI FOR TRAFFIC E-STROOP

Positive Stimuli	Word length	Obs	Minimum	Maximum	Mean	Std. Deviation	Freq Min	Freq Max	Freq Mean	Freq Std. Deviation	Celex
carpoolen	9	15	4.00	10.00	8.47	1.88	2.00	5.00	3.80	0.94	0
bobben	6	15	1.00	10.00	8.40	2.44	2.00	5.00	3.73	0.96	64
opletten	8	15	5.00	10.00	8.27	1.67	2.00	5.00	3.87	1.06	507
voorrang	8	15	3.00	10.00	8.20	2.11	3.00	5.00	4.53	0.64	330
voorzichtig	11	15	4.00	10.00	8.07	2.05	2.00	5.00	3.60	1.24	4574
attent	6	15	1.00	10.00	8.07	2.76	1.00	4.00	2.60	1.24	383
voorlaten	9	15	4.00	10.00	8.00	1.85	2.00	5.00	3.53	0.83	0
veilig	6	15	3.00	10.00	8.00	2.42	2.00	5.00	4.13	0.99	3340
vooruitkijken	13	15	5.00	10.00	7.93	1.58	1.00	5.00	2.67	1.23	14
meerijden	9	15	1.00	10.00	7.93	2.40	2.00	5.00	3.47	1.13	168
milieuvriendelijk	17	15	1.00	10.00	7.80	3.14	2.00	5.00	3.60	1.18	13
respecteren	11	15	3.00	10.00	7.73	2.19	1.00	5.00	3.07	1.22	630
rustig	6	15	3.00	10.00	7.71	2.16	1.00	5.00	2.87	1.30	6810
verlichting	11	15	1.00	10.00	7.60	2.32	1.00	5.00	3.87	1.13	760
fietshelm	9	15	1.00	10.00	7.60	2.56	2.00	5.00	3.07	1.10	26
geduldig	8	15	1.00	10.00	7.60	2.47	1.00	4.00	2.60	1.06	819
comfortabel	11	15	1.00	10.00	7.53	2.39	1.00	5.00	2.93	1.39	348
groenlicht	10	15	1.00	10.00	7.53	2.67	3.00	5.00	4.60	0.63	38
hoffelijk	9	15	1.00	10.00	7.53	2.90	2.00	5.00	3.53	1.13	248
opmerkzaam	10	15	1.00	10.00	7.53	2.92	1.00	5.00	2.53	1.36	166
	Average 9,35										Average 962

Auteursrechtelijke overeenkomst

Ik/wij verlenen het wereldwijde auteursrecht voor de ingediende eindverhandeling:
Measuring explicit and implicit aggressive attitudes in drivers □ **A new approach to novice driver education**

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Datum: **23/01/2017**