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Dissertation

Titel der Dissertation

“Effects of ISA-like IST - applications on the communication behaviour of young car drivers in urban areas”

Verfasserin

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Summing up

The time when I was completing my thesis was not easy – full of limitations and many breaks in my private life. However, I daresay that the completion of the thesis would not be possible in any other way. Once the difficulties were mastered, the hindrances surmounted, it was only pride and elation that I felt in the end. Today I look forward to a sunny future, ready to face life's coming challenges!

Prefacing words

The current study was financed by the Network of Excellence HUMANIST, sponsored by the EU. A most welcome condition for the funding was the obligation to co-operate with at least one project partner. In this case the Czech Partner CDV was asked to host the current PhD work. The colleagues there were highly supportive and were involved significantly in the progress of the study.

Abstract

One crash and several critical incidents in the course of 194 observed car rides are some figures of the study which in a way reflect the reality of young car drivers in road traffic. Young drivers are the group with the highest accident risk. Their risk of being involved in an accident is about three times higher than for the rest of the population. Two different reasons for their accident proneness can be identified. The youthfulness of novice drivers on the one hand leads to a greater willingness to take risks. On the other hand, young drivers become involved in risky situations just because of their lack of experience. Probably both factors entail the speed behaviour of novices. This specific group of road users tends to speed much more than other car drivers do. As speed, however, is one of the major accident risks, the crash involvement of young car drivers seems not surprising. Another issue can be seen in the fact that a higher speed results in more severe casualties. Hence, speeding among young car drivers must be specified as a major safety problem which has to be solved.

To make novices aware of their problematic driving behaviour several approaches seem to be feasible. One potential solution could be to intensify the practical training within the scope of the driver education and thus, the experience on the road. Furthermore, the risk awareness of young drivers might be improved by specific training lectures. Another approach could be to intensify enforcement or to improve the self-monitoring skills by installing telematic devices in cars. The current PhD thesis concentrates on the impact of training and the use of an Advanced Driving Assistance System (ADAS) on the behaviour of young drivers. The implemented system, Intelligent Speed Adaption (ISA), regulates the driven speed by increasing the counter pressure in the gas pedal as soon as the legal speed limits are exceeded. It was assumed that especially the communication with other road users could be improved by using such a system, as it should lead to lower speeds and thus facilitates the detection of vulnerable road users. Moreover, based on the findings of former studies, it should be demonstrated that a short-term use of such a system is not capable to cause a long-term effect on the behaviour. Furthermore it was intended to achieve the goal of changing behaviour over a longer period of time by implementing a specific training, developed for the purpose of the study. Another notion for offering a specific type of training was to improve the attitude of young drivers towards the ISA system as well as speed behaviour in general.

In order to examine the considerations mentioned above, a longitudinal approach with repeated measurements was adopted. At first, young drivers in two countries (Austria and Czech Republic) were observed while driving a driving school car along a standardised route so as to survey a baseline of their driving style. After a few months, the same drivers were observed on the same track, this time while using an ISA equipped car. To determine changes in their driving behaviour, finally the attendees were asked to drive the driving school car along the same route as twice before. Furthermore, all participating young grown-ups were asked to answer several questionnaires in order to evaluate their attitudes towards speeding, traffic safety and other issues. Altogether 74 young drivers could be attracted to participate in the current PhD study.

As anticipated, the results of the data analysis indicated a positive effect of the ISA system on the communication behaviour. However, the possible impact of the system seems to depend significantly on the attitude of the driver. Especially risk prone participants or those who drive their car just for fun, did not improve their communication with other road users while using the system, as it was the case for anxious

drivers. The results further support former research findings, which rebutted a long-term effect of an ISA system. Unfortunately the implemented training did not have the power to change the attitudes of young drivers. The training, however, positively influenced the driving behaviour in some respect, as fewer critical incidents happened during the ride after the training.

The main conclusion which can be drawn from the experience of the current study probably is that the ISA system seems to be a very effective instrument to change young driver's behaviour. Not only experienced drivers can profit from the ISA, which already has been proven in several studies before, but also those drivers who are most at risk can be influenced positively by the system. However, the designated impacts on the behaviour occur just for the time the system is used. Thus, if the system ought to work effectively it needs to be implemented permanently.

Kurzusammenfassung

Ein Unfall, unzählige kritische Situationen im Rahmen von 194 Fahrverhaltensbeobachtungen von AutofahrerInnen sind nur einige Zahlen der vorliegenden Studie, die aber gut die Realität junger LenkerInnen im Straßenverkehr widerspiegeln. Junge LenkerInnen sind jene Gruppe mit dem größten Unfallrisiko überhaupt. Ihr Risiko in einen Unfall verwickelt zu werden ist etwa drei Mal so groß wie für den Rest der Bevölkerung. Für diese Tatsache können vornehmlich zwei Gründe verantwortlich gemacht werden. Einerseits führt die „Jugendlichkeit" heranwachsender AutofahrerInnen zu einer größeren Bereitschaft Risiken in Kauf zu nehmen und andererseits geraten sie aufgrund mangelnder Fahrerfahrung schneller in kritische Situationen. Beide Faktoren haben ebenfalls einen Einfluss auf das Geschwindigkeitsverhalten von FahranfängerInnen, da jüngere LenkerInnen generell häufiger zum Schnellfahren tendieren. Da unangepasste Geschwindigkeit jedoch als eine Hauptunfallursache angesehen werden kann, verwundert das erhöhte Unfallrisiko jugendlicher AutofahrerInnen kaum. Nicht zu vernachlässigen ist außerdem die Tatsache, dass höhere Geschwindigkeiten Unfälle mit schwerwiegenderen Konsequenzen nach sich ziehen. Aus genannten Gründen muss das Geschwindigkeitsverhalten besonders von jungen AutofahrerInnen als großes Sicherheitsproblem angesehen werden, das schnell einer Lösung bedarf.

Unterschiedliche Ansätze sind vorstellbar, um FahranfängerInnen vor sich selbst zu schützen. Etwa könnte der praktische Teil der Fahrausbildung ausgedehnt werden, um die Fahrerfahrung im Straßenverkehr zu vergrößern. Spezielle Ausbildungseinheiten könnten helfen die Risikowahrnehmung von jungen LenkerInnen zu verbessern. Ein anderer Ansatz wäre, die Überwachung zu intensivieren oder aber durch technische Hilfsmittel die Fähigkeit zur Selbstkontrolle zu fördern. Gegenständliche Doktorarbeit beschäftigte sich in erster Linie mit der Wirkung von Trainingsmaßnahmen, sowie dem Einfluss von technischen Hilfsmitteln auf das Fahrverhalten von jungen LenkerInnen. Im Rahmen dieser Studie fand daher ein System (Intelligent Speed Adaption, ISA) Anwendung, das durch Gegendruck im Gaspedal bei Überschreiten der erlaubten Höchstgeschwindigkeit, Rückmeldung über die gefahrene Geschwindigkeit bot. Es wurde angenommen, dass ein derartiges System die gefahrene Geschwindigkeit reduzieren und damit das Erkennen von ungeschützten VerkehrsteilnehmerInnen erleichtern würde, und damit die Kommunikation zwischen diesen und AutofahrerInnen verbessert werden kann. Basierend auf früheren Studien sollte außerdem gezeigt werden, dass die Verwendung von ISA über einen nur kurzen Zeitraum nicht ausreicht um eine langfristige Verhaltensänderung zu erzielen. Die längerfristige Veränderung im Fahrverhalten sollte deshalb mittels eines eigens entwickelten Trainings erreicht werden. Mit Hilfe des Trainings sollte außerdem die Einstellung junger AutofahrerInnen zu ISA, aber auch zum Thema Geschwindigkeit generell verbessert werden.

Die Überprüfung eben genannter Überlegungen und Annahmen erforderte den Einsatz einer Längsschnittuntersuchung mit Messwiederholung. Junge AutolenkerInnen aus zwei Ländern (Österreich und Tschechische Republik) wurden zuerst beim Lenken eines Fahrschulwagens entlang einer standardisierten Strecke beobachtet, um eine Art Baseline ihres Fahrverhaltens zu erhalten. Einige Monate später wurde notiert, wie sich die selben jungen LenkerInnen auf der selben Teststrecke in einem mit ISA ausgestatteten Wagen verhielten. Um Unterschiede im Fahrverhalten ermitteln zu können wurden alle TeilnehmerInnen abschließend gebeten, noch einmal einen Fahrschulwagen, auf der selben Strecke wie die beiden Male davor, zu lenken. Um die Einstellung der jungen AutofahrerInnen bezüglich

Schnellfahrens, Verkehrssicherheit sowie anderer Themen zu erhalten wurden die TeilnehmerInnen gebeten zusätzlich auch noch mehrere Fragebogen auszufüllen. Insgesamt nahmen 74 Personen an der gegenständlichen Studie teil.

Die Daten bestätigten den positiven Effekt von ISA auf das Kommunikationsverhalten mit ungeschützten VerkehrsteilnehmerInnen. Diese positive Auswirkung des Systems hängt jedoch sehr von der Einstellung des Nutzers ab. Besonders risikofreudige LenkerInnen, oder jene, die Autofahren als Hobby betrachten, profitieren am wenigsten von dem elektronischen Geschwindigkeitsbegrenzer, im Gegensatz zu eher ängstlichen TeilnehmerInnen. Wie aus der Literatur zu erwarten war, zeigte sich auch in gegenständlicher Untersuchung kein Verhaltenstransfer im Sinne eines Langzeiteffekts. Bedauerlicherweise konnte mit Hilfe des entwickelten Trainings die Einstellung der jugendlichen AutofahrerInnen nicht positiv beeinflusst werden, dafür zeigte sich jedoch eine Verhaltensänderung in einigen Bereichen, vor allem hinsichtlich des Auftretens kritischer Situationen.

Die wichtigste Schlussfolgerung aus der vorliegenden Studie liegt wahrscheinlich darin, dass ISA ein sehr effektives Instrument zur Verhaltensänderung zu sein scheint. Es zeigt seine Wirkung nicht nur bei erfahrenen LenkerInnen, wie in früheren Studien gezeigt werden konnte, sondern auch bei jener Gruppe, die aufgrund ihrer Jugendlichkeit sowie ihrer mangelnden Fahrerfahrung im Straßenverkehr besonders gefährdet ist. Der Wermutstropfen angesichts derart erfreulicher Ergebnisse ist die Tatsache, dass ISA sich nur solange positiv auf das Verhalten auswirkt, so lange das System auch tatsächlich verwendet wird. Um effektiv wirken zu können, müsste ISA dauerhaft im Fahrzeug installiert werden.

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Abbreviations, Agencies, Associations and Projects

AAP	Active Accelerator Pedal
ADAS	Advanced Driver Assistance Systems
AICC	Adaptive Intelligent Cruise Control
ATSB	Australian Transport Safety Bureau
AXA	French global insurance companies group
BASt	Bundesanstalt für Straßenwesen; Federal Highway Research Institute
BSVI	Bundesvereinigung der Straßenbau und Verkehrsingenieure
CDV	Centrum dopravního výzkumu
DBQ	Manchester Driver Behaviour Questionnaire
ECMT	European Conference of Ministers of Transport
ERF	European Union Road Federation
ERSO	European Road Safety Observatory
ETSC	European Transport Safety Council
EU	European Union
FACTUM OHG	SME (Small and Medium-sized Enterprises) with the focus on traffic and mobility; located in Vienna
GPS	Global Positioning System
GRSP	Global Road Safety Partnership
HOPES	Evaluation study of a dual-mode route-guidance system
HUMANIST	HUMAN centred design for Information Society Technologies; a network of excellence financed by the European Commission
INFANTI	INtelligent FartTIlpasning; a Danish project focusing on the development of speed limiting technologies
IRF	Brussels Programme Centre
ISA	Intelligent Speed Adaptation
ITS	Intelligent Transport Systems
IVIS	In-Vehicle Information Systems
KfV	Kuratorium für Verkehrssicherheit; Austrian Road Safety Board
LIVES	LenkerInnenInteraktion mit VErkehrstelematischen Systemen; project to investigate the effect of the combined use of in-car devices
MASTER	Managing Speeds of Traffic on European Roads

OECD	Organisation for economic co-operation and development
ORS	Office of Road Safety
PAYS	Pay as You Speed; project aiming at ISA related attitudes of young drivers
PCA	Principal component analysis
Psychonomics AG	International market research institution
ROSPA	Royal Society for the Prevention of Accidents
SICHER MOBIL	Project to improve the mobility of disabled people
SIZE	EC project about life quality of senior citizens in relation to mobility conditions
SMS	Short Message Service
SNRA	Swedish National Road Administration
TAC	Transport Accident Commission
VOLVO	Swedish supplier of vehicles
VTI	Statens Väg-och TransportforskningsInstitut; Swedish National Road and Transport Research Institute
Wiener Fahrprobe	Standardised behaviour observation method

1. Introduction

In relation to the field of traffic psychology, the current PhD thesis focuses on one detail of road traffic safety work. The communication between equipped car drivers and other road users in connection with the use of an Intelligent Speed Adaptation system (ISA) was investigated in two countries (Austria and Czech Republic). These countries were chosen because of practical reasons. An extensive literature review provided an insight into the positive impacts the system has on the behaviour of car drivers, as well as into the situation of young car drivers with regard to road traffic. Based on the “state of the art”, a positive influence of the ISA system on the interaction behaviour of young car drivers was expected, depending on their attitudes and other factors like age and gender. Furthermore it was assumed that no long-term impact would occur. In order to achieve a lasting change in the participants’ behaviour, regardless of the ISA system, a psychological group training was implemented as well. Several questionnaires provided information on the attitudes and characteristics of young drivers. The “ISA” questionnaire delivered insight into the attitudes and motives of young car drivers concerning speed and the system itself, the Manchester Driver Behaviour Questionnaire (DBQ) focused on erroneous behaviour and the “Type” questionnaire was about the belonging to a certain driver category.

The PhD thesis will start with an overview of the special group of road users, young drivers, followed by a section about ISA, and the impact of common training methods. After illustrating the aim and the hypothesis of the current work, the study design will be discussed and the methods used will be described in detail. Subsequently the results will be presented, leading into the discussion, critical remarks concerning the study, and recommendations for policy makers.

2. Sociological framework

If one talks about the concept of „mobility”, various words might come into people’s minds like “motion”, “change”, “action”, “progress” or even “flexibility”. The term itself comprises many different meanings. This chapter deals with “mobility” from a sociological point of view. The ideas presented in the current sub-chapter are mainly based on the literature of Franz (1984), Geiger (2002), Haslinger (2006), Hilgers (1994), Rammler (2001), Amann and Reiterer (2003), Vogt (2002) but also Flade (1994).

2.1. Mobility

The term mobility originates from the Latin word “mobilitas”, which means motility, velocity but also unstableness (Zängler, 2000) and mental agility (Stowasser, 1998). It is defined as the movement of individuals and properties between two social, spatial or mental positions (Werlen, 2008; Zängler, 2000). Expressed in more abstract words, mobility represents the movement of an individual between defined units of a system (Mackensen et al., 1975; as cited in Bähr, 2004).

When investigating the mobility of people, two approaches can be applied. One can either stress individual changes or the changes caused by structural conditions. Individual mobility is characterised by the behaviour of one single person (microanalytical approach), whereas focusing on a broader range of factors gives information about structural changes (macroanalytical approach). The technical progress that has enabled the bulk production of passenger cars played a decisive role in the dissemination of the car to a wide range of the population, also the less wealthy proportion. Thus, structural changes influenced the mobility of thousands of people.

2.1.1. Social mobility

One of the most important issues in sociology with regard to the concept of mobility is the social mobility of people (Fuchs-Heinritz et al., 1995; Korte and Schäfers, 2008; Reinhold et al., 2000; Schaefer, 2007; Wiswede, 1998). Social mobility connotes the movement of individuals between different positions within society (see table 1). In literature several aspects of social mobility are differentiated. Within a hierarchy people might move vertically or horizontally. Furthermore, changes can take place in the course of one or several generations.

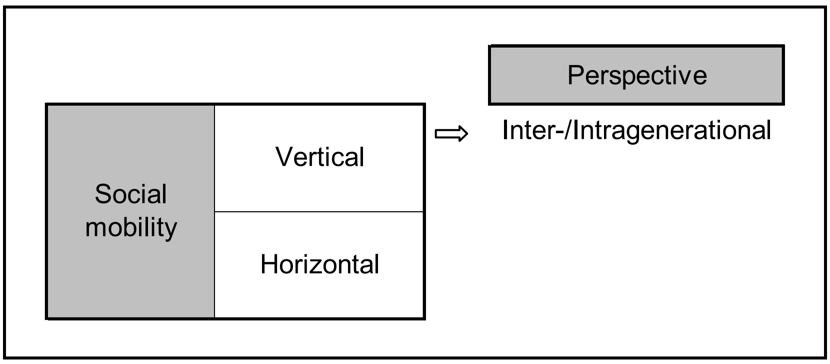

Table 1: Description of social mobility

Vertical mobility stands either for a social advancement (upward mobility) – the movement from one level to another, higher level – or a social decline (downward mobility) – the movement to a lower rank. The higher level might be reached through a better job or a marriage, linked to more power or a more respected social status. If the change causes less/fewer prestige, there is a downward mobility. Horizontal mobility describes a movement within the same social level, for example an occupational chance that does not involve gaining a higher status.

Another perspective on social mobility is to focus on changes between generations or in one person's life. The professional advancement of children in comparison to the jobs of their parents belongs to the object of intergenerational mobility; changes in-between the generations. The occupational career of one individual is referred to as intragenerational mobility.

2.1.2. Spatial mobility

The term "**spatial mobility**" characterises the movement in space, irrespective of the distance (how far one moves) or the frequency (how often one moves from one place to another). Again, the term merges different aspects of locomotion. In literature spatial mobility is mainly divided into the two aspects "migration" and "circulation" (see table 2; Bähr et. al, 1992; Bähr, 2004).

			Perspective
Spatial mobility	Migration		⇨ Internal - International ⇨ Voluntary - Enforced
	Circulation	Everyday mobility	
		Mobility to maintain housekeeping	
		Leasure time related mobility	

Table 2: Description of spatial mobility

Migration describes mobility in combination with a residential change. The relocation can be enforced by a war for instance or, rather can be voluntary.

All movements of an individual, which revolve around the place of living, are called circulation. The everyday mobility characterised by commuting, the mobility to maintain the housekeeping and the mobility related to leisure activities belong to this category (Zängler, 2000). Within the framework of the EC project SIZE (Transport Research Centre – CDV, 2003) another categorisation was provided. Nine areas related to goals or contexts of outdoor mobility have been identified and summarised into two categories of mobility: Inevitable and optional mobility. The former includes activities to maintain physical life and a good health status, to care for the financial basis of life, to comply with official affairs and to care for mobility. The latter contains activities to maintain the social network, to be involved in an organisation, association, etc. as well as all leisure activities that represent or imply mobility and finally intrinsically motivated mobility.

However, the transition from migration to circulation is rather smooth. The seasonal change of the residence, for instance, can neither be described as migration, nor as circulation. The case is quite similar for people who are away from home for weeks because of a construction job as well as for people who live at different places during the week on the weekend.

In the Western industrial countries the mobility behaviour of people is closely linked to their socio-economical status and especially circulation gained in importance in the last decades due to structural changes in everyday life like urban sprawl (see sub-chapter 2.2.2). The everyday mobility of individuals is connected with the term “traffic”, which will be discussed in more detail in sub-chapter 2.2.

2.1.3. The crux of the matter – some more aspects of mobility

People who change their place of residence frequently often also experience an inwardly alteration (Berger, 1977; as cited in Rammler, 2001). Thus, the claim of the current chapter 2 is not only to describe social or spatial mobility but also other aspects and underlying factors of mobility. Walzer (1993; as cited in Geiger, 2002) distinguishes between four different types of mobility; apart from social and spatial mobility he mentions relationship – divorces, blended family, friendships scattered all over the world - and political mobility implicating less loyalty to a specific party. Sorokin (1964; as cited in Rammler, 2001) constituted cultural mobility as the transformation of language and ideas. Another type of mobility, the movement of information, either within one person’s mind or between several people, was specified by Zängler (2000). Similarly Canzler and Knie (1998) and Opaschowski (1999) described mobility as mental flexibility.

In addition, mobility is more than just being mobile and describing the movement of individuals, goods or ideas between two positions. Far beyond, mobility is the driving force of life in general and of modern life in particular. According to Geiger (2002) mobility is an inherent desire of human beings. Opaschowski (1999) characterises mobility as a guiding principle of mankind; the desire to be mobile is part of the human nature. Mobility has become a synonym for the dreams of a better life.

Mobility is hardly ever self-sufficient, far more often it serves the purpose of satisfying immaterial (e.g. social contacts) or material (food) needs (Zängler, 2000). A similar definition is given by Vogt (2002); from his perspective, mobility enables individuals to participate in economical, social and societal processes.

Mobility as status symbol was discussed in the work of Haslinger (2006). For Hilgers (1994) mobility is closely connected with the sensation of autonomy and the self-worth of a person. A similar notion is seized by Vogt (2002), who relates mobility to people’s sensation of freedom (see also Opaschowski, 1999); being able to go wherever and whenever one likes to. Furthermore, mobility enables people to enlarge their sphere of action (Geiger, 2002).

In modern life the word mobility still has a positive connotation. Synonyms of “mobile” are: dynamic, agile, clever, flexible, active, spirited, etc. (Bulitter and Bulitter, 2001 and Duden, 2002; as cited in Vogt, 2002). The mentioned aspects, of course, influence the behaviour of people in general as well as their behaviour in traffic; which is illustrated in the following sub-chapters.

2.2. Traffic

Traffic in a narrow sense is about the physical transport of individuals or goods. Zängler (2000) described traffic as the sum of the mobility of all individuals. To focus only on the technical aspect of traffic, but not keeping in mind traffic as social phenomenon would not reflect the idea of traffic in its entirety. In order to distinguish between the social aspects as well as the “hard facts” of traffic, the term mobility was used, representing the overarching concept (Canzler and Knie, 1998). In literature, however, both terms – traffic and mobility - are often used synonymously (Rammler, 2001). The definitions for “traffic” and “mobility” by

Canzler and Knie (1998) are the basis for the further considerations in this PHD-thesis. They described mobility as the possibility to move, whereas traffic was defined as actual movement in the real world.

Traffic can be specified as social interaction within given spatial and temporal boundaries. It is important to communicate and participate in social life. The freedom to move is a good that human beings possess. Traffic can be seen as part of a social paradigm, classified by democracy, equity, performance, wealth, etc. (Milbrath, 1984; as cited in Rammler, 2001).

2.2.1. A short abstract of the history of traffic

The mobility of human beings started about 3.6 million years ago, by learning to walk upright (Haslinger, 2006). Our feet were loyal companions on the way to our modern society. As one was not able to cover long distances in a short period of time on foot, our ancestors used skids, built boats, domesticated horses and harnessed them to carriages, invented the wheel, etc. to faster reach destinations. In the course of the industrial revolution, trains became important modes of transport at the beginning of the 19th Century. In the first Half of the 20th Century, the individual traffic was tightly linked to the bicycle, followed by the motorbike. The car started its triumphal procession in Austria rather late, after 1955 (Statistik Austria, 2009a, b). Since then, the number of newly registered cars has increased continuously. Whereas in 1955 far less than 500.000 Austrians owned a car, the number increased to 5.873.000 car owners in 2008. The transport capacity with regard to freight traffic was 80 times higher in 1997 than in 1929 and numbers are only slightly smaller for the train (Merki, 2002). Today a new medium influences our mobility behaviour: the internet (Vogt, 2002). The internet influences various aspects of our lives, such as providing the possibility for tele-working, exchanging information (quite) rapidly, giving information about the quickest route for a journey, etc.

2.2.2. The modern man and the consequences of his/her mobility

The main question in this sub-chapter is: “What are the mobility patterns today, and why do people prefer certain transport modes?”. One possible answer might be found in our past. Considering the theory of evolution, mobility leads to success by facilitating the accessibility of resources and maximising the personal “fitness” (Haslinger, 2006; see also Grammer and Atzwanger, 1993; as cited in Vogt, 2002). Spatial mobility implies the freedom to move without any restrictions. The intrinsic motivation of human beings to increase their sphere of influence by exploring their environment in order to achieve progress can be perceived to the present day. The faster one acquires the resources one need for living, the better one's circumstances are. It seems that velocity is an important issue for one wanting to have a successful career in society. It explains why mankind has been striving for thousands of years to reduce travel time by inventing means allowing a faster locomotion. Just achieving a cruising speed of 4 km/h in the Middle Ages, today a speed of about 200 km/h can be reached with a car, or almost 1.000 km/h with a plane. Since the industrial revolution mobility has been characterised by speed. Vogt (2002; see also Rammler, 2001) recapitulated that modernity, economic growth and spatial mobility are tightly interlinked. Traffic seems to depend on the economic development of a society (Rammler, 2001).

In order to meet the requirements for an unobstructed locomotion, adequate facilities had to be provided; road after road was constructed. Initiated by the increasing individual traffic and caused by modernisation, residents started to leave the cities, which were crowded with cars. This viscous circle, the so-called urban sprawl, has run its course. The tendency now is to have the living environment decoupled from the working place of people and generally no shops are close to people’s homes whilst public transport cannot meet the claim to pick up everyone from his/ her front door. Thus, it seems to be essential to use the car in order to be successful in modern society (Vogt, 2002; Geiger, 2002; Hilgers, 1994).

However, the assumption that the car is necessary to manage the everyday challenges, leads to several negative consequences (Opaschowski, 1999; Vogt, 2002; Zängler, 2000; Rammler, 2001; Hilgers, 1994 and Haslinger, 2006). Apart from the destructive effects on the environment, noise pollution and stress, the extensive individual traffic sometimes reverses into a complete standstill in terms of a traffic jam.

The car is one of the biggest achievements of mankind; at the same time it causes the most notable challenges society has to face nowadays. This is not only true because of the issues mentioned above but also because of the social and economic consequences of accidents, that happen on our roads every day. Thus, the question is, how can it be possible that the car has become such an important part of our lives despite its negative consequences for the environment, people’s quality of life and the vast costs (acquisition as well as maintenance).

2.3. „Auto“-motion

The car is a means of transport that allows people to reach a destination individually, without being restricted by timetables, being limited in covering long distances or being unable to carry the whole family or heavy goods. As chapter 2.2.1 has showed, in Austria the car has gained importance since the fifties. But why does the car fascinate people? How does the car affect people’s mobility behaviour?

2.3.1. “Me and my car”

Hilgers (1994) describes in his book “Total abgefahren” – “completely crumped” – the mechanism which causes the affection for the car. His work as well as the work of Haslinger (2006) constitute the basis of the current sub-chapter.

The socialisation to become a car driver already starts in the early years of our infancy. After being able to crawl, children get their first Bobby-car, then they gain a bigger radius of independence by using a bike, later adolescents ride a moped until they are old enough to acquire their driving licence for a car. From the early childhood on, one gains autonomy by using individual transport modes. This experience implies a quite close relation between gaining autonomy and individual traffic.

Hence, it is not surprising, that nowadays the car is most commonly not experienced as a means of transport (see also Möser, 2002), but it is rather linked to extra motives like <u>freedom, autonomy and the self-esteem</u> of the owner. Rheinberg (1996; as cited in Drengner, 2003) described driving a car as a Micro-Flow experience, characterised by a congruence of challenge and ability. Keeping in mind these emotional connotations, a car is an object of desire, rather than a means of transport.

Each type of vehicle represents a specific image and status. A strong and expensive car might be used to compensate one’s own weaknesses The driver can escape from reality, at least for a while. It even enables its owner to break with traditional roles. By buying a “better” car than the own boss has, an employee can go beyond his or her career status; at least on the road. The image of the car is accompanied by the possibility to express the own personality as well. Depending on the brand, type or/and model of the car, various characteristics are imputed to the driver.

In addition the car is a shelter for the driver. It is a rolling part of the private home (Haslinger, 2006), the “extended living room”. The vehicle protects the driver from rain, snow and wind, but also from crowds and other people (sick, sweating, smelling, etc.; Haslinger, 2006).

Summing up the current sub-chapter, if one wants to analyse the driving behaviour of car drivers, one should always bear in mind the extra motives mentioned above.

2.3.2. “Me, my car and the others”

According to Hilgers (1994) traffic can be described as a group process, as a social phenomenon, which is characterised by mutual dependencies, prejudices against each other, aggression and a lack of relationship due to the difficult preconditions on the road hindering the communication with one another. Similarly, Tofote (1992) specified anonymity, competitiveness, lack of solidarity as well as an increasing tentativeness as factors of modern life that influence our traffic behaviour.

According to Schönhammer (1991; as cited in Haslinger, 2006) driving results in a competition with other road users for sphere of action. As each individual drives his own vehicle, people hardly communicate with each other and conflicts are predetermined; often other road users do not have the possibility to give feedback to those drivers who have behaved carelessly. As it is not possible to talk to each other and to build a mutual trust, the behaviour towards others is characterised by the stereotypes one holds as well as the protection of the own aggressive tendencies (Hilgers, 1994). Based on the estimation of the own status, drivers might require a diverse right to predominance (Haslinger, 2006) and behave more aggressively against other road users. Thus, the interaction with other road users is tightly linked to the self-concept (Hilgers, 1994). The car, on the one hand provides some kind of shelter but on the other hand can be used as weapon to display one’s power at the same time (Haslinger, 2006).

Another explanation why especially men behave rather riskily in traffic can be found in the theory of evolution, or rather in the “Handicap principle”. The “Handicap principle” implies that if a person can afford a drawback and still is successful in the competition against others, he or she will be experienced as particularly potent. Applied to the area of traffic, Haslinger (2006) presumed “inadequate” mobility with respect to frequency, time, speed, money as well as risk to be an indicator for an outstanding appeal and thus, worth striving for. In simple words, the more expensive the car, the faster one drives, the greater risks one takes, the better his social status will be. Zängler (2000) argues in a similar way, when he states that one can supply the need for social acceptance by behaving ostentatiously or riskily in traffic.

Thus, mobility is highly related to testing one’s limits as well as going beyond those limits. Transgressing limits, however, might cause fear and thus, lead to a state of ambivalence. The psychoanalyst Balint (1959/1988) called this state thrill, an emotion between fear and desire. These emotions are especially important for adolescents.

This subchapter has given some hints why people, especially men, and young men in particular, show a risky driving behaviour on our road.

2.4. Coming full circle

The chapter “sociological framework” started with a short discussion about mobility from the point of view of social sciences. The social and spatial mobility were characterised and supplemented by the emotional aspects of mobility. Special emphasis was given to traffic, which constitutes the basic framework of the current PhD work. In literature traffic is linked to circulation, or rather a consequence of it. Traffic behaviour, however, is highly influenced by emotional aspects. Especially the desire for autonomy and freedom might be the reason, why the car has become such an important means of transport in our modern society. Some emotional aspects of mobility were directly linked to the car (autonomy, freedom, self-worth); some other motives were added (car as a shelter, car as a status symbol, etc.). All of these underlying psychological factors influence our behaviour on the road and thus our driving behaviour. The road is not only a place where one can move from one place to the other but where people can satisfy their “extra needs”; the car to some extent has become an object of desire rather than a means of transport. Table 3 illustrates the train of though that has been followed so far.

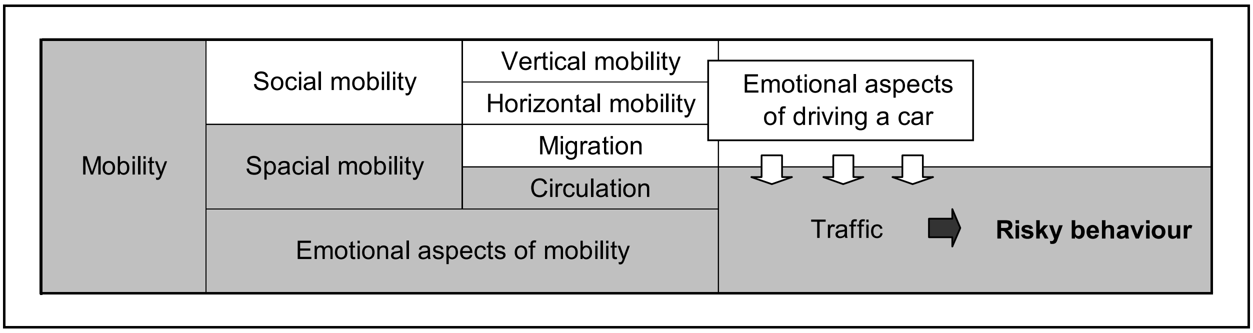

Table 3: Illustration of the train of thought from the need of mobility to risky behaviour in road traffic

Changing the point of view in the current sub-chapter only slightly, a structure (see figure 1) other than the train of thought illustrated above appears. One can focus on the physical/technical versus social/mental/emotional aspects of mobility rather than on the types of mobility. It was already discussed that mobility and progress, representative for the modern life, are tightly linked to each other. As mankind wanted to explore the world, means of transport had to be developed; in turn, those means of transport facilitated the satisfaction of the need of locomotion and supported the satisfaction of other relevant desires (freedom, autonomy, etc.). The car emerged as the dominant means of transport, which has various reasons and were discussed in sub-chapter 2.2. We nowadays have to face a modern form of traffic with all of its challenges and problems. For sure, one of the greatest disadvantages of traffic is the hundreds and thousands of people who are killed all over the world every year; in 2007 42.000 people died in EU-27 in road accidents (ERF and IRF, 2009). Quite often those accidents are due to a maladjusted or even risky behaviour of the driver. One group which is predestined to show off on the road, are young car drivers; this is reflected by the accident statistics as they are the group with the highest crash risk. The intention of any effective road traffic safety work is to improve the behaviour of the target group, in order to reduce their crash risk. Various actions can be taken; either focusing on the driver, or on the vehicle or on the infrastructure. The technical progress that enabled drivers to go as fast as 200 km/h nowadays features inventions that can prevent people from such risky behaviour. Intelligent Speed Adaption is one of these inventions. As mobility, traffic and the car are highly related to emotions it seems to be important not only to exert influence on drivers through a technical device but also to activate their understanding of their underlying motives for driving as well as their understanding for other road users.

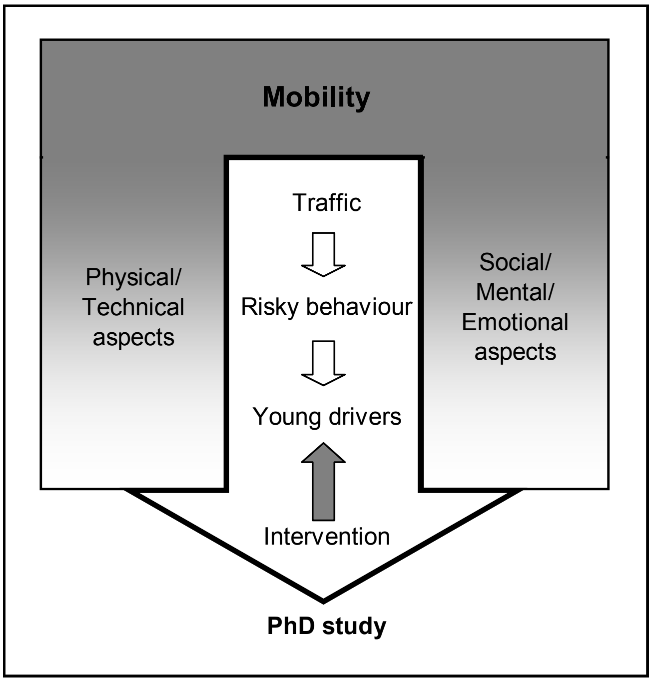

Figure 1: Theoretical framework of the current PhD thesis (based on a memo of Amann, 2009[1])

At the end it has to be stated that it seems to be hard to change the behaviour of drivers. This PhD work is a small contribution to the current road traffic safety activities in order to "mobilise" a change of behaviour of young car drivers at least in a sub-domain of their driving behaviour – speeding. It is an attempt to teach young drivers to behave responsibly in road traffic.

[1] Quotation not available.

3. Setting the scene

Probably most adolescents can not wait to become 18 in order to get their driving licence. The driving licence is often associated with independence, freedom and flexible mobility; as already was discussed in chapter 2. These positive aspects of getting a driving licence unfortunately come along with some downsides as well. Young drivers are the group with the highest accident risk in traffic. The following sub-chapter 3.1 is dealing with the situation of young car drivers caught in the crossfire between their youth and their statistical reality. The most plausible factors causing the accident liability of young car drivers will be discussed. In this context especially the issue of speed will be examined in depth, as poorly adapted speed represents a major risk in traffic. Chapter 3.2 and 3.3 will offer two feasible approaches to enhance the young car driver's chance of survival. At first, a technical device, **I**ntelligent **S**peed **A**daptation (ISA), will be introduced, which might help to reduce the crash risk of young drivers by making them aware of the speed driven. Secondly the potential benefits of several types of trainings will be presented as well. The implementation of ISA in combination with training might be a powerful action to save young drivers´ lives.

3.1. Young drivers and speed

What would our lives nowadays look like without speed? Due to the technological progress in different areas it is possible to travel from Vienna to New York in less than nine hours, which was unimaginable for our ancestors. We are used to visiting different places all over the world without spending much time on travelling. Being fast, however, does not only have advantages. Many people all over the world die in traffic because of inappropriate speed. Especially young people are affected by this fact.

3.1.1. Speed as major risk

According to the OECD (2006a), about 50% of the drivers exceed the speed limit, some of them by more than 20 km/h.

> **Speeding** encompasses <u>excessive speed</u> (i.e. driving above the speed limits) or <u>inappropriate speed</u> (driving too fast for the conditions, but within the limits).

Figure 2: Definition of speeding according to ECMT (OECD, 2006a)

Not only in Austria but across the developed countries, inappropriate speed choice has been identified to be the most important risk factor in traffic safety. About one third of all accidents are caused by inappropriate speed (see e.g. Speed Management Report of the GRSP, 2008; Speed Management Report of the OECD, 2006a). Similar data have been collected for Austria as figure 3 shows (KfV, 2008).

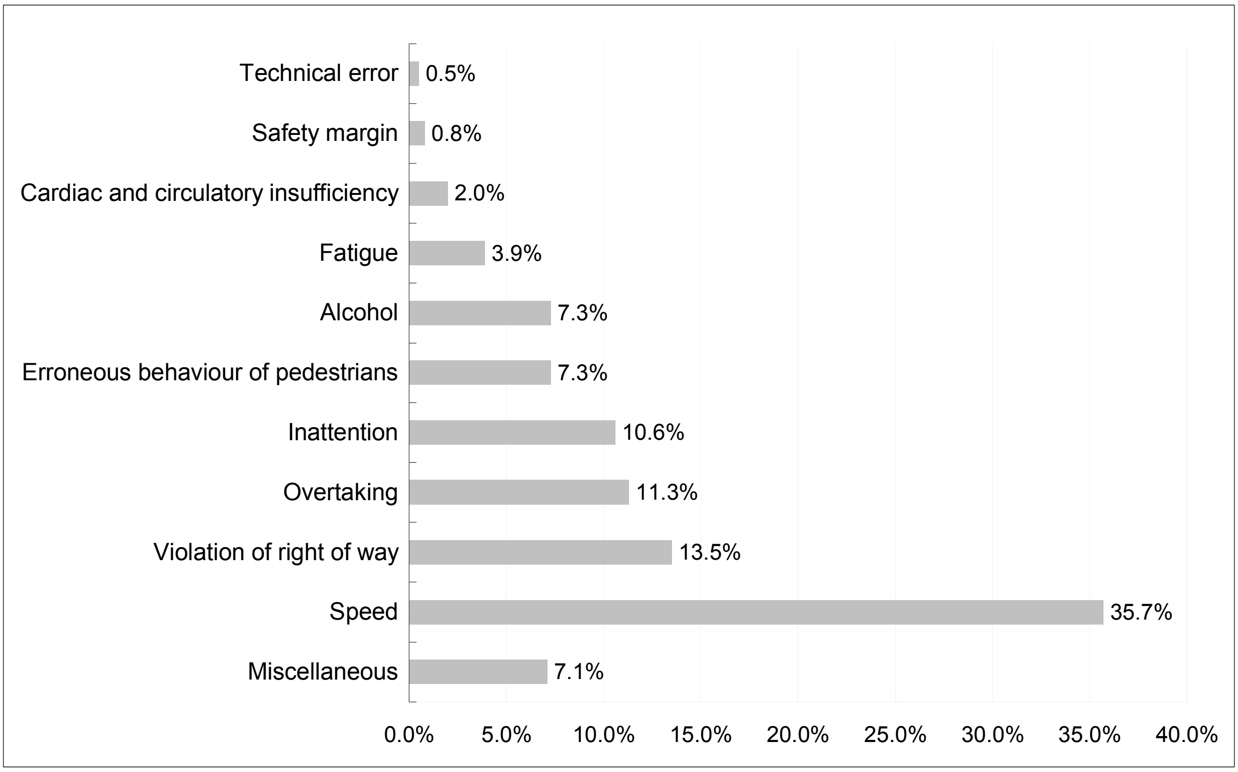

Figure 3: Presumed accident causes in Austria from 2007 (KfV, 2008)

High speed raises the probability of traffic accidents as well as their severity (GRSP, 2008; Van Beek et al., 2007; ATSB, 2008). The speeding driver loses the opportunity to detect hazardous situations and thus the possibility to react to them in time. One reason for late perception is the restricted field of vision due to higher speeds (see figure 4). According to Berger (1996) the focus of human vision tends to be more distant while driving at higher speeds, and thereby peripheral vision deteriorates. At a lower speed, the focus is more on the near-by environment and peripheral vision is more efficient and wider in angle, which facilitates the registration of pedestrians and the communication with pedestrians.

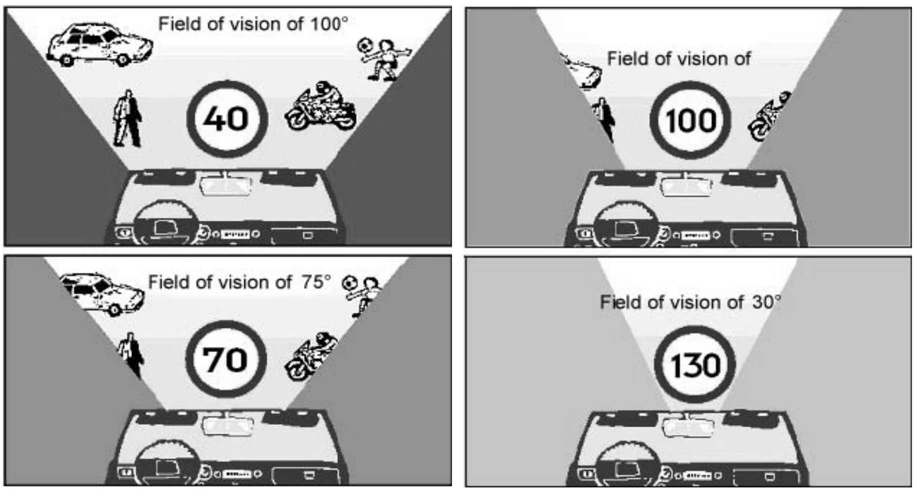

Figure 4: The field of vision at different speed levels (OECD, 2006a; source: French Ministry of Transport)

The faster one drives, the longer the stopping distance is and the higher the possibility of crashes. It is assumed that just a small increase in speed leads to a large increase in accident risk. Moreover, the probability of serious injuries increases with rising speed (GRSP, 2008; OECD, 2006a). Driving on a 60 km/h urban street with 5 km/h above the average speed limit or 10 km/h above the limit on a rural road can double the crash risk (GRSP, 2008; ATSB, 2008). Kloeden et al. (1997) postulate a doubling of risk with each 5 km/h increase in speeds above the 60 km/h limit. Based on several studies (Nilsson, 1982, 2004; Kloeden et al. 1997, 2001, 2002) Van Beek et al. (2007) concluded that the relation between speed and crash rate can be best described as power function. Nilsson's power model (2004) for instance suggests that a change of 5% of average speed gives rise to an increase of approximately 20% of fatal crashes (see figure 5).

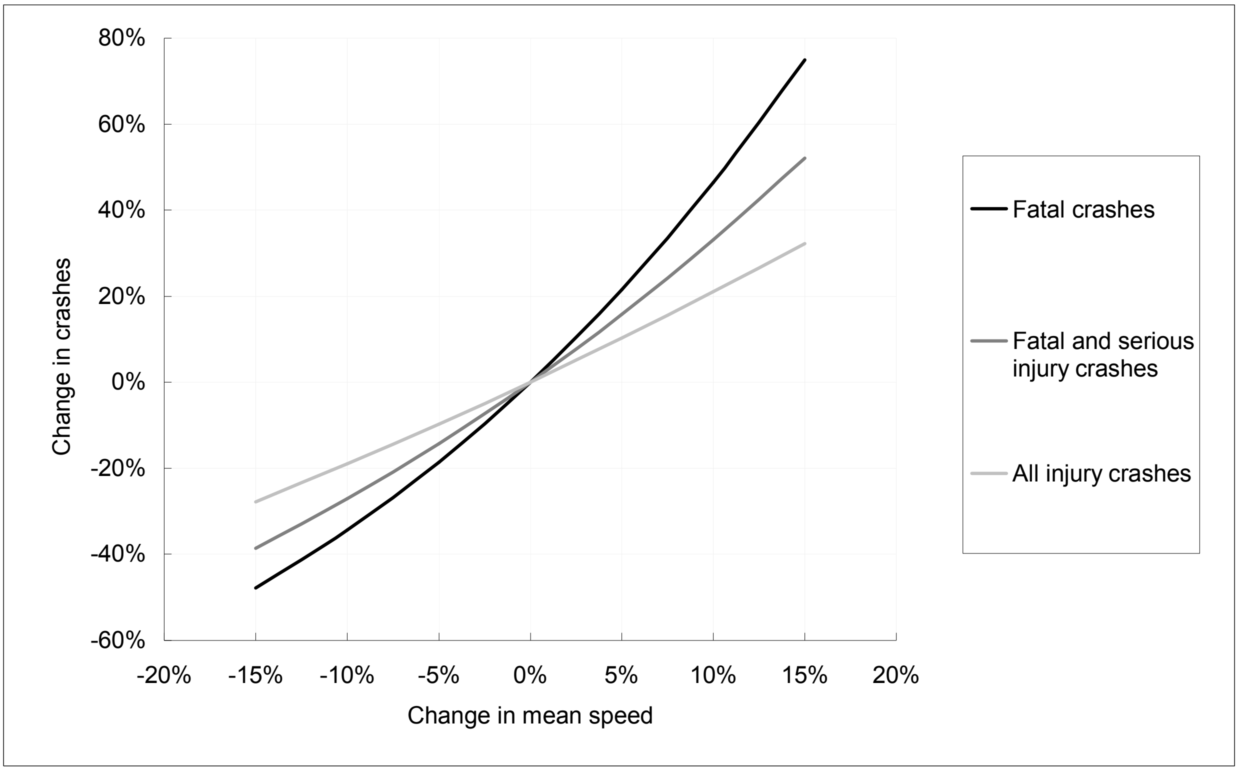

Figure 5: Illustration of the Power model (Nilsson, 2004; design inspired by GRSP, 2008)

Not only speed itself, but also differences in speed levels between various road users (pedestrians, cyclists, mopeds, lorries, etc.) lead to a higher accident risk (OECD, 2006a). Heterogeneous speeds tempt the faster road users, mostly car drivers, to overtake the slower ones and thus increase the accident risk. But not only car drivers are affected by their own speed choice, vulnerable road users have to bear the risk even more. Pedestrians or cyclists are those road users without any protection, hit by a car, their risk of a severe or even fatal injury is enormous. According to the KfV (2008), in 2007 in Austria 7.9% of injured road users were pedestrians. Even worse are the figures for fatalities; 108 pedestrians (15.6%) were killed. As figure 6 illustrates, a difference in the speed level of just 5 km/h considerably changes the likelihood of injury for a pedestrian.

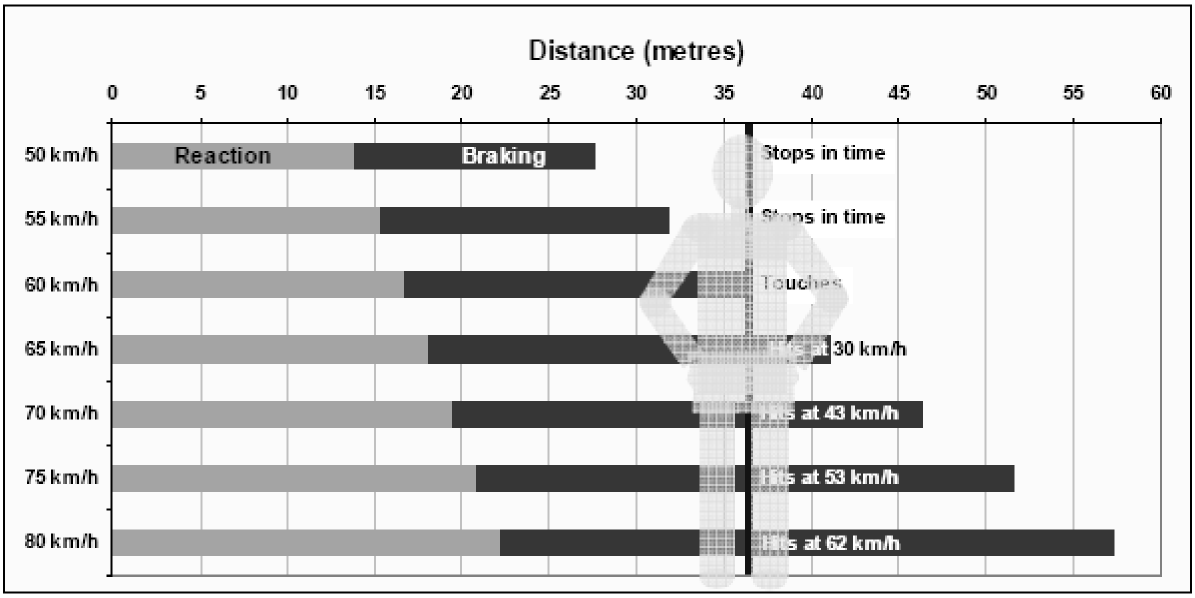

Figure 6: Stopping distance with a reaction time of about one second (OECD, 2006a; based on ATSB, n.a.)

Summing up, speeding negatively affects the crash risk as well as the severity of crashes. Many researchers have tried to answer the question, why drivers are still speeding, although the negative effects on traffic safety are well known. Stradling et al. (2003) citing Silcock et al. (2000), Furnham and Snaipe (1993) as well as Gabany et al. (1997) identified several reasons for driving above the speed limit, and so did Ruch and Zuckerman (2001; as cited in Krampe, 2004) as well as the authors of the GRSP (2008). The reasons cited are shorter journey times, time pressure but also fun, excitement or inattention. Drivers consider their own driving abilities as above average, experience speed limits as wrong, their cars as very well equipped or feel forced to speed by other road users. Furthermore personality traits like thrill or sensation seeking, risk-taking or ego-gratification are mentioned.

3.1.2. Statistical reality

In literature, speeding is often related to young drivers (Parker et al., 1992; Ingram et al. 2001 and Shinar et al. 2001; as cited in Stradling et al., 2003; Clarke et al., 2001; ATSB, 2008). In the European Road Safety Observatory (ERSO, 2006) high speeds have been identified as main causes for crashes of young car drivers. Likewise Engström et al. (2003), ROSPA (2002) and Clarke et al. (2001) identified excessive speeding as important reason for accidents among young drivers. Krampe (2004) credits one accident in four to poorly adapted speed. The Federal Statistical Office in Germany (Statistisches Bundesamt, 2007) ranks poorly adapted speed (22%) as the main cause of accidents, followed by mistakes in distance keeping (11%), mistakes in respecting the right of way (10%), and problems with making turns (6,3%).

The most frequent types of crashes young drivers are involved in are single-vehicle crashes, loss-of-control crashes, alcohol related crashes, night time and weekend crashes and crashes while chauffeuring passengers (Engström et al., 2003; TAC, 2008; ERSO, 2006; Cavallo and Triggs, 1996; ATSB, 2008; Krampe, 2004; Drummond, 1989).

In 2006 about 29% of fatalities of all road user groups in Austria happened in traffic (KfV, 2007a, b). Pedan et al. (2002) identified road accidents in high income countries as the main cause of fatalities for adolescents between 15 to 29 years. There is no doubt that young drivers are the group with the highest accident risk (Clarke et al., 2001). In 2004 9.253 Austrian adolescents[2] were involved in traffic accidents; 99 thereof died (KfV, 2004a, b). Although 15 to 19 year olds represent just about 6% of the total population, 16.6% are represented in traffic crashes and 11.3% in fatal accidents. For this age group the risk of getting involved in an accident is three times higher than for the whole population. 82% of the 18 to 19 year olds injured in traffic had a car accident, about 70% as drivers. More recent statistical graphs give a similar impression (KfV, 2008).

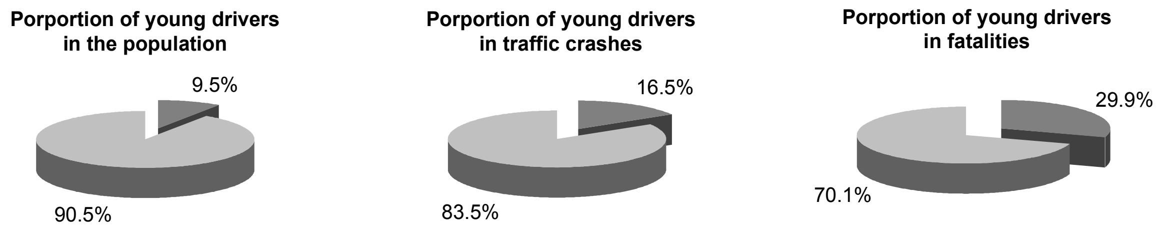

Figure 7: Proportion of young drivers in the population (17 to 24 year olds), in traffic crashes (15 to 19 year olds) and in fatalities (17 to 24 year olds) in Austria 2004 (OECD, 2006b; KfV 2204b)

Novice drivers are over-represented in traffic accidents not only in Austria but also in the rest of the western industrialised countries. In 2006 in Germany, 1 in 5 injured and killed persons was between 18 and 24 years old, whilst the ratio is 1 out of 12 for the total population (Statistisches Bundesamt, 2007). Again, the accident risk of young drivers triples and again, they are predominantly involved as drivers; about 72% of the adolescents were driving themselves. Furthermore they were responsible for the accidents in 1 out of 5 cases.

In the OECD countries in 2004, a total of 8500 young drivers were killed in traffic. Traffic crashes were the leading cause of death for 15 to 24 year olds in industrialised countries. The risk of young drivers of getting involved in an accident is OECD-wide 2 to 3 times higher than for the rest of the driving population. Young people’s risky driving behaviour has negative effects on other road users as well. About 1.3 other road users are killed per crash with novice drivers involved (ERSO, 2006). Even though the trend is the same in all EU countries, Austria is almost at the top of the table according to fatalities among adolescents in traffic.

[2] 15 to 19 year olds

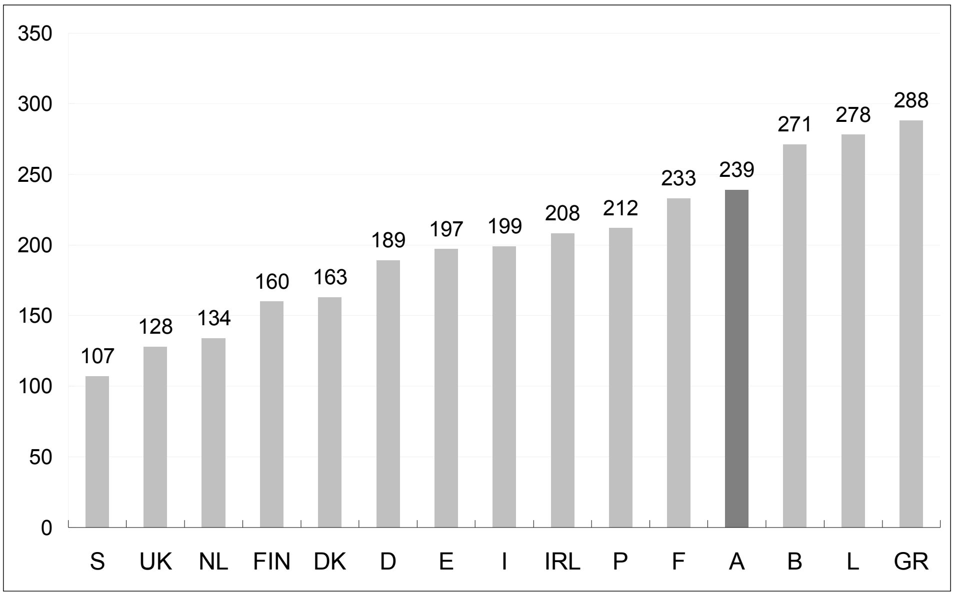

Figure 8: Killed adolescents between 18 and 24 years per one million inhabitants of this age group in 2004 (Statistisches Bundesamt, 2007)

Concerning gender it must be stated that male drivers head the Austrian accident statistics with 59% (KfV, 2004b). A closer look at the figures of Germany and the OECD countries reveal a similar picture (Statistisches Bundesamt, 2007; ERSO, 2008; Krampe, 2004). In western industrialised countries, male drivers have a three times higher risk of getting involved in a traffic accident than female drivers. Crashes in which male drivers are involved tend to be more severe; 78% of all people killed in traffic are young men, but only 22% adolescent women. Furthermore, young male drivers cause 70% of all accidents (Krampe, 2004).

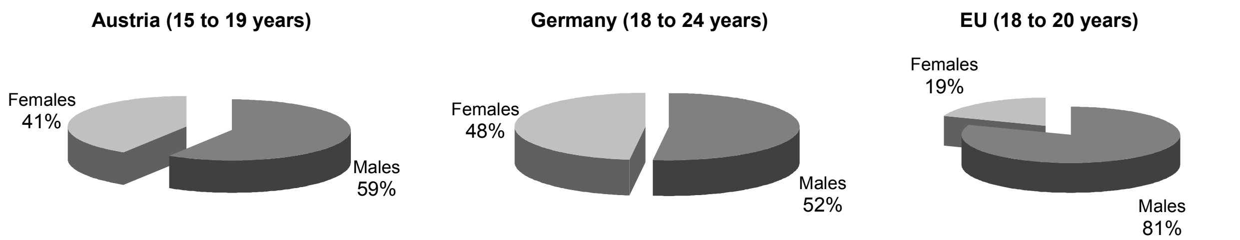

Figure 9: Accident risk of male drivers (KfV, 2004b; Statistisches Bundesamt, 2007; based on ERSO, 2008)

3.1.3. Risk of being novice versus risk of being young

What is the reason for society having to face bad statistical news about the traffic safety of novice drivers? According to Mienert (2002), one has to differentiate between the "risk of being a novice driver" and the "risk of youth". He describes the difference as follows: the main discrepancy is the degree of becoming involved in risky situations or taking risk consciously. Smart et al. (2005) ascribe the greater risk exposure of young drivers to the combination of inexperience, age, exposure to dangerous situations and risk-taking behaviour.

According to Maycock et al. (1991; as cited in Willmes-Lenz, 2002) especially in the first three years, driving experience seems to have a strong bearing on the accident liability as table 4 below shows.

Percentage reduction in accident liability				
Experience Alone		Age Alone		Age and Experience
During year 1	30%	Between 17 and 18	6%	34%
2	17%	18 and 19	6%	22%
3	11%	19 and 20	5%	15%
4	7%	20 and 21	4%	12%
5	5%	21 and 22	4%	9%
6	4%	22 and 23	4%	8%
7	3%	23 and 24	4%	7%
8	3%	24 and 25	3%	6%
Overall 8 years	59%	Between 17 and 25	31%	72%

Table 4: The effect of age and experience on accident liability for car drivers (Willmes-Lenz, 2002)

The ROSPA report (2002) supports these findings based on the study carried out by Forsyth et al. (1995) where similar results were found. Driving experience was identified as the more important component for traffic safety of young drivers. In the Netherlands Vlakfeld (2004[3]; as cited in ERSO, 2006) found out that the crash risk is lower for "older" novice drivers.

Engström et al. (2003) attribute the risk of novice drivers to their lack of experience in car handling as well as to in-experience on how to react in various complex situations and also to mental demand; young drivers do not possess the required routine (Krampe, 2004). Sagberg and Bjørnskau (2003) found novice drivers to perform worse in hazard perception, handling skills as well as bad road user interaction in comparison to those with driving experience of 5 up to 9 months. Akin to Engström et al. (2003) they concluded that there were short-comings in the cognitive ability of novice drivers. A lack of experience leads to misjudgement of risk and hazardous situations, often combined with the overestimation of one's own skills (Engström et al., 2003; ERSO, 2006).

On the other hand, according to literature (Brown, 1982 and Parker, 1991; as cited in Clarke et al., 2001; ERSO, 2006; Krampe, 2004; Mienert, 2002; Lamszus, 2002; Deery, 1999; Willmes-Lenz, 2002; Cavallo and Triggs, 1996; Smart et al., 2005), there is also evidence that the "risk because of youth" is the determining parameter for high accident rates. The "risk because of youth" seems to be much more complex than the factor "driving experience". Adolescence is a period in life when several processes of psychological development take place while a person becomes a grown-up. Some areas of the brain that are responsible for planning, impulse control or reasoning - abilities that are very important for driving - are not fully developed at the age of 18. Furthermore the young are looking for a new identity, for autonomy and acceptance. To behave riskily is an important strategy for adolescents in order to find their own limits and also to get familiar with their own personality, their strengths and weaknesses. Through tests of courage adolescents try to impress their peer group, which becomes even more important at this stage of life. In this context the car gets a different meaning for adolescents. It is no longer just a means of transport but an instrument for profiling, a possibility to experience strong feelings, or just a sign of freedom. The car is used to demonstrate power or to provide adventure and thrill through dangerous driving manoeuvres. Especially those young drivers who are willing to take risks want to satisfy such "extra motives" while driving. Adolescents often are overconfident about their driving skills, tend to seek sensation and believe in their inviolableness. Another relevant aspect concerning the threat to young

[3] Quotation not available.

drivers in traffic is related to their exposure. Adolescents mainly drive on weekends, during night-time and mostly they carry friends. All of these parameters are related to a higher accident risk.

However, Waller et al. (2000) and Jonah (1986; both as cited in Clarke et al., 2001) argue that the effects of age and experience cannot be separated from each other. Mienert (2002) likewise summarises that one reason for the accident involvement of adolescents can be found in “the risk of being a novice driver” but nevertheless one should not forget about “the risk of being young” of aspects that influence personality.

3.1.4. How to protect young drivers?

Most of the accidents involve two or more road users (about 65%; KfV, 2008), which suggests a breakdown of communication in those situations (Risser, 2007). Communication with other road users can only happen if the drivers detect them in time. As mentioned before (sub-chapter 3.1.1), the chosen speed is one of the major factors affecting hazard perception. The faster one drives, the lower is the probability to identify other road users, the lower is the chance to communicate and the higher is the risk of a crash. Thus, young drivers have to be made aware of the consequences of speeding, since they might not be able to assess them appropriately. This thought becomes even more important when considering the results of Schade (2000), who investigated the resistance of drivers to changing their speed behaviour on the road. According to the results, wilful speeding seems to be stable over time. Depending on the extent of speeding, a period of about 49 up to 77 years is needed to change the learned behaviour. What can be done to teach young drivers the favoured behaviour from the beginning will be discussed in the following passages.

To reduce speed related accidents, in literature (Stradling et al., 2003; ERSO, 2006) enforcement, engineering and education are recommended as the three pillars for safety assignment. As proven in several studies and discussed in many reports (Holland and Conner, 1996; Campbell and Stradling, 2001; Hooke et al., 1996; Aljanahi et al., 1998; Vaa, 1997 and many others), enforcement due to police intervention, the implementation of speed cameras or the lowering of speed limits can reduce speeding among road users and thus decrease the amount of crashes.

Engineering measures such as physical obstacles (road humps or chicanes for instance), flashing signs or signs giving positive reinforcement, as well as electronic speed limiters have been successful in reducing the driving speed as well (Webster and Wells, 2000; Mackie, 1998; Hagemeister and Westhoff, 1997; ATSB, 2008).

Aiming on novice drivers Cavallo and Triggs (1996) call for more driving experience within the education of novice drivers. They pinpointed an actual driving experience of 500 kilometres driven by young drivers before receiving their licence as far too less, since at least 4.000 kilometres practice are recommended. Supervised driving represents one possible solution to increase the amount of driven kilometres before driving solo (ERSO, 2006).

Furthermore education is seen as a crucial activity to change driving behaviour. Webster and Wells (2000) emphasised the importance of making drivers aware of possible consequences and risks with regard to speeding. This can be achieved by peer teaching or as Haglund and Aberg (2000) suggest through observational learning.

Subsequently, two approaches to improve the performance of young car drivers will be discussed in more detail.

3.2. ISA

If one searches the internet for the term “Intelligent Speed Adaptation” (ISA), thousands of links with general information about the system or project summaries will be detected. This, however, was not always like that. 20 years ago people did not know that much about ISA. Sweden can be seen as one of the forerunners worldwide, as studies about ISA have been carried out there since the early 80ies (SNRA, n.a.). Other European countries such as Great Britain, the Netherlands, Denmark, Finland or France followed (Jamson et al., 2006).

Before describing ISA in more detail, a closer look on how the system is allocated in the scenery of Intelligent Transport Systems (ITS) will be provided. The operation mode of ISA systems will be presented as well as some of the most important ISA studies from all over the world.

3.2.1. Intelligent Transport Systems

A broad range of field of application for Intelligent Transport Systems (ITS) can be identified, for example the display of the remaining waiting time at public transport stops or the section control on motorways to reduce speed.

The European Transport Safety Council (ETSC, 1999) identified three telematic waves in respect to the development of Intelligent Transport Systems; the first in the fifties, the second in the seventies at the time when the computer development exploded and the final one in the eighties. In the middle of the eighties, European projects like Prometheus or Drive were carried out. ITS were expected to boost traffic safety. Besides the positive effects on safety, also a reduction of traffic jams was expected, as well as an enhancement of the efficiency of the current infrastructure and ecological impacts like the saving of energy (Cerwenka, 2001; Hahn and Kretschmer-Bäumel, 1998; as cited in Gieler, 1999; Pfliegl et al., 2001). Additionally ITS were supposed to guarantee better mobility, more comfort and service while travelling from point A to point B (Pfliegl et al., 2001; BSVI, 1999).

ITS are implemented in shipping, in rail traffic as well as in air transportation. Some ITS were even developed for pedestrians and cyclists (Ausserer et al., 2006). The main fields of interest, however, are public transport and road traffic (BSVI, 1999). Zackor et al. (2003) assume that road traffic can be improved to a high extend, because it is very disharmonious and error-prone due to the fact that many individuals participate in it.

To manage the traffic volume on the road in order to reach the goals mentioned above (traffic safety, less traffic jams, less pollution, etc.), collective actions can be undertaken, such as traffic light pre-emption (progressive signal system), section control, car-park routing systems and many more (see Ausserer et al., 2006). Another sector concentrates on the car itself. In this respect, the industry has discovered telematics to be a lucrative business in the last years. That is why a vast number of “In Vehicle Information Systems” (IVIS) and “Advanced Driver Assistance Systems” (ADAS) have been developed quite rapidly. IVIS focus on informing the driver for instance about the best route (navigation systems) or provide traffic information like warnings about traffic jams via Short Message Service (SMS). ADAS rather aim at warning and assisting the driver (Humanist, n.a.). Ausserer et al. (2006) mention several categories of systems that assist with lateral or longitudinal control, extend the field of vision or just assist with parking. ISA is such an ADA-system to which Harms et al. (2007) credit a significant safety potential.

<table>
<tr><td rowspan="3">Management of individual motorised traffic</td><td>Collective</td><td colspan="2">Traffic management
Section control
Car-park routing
….</td></tr>
<tr><td rowspan="2">Individual</td><td>IVIS</td><td>Navigation
Travel information
Infotainment
….</td></tr>
<tr><td>ADAS</td><td>….
Vision Enhancement
Lateral Control
Longitudinal Control ➔ ISA</td></tr>
</table>

Table 5: Classification of ITS and the location of ISA (based on Ausserer et al., 2006)

3.2.2. Characteristics and the operation mode of ISA

ISA is an ADA-system, implemented in the car that either informs (“advisory”) the driver about the legal speed limit, supports (“warning”) the driver or intervenes (“mandatory”) (ETSC, 2005; ORS, 2008; Young and Regan, 2002; “Isaweb”-homepage). An advisory system gives the driver feedback about the legal speed limit via visual or acoustic signals, which the driver can use voluntarily. A supporting ISA informs the driver by increasing counter pressure in the gas pedal. It is still possible to override the system, which is not the case for a mandatory ISA. This type of system for instance reduces the fuel injection or manipulates the braking system, which then prevents the driver from speeding. According to literature (ETSC, 2005) the mandatory type would have a much bigger impact on traffic safety than the voluntary system.

To create an ISA system one needs a device that detects the local position, another one that “knows” the current legal speed limit, an additional one that registers the driven speed and finally a gadget that gives information to the driver. In the case of speed limit systems, different technologies are used (Van Boxtel, 1999; as cited in Young and Regan, 2002; ETSC, 2005; Young and Regan, 2002). Presumably the most common system used in this context is the global positioning system (GPS). The GPS accurately determines the position of a car from five to ten meters by comparing data of several satellites. Additionally, digital maps containing detailed information about the legal speed limits are implemented in the vehicle. An on-board computer continuously compares the information from the GPS with the information of the digital maps and then gives the driver visual, acoustic or haptic feedback on the legal speed limit.

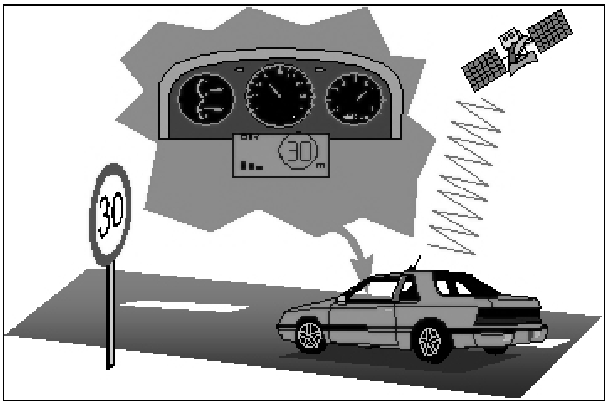

Figure 10: ISA based on GPS[4]

Another way for giving the driver feedback about the local speed limit is to use information of radio beacons fixed on speed signs, other facilities on the roadside or in the road. Those beacons transmit information about speed limits, traffic warnings, etc. to a receiver in the car. By using an adequate number of beacons, the driven speed of a car can be calculated as well. Again, the information about the legal speed limit is given to the driver in a visual, acoustic or haptic mode.

Figure 11: ISA based on Beacons[5]

For the haptic system, an Active Accelerator Pedal (AAP) is most commonly used. The pedal increases the counter pressure if the driver is exceeding the speed limit by 2 to 5 km/h. If the system is intended to be a voluntary one, the driver can override it by using the “kick down” function - pressing the gas pedal harder.

3.2.3. Studies about ISA

As has already been mentioned above, an impressive range of studies about ISA exists. Depending on the research purpose, different types of speed limiters with different feedback modes have been studied in instrumented vehicles or simulators, which provided information on the impact of driving behaviour, traffic safety, fuel consumption, etc. So far, the findings are quite promising. As the following sub-chapters will show, ISA did reduce speed in many cases, harmonised the speed behaviour, decreased the fuel

[4] http://www.autosafetyreviews.com/wp-content/uploads/2008/08/isa.bmp

[5] http://virtual.vtt.fi/virtual/proj6/master/andani.gif

consumption and by doing so, had no negative effect on the overall travelling time in most of the cases. Overall, the speed limiter system was readily accepted, even though the inclination strongly depended on the type of ISA and the acceptance was generally greater for informative systems. However, also negative effects on the distance to the car ahead as well as an irritation of users and non-users have been detected. Furthermore a speed limiter seems to be most effective for drivers who are already responsible, but not that much for those who would need it the most, like young, risky drivers.

3.2.3.1. Sweden

Almqvist and Nygård (1997; as cited in Hjälmdahl, 2004a; Young and Regan, 2002; Almqvist et al., 1997; Kaufmann and Risser, 2003) conducted a field trial in 1996 in Eslöv, a small Swedish town, in order to test the effects of speed limiters on driving behaviour and the acceptance of drivers of such an assisting system. The results have been amazingly favourable. Drivers generally showed a rather positive attitude towards the system and even more so after having tested it. The greater part of the participants experienced the speed limiter as comfortable. Participants confirmed that driving became smoother and that the general speed decreased. This impression could be verified by the data, as speed adaptation improved and the average speed decreased. Another noteworthy aspect is the positive effect that ISA had on the interaction with other road users. The system also led to decreased speed in low speed zones.

As a consequence of those promising findings between 1999 and 2002, the Swedish National Road Administration (SNRA) carried out a large-scale trial in four cities (Borlänge, Umeå, Lund and Lidköping) in order to gain even more knowledge about the effectiveness of different ISA systems and the drivers' acceptance (Vägverket, n.a.; Biding and Lind, 2002; Young and Regan, 2002). To summarise this ambitious project, ISA was identified as an instrument to decrease road injuries in urban areas by 20%. By reducing the average speed and the speed variation, traffic safety could be improved, without prolonging the travel time. Not only those drivers who had implemented a speed limiter in their cars benefitted from it but also the surrounding traffic. Furthermore a high acceptance of ISA was found.

A more detailed description of one part of the study will be given here. In Lund (Hjälmdahl, 2004a, b; Várhelyi et al., 2004; Várhelyi et al., 2002a,b) 284 vehicles were equipped with an Active Accelerator Pedal (AAP). Drivers could test the system between five and eleven months in the city of Lund, including 30, 50 and 70 km/h speed limits. Initially the behaviour without the system was recorded and then using the ISA. The aim of the study was to learn more about long-term effects of ISA on traffic safety, driver behaviour and the effect on different types of drivers. The findings are quite promising as the use of the system significantly reduced the average speed and the speed variance. Furthermore a slight increase of the following distance to the car ahead could be observed and the interaction of drivers with other road users became more cooperative. Participants showed a significantly better yielding behaviour within the test area. Additionally the travel time decreased by 0.6% when using the AAP. Nevertheless some negative aspects have been found as well. Participants started to rely on the system; without the support of ISA they did not adapt their speed to the legal speed limit. Although a non-compensatory behaviour in terms of higher speeds outside the test area has been found, the contrary (lower speeds) was not the case either. Moreover the system turned out to be most effective for drivers who already had a responsible driving style. Those participants with the most negative attitude towards ISA have not been greatly affected by the speed limiting advice system. They felt rather frustrated and experienced time pressure as well as stress more than the drivers with a positive attitude towards the system.

3.2.3.2. The Netherlands

In 1999, a small-scale experiment was carried out in Tilburg researching the attitudes towards ISA, the acceptance of ISA and how the system might change behaviour (Besseling, 1999; Van Loon and Duynstee, 2001; Hjälmdahl, 2004a; Duynstee et al. 2001; as cited in Young and Regan, 2002). 20 passenger cars were equipped with a mandatory ISA system. Throughout one year, these vehicles were driven by 120 people for a period of 8 weeks. The opinion of the ISA was consistently positive for all respondents, car drivers, bus drivers and the general public. Furthermore a decrease in the average speed was proven and speed behaviour became more homogeneous. Unfortunately the implementation of the system irritated not only the test drivers but also non-participating drivers. However, in general, the public opinion concerning ISA was neutral to positive.

3.2.3.3. Denmark

An advisory ISA system was implemented within the framework of a study carried out at the Aalborg University (Lahrmann et al., 2001a; as cited in Young and Regan, 2002; Lahrmann et al., 2001b; as cited in Hjälmdahl, 2004a). 24 test drivers tried the system for a period of six weeks. The analysed data indicated a lower average speed during the trial as well as a reduction of speed violations. Acceptance was rather good as three quarters of the participants did like the ISA system. Furthermore, no prolongation of the travel time was reported by the drivers.

3.2.3.4. United Kingdom

In the course of the MASTER (Managing Speeds of Traffic on European Roads) project, the effect of different ISA systems on drivers´ behaviour in traffic, the effect on the workload and the acceptance as well as the impact on travel time was tested with a simulator and in real traffic (Várhelyi et al., 1998). As before in many other projects, a speed reduction, an improvement in speed variance and speed adaptation could be shown in both sub-studies of the MASTER project. Nevertheless negative effects like shorter headways, delayed braking, worse behaviour in difficult weather conditions, as well as a higher frequency of collisions have been observed as well. The results of the field study revealed a high frustration amongst the participants. Additionally a slight increase in travel times was registered.

The University of Leeds carried out another project with the aim to examine the impact of a voluntary as well as of a mandatory and a variable ISA system on the driving behaviour (Carsten and Tate, 2001; as cited in Young and Regan, 2002). The study was conducted with a simulator as well as an equipped car. During the simulator part of the study, especially the mandatory system did reduce maximum speed, although just a small effect on average speed was found. However, the system led to shorter headways and smaller gaps at junctions. The on-road experiment showed a tendency for not using the voluntary system in areas where all other drivers did speed. Indeed, the mandatory system diminished excessive speeding and improved the following as well as the braking behaviour. Even though no negative effects could be found in this part of the study, both experiments revealed a frustration among drivers when using the system. Concerning acceptance, the voluntary system was assessed as more useful than the mandatory one.

In the recent past one more study has been carried out in the UK (Jamson, 2006) to explore the notion of drivers for a voluntary use of an ISA system. A total number of 18 participants took part either in a simulator or in a field study. For both studies a mandatory ISA system that prevents drivers from driving above the legal speed limit by throttling the engine was implemented. However, drivers had the possibility to switch off and switch on the system if they wanted to. The results of both studies indicated a positive effect of the speed limiter on the speed behaviour. Depending on the road and the behaviour of other road users, drivers turned off the ISA system for about half of the driving time. Especially those participants who announced to enjoy driving above the legal speed limit, tended to disengage the ISA.

3.2.3.5. Finland

In a field trial, Päätalo et al. (2002; see also Young and Regan, 2002) evaluated the effects of three different types of ISA (informative, compulsory and recording) on the driving behaviour as well as on the experience drivers had with the systems. The informative system gave notice of the current speed limit on a visual display and supplementary auditory warning. The compulsory system limited the car to the legal speed limit. In the “recording” condition the driver got feedback of his/her speeding behaviour, which was displayed on a monitor in the car. 24 participants took part in the study and drove the instrumented vehicle four times under varying test conditions; once using just a GPS and then using each type of ISA. The different systems were sampled on the same route, including different speed limit areas (40, 60, 70 and 80 km/h) and road types (motorway and residential zones). The outcome shows a reduction in speeding with the biggest effect in the 40 and 80 km/h areas, where speeding was most common in the “GPS” condition. No difference in travel time has been found. Driving with the compulsory system led to the impression of having time pressure, frustration and insecurity, though. Moreover this type of system has been experienced as very demanding. The authors concluded that the compulsory ISA, the system with the highest effect on speed reduction, is overall the least accepted system. Additionally the effects of the recording system have been pointed out, because it worked without having any negative consequences for the participants.

3.2.3.6. Belgium

From 2002 to 2004 an ISA study was carried out in Ghent with 37 vehicles (private and company cars, as well as buses) using an active accelerator pedal (AAP) (Page, 2005; Broekx et al., 2006; Vlassenroot et al., 2007). The impact of ISA on traffic safety, drivers’ behaviour concerning speed, drivers’ attitude and acceptance, as well as the impact on emissions were analysed. The results of logged speed data showed just a small effect of ISA on the average speed, but the largest reduction at a speed of 90 km/h. The amount of speeding even increased over time, especially in low speed zones. Moreover, large differences between the individual drivers were found. The average speed of less frequent drivers tended to increase, whereas the average speed of more frequent drivers tended to decrease. However, the acceptance of the system was good; drivers were satisfied with the ISA. The voluntary usage of the system as well as the fact that about three quarters of the participants kept the system after the end of the project, strengthen the findings of the questionnaire.

3.2.3.7. Australia

The Monash University Accident Research Centre, together with the Victorian Accident Commission and Ford Australia carried out the TAC SafeCar project over a period of six years (Regan et al., 2005a, b).

The study aimed at exploring the effects of three different IT systems (speed limitation, following distance warning and seat belt reminder) on the driving behaviour, traffic safety in general and on the acceptance of such systems. 15 equipped passenger cars were used by 23 drivers. Additionally a simulator study was conducted. The applied ISA provided feedback for the driver through a combination of visual, acoustic and haptic information. Data analysis showed more homogenous speed behaviour while using a speed limiter. Further, a reduction in average speed as well as in 85 percentile[6] speed was found. The effect was even larger with the simultaneous usage of the following distance warning system. However, the positive effect diminished when the ISA was eliminated. The travel time did not increase significantly, only a rather slight decrease was observed.

3.2.3.8. Simulation studies

In their study Gynnerstedt et al. (1996) did not concentrate on the individual effect ISA might have, but rather examined the impact on traffic safety in general. Based on the PRO-Gen Traffic safety checklist (Broughton et al., 1992) and the results of previous studies, predictions about the influence of ISA on individual behaviour changes on traffic have been tested with a computer simulation. The authors identified several positive consequences of a speed limiter. For conditions with less dense traffic, a reduction of fuel consumption was discovered. Under all traffic conditions, varying from low to very high density, the travel time decreased, the speed became more homogeneous as well as a smaller number of overtaking manoeuvres was calculated. However, although the number of overtaking manoeuvres decreased, those with low headways increased.

In the UK another simulation study was carried out in order to examine the network effects of mandatory and voluntary ISA systems (Liu and Tate, 2004). The simulation showed a positive effect of ISA in less congested traffic conditions by reducing excessive traffic speed as well as average speed, even though travel time increased. However, the assumed implementation of ISA led to more homogeneous speed and less fuel consumption.

3.2.3.9. ISA and young drivers

In Denmark Harms et al. (2007) concentrated their work explicitly on the sub-group of young car drivers. The PAYS (Pay as You Speed) project, which is a follow-up to the INFANTI (INtelligent FArtTIlpasning) project, aimed at comparing ISA related attitudes of young drivers (between 18 and 28 years) volunteering to participate in the study with those who did not. Moreover, the effect of different ISA systems and incentives on the speeding behaviour of the drivers were compared. According to the results of the questionnaires both groups of young drivers did not really differ in their attitudes, except in the assessment of the impacts of a speed limiter. The volunteers showed a more positive evaluation of the system. Data analysis indicated a speed decreasing effect of ISA as well as of ISA combined with incentives. The same held true for the incentive condition, but with a less significant speed reduction.

Another aim of the large-scale trial in Sweden (see above) was to estimate the efficiency of ISA for different types of drivers depending on their age, gender, exposure or attitude towards the system. The popular assumption that young, male, high mileage drivers with negative attitude towards restriction (the ISA system) are likely to speed, is strengthened by Hjälmdahl's (2004b) findings. Not surprisingly he

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[6] The 85 percentile speed is that speed, kept by 85% of the driver population.

discovered a reduction in speed by using a supporting ISA only for participants with a positive attitude towards the system. Those participants try to keep the speed limit anyway. For drivers who speed intentionally, the system is less effective. The author concluded that the effect of an ISA system on driving behaviour and therefore on traffic safety varies very much between different groups of drivers.

3.3. Training

The concept of training includes a wide range of different activities for driver education. According to Christie (2001) “training” and “education” are not the same; both terms have been confused over time. “Training” contains the development of specific skills and competencies, whereas “education” focuses more on communicating information. In this chapter a theoretical outline of that issue, as well as a short overview of already existing training and education programs will be given in order to emphasise the effectiveness of such measures. Furthermore the didactical organisation and the content of a specific training will be discussed. The content of this chapter is mainly based on the work of Christie (2001), Gregersen and Bartl (2004; MERIT project), Trainer (2001), Engström et al. (2003) and Hatakka et al. (1999).

3.3.1. What a successful training should focus at

The road to success concerning an effective novice driver training has not been found so far. A very elaborate theoretical overview of educational necessities exists, on how to bring up safe road users. Michon (1985) suggested a hierarchical model with three levels to describe the driving task. He distinguished between the control, the manoeuvring and the strategical level. The control (operational) level is about car handling like steering or braking. On the manoeuvring level, the driver has to react to specific traffic situations, to road signs or other road users, whereas the strategical level aims for instance at trip planning - the more general stage of a trip.

Rasmussen (1983; as cited in Li, 1999) described three types of behaviour for skill learning that are hierarchically ordered as well. Skill-based behaviour can be defined as more or less automated behaviour; no conscious attention is needed to perform an action. The next level is characterised as rule-based. Human beings learn behavioural rules at any occasion for their whole lives, by observing others, by being taught, etc. in order to apply them in new situations. Knowledge-based behaviour is located at the last level of the model, where a goal is formulated and plans for achieving this goal are developed. The combination of Michon´s model and the model of Rasmussen is shown in table 6.

Level	Knowledge	Rule	Skill
Strategic	Navigation in unfamiliar area	Choice between familiar routes	Route used for daily commute
Manoeuvring	Controlling skid	Passing other vehicles	Negotiating familiar intersection
Control	Novice on first lesson	Driving unfamiliar vehicle	Vehicle handling on curves

Table 6: Classification of driving tasks (adapted from Hale et al., 1990[7]; as cited in Trainer, 2001)

Based on the work of Keskinen (1996) within the EU-project GADGET (Hatakka et al., 1999) the model of Michon (1985) was supplemented by a fourth level called "goals for life and skills for living". The GDE-Matrix (Goals for Driver Education – Matrix; see table 7) can be best described as a hierarchical approach. Thus, it is assumed that competencies on a lower level affect the higher levels as well as the motives or attitudes located at a higher level influence the behaviour on the lower levels. Similar to the model of Michon, the bottom level "vehicle control" focuses on the vehicle and how it is manoeuvred. "Driving in traffic situations", the second level, emphasises the driving behaviour in a certain situation. On the road, a driver must be able to react to changing conditions, e.g. to the actions of other road users; hazards must be detected and the right decision about how to react must be made. The third level "goals and context of driving" brings the purpose (Why?) and the context of the journey (Where?, When? and With whom?) into focus. The highest level "goals for life and skills for living" is about motives and attitudes in a more global sense. This level takes into account the lifestyle, the social background, the gender, the age, etc. of a person, as all those characteristics have an influence on the personal attitudes and thus, the driving behaviour. The GDE-Matrix not only emphasis the skills of a driver but also the risk awareness of a person as well as the accuracy of self-evaluation concerning risk taking. This is why the four levels have been supplemented by the three dimensions "knowledge and skills", "risk increasing factors" and "self-assessment". The first dimension describes what a driver needs to know and what he/she should be able to do under "normal" circumstances. Depending on the level, the implications of this dimension range from controlling the direction and position of the car to knowledge about personal attitudes influencing the own driving style. The second dimension "risk increasing factors" is about the risk taking tendencies of a person, varying from using worn-out tyres (level 1) to high risk leisure time activities (level 4). The last dimension on the lowest level is about how a person estimates the own skills, whilst the highest level is concerned with the awareness of personal characteristics.

[7] Quotation not available.

		Essential curriculum		
		Knowledge and skills	Risk-increasing factors	Self-evaluation
Hierarchical levels of behaviour	Goals for life and skills for living	Knowledge about/control over how life-goals and personal tendencies affect driving behaviour	Risky tendencies (acceptance of risk, high level of sensation seeking, use of alcohol and drugs, …)	Awareness of personal skills for imulse control, risky habits, …
	Driving goals and context	… concerning effects of journey goals on driving, planning and choosing routes, …	Risks connected with driver´s conditions, purpose of driving, social context, …	Awareness of personal planning skills, typical driving goals, …
	Mastery of traffic situations	… concerning traffic regulations, observation of signals, speed adjustment, communication, …	Risks caused by wrong expectations, information overload, vulnerable road users, …	Awareness of personal driving style, safety margins, …
	Vehicle manoeuvring	… concerning control of direction and position, tyre grip and friction, vehicle properties, …	Risks connected with insufficient automatism or skills, difficult conditions, …	Awareness of strong/weak points of basic manoeuvring skills, skills for hazard situations, …

Table 7: GADGET-Matrix (based on Hatakka et al., 1999)

To effectively prepare young drivers for the challenges and dangers of the road traffic, training should include as many aspects of the matrix as possible.

3.3.2. Modes of training

Most driver trainings concentrate on pre-licence adolescents to instruct them in basic driving skills and to provide them with knowledge about traffic regulations, which is represented by the bottom left cells of the GDE matrix. Hence, neither mandatory pre-licence training nor voluntary pre-licence training can prevent young drivers from being the group in traffic who is most at risk. To increase the safety of novice drivers, different efforts have been made. For instance in Sweden the increase of supervised on-road experience of novice drivers helped to reduce the crash risk by up to 35%. Evidence also exists that a graduated licensing system (GLS) has the potential to support adolescents in road traffic. Within such a GLS, novice drivers receive a restricted licence at first, linked to more comprehensive rules such as restrictions on maximum speed, zero blood alcohol content or bound to extra tests.

Based on the results of the EU project “DAN” and the example of the Finnish driver education, a multiphase driver training was implemented in Austria (Bernkopf, 2004; Winkelbauer, et al. 2003). The new training was established by law and came into effect in January 2003. After passing the driving test, Austrian novices get their licence for a two-year period just on probation, including a zero alcohol limit. Two to four months after receiving the licence, they have to attend a feedback drive in real traffic. Between the third and the ninth month of being a novice driver, a safety training (6 hours) as well as a psychological group session (2 hours) have to be attended. The psychological training focuses on the sense of responsibility of young drivers. The second feedback-drive should be carried out after six to twelve months experience in real traffic. Following the Finnish model, a reduction of accidents of about 20% was estimated, which entails a reduction of economic costs of about 27 million Euros. In 2006 the multiphase driver training was evaluated on the basis of the amount of accidents with personal injury, on the amount of traffic offences, the participants' responses in interviews, as well as a survey among the Austrian population (Risser and Chaloupka-Risser, 2006 and Gatscha and Brandstätter, 2008). A reduction of accidents was found. Still, some potential to improve the model by enhancing the feedback-drive and the time-flow of the particular sequences remains.

Apart from pre-licence trainings, as described above, in many countries post-licence defensive or advanced driver trainings are offered to novice drivers. These types of trainings mostly aim at improving driving skills under difficult conditions such as bad weather conditions, how to behave on slippery roads and how to regaining control over the car (after having lost it), again focusing only on parts of the GDE-matrix. However, in various studies it was indicated that trainings to improve driving skills such as skid control in off-road training or loosing control may lead to more confidence and thus to a greater accident risk in such situations (Sowerbutts, 1975; Glad, 1988; Gregersen, 1996; Mayhew et al., 1996; Potvin, 1991); especially young male drivers seem to be affected. The consequence of that experience was an effort to develop different types of trainings, aiming at over-confidence or risk-taking, the higher levels of the GDE-matrix. Some examples will be given in the following chapter.

3.3.3. Voluntary trainings aiming at novice drivers

Young drivers not only have to go through obligatory trainings but also have the possibility to participate voluntarily in various training programmes. These trainings range from skill-oriented courses to lectures focusing on the responsibility as a car driver. As already mentioned above, especially trainings focusing on motivational and attitudinal factors seem to be of great importance in the context of road safety work for young drivers. Thus, some examples of awareness raising trainings as well as their impact on the attitudes and behaviour of young drivers will be given in the following.

3.3.3.1. Austria

The project "Road Expert", the forerunner of the already described multiphase driver training, focused on young Austrian drivers who had just passed their driving test (Bernkopf, 2004). From August 1999 until December 2002, 13.000 novice drivers took part in a driver safety training (theoretical and practical) and, for the first time ever, a psychological seminar, lasting for 45 minutes. The goal of the psychological lecture was to improve the self-estimation in a self-critical way and to concentrate on how to avoid dangerous situations in road traffic, instead of how to deal with critical incidents. All three parts of the project were evaluated. 900 participants filled in a questionnaire. The most popular training sequence turned out to be the practical training, whereas the psychological seminar was least liked (see also Risser and Chaloupka-Risser, 2006).

3.3.3.2. Germany

Based on the vast amount of accidents, as well as traffic violations of mainly young male drivers, from 1999 until 2001 a model test was carried out in the German province Niedersachsen, aiming at a more responsible participation of young car drivers in the traffic system (Stiensmeier-Pelster, 2002; Stiensmeier-Pelster, J., 2005). Therefore learners were invited to attend a school project group additionally to the regular driving education. In the course of 14 block periods, issues like “traffic as social system”, “rules and norms in traffic”, “traffic and environment” or “public transport and car as means of transport” were discussed with the novice drivers. The results were quite promising. Young drivers as well as teachers and driving instructors evaluated the method as useful to reduce the risk in traffic for novice drivers. Participants of the school project group showed an environmentally-friendly driving style as well as a better communication behaviour with other road users and committed a lower amount of near-accidents. No positive effects relating to driving skills or foresight could be observed.

3.3.3.3. Sweden

“The Insight” (Gregersen, 1995, 1996, 1997; Gregersen and Bjurulf, 1996) program is an example of an attempt to emphasise the personal factors of novice drivers that determine the amount of risk they are willing to take. In off-road centres learners gained knowledge about the stopping distance, estimated the distance to the car ahead but also discussed attitudinal and personality factors. The evaluation of Nyberg and Engstrom’s (1999) detected a success for some aspects of the training, since young drivers improved their attitudes towards seat belt use. However, the attitudes towards speed, distance to other vehicles, etc. could not be affected by the training.

3.3.3.4. The Netherlands

An approach similar to the one in Sweden was carried out in the Netherlands (Goldenbeld and Hatakka, 1999). After a theoretical introduction to the statistical facts about the accident liability of learners, the most frequent crash characteristics, as well as the behaviour of other road users or how to anticipate danger, two demonstrative parts followed. Young drivers were taken on a journey on a public road, where they got further information about road characteristics, but also got feedback on their driving behaviour. Furthermore participants took part in an off-road training, where exercises concerning the stopping distance, emergency situations but also the right sitting position or steering technique were carried out. The most important aim of the last part was to teach learners their inability to control a car in certain situations. The findings of the evaluation were quite akin to the results of the Swedish programme. Participants for instance improved their knowledge concerning braking distances and speeds. The training enhanced the acceptance of wearing a seat belt. Anyhow, young drivers who attended the training, afterwards felt very confident about their driving skills and thus, they did not realise the long lasting learning process of an experienced driver.

3.3.3.5. Australia

Martin and Horneman (1998; as cited in Christie, 2001) compared three different post-licence training methods for novice drivers that target at a reduction of confidence and optimism. Those drivers who participated in a more cognitively-based training showed better attitudinal and judgement factors than those who were trained with a more traditional approach.

3.3.4. Lessons learned

The previous sub-chapters have demonstrated the vast effort of European countries to improve the education and training of learner and novice drivers. Most of the approaches aimed at expanding the content coverage of the educational measure, to include more than just the bottom left boxes of the GDE-matrix, illustrated in sub-chapter 3.3.1. At best, all hierarchal levels of the GDE-Matrix should be covered.

Thus, an effective training measure should not only focus on the driving skills but also on personal factors like lifestyle, social circumstances and group norms as well as how motives influence driving behaviour on the road. The conflict between the experienced self-confidence, or rather overconfidence, and the actual lack of experience, e.g. in hazard perception, needs to be discussed. Therefore not necessarily more but different, active training methods have to be developed and implemented. According to Christie (2001) these trainings, aiming at the reduction of over-confidence and attitudinal or motivational factors, have the potential to improve the driving behaviour of novice drivers.

4. Aim and hypothesis

The starting point of the present PhD thesis was the work run by Swedish researchers, mainly at the University of Lund (Almqvist and Nygård, 1997; Hjälmdahl, 2004a, b; Almqvist et al., 1997; Várhelyi et al., 2004; Kaufmann and Risser, 2003). Hjälmdahl (2004a) proved a positive influence of ISA on the communication between car drivers and other road users. In this thesis the question was posed if ISA has the same effect on a specific target group, namely young drivers, who violate traffic rules more often than other road users. Considering the speed behaviour of adolescents as described in chapter 3 in combination with the insufficient hazard perception of young drivers due to a lack of experience, it can be assumed that ISA can improve the communication with other road users. By deceleration ISA supports young car drivers in detecting other road users and thus enables them to communicate. Regarding the **influence of the ISA system** on the communication behaviour, hypothesis 1 was formulated based on the assumptions mentioned above.

Hypothesis 1: The use of an ISA system will improve the communication between young drivers and other road users.

The degree of the positive impact of the ISA system can be assumed to be different for different driver groups. Age, gender, driving experience as well as the attitude towards the system and other traffic related characteristics seem to influence the effect on the driving behaviour; especially young, male, experienced drivers with a negative attitude towards ISA respond less on the system (Hjälmdahl´s, 2004b). Taking into consideration the crash risk of young drivers all over Europe (see sub-chapter 3.1), no differences with respect to nationality can be expected. Based on these assumptions the data were analysed with regard to the mentioned variables. Additionally it was explored, if different communication patterns can be identified on the basis of the DBQ and the “Type” questionnaire.

However, as shown in chapter 3, especially speed behaviour seems to be steady over time. For wilful speeding Schade (2000) estimates change to take place in a period of 49 up to 77 years. Thus, it cannot be assumed that drivers will change their habits just because of using a system once. That assumption was confirmed by the findings of Hjälmdahl (2004a) and Várhelyi et al. (2004), as car drivers did not adapt their speed to the legal speed limit without the support of the ISA system. Hypothesis 2 shall be linked to this fact.

Hypothesis 2: A short-term use of ISA does not have a long-term effect on the drivers' communication behaviour.

Moreover the **influence of** some kind of **training** on the driving behaviour was investigated. Evidence of the effectiveness of different types of training on the behaviour of young car drivers was found in literature (see sub-chapter 3.3). On the basis of these assumptions hypotheses 3 and 4 were formulated.

Hypothesis 3: Training can improve a negative attitude towards ISA and speed behaviour.

Hypothesis 4: Training has the potential to improve young drivers' behaviour for a long period of time.

It also was investigated whether people’s attitudes, which were evaluated in the questionnaires, have consequences on their actual driving behaviour. Three different instruments have been used, the ISA questionnaire, the “Type” questionnaire as well as the DBQ. It can be assumed that participants will put their attitudes, determined by the questionnaires, into action while driving a car.

5. Method

This chapter deals with the study design, the test driver selection as well as the various methods that have been applied. A major point of interest is the description of behaviour observation in general, advantages and challenges of such an approach. The adopted method, the “Wiener Fahrprobe”, will be illustrated and discussed. The questionnaires used will be presented briefly, as well as the training method, which was developed just for the study. Finally an overview of all statistical measures, which were used for the data analysis, will be given.

5.1. Study design

The main aim of this PhD thesis is to evaluate the effects of an ISA application on the communication of young novice drivers with other road users. The study was carried out in two countries, in Austria and in the Czech Republic. The research work in the Czech Republic was done in co-operation with Centrum dopravního výzkumu (CDV). These circumstances permit some kind of cross-cultural study. In order to have a sufficient data base for statistical analysis, it was intended that at least 40 persons of each country participate. Since concentrating on young drivers, participants should be aged between 18 and 25 years. Their driving experience was no central selection criteria, as a variation in mileage was of interest in order to verify the hypothesis.

In a first step, the driving behaviour of the young participants was observed in order to get some kind of baseline of their natural driving style. An in-car-observation instrument based on the principle of registration of critical incidents was applied. To guarantee the safety of all involved persons (the participants as well as the observers), this observation was done in a driving school car with the assistance of a driving instructor. After that first ride, all young drivers filled in a questionnaire, the “ISA” questionnaire, to identify their attitudes in respect to traffic safety, speed and other issues. In the following all information referring to the **first step** of the study will be marked with an “a” or “step1”.

Being observed while driving an ISA equipped car on the identical standardised route was part of the **second turn** (“b” or “step2”) of the study. To make participants familiar with the system, an extra route was scheduled. After the second ride, participants again filled in the same “ISA” questionnaire. Additionally they were asked to complete two more questionnaires, the Manchester Driver Behaviour questionnaire (DBQ) and the “Type” questionnaire.

In addition to the observed car rides, another method was applied – an interactive, psychological group training – in order to give young drivers the possibility to exchange experiences with each other and to discuss issues concerning speeding, the consequences of it, the reasons for speeding, etc. Two sessions within two weeks, each of them lasting two hours, were to be held. Half of the people in each country were to undergo the training. The rest of the participants were not to be trained at all. After this **third part** (“c” or “step3”) participants were to complete the “ISA” questionnaire, the “Type” questionnaire and some kind of training evaluation.

The **fourth step** (“d” or “step4”) was quite similar to the first one. Participants were observed while driving a driving school car and again they filled in the “ISA” questionnaire as well as the “Type” questionnaire. It was decided to make the last run in the driving school car again, in order to ensure comparability.

Table 8 gives an overview of the study design, structured in those four steps as described above as well as the actual time schedule. The whole process was estimated to take about one year. Immediately after the first ride it was planned to observe participants while driving the ISA equipped car, followed directly by the psychological group training. For investigating a long-term effect of the training, at least four months have been planned to pass before the last ride.

Steps of the study		**Time schedule in months**															
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Step 1 (a)	Drive in a driving school car Fill in "ISA" questionnaire	■	■	■	■												
Step 2 (b)	Drive an ISA equipped car on an extra route to get used to the system Drive an ISA equipped car on the original route Fill in "ISA" questionnaire Fill in DBQ Fill in "Type" questionnaire			■	■												
Step 3 (c)	Participate in the pschological group training Fill in "ISA" questionnaire Fill in "Type" questionnaire Fill in "Training" evaluation								■	■							
Step 4 (d)	Drive in a driving school car Fill in "ISA" questionnaire Fill in "Type" questionnaire											■	■	■	■	■	■

Table 8: The four steps of the study design including the time schedule

Table 7 to 11 visualise briefly which particular hypotheses are tested with the various research steps. The procedure will be described more deeply in chapter 7, when the results are discussed.

Hypothesis 1: The use of an ISA system will improve the communication between young drivers and other road users.

	Steps of the study	Hypothesis 1
Step 1 (a)	Drive in a driving school car Fill in "ISA" questionnaire	
Step 2 (b)	Drive an ISA equipped car on an extra route to get used to the system Drive an ISA equipped car on the original route Fill in "ISA" questionnaire Fill in DBQ Fill in "Type" questionnaire	
Step 3 (c)	Participate in the pschological group training Fill in "ISA" questionnaire Fill in "Type" questionnaire Fill in "Training" evaluation	
Step 4 (d)	Drive in a driving school car Fill in "ISA" questionnaire Fill in "Type" questionnaire	

Compare the communication behaviour data (step 1) with the communication behaviour data (step 2)

Table 9: Visualisation of the approach to answer hypothesis 1

Hypothesis 2: A short-term use of ISA does not have a long-term effect on the drivers' communication behaviour.

	Steps of the study	Hypothesis 2
Step 1 (a)	Drive in a driving school car Fill in "ISA" questionnaire	
Step 2 (b)	Drive an ISA equipped car on an extra route to get used to the system Drive an ISA equipped car on the original route Fill in "ISA" questionnaire Fill in DBQ Fill in "Type" questionnaire	
Step 3 (c)	Participate in the pschological group training Fill in "ISA" questionnaire Fill in "Type" questionnaire Fill in "Training" evaluation	
Step 4 (d)	Drive in a driving school car Fill in "ISA" questionnaire Fill in "Type" questionnaire	

Compare the communication behaviour data (step 1) with the communication behaviour data (step 4)

Table 10: Visualisation of the approach to answer hypothesis 2

Hypothesis 3: Training can improve a negative attitude towards ISA and speed behaviour.

	Steps of the study	Hypothesis 3
Step 1 (a)	Drive in a driving school car Fill in "ISA" questionnaire	
Step 2 (b)	Drive an ISA equipped car on an extra route to get used to the system Drive an ISA equipped car on the original route Fill in "ISA" questionnaire Fill in DBQ Fill in "Type" questionnaire	
Step 3 (c)	Participate in the pschological group training Fill in "ISA" questionnaire Fill in "Type" questionnaire Fill in "Training" evaluation	
Step 4 (d)	Drive in a driving school car Fill in "ISA" questionnaire Fill in "Type" questionnaire	

Compare the attitude towards ISA and speed (step 2) with the attitude towards ISA and speed (step 4)

Table 11: Visualisation of the approach to answer hypothesis 3

Hypothesis 4: Training has the potential to improve young drivers' behaviour for a long period of time.

	Steps of the study	Hypothesis 4
Step 1 (a)	Drive in a driving school car Fill in "ISA" questionnaire	
Step 2 (b)	Drive an ISA equipped car on an extra route to get used to the system Drive an ISA equipped car on the original route Fill in "ISA" questionnaire Fill in DBQ Fill in "Type" questionnaire	
Step 3 (c)	Participate in the pschological group training Fill in "ISA" questionnaire Fill in "Type" questionnaire Fill in "Training" evaluation	
Step 4 (d)	Drive in a driving school car Fill in "ISA" questionnaire Fill in "Type" questionnaire	

Compare the driving behaviour data (step 1) with the driving behaviour data (step 4)

Table 12: Visualisation of the approach to answer hypothesis 4

5.2. Test driver selection

The first important step to start this research work was to recruit young novice drivers in Austria and the Czech Republic. The recruitment of young drivers turned out to be more complicated than expected. In two driving schools in Vienna (Austria), placards were posted (Annex 1 and Annex 2). In addition, the study, its aims and advantages for novice drivers, were presented to participants of an ongoing theoretical driving school course. After the presentation people had the possibility to register if they wanted to be contacted. However, due to the low response rate, another approach had to be found. In Austria, different internet platforms exist, where students can search for jobs, apartments and other useful information. The idea was to announce the study as a "job" there, as the use of these platforms is quite common among young people. In the end this was the most effective method. 48 persons aged between 18 and 25 (only two exceptions) indicated their interest to participate in the study.

For Brno (Czech Republic) a different solution was found. There, thanks to the effort of the employees of CDV, novice drivers were contacted through a driving school instructor. 28 participants between 18 and 21 years old could be recruited.

5.3. Behaviour Observation

5.3.1. General introduction to the method

In social sciences different methods for data collection, like carrying out interviews or experiments, are applied. Behaviour observations play an important role in traffic research. In scientific literature (Greve and Wentura, 1997; Atteslander, 2006; Schnell et al., 2005; Kromrey, 2002; Gehrau, 2002; Kubinger, 1996; Lamnek, 1995) a distinction is made between the daily observation and the scientific observation. A definition of the scientific observation method is given in Schaefer (2007: 45): "*a research technique in which an investigator collects information through direct participation and/or by closely watching a group or community*". According to Martin and Wawrinowski (1993), observation is always related to an active and intense involvement and an analysis of the subject and the situation.

5.3.1.1. Historical context

Even though every human being is observing different situations every day, the scientific observation has a comparatively short history (Atteslander, 2006). The method of scientific observation originates in different fields of research (Gehrau, 2002). This chapter will give a short overview of the history of this method in the field of sociology, psychology as well as pedagogy.

The following details are based on the work of Atteslander (2006) who maintains that the roots of behaviour observation in the field of sociology can be found in the "Social Surveys" implemented in England in the 18^{th} century. Those surveys, among other things, are concerned with the household income of the poor population. Data has been collected systematically with the help of various methods of social science like interviews, expert interviews, desk research but also observation. The probably most famous study about the situation of the working class was carried out by Friedrich Engels in 1845. Furthermore, Atteslander (2006) refers to Ethnology as having inspired the method of participating observation and field studies in the 19^{th} century. Through the work of the School of Chicago at the beginning of the 20^{th} Century, behaviour observation has become an inherent element of the methodological repertoire of social research (see also Lüders, 2005; Lamnek, 1995). The most important studies, stimulated by the School of Chicago, have been the “Middletown-Studies” (Lynd and Lynd, 1929, 1937), and the “Street-Corner-Society” (Whyte, 1996) and the “Hawthorne-Study” (Roethlisberger et al., 1949). After the Second World War, the scientific interest turned towards more quantitative observation methods, exemplarily implemented in the “Interaction Process Analysis” of Bales in 1972 (Atteslander, 2006). Nowadays both methods, quantitative but also qualitative observation methods, are used in social science.

Greve and Wentura (1997) looked at the subject of behaviour observation from a psychological point of view. At the beginning of the century, first introspection was the method of choice among psychologists. Subjects were asked to describe inner processes as precisely as possible. Behaviourism effected a change in approach, with inner procedures no longer being the focus of research but only observable behaviour. This entails that in the tradition of behaviourism, every observation can be expected to be repeated. In the late fifties behaviourists were confronted with criticism. The “observation” of inner processes became important again. Nevertheless there was, and still is, the demand for objectivity in terms of the repeatability of results.

Gehrau (2002; based on Deschler, 1974) dates the beginning of scientific observation in the pedagogical field to the thirties. At first researchers observed and recorded the behaviour of pupils as well as of teachers directly in the classrooms. There was no clear separation between data collection and their interpretation. For the purpose of repeatability and verifiability an assistive technology was adopted in the fifties. As a consequence tape records or videos made a detailed data analysis possible, which led to a very high standardisation and systematisation.

5.3.1.2. Requirements for scientific behaviour observation

Greve and Wentura (1997) differentiate between “heuristic” and “deductive” observation. Whereas “heuristic” observation can be understood as a specific mindset towards the researched objectives with the aim to generate a hypothesis, “deductive” observation is conducted by theoretical principles. Therefore, the “deductive” observation, in particular, fulfils the requirements of a scientific observation. Furthermore in literature (Greve and Wentura, 1997; Feger, 1983; Schnell et al., 2005; Martin and Wawrinowski, 1993; Atteslander, 2006; Lamnek, 1995; Gehrau, 2002) scientific observation is mostly seen as “systematic observation”. It can be distinguished from an everyday observation on the basis of specific characteristics.

Scientific observation implies a scientific purpose, like a theory or already a concrete research question. The scientific observation is selective and planned. Depending on the research interest, not every, but specific behaviour is observed. Furthermore in the course of a scientific observation, the researcher always aims at collecting and analysing the data. Moreover a scientific observation has to fulfil the criteria of objectivity, reliability and validity.

5.3.1.3. Types of behaviour observation

Within the literature (Greve and Wentura, 1997; Lamnek, 1995; Martin and Wawrinowski, 1993; Gehrau 2002; Kromrey, 2002; Schnell et al., 2005; Atteslander, 2006) various modes of observations are differentiated. The most important one will be mentioned in the following.

o <u>Structured – unstructured</u>

In the unstructured mode, the observation is verbalised in the researcher's words without using any scheme. By using this procedure it is most probable that not every behaviour can be recorded. The difficulty is that the researcher either records while observing or observes first and records afterwards. In both cases information might get lost because of missing in the first case or forgetting it in the second scenario. Therefore, the unstructured behaviour observation is rather used to explore a research field and to generate hypotheses. The structured approach requires knowledge about the area of interest and is very selective. So it must be decided beforehand which behaviour is of interest and how it should be recorded. Occurrences of the behaviour is not noted in words but encoded in a specific scheme. This procedure entails a significant advantage, namely a much easier data analysis. Nevertheless, in most studies intermediate modes are used.

o <u>Open – hidden</u>

Another parameter of behaviour observation is the level of transparency. Depending on the research question, the presence of the observer may not be likely to alter the results or it might be necessary to conduct the observation covered. The second method provides the opportunity to observe natural behaviour. However, it is a drawback that it also causes the problem to miss important inputs, for instance because of an inappropriate perspective of the observer. Additionally ethical concerns exist, if subjects are observed without knowing it.

o <u>Participating – non-participating</u>

In the scenario of a participating observation, the researcher becomes more or less a part of the field. Participating observation can be realised very actively or more passively. Whereas active participation means to assume a member part, passive participation comes along with restriction concerning the role as observer. In the case of participating observation it is easier to observe natural behaviour but there is also the challenge not to influence the behaviour of the subjects in an active way. Additionally it is more difficult to record the data without losing one's camouflage (see also open – hidden observation). A non-participating researcher observes the field from "outside". The disadvantage hereby is seen in the fact that, depending on the overall setting, spontaneous behaviour of the subject occasionally becomes improbable.

o <u>Field – laboratory</u>

Furthermore an observation can be conducted in the field or in the laboratory. In the field-setting behaviour is observed under natural circumstances. In the last few years, this type of observation has even attracted attention in the field of traffic and mobility research (100 – car Naturalistic Driving Study). The advantage of observation in the laboratory is that it constitutes a more standardised approach.

o <u>Sudden – arranged observation</u>

Observation can be conducted in view or with the help of videos or other technical resources. The face observation gives the researcher an authentic impression of the situation. Using technical support permits to watch complex situations as many times as necessary. However the biggest constrain in this regard is the quality of the material or the position of the camera for instance.

Depending on how structured and how open an observation is, as well as how active the participation of the researcher is etc., an observation procedure can be classified as a more quantitative or a more qualitative approach. According to Schnell et al. (2005) structured participating or non-participating procedures are common practice in the empirical social science.

5.3.1.4. Advantages and challenges of the behaviour observation method

Observation is a very specific way to experience an environment and social reality (Lamnek, 1995). This method also gives some clues. Among experts (Greve and Wentura, 1997; Faßnacht, 1995; Schnell et al., 2005; Martin and Wawrinowski, 1993; Kromrey, 2002; Kubinger, 1996; Lamnek, 1995; Atteslander, 2006) an agreement exists about the advantages and challenges of the observation method.

Atteslander (2006) describes scientific observation as a method for measuring (sensually perceivable -) behaviour as soon as it happens. Likewise Frankfort-Nachmias and Nachmias (1996) remark: „*The main advantage of observation is its directness; it enables researchers to study behavior as it occurs*." Additionally with observation "real" behaviour, not just verbally evinced behaviour, can be recorded. The self-assessment of subjects is just one interpretation of their own behaviour; maybe a quite naïve one. Furthermore people sometimes tend to consciously declare false details, or they are subject to a bias of their self-image. Occasionally the research question concentrates on people who cannot speak, children for instance. In the context of these challenges of social research, behaviour observation offers a beneficial alternative.

On the other hand there are also restrictions regarding the observation method. Different types of errors can be distinguished. There are errors that are based on the observed subject and those caused by the observer, because no event can be captured well enough.

- Errors that are based on the observed subject

The so called "*guinea pig effect*" means that simply the knowledge about being observed may change the subjects' ordinary behaviour. A *long-lasting observation study* as well may change the behaviour of subjects. Subjects who are being observed sometimes intentionally assume a *specific role* as soon as they realise that they are being monitored or they behave according to their idea of *social desirability*.

- Errors caused by the observer

The *interviewer effect* can be seen as link between the first group of errors, based on the observed subject, and the second one caused by the observer. Depending on age, gender, appearance etc., of the researcher subjects may behave differently. *Intra subjective changes* caused by fluctuation of alertness, fatigue, emotions, needs or motives, modification of standards ("observer drift") etc., may lead to a different perception of what is seen. In the course of a participating observation the researcher may "*go native*"; which means that he/she identifies him-/herself with the studied subjects (Tashakkori and Teddlie, 2003). Also *classic assessment errors* can take place. The observer may tend to *assess* behaviour on rating scales more *moderate* and may avoid the extreme positions; error of central tendency. The evaluator potentially *assesses* a person too *favourably*. The rating can be influenced by the *primacy-recency-effect* as well. In that case the error evolves due to the chronological sequence of incidents. Furthermore the observer may let himself be guided by his impression or by a *prominent feature*, the so-called halo-effect. Furthermore the *logical error* can lead to a biased perception. In that case the observer notices behaviour based on private presumptions or based on cultural differences (ethnocentrism). Additionally the researcher may record the data “erroneously”. This error is related to inappropriate category schemes that hinder the observer in producing valuable data.

This list of errors is not exhaustive. It ought to give an impression about some difficulties every researcher has to face if carrying out an observation study. Fortunately most of these errors can be reduced by choosing observation periods of an adequate length, by training of the observers and by periodic support.

5.3.2. Observation of road traffic behaviour – the “Wiener Fahrprobe”

The method of behaviour observation has a comparatively short history in road traffic. It can be traced back until the 30ies of the last century. Maag (1992) (see also Sömen, 1990) mentions a study of Roger and Laurer (Laurer, 1957) who conducted an observation based on a scale in 1938. Graf (1949) and Shaw (1955) examined behaviour in traffic by using an instrument-based method. These pioneers have been followed by many others (Greenshields, 1955; Abele, 1956; Smith et al., 1957; McGlade, 1963; Soliday and Allen, 1972; Wilson and Greensmith, 1983; Friedinger, 1982 and many more).

Rolle (1979) was the first scientist who distinguished between two methodological alternatives to observe behaviour in road traffic. The driving behaviour can be recorded by *machine* or by a *human observer*. Furthermore the driver can be informed or he/she can be kept uninformed about the observation. If the driver knows about being watched, researchers mostly use specific sheets to record and to describe the observed behaviour. Concerning this type of observation, when participants know about the observation, Risser and Brandstätter (1985) continue the work of Rolle (1979). They differentiate between two research approaches depending on whether the observer is out- or inside the participant’s car. If the observer is outside the car, it is rather vehicle control that is being observed and not the actual behaviour of the driver.

In the recent past in-car observations of drivers have been carried out by various scientists e.g. by Klebelsberg et al. (1968), Quenault (1967), Barthelmess (1974) or Kroj and Pfeiffer (1973). On the basis of these studies Risser and Brandstätter (1985) developed a new observation method, the “Wiener Fahrprobe” which will be explained in more detail in the following chapter.

	Implementation	Cognition of participants about observation	Location of the observer
Wiener Fahrprobe	Machine aided	Unkown	Outside
			Inside
		Known	Outside
			Inside
	Human observer	Unkown	Outside
			Inside
		Known	Outside
			Inside

Table 13: Characteristics of the “Wiener Fahrprobe”

5.3.2.1. The method “Wiener Fahrprobe”

The “Wiener Fahrprobe” was developed in the eighties by Risser and Brandstätter (1985) to analyse road traffic behaviour. “*The “Wiener Fahrprobe” helps to get a structured impression of the driving behaviour of* *participants"* (Turetschek and Risser, 2004). Since then the method has often been used for diagnostics in order to assess a person's driving ability driving a vehicle but it is also frequently applied for scientific research (see sub-chapter 5.3.2.2).

Risser and Brandstätter (1985) started from the assumption that that every driving behaviour that does not comply with the traffic rules is wrong. However, there are also exceptions to this rule, such as speed behaviour. In case a participant drives slightly above the legal speed limit on a road where other car drivers do the same, the behaviour should be rated as "ok". If so, the existence of an informal rule can be assumed and to behave legally correct (driving according to the speed limit) might reduce one's safety. On the other hand drivers may behave absolutely according to the traffic law while endangering others by not having the possibility to compensate errors. The authors suggest evaluating behaviour not only regarding its "legal accuracy" but to also take into consideration if sources of errors can be detected that are associated with the shown behaviour. Many variables have been deduced that should reflect proper driving behaviour. Lajunen et al. (1998; cited in Risser and Lehner, 1998) postulated that the "*total set of variables is meant to be a reflection of the observed participants´ driving behaviour, or driving style*". In the following those variables but also the requirements on the route and the point in time will be discussed (Risser, 2006; Risser and Brandstätter, 1985; Risser and Lehner, 1997, 1998; see also Risser et al., 1995; Kaufmann and Risser, 2003; Kaufmann, in progress).

Observers

The behaviour is usually recorded by two observers, the so-called "free" and the so-called "coding" observer. The two observers take notes on several behaviour variables in both a standardised and a non-standardised way.

The "free" observer is supposed to collect three types of behaviour that are hardly predictable: errors, interaction/communication processes and traffic conflicts.

Errors are events that represent "*a severe offence of the law and/or cause danger*" (Risser et al., 1995) such as neglecting a stop sign.

Interaction/communication processes are assumed to take place since the car driver is rarely alone on the road. In the majority of cases other car drivers, pedestrians, cyclists and others will be on the road as well and the driver has to interact with them, especially in unclear situations. He/she is not independent of other road users.

In literature (Risser et al., 1991; Parker and Zegeer, 1989; Ho, 2004; Chin and Quek, 1997) a traffic conflict is given, if at least two road users are on a collision course and the accident could only be avoided due to an evasive action of at least one of them. Three different types of severity of critical incidents can be distinguished. A high risk is given if the time to collision is between 0.0 and 1.0 seconds, a time to collision of 1.0 to 1.5 seconds is defined as moderate risk and a low risk is given between 1.5 and 2.0 seconds.

The "coding" observer concentrates on standardised behaviour such as lane keeping, speed behaviour, distance keeping, as well as behaviour while turning, behaviour at crossings or the use of the indicator. The observer records the observation on a specific sheet that has to be completed per section (see sub-chapter 5.3.3.2).

Route

The method is applied in real traffic. For the observation a standardised route with a length of 25 to 50 kilometres is used. It should include different road types with mainly urban roads but also rural roads and motorways. The route is divided into sections like motorway entrances or exits or sections between intersections. All characteristics like stop signs, stations, zebra crossings, etc. should be noted.

Point in time

Especially in a scientific context rides ought to be comparable, hence observations should always be done at the same time of day. Driving observations usually are made during weekdays. Therefore it is utterly important to avoid rush hours in order to adhere to the schedule, as it is crucial to get a comprehensive impression of the driving behaviour, not just the behaviour while the car is rolling or even standing still. In practice, an observation ride along a route with standardized lengths takes between 40 and 60 minutes, depending on the actual traffic situation and the driving style of the participant. According to Schubert and Wagner (2003) a ride should last 45 minutes, at least.

The actual recording of the observation starts about 15 minutes after the beginning of the trip. Studies have shown that drivers tend to forget that they are observed after this amount of time (Höfner, 1972; as cited in Risser and Brandstätter, 1985; see also sub-chapter "Quality criteria").

Quality criteria

In social science three criteria are very important in order to guarantee high quality research: objectivity, validity and reliability. The value of a research instrument has always been, and will be assessed on the basis of these criteria. In the basic literature about methodology of social science (Bortz and Döring, 2002; Schnell et al., 2005; Lamnek, 2005; Frankfort-Nachmias and Nachmias, 1996; Tashakkori and Teddlie, 2003; Kubinger, 1996; Zimbardo, 1995) many definitions of those criteria can be found. In the history of the "Wiener Fahrprobe", researchers (Risser and Brandstätter, 1985; Risser, 2006; Chaloupka and Risser, 1995; in Risser and Lehner, 1998) also had to take these criteria into consideration and their results will be presented shortly in the following.

If the outcome of an instrument such as the "Wiener Fahrprobe" is independent from the <u>operating</u>, <u>coding</u> and <u>interpreting</u> person it can be characterised as **objective** (Lamnek, 2005). The objectivity concerning coding and interpreting the data can be enhanced through a comprehensive observer training (Risser and Brandstätter, 1985; Hjälmdahl and Várhelyi, 2004). Risser and Brandstätter (1985) calculated a congruence of six different observers in 67%. So did Hjälmdahl and Várhelyi (2004) who found a congruence of observers with a "key"[8] observation of 90% after an intense training. To achieve high objectivity, Kubinger (1996) suggests standardising the special, chronological and ergonomic conditions as thoroughly as possible, which is highly realised in the "Wiener Fahrprobe". According to Schubert and Wagner (2003), the modality of instructions has to be standardised as well (e.g. "Please turn right at the next possibility").

[8] Hjälmdahl (2003) theoretically and practically trained three students in the behaviour observation method. Afterwards "test" observations were carried out. The students observed the behaviour of a participant, followed by a video assisted discussion about the ride. On the basis of those discussions between the observers, the trainers and the participants "key" observations have been developed. Subsequently the observation sheets of the observers were compared to the "key" observation.

By using a **reliable** instrument, consistent results can be achieved in the course of repeated measurements. "*Reliability refers to the extent to which a test or other instrument is consistent in its measures."* (http://www.alleydog.com/glossary)

In order to test the reliability of the data collection method of the „Wiener Fahrprobe" via counting errors, Risser and Brandstätter (1985) used Cronbach's alpha (α = 0,84) and the split half method of Spearman-Brown (r = 0,81) and Guttman (r = 0,80). Hjälmdahl and Várhelyi (2004) considers a very high congruence of observers with the "key" observation (90%) not so much as evidence for objectivity but for reliability, as the effect remained on the same level in follow-up tests.

An instrument that measures the concept it is supposed to measure, can be described as **valid**. "*If the test does indeed measure what it is intended to measure, then we can say that the test is valid (or has validity).*" (http://www.alleydog.com/glossary)

Concerning the "Wiener Fahrprobe" Risser and Brandstätter (1985) compared the amount of recorded errors of a driver with the amount of critical incidents he/she was involved in. They found a significant correlation of r = 0.52. This result means that the more errors a driver made the more often he/she was involved in critical incidents and vice versa. According to this study, the same is true for the involvement in conflicts (r = 0.65). Moreover the authors could find a significant correlation between the amount of errors and the accident history of drivers (r = 0.14).

Another validation study was conducted by Chaloupka and Risser (1995; as cited in Risser and Lehner, 1998). In this study the data of the behaviour observation was correlated with accident data of 51 road sections. The results can be found in table 14:

Observation variables	**r_{XY} with accidents**
Driving extremely on the left or on the right side of the lane	.42 (1%)
Inadequate overtaking	.42 (1%)
Too small lateral distances	.37 (1%)
Delayed lane change in case of obstacles	.38 (1%)
Early change of lane before obstacles, reflecting anticipation	
Problems with lane choice (e.g., wrong lane for proceeding after intersection)	.48 (1%)
Speed not exceeding limit and well adapted to situation	
Exceeding speed limits	.46 (1%)
Early deceleration whenever deceleration becomes necessary	
Distance to the car ahead too short	.29 (5%)

1%" = highly significant, 5% = significant

Table 14: Correlations between behaviour observation data and accident data (Chaloupka and Risser, 1995; as cited in Risser and Lehner, 1998)

Hjälmdahl and Várhelyi (2004) tested the validity of the "Wiener Fahrprobe" by comparing the speed driven in the own car with the speed driven during the observation. He did not find any differences in the speed behaviour, which is another evidence of validity of this method. However this finding is contradictory to the result of the study by Rathmayer et al. (1999; as cited in Hjälmdahl and Várhelyi, 2004), where the participants' mean speed was lower during the test condition by 1-2 km/h compared to their normal driving behaviour.

5.3.2.2. Previous applications of the "Wiener Fahrprobe"

So far, the Wiener Fahrprobe has been use several times in numerous national and also international studies. A short summary about the various application areas is given in Risser and Lehner (1998) as well as in Kaufmann (in progress).

Several mutations of the "Wiener Fahrprobe" exist. The original version of the "Wiener Fahrprobe" was used in an evaluation study of a dual-mode route-guidance system (HOPES project; Risser et al., 1995), for the evaluation of the AICC-system (Chaloupka et al. 1998; Risser and Lehner, 1997) as well as for the evaluation of the effects of an active accelerator pedal (Várhelyi et al., 2002a, b).

Moreover the method was adapted several times to the research needs. In some studies the participants did not know about the observation. Brühning et al. (1989) for instance used the "Wiener Fahrprobe" to observe car drivers along a transit-route from a following car. In 1990 Risser et al. investigated the interactive behaviour between pedestrians and cyclists with a modified version of the instrument.

As the application of two observers is rather time- and cost-intensive, in some evaluation studies only one observer was involved (Gstalter, 1991; Almqvist et al. 1991, 1993; Almqvist and Nygård, 1997). Risser et al. (1993) for example analysed the driving behaviour of electric mini-car users with only one observer. In an ongoing study ("SICHER MOBIL MIT HANDICAP"), the driving behaviour of disabled people is observed in order to assess their ability to take part in road traffic (http://www.clubmobil.at). 2007 FACTUM OHG together with CDV ran a study with the aim to combine the observation data of the "Wiener Fahrprobe" with the data of a Black Box (Kaufmann et al., 2007).

A more recent study (LIVES project) for which the "Wiener Fahrprobe" was used to observe behaviour in a driving simulator (Geven et al., 2006) was conducted in 2006.

5.3.2.3. Specific challenges of the "Wiener Fahrprobe"

Even though the "Wiener Fahrprobe" was very successfully implemented in several studies, some constraints of the method have to be mentioned. Risser and Brandstätter (1985) specified four different types of problems when implementing the "Wiener Fahrprobe". There are problems with registration, such as recording continuous behaviour like driving above the legal speed limit for a few minutes. Furthermore it sometimes is not easy to decide how to make a note of a complex behaviour like lane changing while other road users are endangered. Finally the observer is affected by the position in the car. Another problem is the alternating concentration of the observer due to communication with the participant and due to his/her function to note the driving behaviour. In some cases it is not that easy to stick to the standardised instruction as some drivers for instance ask for more information. Sometimes construction work on the road makes it necessary to change the route (and thus the data are hardly comparable).

Furthermore Kaufmann (in progress) notes that the fact of changing traffic conditions cannot be avoided. Although the behaviour observation should not be done during peak hours one cannot guarantee equal traffic volume or the occurrence of similar situations.

Sömen (1990) criticises the “Wiener Fahrprobe” for not being accurate in describing the standardised variables. Moreover he doubts the observer’s ability to recognise the diversity of variables.

Some of the above mentioned challenges can be met with an extensive training of the observers; e.g. the ability to concentrate on various aspects of the driving behaviour as mentioned by Sömen (1990) or the problems of registration as discussed by Risser and Brandstätter (1985). Furthermore the “Wiener Fahrprobe” can be adapted to the research needs of the certain study and thus, the number of observed variables can be extended or reduced.

Although the implementation of the “Wiener Fahrprobe” raises some difficulties, it is worthwhile to accept the challenge in order to actively analyse the driving behaviour of other people.

5.3.3. Application of the method in the present study

In the current study the behaviour of drivers was observed three times. In the first step participants were asked to drive with a driving school car in presence of a driving school instructor on the front passenger’s seat and one observer on the right-hand back seat of the car. In Vienna as well as in Brno the driving instructor gave the instructions which way to choose. The more important task was to ensure the safety of the passengers and the observers.

In order to conduct the second step an ISA equipped VOLVO from the University of Lund was borrowed. As the car was quite big the participants were given the possibility to get used to the car and the system before the actual observation. Therefore a second route in Vienna as well as in Brno of approximately 15 to 18 kilometres was established. The average duration of one trip was approximately 30 to 60 minutes. During the implementation phase the length of the route was sometimes slightly adapted, depending on the traffic situation and weather conditions. As the ISA system did not work automatically in Vienna and Brno because of the missing GPS and digital maps, including the speed limits, it was necessary to handle the system manually. As the car was not a driving school car, there was no driving instructor present but another researcher. There was one person in the front of the car who told the participants where to go and simultaneously handled the ISA system and one person who did the observation in the back.

It was decided to make the last observation (round three) again in the driving school car in order to get a comparable picture about changes in the driving behaviour. Once more the driving instructor announced the route.

5.3.3.1. Observers

The “main” observer of the study, who did most of the observations in Vienna and all of them in Brno, was trained by an experienced observer. Therefore the route in Vienna was studied several times by going there by car. Furthermore the main observer was advised at which certain sequences of the road what behaviour might occur and where more attention might be necessary because of delicate sections. In order to practise the gained knowledge some “test” observations were carried out and subsequently the outcome of the “main” observer was compared to the results of an experienced observer.

Since a rather vast amount of observations was planned, two already experienced observers supported the main observer and took over some of the observation rides.

5.3.3.2. Observation

In the current study the observation was done by only one observer due to economical reasons. Therefore the original coding sheet of the “Wiener Fahrprobe” had to be adapted. For registration the observer used one sheet with different categories per section. Additionally those events that were not included in the standardised variables were noted on the same sheet. The beginning and the end of the ride as well as the weather conditions were recorded. In the following section all of the parameters of the observation sheet will be described in more detail.

Standardised variables

	Speed	Too fast according to the law	
		Too fast according to the situation	
		Too slow according to the situation	

Table 15: Illustration of the variable “speed” on the observation sheet

Erroneous speed behaviour was commented on three different ways. Although Risser and Brandstätter (1985) suggest tolerating driving above the speed limit on roads where an informal rule exists, it was marked as wrong action as soon as the driver was driving faster than allowed according to the law, even if it was just for one km/h faster. The main reason for this decision was the application of the ISA system. The ISA system gives feedback in relation to the legal speed limit, but not to informal rules. Due to the fact that speed was not registered through technical equipment but via observation, it seems to be easier to decide whether ISA works or not if no “speeding” is accepted.

Whether the young driver went too fast according to the situation was a more or less subjective impression of the observer. It was noted for instance when the driver passed a pedestrian too fast, or made a turn at a too high speed or when the speed was not adapted to wet road conditions. As soon as the driver hindered another vehicle by driving too slowly according to the situation, this was noted as well.

Adaptation of speed before/in intersection or before obstacles	Late	
	Abrupt	

Table 16: Illustration of the variable “adaptation of speed” on the observation sheet

Poorly adapted speed before or in an intersection as well as before an obstacle was marked as late if the candidate did not slow down the vehicle anticipatory but just in time. The breaking behaviour was considered as abrupt behaviour when the novice/young driver did not decelerate smoothly.

	Overtaking	Illegal	
		Dangerous	
		Unnecessary	

Table 17: Illustration of the variable “overtaking” on the observation sheet

Overtaking behaviour was categorised as wrong if the participant passed another vehicle illegally. This could be the case on motorways by using the right instead of the left lane. A dangerous manoeuvre was characterised by not watching out what happened behind, blocking the car behind, to cut-in before a vehicle or passing a cyclist too closely. If drivers overtook a car just before a crossing or a motorway exit the behaviour was marked as “unnecessary”

Distance to the road user ahead	Dangerous	
	Too short	

Table 18: Illustration of the variable “distance” on the observation sheet

The headway was categorised as too short, as soon as the legally recommended distance of two seconds, or one second, respectively, in urban traffic, was violated. Whether the distance to the car ahead was dangerous or not, depended on the observer’s impression of the situation. If he/she felt unsafe in the car, the headway was marked as dangerous.

⇦ ⇨	Use of the indicator	Too short	
		Too late	
		Not at all	

Table 19: Illustration of the variable “indicator” on the observation sheet

By the time the indicator was flashing just once or twice the indicator use was assessed as being too short. “Too late” was noted when a young driver already started a driving manoeuvre not using the indicator before but afterwards. Some of the participants did not use the indicator at all for signalising lane change, turning, overtaking or passing a parked car.

Lane change	Lane change before x/obstacles	Too late	
	Lane change after x/obstacles	Hesitant	
	Cross solid line		
	Lane change	Too fast	
		Dangerous	
		Hesitant	
	Eye glance behaviour	Glance over shoulder	
		Insufficient	
	Lane keeping behaviour	Too far left	
		Too far right	
		Unsteady	

Table 20: Illustration of the variable “lane change” on the observation sheet

The lane change before crossings or obstacles was considered as being too late, if the driver took the last opportunity to change the lane. Some drivers wanted to change lane, even indicated but did not realise the manoeuvre. This type of behaviour was noted as hesitant lane change after crossings or obstacles. Another example for this variable might be that drivers started the lane change but afterwards drove back to the original lane. If the young drivers crossed a solid line or zone, this was marked as well.

In cases when drivers did not assure themselves that they can change the lane, for instance, via glancing into the mirror, if they speeded up or sheered out of lane rapidly, this lane change was described as too fast. If other road users were endangered or at least hindered because of this manoeuvre, the behaviour was considered to be dangerous. Again, an intended but not realised manoeuvre was noted as hesitant.

In Austrian as well as in Czech driving schools, novice drivers learn to execute the "3S-Blick", which stands for a glance in the inside rear view mirror, a glance in the outside rear view mirror and a glance over the shoulder. If the driver did not look over his/her shoulder before a lane change this was marked as error. If the driver did not take a sufficient look down a side street for instance, this type of behaviour was noted as insufficient eye glance.

The lane keeping was characterised as too far left or too far right in case the driver crossed the middle line or the bordering line of the road. But even if the car came very close to the line an error was noted, because it might be dangerous to drive too far left if the oncoming vehicle is doing the same. In case the car was see-sawing within the lane the lane keeping behaviour was described as unsteady.

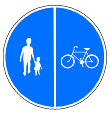
			Pedest.	Cyclists
	Vulnerable road-users	Not realised		
		Ignores Zebra Crossing		
		Gives priority late		
		Is waiting at the roadside		
		Forces to stop		
		Hazards		

Table 21: Illustration of the variable "vulnerable road users" on the observation sheet

It was assumed that participants did not notice vulnerable road users if they did not turn their head towards them. In cases when the driver did not stop for pedestrians waiting to cross the road at a zebra crossing, the behaviour was marked as "ignores zebra crossing". However, if participants stopped the car, but did slow down quite late, the behaviour was characterised as "gives priority late". Sometimes vulnerable road users tried to cross the road although there was no zebra crossing. In such instances, it was noted whether participants kept them waiting at the roadside or if they forced pedestrians or cyclists to stop even though they had already started walking/ cycling. When drivers did endanger pedestrians or cyclists by passing them too closely that was marked as error ("Hazards") as well.

	Bus or tramway stops	Dangerous	

Table 22: Illustration of the variable "stations" on the observation sheet

The behaviour was characterised as dangerous at bus or tramway stops if the car was too fast, if there was not enough distance to the pavement or if the vehicle entered the station although there was a bus/tramway already there.

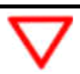
	Behaviour as one who has to give way	Ignored	
		Narrow, dangerous	

Table 23: Illustration of the variable "give way sign" on the observation sheet

If right of way of other road users was ignored for instance by not keeping the right of way for the right hand side or by not caring about the right of way sign, this was marked as an error. The behaviour was classified as narrow or dangerous when compliance with the rule involved an immense reaction like hard braking.

	Behaviour as one who has to stop	Ignored	
		Narrow, dangerous	

Table 24: Illustration of the variable “stop sign” on the observation sheet

A stop sign was marked as ignored in cases when the driver didn’t stop in front of the sign. If the vehicle was still coasting this was counted as error as well. Again, the behaviour was classified as narrow or dangerous when, for instance, compliance with the rule involved braking sharply.

	Insist on one´s own priority	

Table 25: Illustration of the variable “stick to priority” on the observation sheet

Sticking to one’s priority can be characterised by not avoiding a conflict with another road user although there would have been the possibility to do so.

Non - standardised variables

Apart from the variables mentioned above, any behaviour that was in some way worth mentioning was written down as well. Every conflict or near accident as well as explicit communication with other road users, for instance by hand signs, have been noted.

5.3.3.3. Route

The “Wiener Fahrprobe” is a well-established method at FACTUM OHG and INFAR (Institute for driver improvement). For this study in **Vienna** an existing route was chosen, which is often used for driving observations in the context of traffic-psychological diagnostics. The length of the route is approximately 17 kilometres and the average duration of one trip is approximately 40 to 50 minutes, depending on the traffic situation. The route is divided into 25 sections and includes sections with four different speed limits, 30, 50, 60 and 80 km/h with up to 5 lanes. Besides, junctions with and without traffic lights, zebra crossings, stops of public transport as well as lane choice situations have to be passed. In **Brno**, there was no such established route. A new route was designed, similar to the Viennese route, with the help of colleagues from CDV and Factum. The route in Brno was 18 kilometres long, was divided into 18 sections and again with an average duration of approximately 40 to 50 minutes per trip. The Czech route as well included speed limits from 30 up to 80 km/h. The maximum amount of lanes was four. Table 26 gives a short comparison of the characteristics of both routes.

	Speed limit				Number of lanes					Junctions with traffic light	Junctions without traffic light	Zebra crossing without traffic	Lane choice according to pavement markings/informatio signs	Stops of public transport
	30	**50**	**60**	**80**	**1**	**2**	**3**	**4**	**5**					
Number of sections in Vienna	6	21	2	3	11	13	11	6	1	14	6	6	20	1
Number of sections in Brno	3	14	11	2	13	15	11	3	-	9	12	9	13	8

Table 26: Comparison of the characteristics of the route in Vienna and the route in Brno

In the following both routes are visualised on a map (http://maps.google.com).

Route in Vienna

The route was split into 25 sections and for each section one extra coding sheet was used. Below the sections and the course of the track through the city of Vienna is illustrated.

Section 1: Danhausergasse turn right into Waltergasse; turn right into Graf Starhemberggasse; turn right into Mayerhofgasse turn left into Favoritenstraße

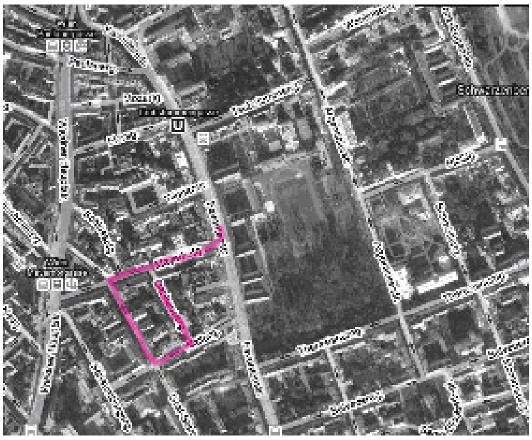


Figure 12: Picture of the route in Vienna - Section 1

Section 2: Favoritenstraße turn right into Gußhausstraße until exit in Schwarzenbergplatz

Figure 13: Picture of the route in Vienna - Section 2

Section 3: Crossing Schwarzenbergplatz and turn right into Lothringerstraße

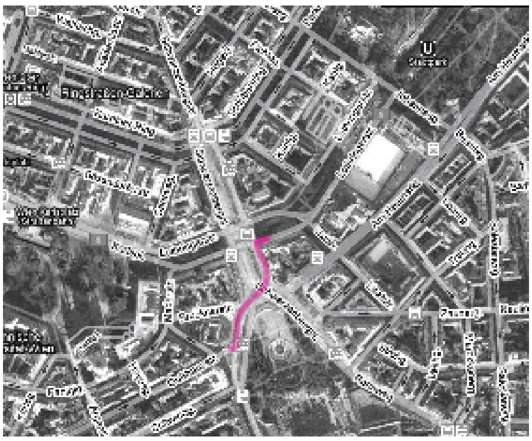


Figure 14: Picture of the route in Vienna - Section 3

Section 4 (start of recording): Lothringerstraße turn right into Johannesgasse; turn left into Am Heumarkt

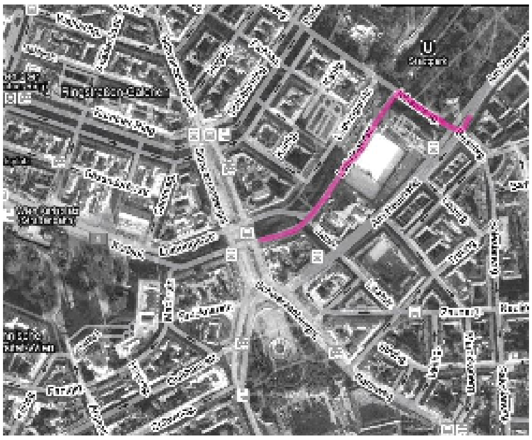


Figure 15: Picture of the route in Vienna - Section 4

Section 5: Am Heumarkt leads into Am Stadtpark; leads into Vordere Zollamtsstraße; turn right into Dampfschiffstraße

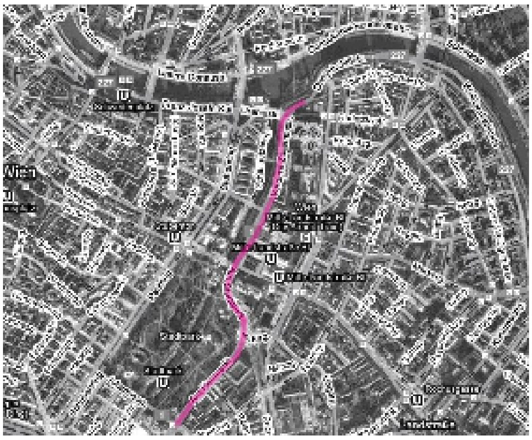


Figure 16: Picture of the route in Vienna - Section 5

Section 6: Dampfschiffstraße turn right into Franzensbrückenstraße

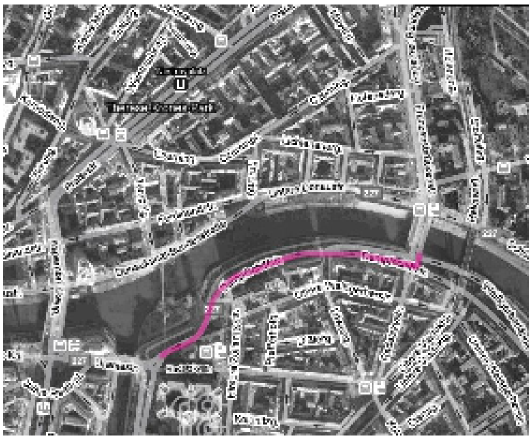


Figure 17: Picture of the route in Vienna - Section 6

Section 7: Franzensbrückenstraße until exit in Praterstern

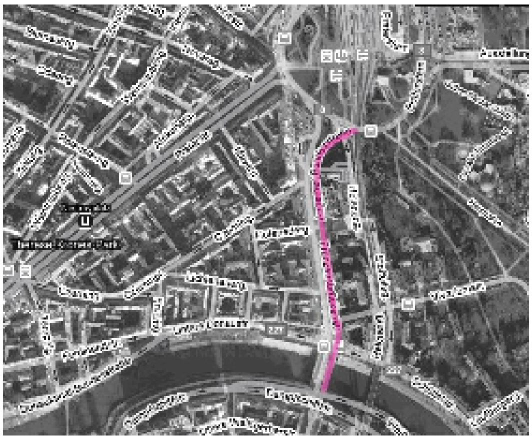


Figure 18: Picture of the route in Vienna - Section 7

Section 8: Praterstern turn right into Lassallestraße until BACA building

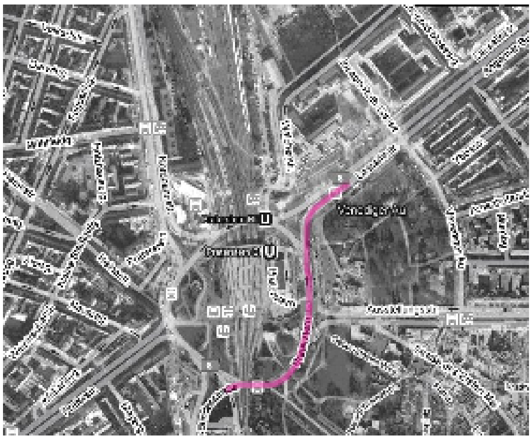


Figure 19: Picture of the route in Vienna - Section 8

Section 9: Lassallestraße until Vorgartenstraße

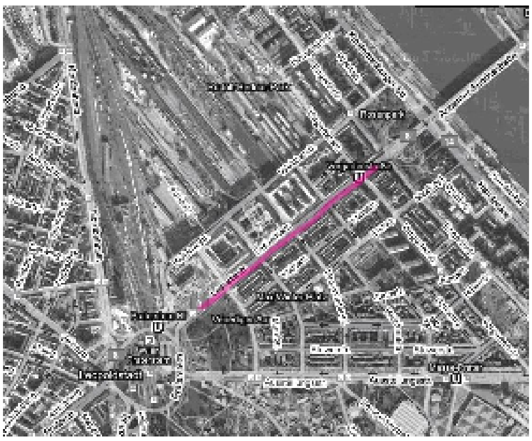


Figure 20: Picture of the route in Vienna - Section 9

Section 10: Reichsbrücke turn right into exit Graz (Donauuferautobahn)

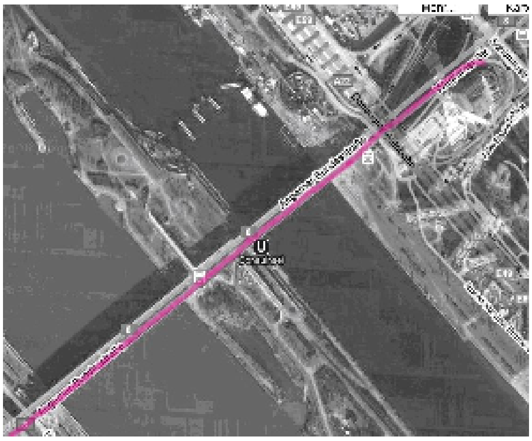


Figure 21: Picture of the route in Vienna - Section 10

Section 11: Highway exit to Graz (Donauuferautobahn) until entering the highway

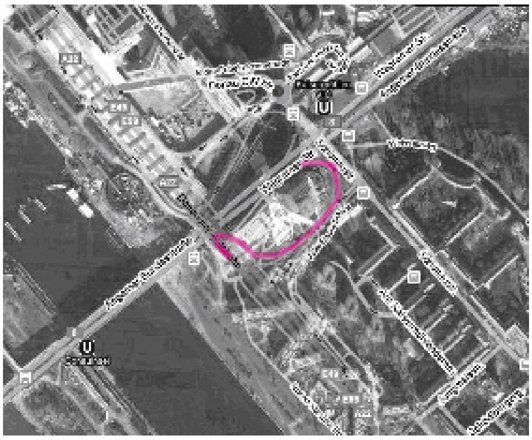


Figure 22: Picture of the route in Vienna - Section 11

Section 12: Highway (Donauuferautobahn) until exit Praterbrücke

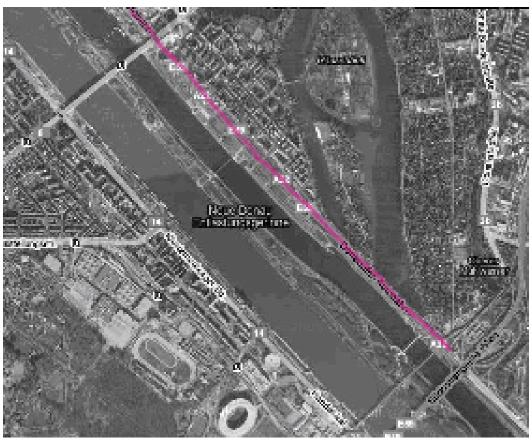


Figure 23: Picture of the route in Vienna - Section 12

Section 13: Exit Praterbrücke until entering the highway (Süd-Ost-Tangente)

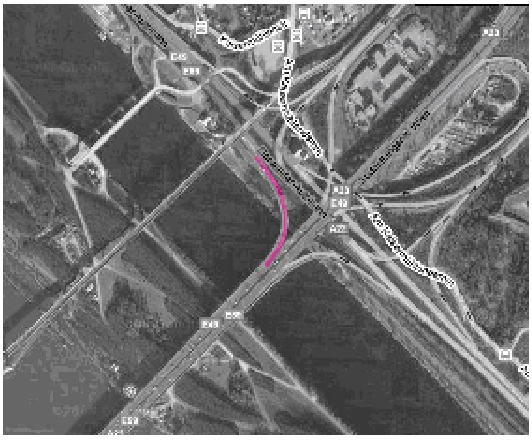


Figure 24: Picture of the route in Vienna - Section 13

Section 14: Highway (Süd-Ost-Tangente) until exit Center

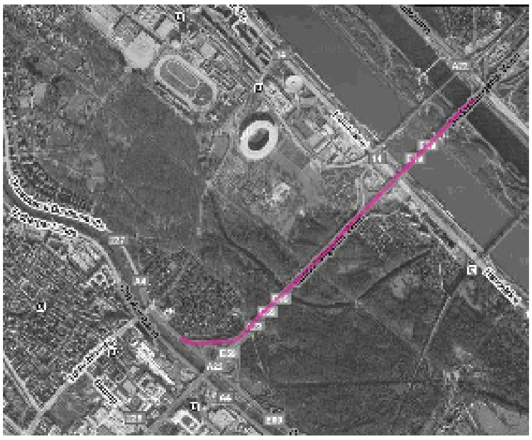


Figure 25: Picture of the route in Vienna - Section 14

Section 15: Schüttelstraße turn left into Stadionallee

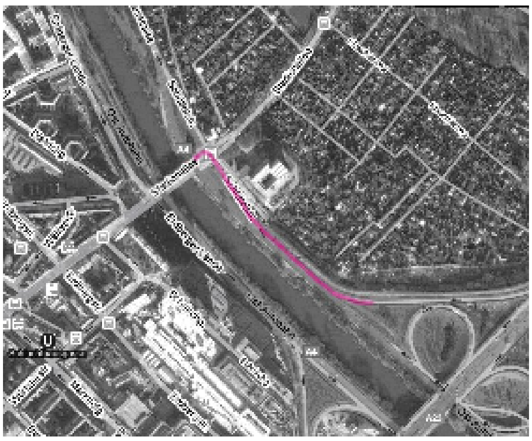


Figure 26: Picture of the route in Vienna - Section 15

Section 16: Stadionallee leads into Wiener Gürtel Bundesstraße until crossing Rennweg

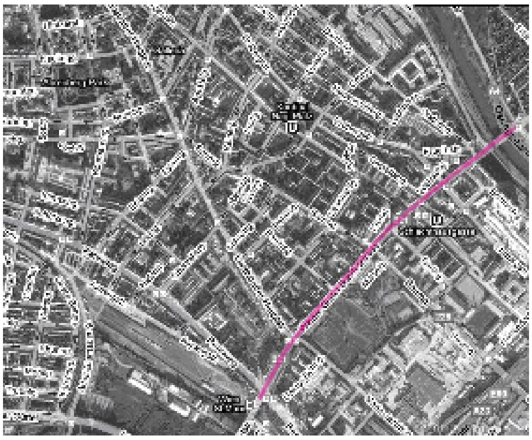


Figure 27: Picture of the route in Vienna - Section 16

Section 17: Wiener Gürtel Bundesstraße turn right into Landstraßer Gürtel

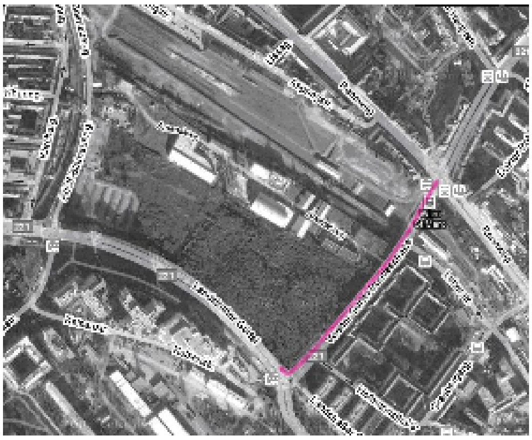


Figure 28: Picture of the route in Vienna - Section 17

Section 18: Landstraßer Gürtel until crossing Prinz-Eugen-Strasse/Arsenalstraße

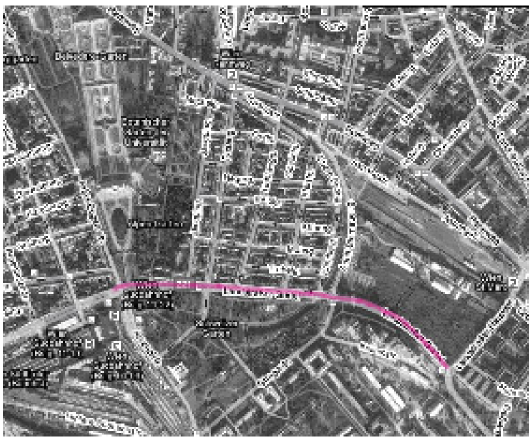


Figure 29: Picture of the route in Vienna - Section 18

Section 19: Wiedner Gürtel turn right into Mommsengasse

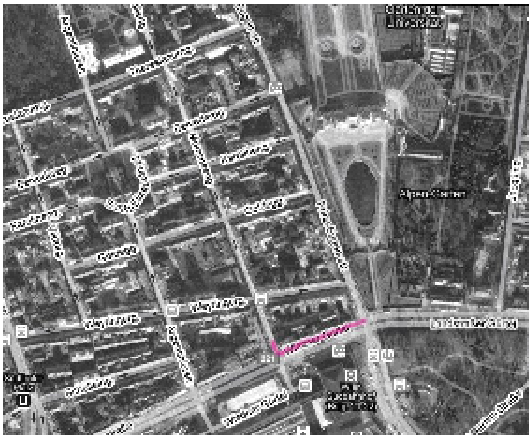


Figure 30: Picture of the route in Vienna - Section 19

Section 20: Mommsengasse turn left into Weyringergasse

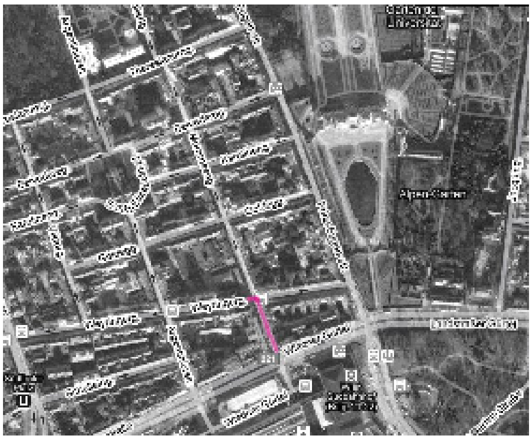


Figure 31: Picture of the route in Vienna - Section 20

Section 21: Weyringergasse turn right into Viktorgasse; turn left into Karolinengasse; turn right into Favoritenstraße

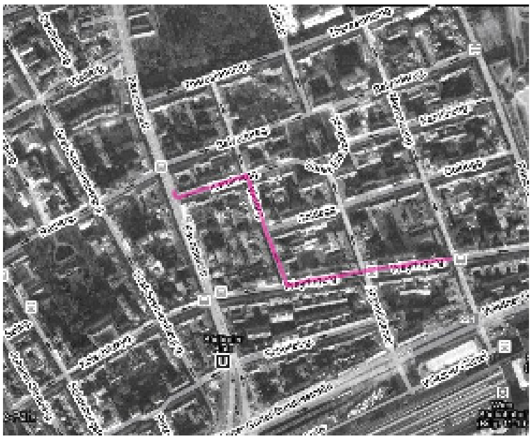


Figure 32: Picture of the route in Vienna - Section 21

Section 22: Favoritenstraße turn left into Waltergasse

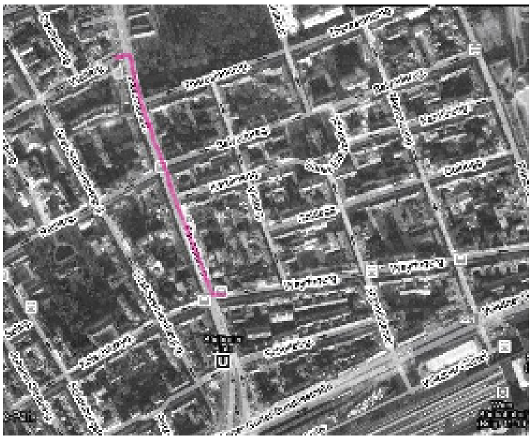


Figure 33: Picture of the route in Vienna - Section 22

Section 23: Waltergasse turn right into Graf Starhemberggasse

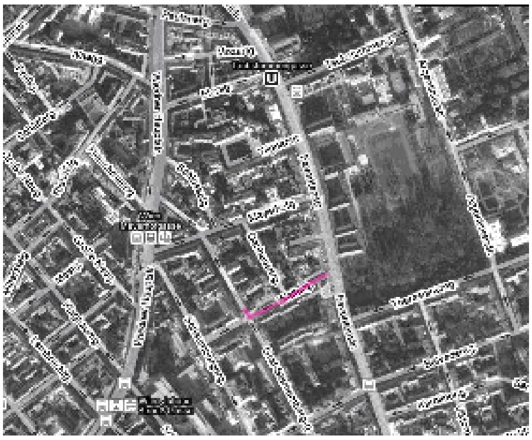


Figure 34: Picture of the route in Vienna - Section 23

Section 24: Graf Starhemberggasse turn right into Mayerhofgasse

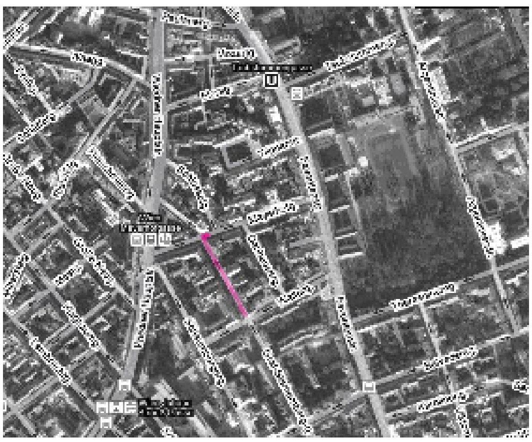


Figure 35: Picture of the route in Vienna - Section 24

Section 25: Mayerhofgasse turn right into Danhausergasse

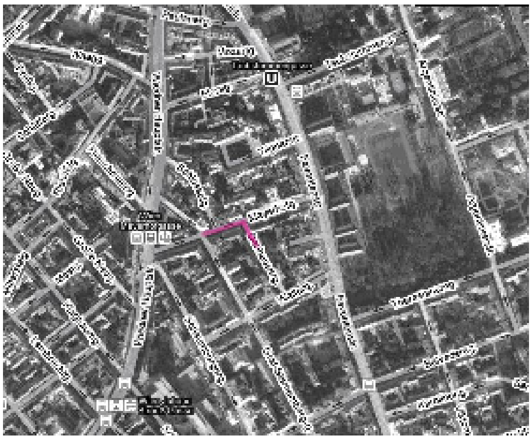


Figure 36: Picture of the route in Vienna - Section 25

Route in Brno (Czech Republic)

In Brno the route was split into 18 sections. Again an overview of the sections as well as the course is presented in the following.

Section 1: Líšeňská turn right into Křtinská; turn right into Věstonická; turn right into Jedovnická

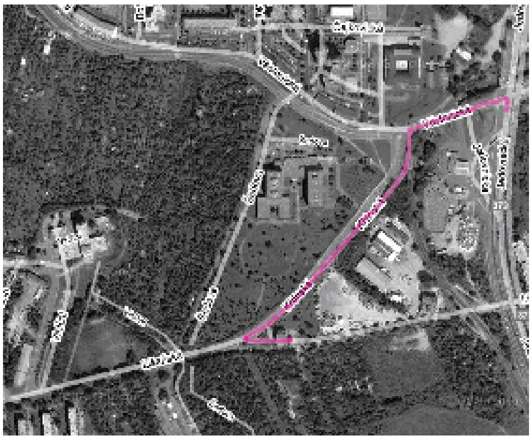


Figure 37: Picture of the route in Brno - Section 1

Section 2: Jedovnická turn right into Bělohorská

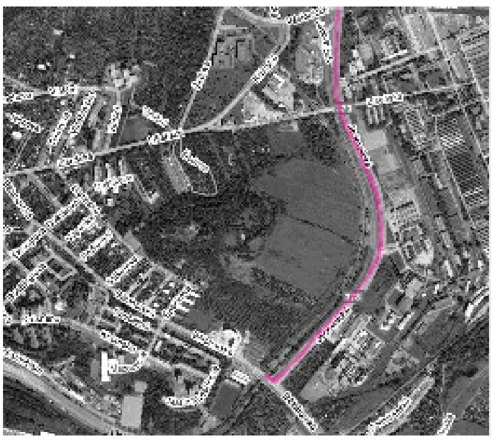


Figure 38: Picture of the route in Brno - Section 2

Section 3: Bělohorská leading into Jamborova; until crossing *Líšeňská*

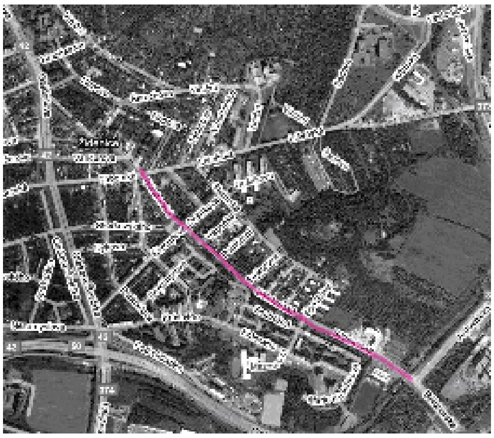


Figure 39: Picture of the route in Brno - Section 3

Section 4: Jamborova turn right into Gajdošova

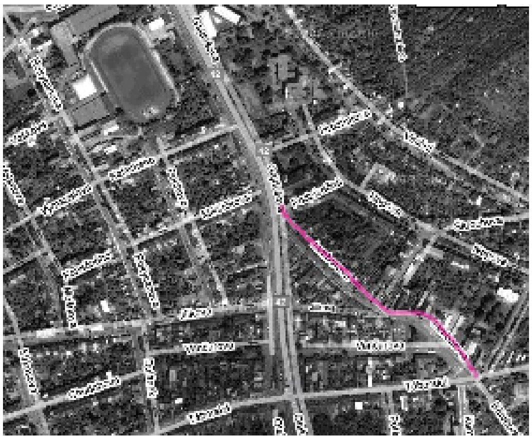


Figure 40: Picture of the route in Brno - Section 4

Section 5: Gajdošova leading into Svatoplukova; leading into Karlova; turn lift into Provazníkova

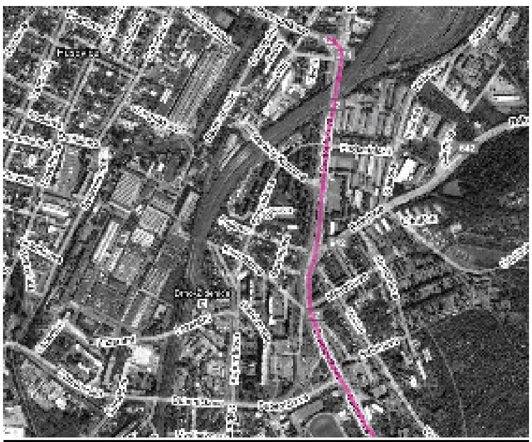


Figure 41: Picture of the route in Brno - Section 5

Section 6: Provazníkova leads into Křižíkova until exit tunnel

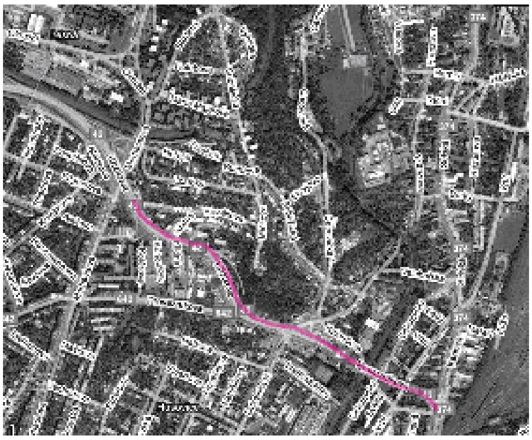


Figure 42: Picture of the route in Brno - Section 6

Section 7: Křižíkova till beginning one lane

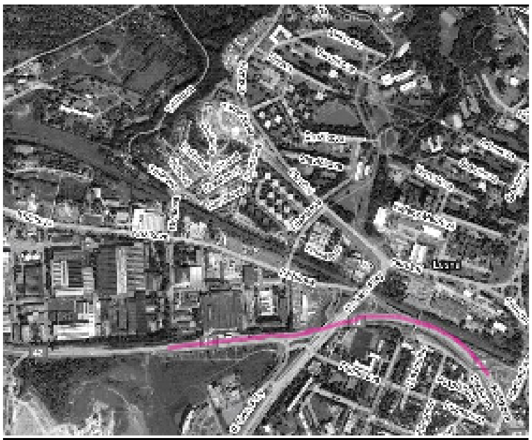


Figure 43: Picture of the route in Brno - Section 7

Section 8: Křižíkova leads into Sportovní

Figure 44: Picture of the route in Brno - Section 8

Section 9: Sportovní turn right into Křižíkova

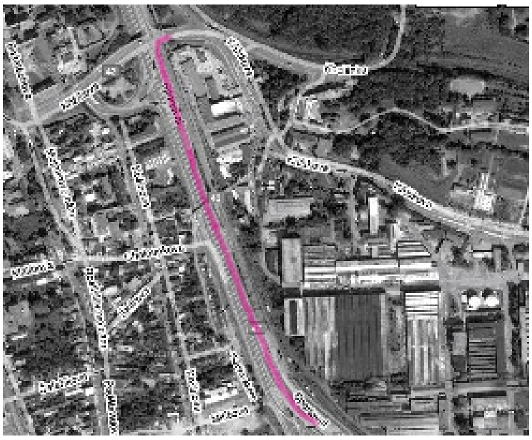


Figure 45: Picture of the route in Brno - Section 9

Section 10: Křižíkova turn into třída Generála Píky

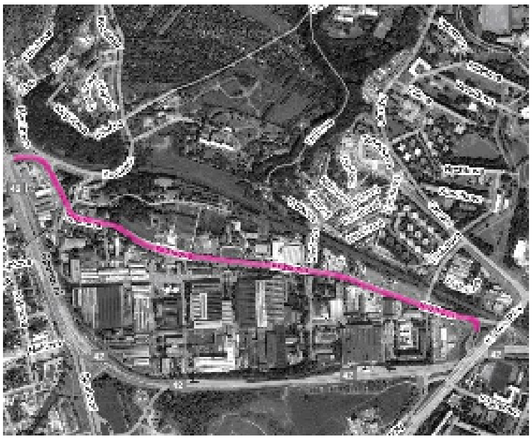


Figure 46: Picture of the route in Brno - Section 10

Section 11: On-ramp Třída Generála Píky until exit

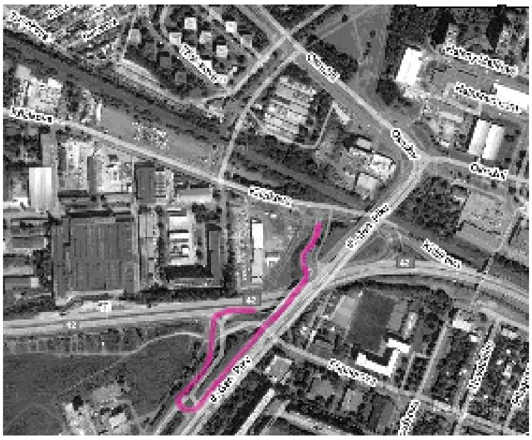


Figure 47: Picture of the route in Brno - Section 11

Section 12: Křižíkova until exit tunnel

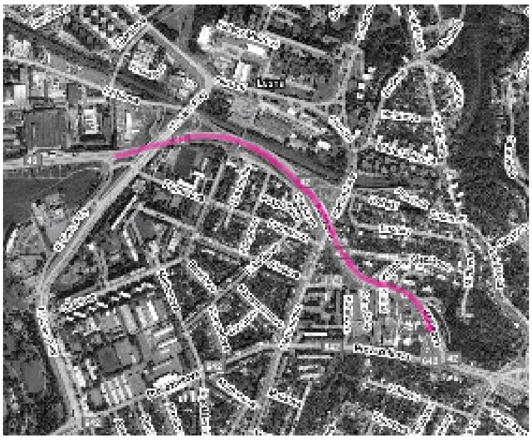


Figure 48: Picture of the route in Brno - Section 12

Section 13: Křižíkova leads into Provazníkova; turn right into Dukelská třída

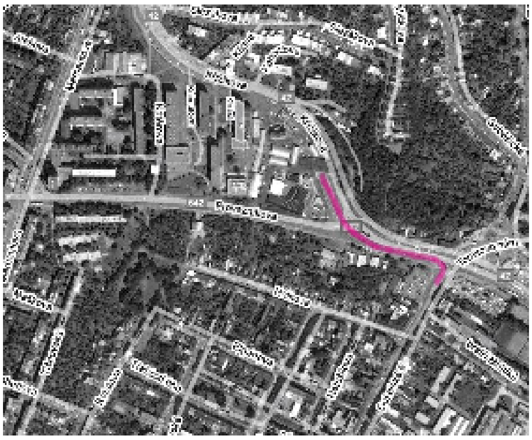


Figure 49: Picture of the route in Brno - Section 13

Section 14: Dukelská třída turn right into Dačického; turn left into Nováčkova; turn rigt into Svitavská; turn left into Vranovská; turn left into Cejl

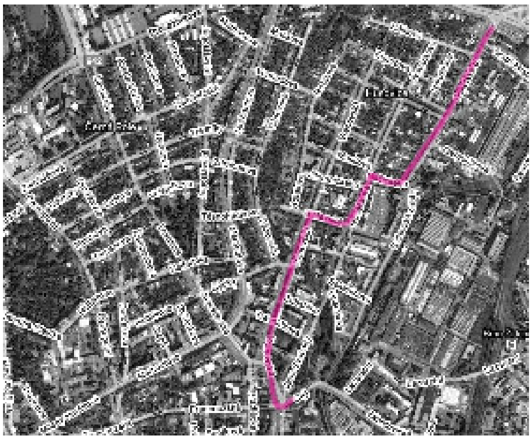


Figure 50: Picture of the route in Brno - Section 14

Section 15: Cejl leads into Zábrdovická; leads into Bubeníčkova; turn right into Rokycanova

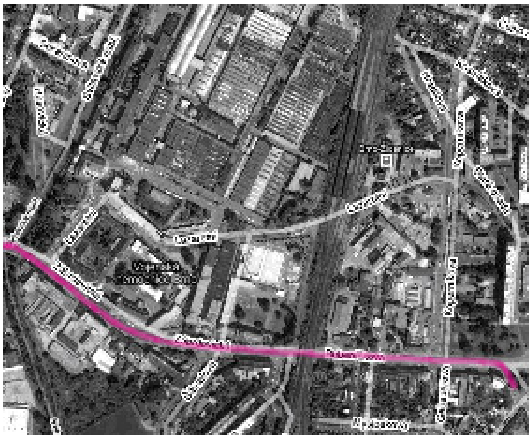


Figure 51: Picture of the route in Brno - Section 15

Section 16: *Rokycanova* turn left into Kaleckého; turn right into Gajdošova

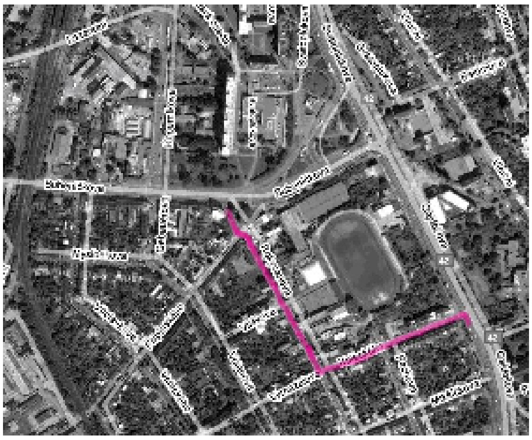


Figure 52: Picture of the route in Brno - Section 16

Section 17: Gajdošova turn left into Táborská

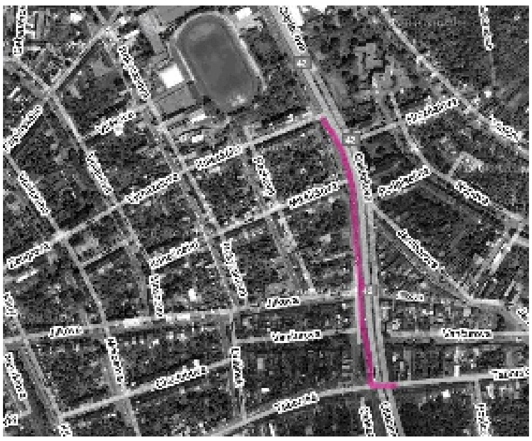


Figure 53: Picture of the route in Brno - Section 17

Section 18: Táborská leads into Líšeňská

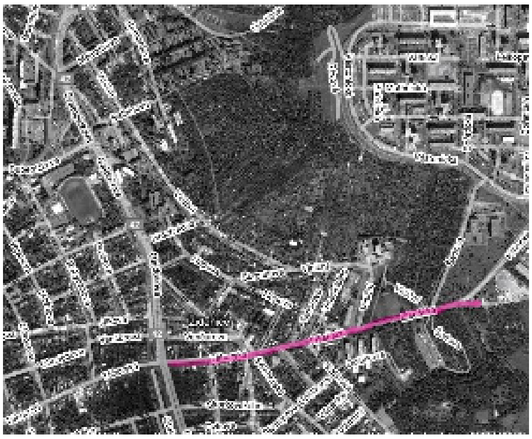


Figure 54: Picture of the route in Brno - Section 18

5.4. Questionnaire

In order to get to know the attitudes of novice drivers towards traffic safety, speed in general as well as towards the ISA system, participants were asked to fill in up to three different questionnaires during every phase of the empirical part of the study. The questionnaires were translated into Czech so that they were available in German and Czech. The origin of these instruments will be described in more detail in the following sub-chapters.

5.4.1. "ISA" questionnaire

The "ISA" questionnaire was developed to answer hypothesis 4. This instrument was based on the literature (Hjälmdahl, 2004a), on an expert interview, but also on two in-depth interviews with persons belonging to the target-group. As the results of the preparatory works were not exhausting, the questionnaire for the first phase was designed to include open questions (Annex III). It was subdivided into four main sections. At the beginning participants were asked to provide general information, like age, gender, job, date of acquisition of driving license, driving experience, how they estimate their own driving skills and some more. That section was followed by questions about traffic safety. Here, the focus of interest was on the perceived subjective risk in traffic and if the participants had any preferred modes in order to reduce the experienced risk. Respondents were asked about traffic rules, who is responsible for traffic safety and how a driver, who endangers others, might behave. The section to evaluate the attitudes towards speed included a specification of what speed means to the participants but also questions about the speed limit in the particular country. Finally young drivers had to think about advantages and challenges of an ISA system and they were asked about their willingness to use such a system and to specify reasons for their decision.

In the second phase of the study the same questionnaire was used, but it was designed in a more standardised way (Annex IV). This newly designed measurement method included the same questions as the first version but additionally different answer categories were added. These categories derived from the responses of the first questionnaire. The answer options were based on a five point Likert scale.

5.4.2. The Manchester Driver Behaviour Questionnaire – DBQ

In this chapter a short overview of the origin but also of the widespread application of this instrument will be given according to Freeman et al. (2007), Wishart et al. (2006), Lajunen et al. (2004), DfT (n.a.), Lawton et al. (1997), Özkan and Lajunen (2005) as well as Bener et al. (2008).

Based on the idea of different causes for erroneous driving behaviour, Reason et al. (1990) developed the Driver Behaviour Questionnaire. At the very beginning a differentiation was only made between "errors" and "violations". It was assumed that both types of behaviour have a different psychological origin. However, a third class of behaviour "lapses" was found. Due to further research, Lawton et al. (1997) were able to split the factor violation into two scales. Hence, the DBQ discriminates between "lapses", "errors" and two types of "violations". Lapses are behavioural patterns that occur because of inattention of the driver. Errors can be described as mistakes, caused by misinterpretation of the situation. Hence they are of a more knowledge-based nature. Further the questionnaire tends to establish the attitude of respondents towards violations, "normal" violations as well as "interpersonally aggressive" violations. Violations are assumed to be committed consciously, whereas lapses and errors happen unintentionally.

In a study involving 1.600 drivers Parker et al. (1995) identified a connection between the accident involvement and violating behaviour; for errors or lapses such a correlation could not be confirmed. Reason et al. (1990) determined young male drivers to be the group to most readily confess to the violations of law. Besides, the driving experience seems to have an influence on the willingness to violate traffic rules; experienced drivers tend to violate traffic rules more often than novices (Åberg and Rimmö, 1998; Blockey and Hartley, 1995; as cited in Bener et al., 2008). Özkan et al. (2006) could extract international differences in the scores; Southern and Middle Eastern drivers committed more errors and violations than Western and Northern Europeans did.

Until now the DBQ has not only been applied in the UK but in several studies all over the world. Sullman et al. (2000) identified the same four factors (errors, lapses, violations and aggressive violations) as Lawton et al. (1997) did. In Sweden Åberg and Rimmö (1998) located a four-factor solution with errors and violations but two types of lapses. Blockey and Hartley (1995) extracted three factors among Australian drivers: general errors, dangerous errors and dangerous violations. Among a sample of 363 Chinese drivers, Xie and Parker (2002) found three factors which were slightly different in their composition than the original ones from Reason et al. (1990). Further studies were conducted in Brazil (Bianchi and Summala, 2002), in Greece (Kontogiannis et al., 2002), in Finland and The Netherlands (Lajunen et al., 1999) and Turkey (Sümer et al., 2002). Although not all of the studies mentioned have classified the four types of behaviour identically, the distinction between error and violation seems to be robust.

The version of the DBQ implemented in the present study consists of 28 questions, to be answered on a six-point scale (Annex V).

5.4.3. The "Type" questionnaire

The "Type" questionnaire (Annex VI) is a good possibility to gain more information about the personality of drivers. It was developed by the Psychonomics AG for the AXA group and can be downloaded from the website http://www.autofahrertypen.de (2009). This instrument consists of 28 questions with a 4-point scale of answer options. The questionnaire is concerned with emotions while driving a car, attitudes towards driving and the vehicle, which motives are related to driving and so on. Until January 2009 65.942 people had filled in the questionnaire online and six different driver groups were identified. Participants are classified as functional, anxious, speeding, calm, frustrated or cautious drivers. This categorisation was adapted for the present study.

5.5. Group discussion

The literature review (see sub-chapter 3.3) has highlighted the positive effects of insight trainings on the attitudes of young drivers. For this reason a special training programme was developed which aimed at the sensitisation of young drivers concerning risks in traffic. Furthermore this training is expected to enable the participants to adopt the point of view of other road users, vulnerable road users but also car drivers, in order to establish some kind of mutual understanding. The evolved training was mainly influenced by the GDE-Matrix but also by a report of Engström et al. (2003) who identified psychological and social processes that are relevant for a training of novice drivers.

The training was masked as “group discussion”, as some participants might have been alienated by the name “psycholgical group training”. It was based on literature, on the driver improvement lectures carried out in Austria, as well as on the information received during a visit at VTI. Different methods were applied in the course of the training: plenary discussions, small-group teamwork and a role-play. The training was carried out in Vienna as well as in Brno, where a colleague of CDV assisted. The group discussion was split into two parts, each lasting for two hours, held on two different days with a two-week gap in between.

Figure 55: “Welcome” flip chart of a group discussion in Austria

The first session focused on motives, emotions and expectations that are related to driving. The session started with an introduction round. The participants were asked not only to introduce themselves shortly but also to think of the car of their dreams. This small experiment should give an initial impression of the attitudes and expectations participants have towards a car.

Figure 56: Result of the group discussion about motives of driving of one group

After the introduction round the participants were split into small groups with two or three people. They had to reflect on the role of a vehicle on motives, desires, emotions, attitudes which are related to driving more thoroughly. The findings were discussed with respect to inter- and intra-individual conflicts of interests for example with respect to the consequences for other road users.

Another point of interest was how much importance was ascribed to safety and what motives could counteract safe behaviour (see figure 56). The last part of this session was dedicated to the ISA-system. After reminding the participants on the basic functions of the ISA-system they were asked to discuss pros and cons of an ISA system and which needs, interests, and feelings may be influenced by the system.

The second part of the discussion was focused on traffic safety, speeding and the consequences of speeding, but also on communication with other road users and thus, the traffic system itself. At the beginning participants were asked to estimate their own behaviour and how riskily they behave in traffic according to their opinion (see figure 57). Based on this rating the young drivers were asked to describe an "unsafe" driver. The aim was to identify characteristics of a person who endangers others in traffic.

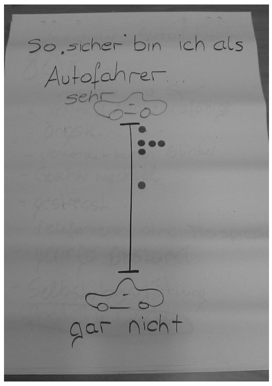


Figure 57: Self-Estimation about traffic behaviour

Further a closer look on speeding was taken. The participants received information about statistics, the consequences of speeding for pedestrians, the definition of the stopping distance and so on. Pictures of a car that crashed a tree with different speeds as well as video clips, produced to prevent speeding, were shown and discussed.

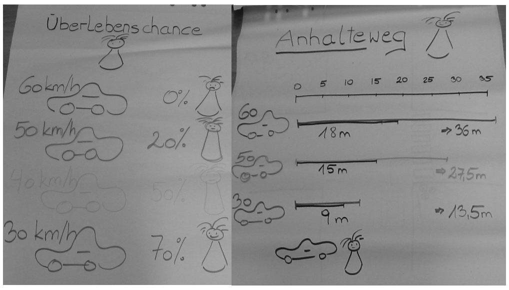


Figure 59: Chance of survival for pedestrians after a crash with a car with different speed; stopping distance

Finally the topic "communication" in traffic was mentioned. "What is communication?", "How do we communicate while steering a vehicle?" but also the question, how one's behaviour influences other road users were discussed. In order to get answers on these questions participants were asked to take part in a role play. They had to imagine a crossing-situation where a car wants to turn right at the same time when a group of pedestrians wants to cross at the zebra crossing and a bicycle wants to cross the street as well. The task was to think about the characteristics of this situation from different points of view (car driver, bicycle and group of pedestrians) in order to achieve differing perspectives and empathy for other groups of road users.

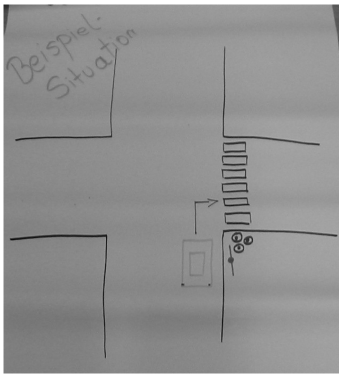


Figure 58: Situation for the role-game

At the end of the training all young drivers had to fill in a feedback questionnaire (Annex VII). The questionnaire concentrated on how participants liked the training, what was most interesting for them and how to improve the training, with regard to the content but also the method.

5.6. Statistical measures

The information of this section is mainly based on Rudolf and Müller (2004), Ponocny-Seliger and Ponocny (n.a.), Bortz (1999), DeCoster (1998), Brosius (2007), Bühl and Zöfel (2000), Field (2005), Boslaugh and Watters (2008), Howitt and Cramer (2005), Blasius (2001) as well as the homepage of Stasoft (www.statsoft.com/textbook). For all tests and analyses, a p-value smaller than 0.05 was assessed as a significant result and a p-value smaller than 0.01 as a highly significant result; results with p-values between 0.09 and 0.05 were considered as indicating a trend.

5.6.1. Chi-square

To calculate the significance of differences between frequencies of nominal data, Pearson's chi-square test is the method of choice. The chi-square test is based on crosstabs and verifies hypothesis 0, two groups are independent from each other, by comparing the observed with the expected frequencies. Hypothesis 0 has to be rejected as soon as p is smaller than 0.05. If the estimated values in each cell of the table are smaller than 5, the Fisher's exact test has to be calculated (see below).

5.6.2. Cluster analysis

The cluster analysis represents an exploratory method. Unlike the factor analysis the cluster analysis does not aim at the reduction of information but, is based on measures of similarity or distance, in the categorisation of data. However, the main objective is to obtain a specific number of groups, so called clusters, each comprising answers as homogenous as possible, but bearing a minimal degree of coherency with the others.

At the very beginning of the data analysis there is typically no information about the amount of groups that is to be elicited through the data. Hence, in literature it is suggested to start with a hierarchical cluster analysis. This method either groups the single values to clusters (agglomerative) or it segments the entity of values (divisive) and thus builds groups. In practice it is very common to build groups based on the distances of the single values, the agglomerative approach.

Initially, distances between the scores have to be calculated. Several distance measures, like Chebychev distance, City-block distance, Euclidean distance, etc. are available. For this thesis the Squared Euclidean distance measure was applied. The decision for this method was based on data characteristics (interval level) as well as on the decision for the linkage technique (see Ward method just below).

In a next step those calculated distances must be linked to each other in order to build clusters. Again, several possibilities to conjoin the variables exist; single linkage, complete linkage, unweighted pair-group centroid as well as the weighted pair-group average method or the Ward method can be adopted. To categorise the data of the DBQ the Ward method was implemented; as suggested in Bortz (1999). The Ward method links the elements in such a way as to minimize the increase of the sum of the squared distances.

The "Agglomeration Schedule", a result of the Ward method, provides all needed information for the decision about a reasonable amount of clusters to extract. At the point where the line shows a steep rise (the "elbow") the number of clusters can be read.

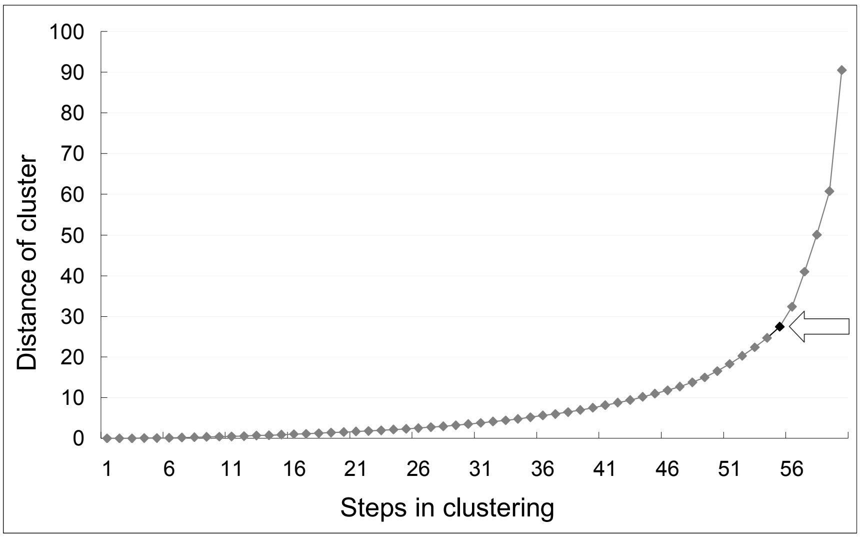


Figure 60: Elbow criterion

In order to improve the consistency of each single cluster, literature recommends the realisation of a partitional clustering method, that re-sorts the elements until no more optimization can be achieved; the method of choice is the k-Means Clustering. Finally the identified clusters have to be specified.

5.6.3. Correspondence analysis

The description of that exploratory method mainly is based on the work of Blasius (2001), the stasoft homepage, as well as on a presentation within the framework of university lectures (Horvath and Böhnisch, 2007). However, the nature of the correspondence analysis is rather similar to the factor analysis. By computing a chi-square distance it reduces the information of crosstabs to a one-, two- or three-dimensional graph and thus graphically illustrates the correlations of the feature characteristics. Each point in the graph reflects one feature characteristic. To interpret the results it is important to have a closer look at the inertia which is defined as “the total Pearson Chi-square for the two-way divided by the total sum” (“Stasoft”-homepage, n.a.). The proportion of inertia indicates the importance of a specific dimension; the higher, the more important. Furthermore the quality of a point (feature characteristic) is described by the contribution of the point to the inertia of the dimension. Moreover the correspondence analysis allows three different representations of the results, a symmetrical normalization or a row versus a columns principal normalization. In this PhD study, the symmetrical version was used which implies that the distances between row and column points must not be interpreted.

5.6.4. Factor analysis

The factor analysis is an explorative, data reductive method to identify underlying patterns of a set of variables in such a way that not much information is lost (Rudolf and Müller, 2004; Ponocny-Seliger and Ponocny, n.a.; Bortz, 1999; DeCoster, 1998). It produces factors that are, to a large extent, independent. The factors consist of highly correlated variables. This procedure helps to reduce the amount of xx variables (affinity to apples and affinity to pears) of a questionnaire to y factors (affinity to fruits in general), representing a set of these variables.

To extract those underlying factors, different statistical procedures are well-known; however, one of the most important methods is the principal component analysis (PCA), which was applied in the present study. Moreover, for a better interpretation of those factors, a rotation is needed. Again, several procedures are well-known. One can choose between an orthogonal or an oblique rotation. The orthogonal rotation entails factors that are highly independent of one another, whereas the oblique rotation leads to correlated factors.

The decision about how many factors should be extracted depends either on the Kaiser criterion or on the elbow criterion of a scree test. The Kaiser criterion suggests to choose only factors with an eigenvalue greater than one. Hence a factor that does not contain at least as much information as a single variable should be dropped. Regrettably in many cases this method results in too many factors. As alternative procedure a scree test can be conducted. This test is a graphical method and is based on a plot illustrating the eigenvalues of factors. As already mentioned for the cluster analysis, the “elbow” criterion can be applied.

Further recommendations found in the literature are:

- The sum of the selected factors should account for about 60 to 70% of the variance.
- The factor loadings (correlations between the variable and the factor) should be 0.5.
- The communalities should be 0.7.
- If at least four factor loadings are 0.6 or above, the result is reliable.
- If the factor loadings of 10 to 12 variables are 0.4 or above, again the result is reliable.

As has already been mentioned above, within the present study the PCA was favoured and an orthogonal, more precisely the varimax rotation, was chosen. The number of factors was based on the Kaiser criterion, the “elbow” criterion of the scree plot and on considerations with regards to the content. Only factors with loadings equal or greater than 0.450 have been considered in the further analysis.

5.6.5. Fisher's exact test

Like the Pearson´s chi-square test, the Fisher´s exact test is based on contingency tables and calculates the differences between the frequencies of nominal data. This test is robust, even if the sample size is small and the expected frequencies are less than 5. Again hypothesis 0, two groups are independent from each other, has to be rejected as soon as p is smaller than 0.05.

5.6.6. Reliability analysis

Referring to sub-chapter “Quality criteria”, reliability is concerned with the consistency of a test or an instrument. The most popular way to evaluate consistency is to use the Cronbach´s alpha (α). This method is based on the split-half reliability that divides a data set randomly into two parts. The results of both parts are correlated. A high correlation value indicates a good reliability. To avoid any bias in the results, the data sets are not divided just once, but are split in any possible way. The average of the correlation coefficient for each split is called Cronbach´s alpha. Values between 0.7 and 0.8 are acceptable, values above 0.8 are good.

5.6.7. T-Test

The t-test is a measure to test whether a sample shows the same attributes as the average population or to compare two samples. Within the framework of this thesis, this method was used to examine the differences between two independent groups of participants; like male/female, young/old or novice/experienced. However, required premises for this type of measure are data on an interval level, bell shape of the scores as well as equality of variances. The distribution of values within one variable can be tested with the Kolmogorov-Smirnov test (K–S test). If the result of the K–S test is significant, no normal distribution can be found and the t-test should not be calculated. Further the Levene´s test shows whether the variances of two samples are equal or not. A significant result of this statistical measure implies non-equal variances; in such cases the Mann-Whitney U test should be the method of choice. In the current thesis the t-test was only calculated if the required conditions were fulfilled; the level of significance was set at the 5% boundary.

5.6.8. Variance Analysis for repeated measures

Similar to the t-test, a variance analysis compares the means of scores of groups in order to test the effects of one or more independent variable/s on one or more dependent variable/s. By comparing the means of just two groups, the result of a variance analysis would be the same as the result of the t-test. Like for the t-test, the data need to be normally distributed, which can be tested with the K–S test (see sub-chapter 5.6.7). Again, the variances should be as similar as possible for the groups. Whether this condition is fulfilled or not can be tested with the Levene´s test. A non-significant result indicates that the variables have a normal curve of distribution (K–S test) or have equal variances (Levene´s test). The variance analysis seems to be quite robust against the violation of both requirements if the number of participants is similar in the tested groups. However, the main function of the variance analysis is to detect correlations rather than identify the strength of those correlations. For this reason the analysis was calculated in the current study, although the distribution might not be normal or the variances might not be equal.

Another requirement of a variance analysis is that the dependent variable/s need to be metric whereas the independent variable/s can be nominal. Furthermore the sphericity, which represents the assumption of similar variations between conditions, should be similar as well. Sphericity can be tested with the Mauchly´s test. If sphericity is violated, several corrections can be used instead, as for instance the Greenhouse-Geisser correction. Because in the current study the values of the corrections were the same as the values for the calculation in which sphericity was assumed, only the latter values have been mentioned.

Results reported in the current studies, were the effect of the independent variables, the interaction effect of the independent variables and the dependent variables as well as the between-subjects effects.

6. From plan to reality – Challenges in the work

As quite often, this study started with an eager plan, well structured and concise. Actually, some challenges had to be accepted in order to successfully implement the plan. It seems to be rather important to discuss these challenges beforehand in order to present the results in a proper light afterwards.

It was planned to have 40 participants in Austria and in the Czech Republic respectively. Eventually 74 young drivers could be attracted to participate in the study. Due to the long-term character of the study some of them decided to withdraw their participation in the course of the study. Table 27 gives an impression of the dropout rate. Furthermore it illustrates the available data in detail. Of course, the dropouts affected the data analysis to some extent, since not all data sets could be used. For instance, if someone did not take part in step 2 of the study, it was not possible to calculate the influence of the ISA system on the communication behaviour. In such a case the data set could not be used to investigate hypothesis 1.

Moreover table 27 illustrates that far less than half of the young drivers did participate in the psychological group training; just one third did.

Concerning the completeness of the data, another aspect has to be mentioned as well. Some of the questionnaires were not filled in properly. If information was missing for some statistical measures, these data sets could not be used.

Another aspect that influenced the data analysis was the availability of the route. Because of construction works or a heavy congestion sometimes a different route had to be chosen or the speed limit was different in that particular case. These issues might cause a bias of the results.

Steps of the study		Number of people (test group) in country					Number of people (control group) in country			
		AUT	CZ	Sum	Drop Out	All in all	Sum	CZ	AUT	
Step 1 (a)	Drive in a driving school	15	8	**23**	51	74	**51**	19	32	Drive in a driving school
	Fill in "ISA" questionnaire	15	8	**23**	51	74	**51**	19	32	Fill in "ISA" questionnaire
Step 2 (b)	Drive an ISA equipped car on an extra route to get used to the system	15	8	**23**	41	64	**41**	16	25	Drive an ISA equipped car on an extra route to get used to the system
	Drive an ISA equipped car on the original route	15	8	**23**	38	61	**38**	13	25	Drive an ISA equipped car on the original route
	Fill in "ISA" questionnaire	15	8	**23**	40	63	**40**	15	25	Fill in "ISA" questionnaire
	Fill in DBQ	15	8	**23**	40	63	**40**	15	25	Fill in DBQ
	Fill in "Type" questionnaire	15	8	**23**	40	63	**40**	15	25	Fill in "Type" questionnaire
Step 3 (c)	Participate in the pschological group training	15	8	**23**						Did not get any treatment
	Fill in "ISA" questionnaire	15	8	**23**						
	Fill in "Type" questionnaire	15	8	**23**						
	Fill in "Training" evaluation	15		**15**						
Step 4 (d)	Drive in a driving school	15	8	**23**	36	59	**36**	15	21	Drive in a driving school
	Fill in "ISA" questionnaire	14	8	**22**	36	58	**36**	15	21	Fill in "ISA" questionnaire
	Fill in "Type" questionnaire	14	8	**22**	36	58	**36**	15	21	Fill in "Type" questionnaire

Table 27: Overview of the participants and their involvement in the study

With respect to the observation, the most important issue was an inconsistency between the notes of the observers. Although the observers were instructed in the course of two to three training rides how to take notes, considerably strong differences between the assessments of the various observers were manifest. Already during the first ride (step 1) the means of the data of the main and one supporting observer (M_{Ob1} = 3.74, SD = 2.00; M_{Ob2} = 0.94, SD = 0.47) were significantly different [t(66.37) = 9.69, p = 0.000] as table 28 illustrates.

	Step 1	
Observer	**1**	**2**
N	63	11
Mean	3.74	0.94
SD	2.00	0.47
T-test (p)	0.000	

Table 28: Inconsistency between the main observer (Observer 1) and the supporting observer 2 in ride one

The picture was quite similar during step 2 (ISA-ride; see Table 29). The main observer (Observer 1) evaluated the behaviour of the young drivers significantly differently from the two supporting observers [t_{Ob1Ob2}(51.07) = 14.24, p = 0.000; t_{Ob1Ob3} (40.22) = 13.86, p = 0.000]. Both supporting observers, however, showed a similar assessment of the behaviour [t(11) = -0.20, p = 0.842]. Thus, when comparing the rating of the main observer with the ratings of both supporting observers again a significant difference appears [t(53.22) = 14.86, p = 0.000)].

	Step 2							
Observer	**1**	**2**	**1**	**3**	**2**	**3**	**1**	**23**
N	46	8	46	5	8	5	46	13
Mean	6.41	0.97	6.41	1.02	0.97	1.02	6.41	0.98
SD	2.35	0.46	2.35	0.40	0.46	0.40	2.35	0.42
T-test (p)	0.000		0.000		0.842		0.000	

Table 29: Inconsistency between the main observer and the two supporting observers in the second ride

Also in the last ride (step 4) the observed data of the main observer and of observer 2 were inconsistent [t(57) = 3.60 p = 0.001)]. On average, the main observer noted more mistakes (M = 4.40, SD = 1.80; M = 0.64, SD = 0.21) than observer 2 did.

	Step 4	
Observer	**1**	**2**
N	56	3
Mean	4.40	0.64
SD	1.80	0.21
T-test (p)	0.001	

Table 30: Inconsistency between the main observer and the supporting observer 2 in the last ride

The investigated difference between the estimations of the main observer and the two supporting observers had a serious impact on the data analysis. Consequently only data of the same observer were compared by means of the several statistical measurements that will be discussed in detail in the following. The assessments of both supporting observers were treated as being from one, as their ratings were sufficiently consistent.

Another point that needs to be mentioned is the observation of the driving speed and, in connection with that, the exceeding of a speed limit. The usage of the indicator can be registered quite easily by taking a note as soon as the behaviour occurs. For the driving speed this simple task became far more challenging, as participants indeed did speed up just once, but for a longer period of time. For this study it was decided to make several entries in such a case. Furthermore the speed in many cases was not kept at a stable rate but changed several times within one marking sequence. The extent of speeding would make a difference for the risk assessment as well. As it was not possible to account for all those issues and as there was no external device to record the speed, it was decided to exclude this variable from the analysis. Although the variable “speed” would have been very relevant for the investigation of the effects of ISA, the exclusion of the variable seemed to be rather important in order to keep the results of the study as reliable as possible.

Summing up, all these challenges that appeared during the implementation and procedure of the current study made a very careful analysis of the data necessary. The discussion of the results, in particular, had to take into account the restraints mentioned above. Both, results as well as the discussion will be presented in the following chapters, completed by recommendations for future research in this area, with similar methods.

7. Results

This chapter starts with an overview of general, descriptive parameters concerning the participants, such as age, gender, driving experience and so on. Then some basic information about the outcomes of the different methods, the behaviour observation as well as the different questionnaires, will be given. Finally the four hypotheses, described in chapter 4, will be dealt with.

7.1. “Who” participated in the study?

74 young drivers participated in the first phase of the PhD study. 27 of them came from the Czech Republic and 47 from Austria, 28 were women and 46 men. The distribution of the sexes in both countries was significantly different [χ^2 (df = 1, p = 0.009)] as can be seen in figure 61. In Austria about half of the participants were women, while in the Czech Republic only a few females participated.

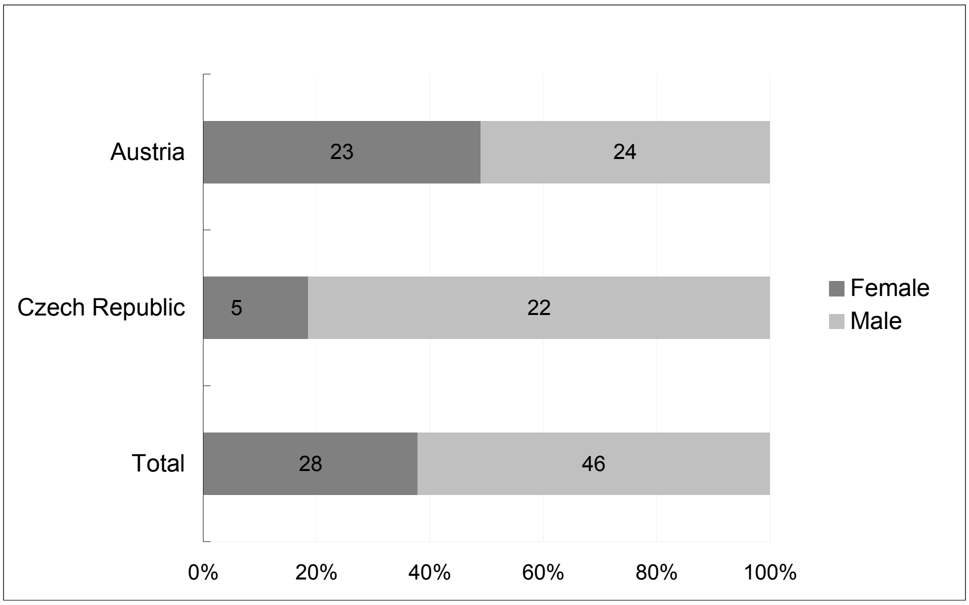


Figure 61: Gender distribution in the Czech and Austrian sample (N = 74)

The participants were between 18 and 30 years old. The mean age in the Czech Republic was about 19 and in Austria about 23 [χ^2 (df = 9, p = 0.000)]. The different methods of recruitment may be the reason for this phenomenon. As mentioned in chapter 5.2 people in Austria were recruited via an internet platform whilst they were recruited via a driving instructor in the Czech Republic.

About 80% of the participants were students. Only some participants (approximately 20%) were working or still at school and one was unemployed, as can be seen in figure 62.

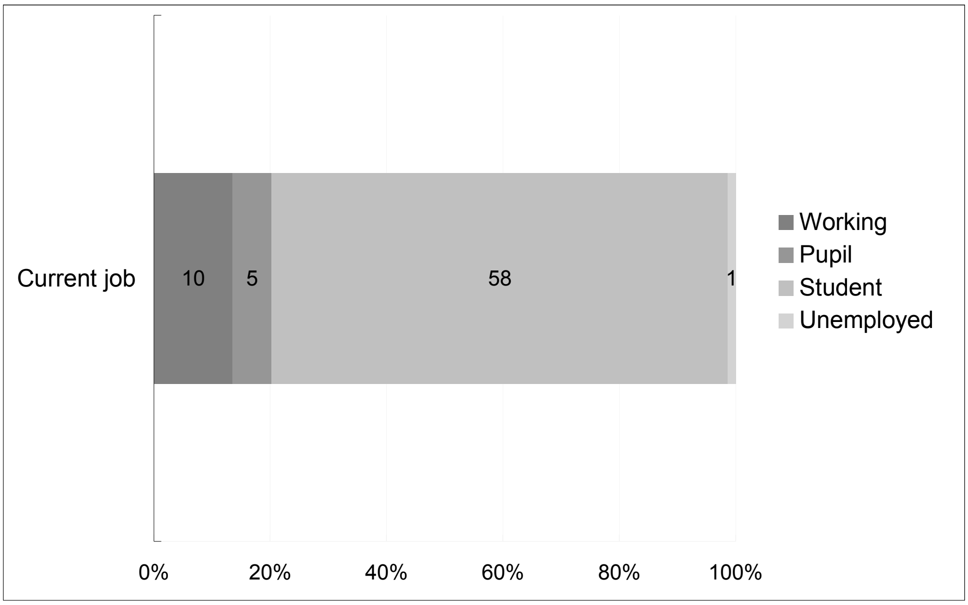


Figure 62: "Current job" in the Czech Republic and in Austria (N = 74)

6 participants did not have a valid driving licence at the beginning of the study. 68 had a driving licence allowing them to drive passenger cars and some of them also had a driving licence for other vehicles, like motorbikes or lorries. The driving experience of both groups was quite different. In Austria participants had acquired their licences on average 58 months ago, whereas in the Czech Republic this was only about 11 months ago [χ^2 (df = 43, p = 0.062)]. Concerning driving experience in proportion to mileage, figure 63 shows a quite heterogeneous picture [χ^2 (df = 258, p = 0.057)]. 21 participants had 5.000 or less kilometres of driving experience, and a distance of 5.000 to 10.000, 20.000 to 50.000 and 50.000 to 100.000 kilometres were covered respectively by 10 participants. 7 participants had covered a mileage of 10.000 to 20.000 kilometres and 9 a mileage of more than 100.000 kilometres in total.

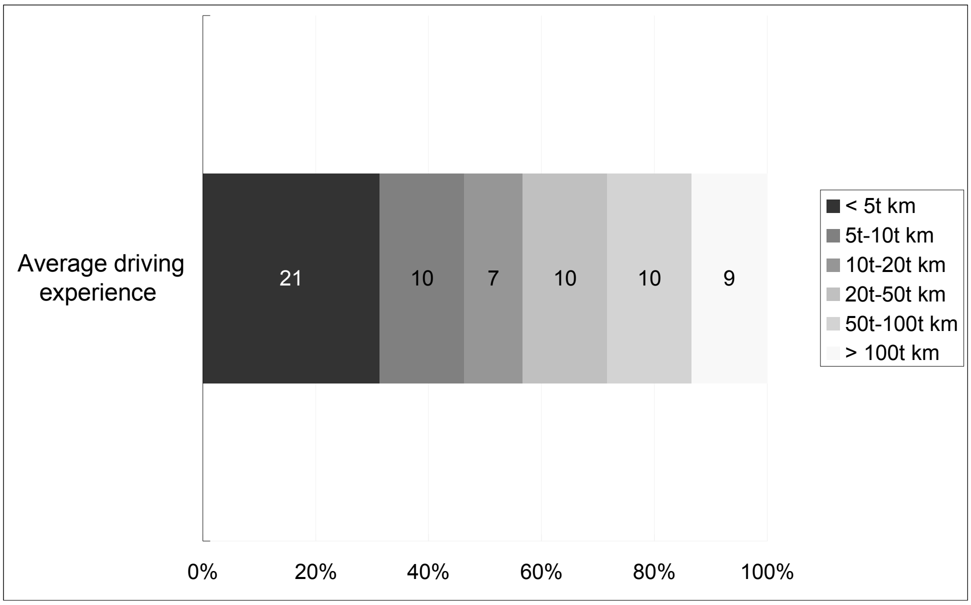


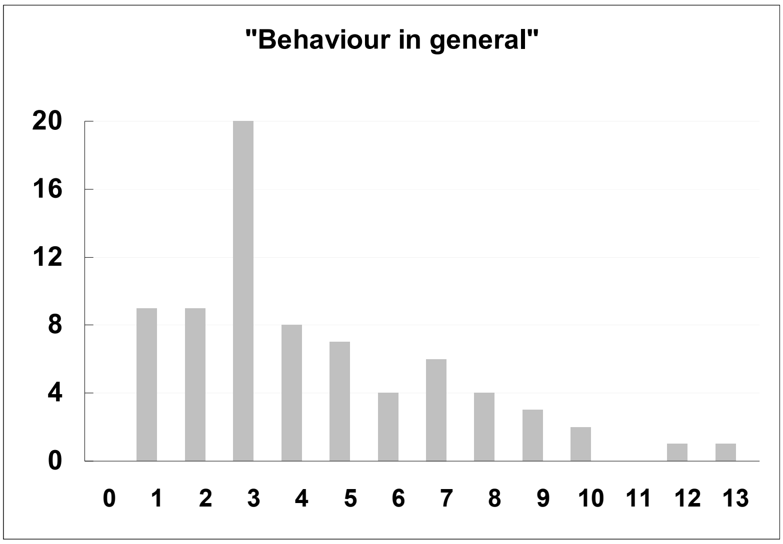
Figure 63: Average driving experience since having obtained the driving licence in absolute figures (N = 67)

No significant difference between female and male drivers could be found with respect to the driving experience [χ^2 (df = 6, p = 0.883)]. As expected, a trend that younger participants possess less driving experience was identified [χ^2 (df = 54, p = 0.084)]. More information about the participants, their attitudes and characteristics will be given in sub-chapter 7.3 to 7.6.

7.2. Behaviour observation

The sub-chapter “behaviour observation” provides an overview of young driver’s behaviour during the first ride (step 1) of the study. The sum of errors, assessed by the observers, was summarized over all sections and averaged. It was decided not to calculate the total amount of errors as in Austria and the Czech Republic a different amount of sections was defined which might distort the results. In order to avoid an extensive amount of figures with not much significance, the procedure was not applied to every single variable, but to a set of variables, and which will be reapplied later on as well. To build such an index (set of variables) the values of each related variable were summarised for each section and, subsequently, averaged over all sections.

To get an impression of the **general** amount of unwanted **behaviour** of young drivers, an index comprising all variables except speed was created. Since the index was used later on as well, the speed variables were excluded from that index, as they are very difficult to observe and thus are not very reliable. Figure 64 illustrates that 12.2% (N = 9) of the participants behaved well with none to one error per section. The same number of people (N = 9) made one to two mistakes in each section. With 47.3% (N = 35), the majority of young drivers made two to five errors per section. For 17 participants observers marked five to nine errors in each section and for 4 nine to thirteen remarks per section were noted. On average young drivers did not behave accurately in about 4 situations per section during the first ride.



Limits	Frequ.	%
0	0	0.0
0-1	9	12.2
1-2	9	12.2
2-3	20	27.0
3-4	8	10.8
4-5	7	9.5
5-6	4	5.4
6-7	6	8.1
7-8	4	5.4
8-9	3	4.1
9-10	2	2.7
10-11	0	0.0
11-12	1	1.4
12-13	1	1.4

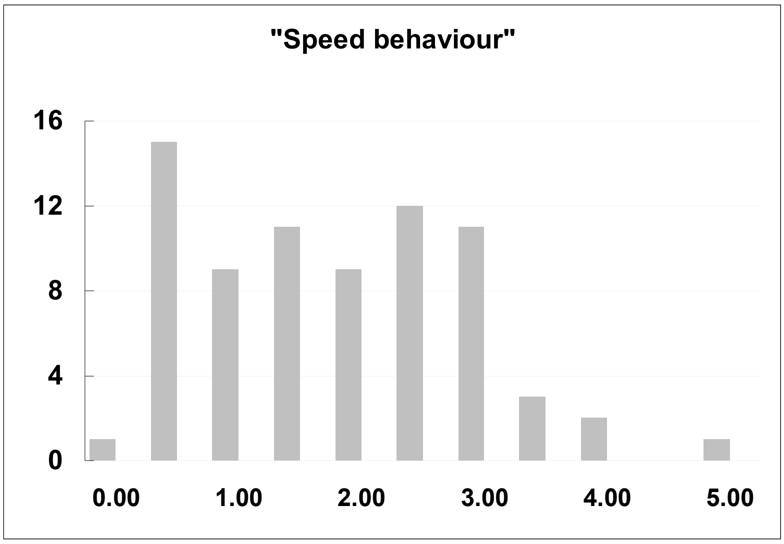
N = 74	
3.93	Mean
2.72	SD

Figure 64: Mean of errors averaged over all sections for the sum of all variables except speeding

The index “**Speed behaviour**” was generated using the variables driving too fast according to law or the situation, as well as driving too slowly according to the situation. On average young drivers neglected the speed limits or drove too fast for the traffic conditions 1.63 times per section. Just one participant never behaved inadequately with respect to speed. One fifth (N = 15) made up to 0.50 mistakes concerning their speed choice per section, or in other words 9 respectively 12.5 times per ride (18 respectively 25 sections). The majority of the sample (N = 52) showed a bad speed choice 0.51 to 3.00 times per section. For 6 participants more than 3.01 mistakes with regard to the chosen speed were noted in each section.

	Speed	Too fast according to the law	
		Too fast according to the situation	
		Too slow according to the situation	

Table 31: List of variables integrated in the “Speed behaviour” index



Limits	Frequ.	%
0.00	1	1.4
0.01-0.50	15	20.3
0.51-1.00	9	12.2
1.01-1.50	11	14.9
1.51-2.00	9	12.2
2.01-2.50	12	16.2
2.51-3.00	11	14.9
3.01-3.50	3	4.1
3.51-4.00	2	2.7
4.01-4.50	0	0.0
4.51-5.00	1	1.4

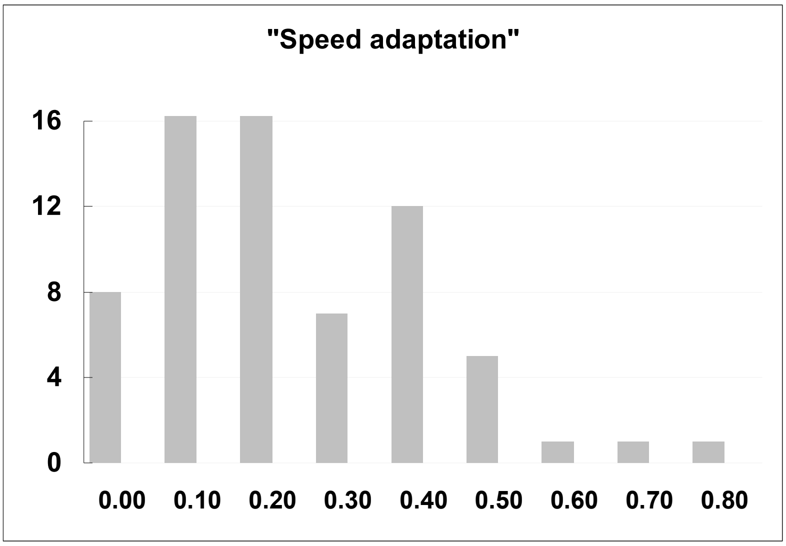
N = 74	
1.63	Mean
1.06	SD

Figure 65: Mean of errors averaged over all sections for the index “Speeding”

Speed adaptation was defined by the two variables “late” and “abrupt” as displayed in table 32. About 11% (N = 8) of the participants correctly adapted their speed in every situation. 39 drivers showed 0.01 to 0.20 mistakes per section with regard to speed adaptation. A quarter of the sample (N = 19) adjusted their driving speed late or abruptly 0.21 to 0.40 times within one section. 8 people did not behave correctly in more than 0.41 situations per section. On average people adapted their speed badly 3.60 respectively 5 times during the first ride (0.20 per section).

Adaptation of speed before/in intersection or before obstacles	Late	
	Abrupt	

Table 32: List of variables integrated in the “Adaptation of speed” index



Limits	Frequ.	%
0	8	10.8
0.01-0.10	20	27.0
0.11-0.20	19	25.7
0.21-0.30	7	9.5
0.31-0.40	12	16.2
0.41-0.50	5	6.8
0.51-0.60	1	1.4
0.61-0.70	1	1.4
0.71-0.80	1	1.4

N = 74
0.20 Mean
0.17 SD

Figure 66: Mean of errors averaged over all sections for the index “Speed adaptation”

The **overtaking** behaviour was described by the variables “overtaking illegal”, “overtaking dangerous” and “overtaking unnecessary”. As figure 67 shows, most of the young drivers did not get any entry with regard to that index. In the Austrian sample two drivers overtook once (0.40) and another two drivers overtook twice (0.80) in an inappropriate manner.

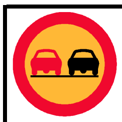
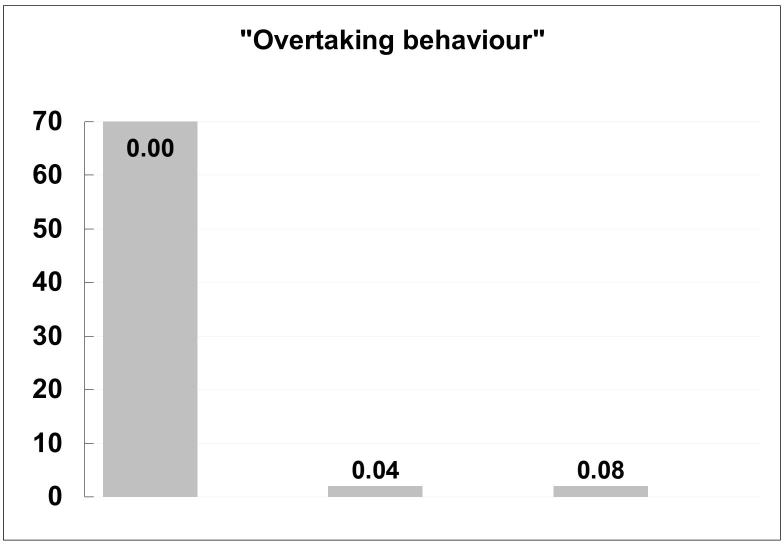
	Overtaking	Illegal	
		Dangerous	
		Unnecessary	

Table 33: List of variables integrated in the “Overtaking” index



Values	Frequ.	%
0.00	70	94.6
0.04	2	2.7
0.08	2	2.7

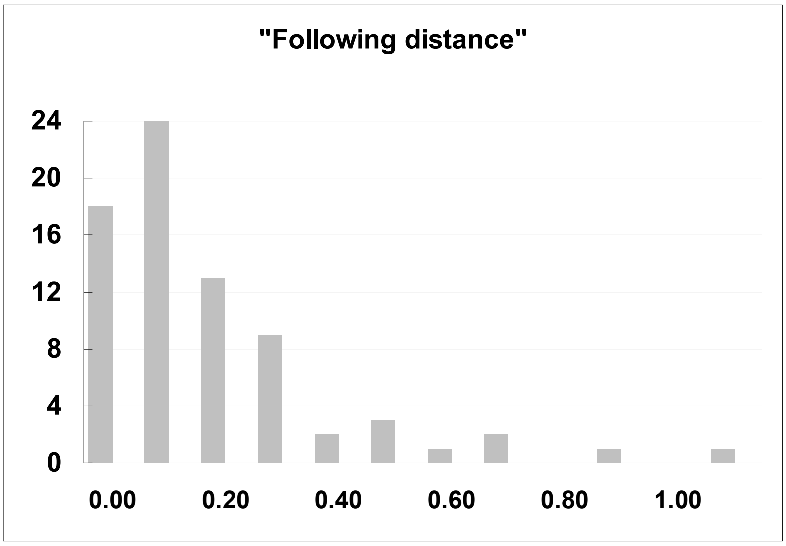
N = 74
0.00 Mean
0.01 SD

Figure 67: Mean of errors averaged over all sections for the variable “overtaking”

If the distance to the car ahead was dangerous or at least too short this was marked as an error as well. Both types of behaviour were used to calculate the index “**Following distance**” (see table 34). The following distance was kept correctly in about one quarter of all cases (N = 18). Half of the young drivers (N = 37) chose a too short distance to the car ahead just 0.01 to 0.20 times per section. For another 15 participants a value of 0.21 to 0.60 was calculated. More than 0.61 errors per section concerning the following distance were noted for 4 people. The average error rate per section was 0.16.

Distance to the road user ahead	Dangerous	
	Too short	

Table 34: List of variables integrated in the “Following distance” index



Limits	Frequ.	%
0	18	24.3
0.01-0.10	24	32.4
0.11-0.20	13	17.6
0.21-0.30	9	12.2
0.31-0.40	2	2.7
0.41-0.50	3	4.1
0.51-0.60	1	1.4
0.61-0.70	2	2.7
0.71-0.80	0	0.0
0.81-0.90	1	1.4
0.91-1.00	0	0.0
>1.01	1	1.4

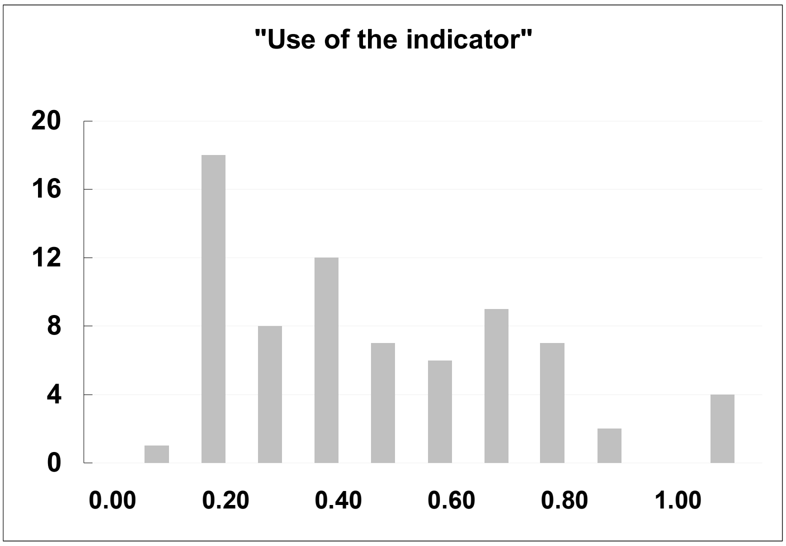
N = 74	
0.16	Mean
0.22	SD

Figure 68: Mean of errors averaged over all sections for the index “Following distance”

The **use of the indicator** was characterized by a use that was either too short, too late or did not occur at all (see table 35) which happened on average 0.46 times per section. A quarter of the sample (N = 19) used the indicator incorrectly up to 0.20 times per section. Another quarter (N = 20) made 0.21 to 0.40 mistakes per section. 22 participants did not behave correctly in 0.41 to 0.70 situations in each section. In 13 cases more than 18 errors (0.71 per 25 sections) in the Austrian and 13 errors (0.71 per 18 sections) in the Czech sample were noted by the observers during the whole ride.

⇦ ⇨	Use of the indicator	Too short	
		Too late	
		Not at all	

Table 35: List of variables integrated in the “Use of the indicator” index



Limits	Frequ.	%
0	0	0.0
0.01-0.10	1	1.4
0.11-0.20	18	24.3
0.21-0.30	8	10.8
0.31-0.40	12	16.2
0.41-0.50	7	9.5
0.51-0.60	6	8.1
0.61-0.70	9	12.2
0.71-0.80	7	9.5
0.81-0.90	2	2.7
0.91-1.00	0	0.0
>1.01	4	5.4

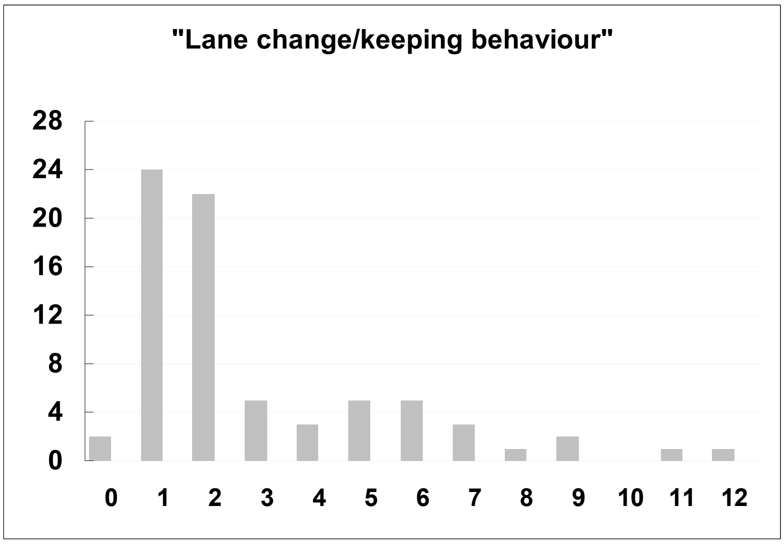
N = 74	
0.46	Mean
0.29	SD

Figure 69: Mean of errors averaged over all sections for the index "Use of the indicator"

For the index "**Lane change/keeping behaviour**" the variables of table 36 were added. As figure 70 illustrates, most of the participants had an average error rate of 2.5 mistakes concerning lane changing and lane keeping per section. 2 drivers did not make an error at all. The majority (62.1%; N = 46) made 0 to 2 errors. 21 participants did not behave appropriately in 2 to 7 situations. The rest of 6.9% (N = 5) showed 7 to 12 errors while riding the driving school car.

Lane change	Lane change before x/obstacles	Too late	
	Lane change after x/obstacles	Hesitant	
	Cross solid line		
	Lane change	Too fast	
		Dangerous	
		Hesitant	
	Lane keeping behaviour	Too far left	
		Too far right	
		Unsteady	

Table 36: List of variables integrated in the "Lane change/keeping behaviour" index



Limits	Frequ.	%
0	2	2.7
0-1	24	32.4
1-2	22	29.7
2-3	5	6.8
3-4	3	4.1
4-5	5	6.8
5-6	5	6.8
6-7	3	4.1
7-8	1	1.4
8-9	2	2.7
9-10	0	0.0
10-11	1	1.4
11-12	1	1.4

N = 74	
2.44	Mean
2.56	SD

Figure 70: Mean of errors averaged over all sections for the index “Lane change/keeping behaviour”

The index concerning the **behaviour towards vulnerable road users** was calculated with all variables of the observation sheet related to vulnerable road-users plus the behaviour at bus or tramway stops (see table 37). 35.1% of the participants (N = 26) behaved correctly when encountering vulnerable road users in every single section. Almost half of the young drivers (N = 36) failed 0.01 to 0.15 times per section when dealing with vulnerable road users. For 10.8% (N = 8) the observers noted 0.16 to 0.25 errors in every section during the whole ride. Just 5.5% of the participants (N = 4) did not behave correctly in 0.26 to 0.40 situations per section. 0.07 errors were recorded on average.

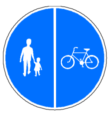
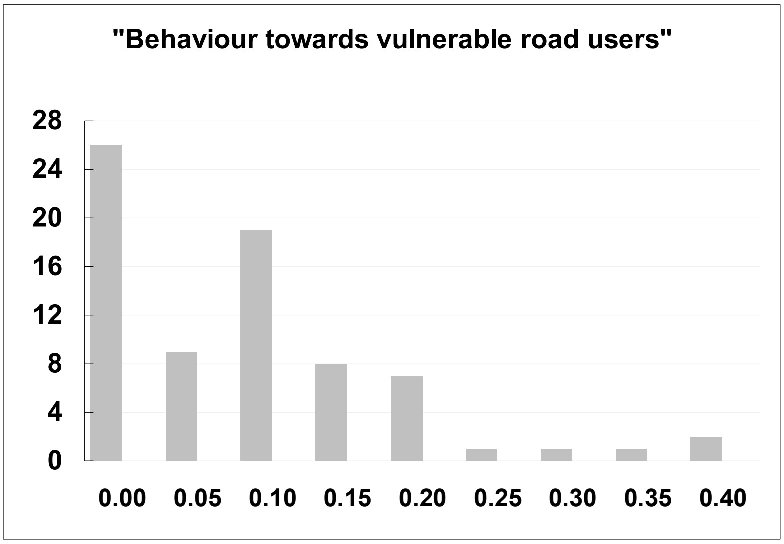
			Pedest.	Cyclists
	Vulnerable road-users	Not realised		
		Ignores Zebra Crossing		
		Gives priority late		
		Is waiting at the roadside		
		Forces to stop		
		Hazards		
	Bus or tramway stops	Dangerous		

Table 37: List of variables integrated in the “Behaviour towards vulnerable road users” index



Limits	Frequ.	%
0.00	26	35.1
0.01-0.05	9	12.2
0.06-0.10	19	25.7
0.11-0.15	8	10.8
0.16-0.20	7	9.5
0.21-0.25	1	1.4
0.26-0.30	1	1.4
0.31-0.35	1	1.4
0.36-0.40	2	2.7

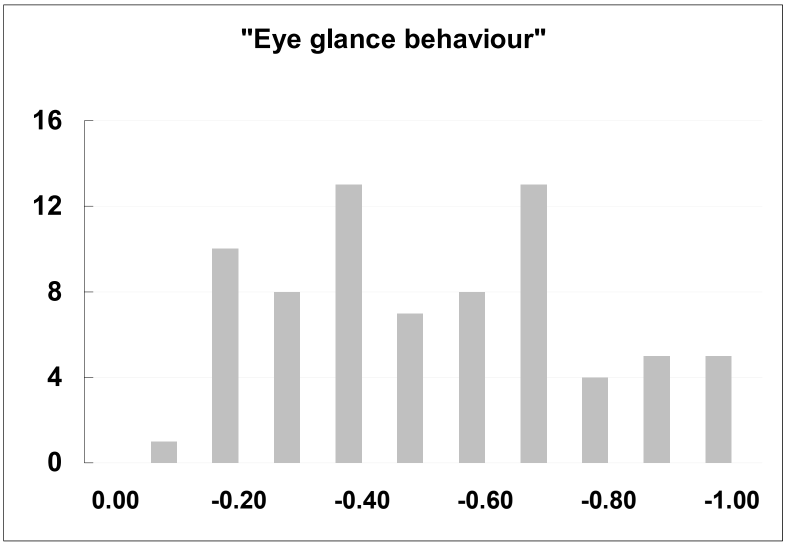
N = 74
0.07 Mean
0.09 SD

Figure 71: Mean of errors averaged over all sections for the index “Behaviour towards vulnerable road users”

The index concerning the **eye glance behaviour** consisted of the two variables “glance over shoulder” and “insufficient eye glance behaviour”, which originally were part of the lane change/keeping behaviour. As figure 72 shows 25.7% (N = 19) of the participants did not assure themselves adequately whether they can make a certain action or not in up to 5.4 respectively 7.5 situations during the whole ride (0.30 per section). For 28 young drivers 0.31 to 0.60 mistakes concerning their glance behaviour were observed in one section. 27 participants did not check adequately in 0.61 cases of each section. On average 0.49 mistakes occurred in one section.

Lane change	Eye glance behaviour	Glance over shoulder	
		Insufficient	

Table 38: List of variables integrated in the “Eye glance behaviour” index



Limits	Frequ.	%
0	0	0.0
0.01-0.10	1	1.4
0.11-0.20	10	13.5
0.21-0.30	8	10.8
0.31-0.40	13	17.6
0.41-0.50	7	9.5
0.51-0.60	8	10.8
0.61-0.70	13	17.6
0.71-0.80	4	5.4
0.81-0.90	5	6.8
0.91-1.00	5	6.8

N = 74	
0.49	Mean
0.25	SD

Figure 72: Mean of errors averaged over all sections for the index “Eye glance behaviour”

To calculate the index “**Yielding behaviour**” three variable sets were considered. These sets comprised having to give way or having to stop and failing to do so (according to law) and having priority but insisting on defending it in a dangerous way (see table 39). A quarter of the sample (N = 18) behaved correctly during the whole ride. For another quarter (N = 18) one error concerning their yielding behaviour was marked (0.04 in Austria and 0.06 in the Czech Republic per Section). 14 Participants failed to behave correctly twice (0.08 and 0.11). Three mistakes (0.12 and 0.17) in giving priority were noted for 13 young drivers. About 15% of the sample (N = 11) either violated or neglected the right of way four to five times during the ride (0.16 to 0.20).

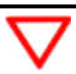
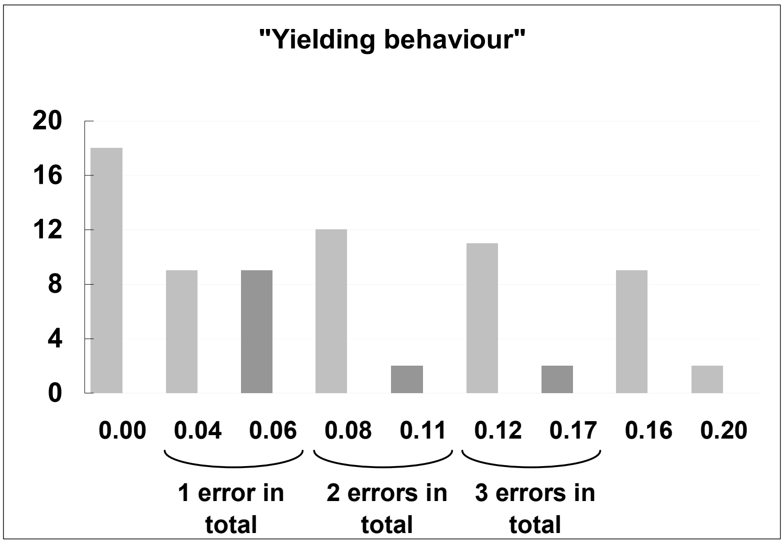
	Behaviour as one who has to stop	Ignored	
		Narrow, dangerous	
	Behaviour as one who has to give way	Ignored	
		Narrow, dangerous	
	Insist on one´s own priority		

Table 39: List of variables integrated in the “Yielding behaviour” index

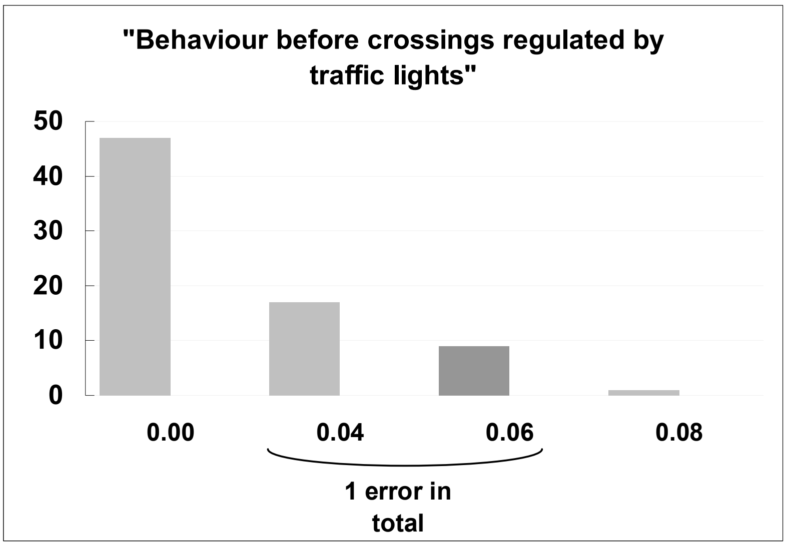


Values	Frequ.	%
0.00	18	24.3
0.04	9	12.2
0.06	9	12.2
0.08	12	16.2
0.11	2	2.7
0.12	11	14.9
0.17	2	2.7
0.16	9	12.2
0.20	2	2.7

	N = 74	
AUT	0.07	Mean
CZ	0.06	SD

Figure 73: Mean of errors averaged over all sections for the index “Yielding behaviour”

The index concerning the behaviour before crossings regulated by **traffic lights** is based on a non-standardised variable. The variable was marked as soon as a driver noticed a “yellow” traffic light too late or ignored a “red” one. As figure 74 shows, this happened once (0.04 and 0.06) during the ride of 26 participants of the whole sample and twice (0.08) during the ride of an Austrian participant. The majority of young drivers (N = 47) behaved correctly in this respect.

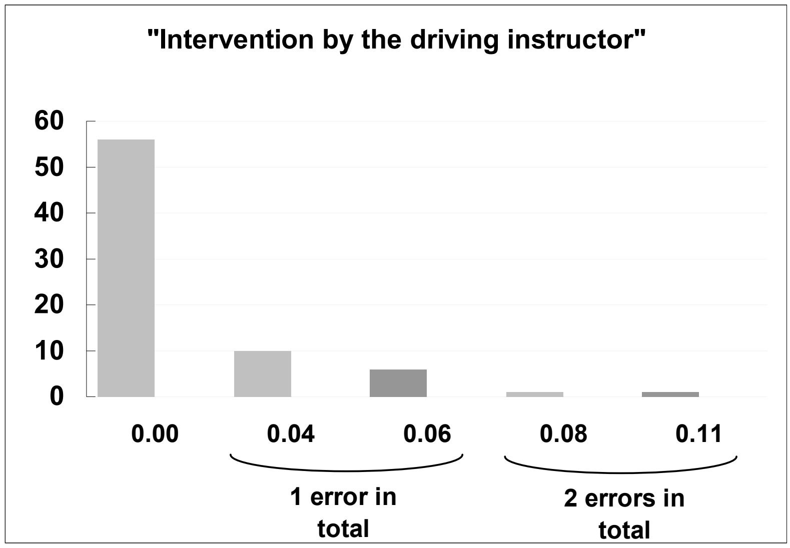


Limits	Frequ.	%
0.00	47	63.5
0.04	17	23.0
0.06	9	12.2
0.08	1	1.4

	N = 74	
AUT	0.02	Mean
CZ	0.02	SD

Figure 74: Mean of errors averaged over all sections for the index “Behaviour before crossings regulated by traffic lights”

Situations where the **driving instructor** had to intervene in order to avoid a traffic accident or at least a dangerous situation hardly ever occurred (N = 56). However, during the rides of 16 participants the driving instructor had to set an action once (0.04 and 0.06) and in two cases even twice (0.08 and 0.11).



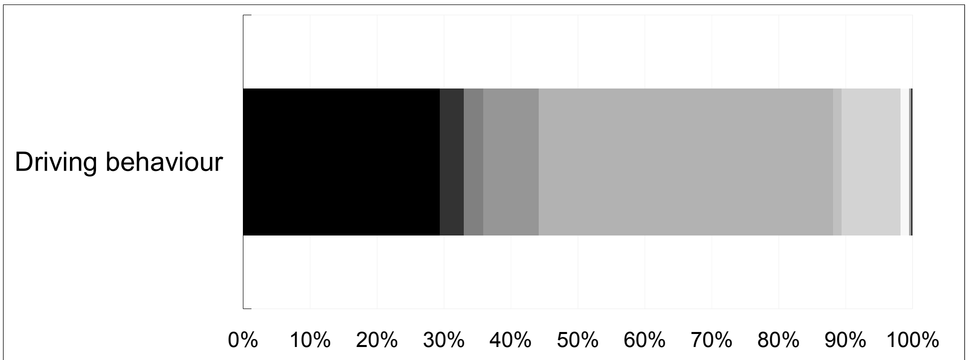
Limits	Frequ.	%
0.00	56	75.7
0.04	10	13.5
0.06	6	8.1
0.08	1	1.4
0.11	1	1.4

N = 74

AUT	0.01	Mean
CZ	0.02	SD

Figure 75: Mean of errors averaged over all sections for the index "Intervention by the driving instructor"

Figure 76 gives an overview of the most important breaches of traffic regulations observed during the first ride with the 74 participants of the study. Errors in relation to lane change/keeping were the most common type (44.0%), followed by driving too fast/slowly according to the law or the situation (29.4%). Inadequate checking behaviour (8.8%), followed by erroneous use of the indicator (8.3%) were observed much less frequently but on average still happened 0.49 to 0.46 times per section. Poorly adapted speed (3.6%) as well as inappropriate distance keeping behaviour (2.9%) were noted 0.20 and 0.16 times in each section of the track. In 1.3% of the cases the young drivers neglected the right of way of other road users or hindered vulnerable road users by their driving behaviour. Rather rarely participants reacted late to, or even ignored the traffic lights (0.4%). 0.2% of the wrong behaviour led to an intervention of the driving instructor. Wrong behaviour when overtaking hardly ever happened and consequently this type of behaviour is not displayed in figure 76.



	%	Mean		%	Mean
Speed	29.4	1.63	Vulnerable road users	1.3	0.07
Speed adaption	3.6	0.20	Glance	8.8	0.49
Overtaking	0.0	0.00	Yielding	1.3	0.07
Distance	2.9	0.16	Traffic light	0.4	0.02
Indicator	8.3	0.46	Driving instructor	0.2	0.01
Lane changing/keeping	44.0	2.44			

Figure 76: Average errors per section in comparison

7.3. Findings of the “ISA” questionnaire

7.3.1. General

Young drivers participating in the study were asked to describe a “good” driver in their own words. Various answers were given (annex I). The ten most frequent ones can be found in figure 77. One third of the participants characterised a good car driver as a driver who can anticipate traffic situations (N = 23; 31.1%). About 26% (N = 19) thought that safe and secure driving habits are most suitable to define a good driver. Further the knowledge of and compliance with traffic rules (N = 17; 23.0%) as well as to consider other road users while driving (N = 15; 20.3%) seem to be very important issues. 14 participants (18.9%) thought that a good driver should be able to foresee traffic situations. According to the respondents, a good driver should be able to navigate a vehicle fast and uninterruptedly (N = 9; 12.2%) but at the same time should adapt the driving behaviour to road and weather conditions (N = 8; 10.8%). Furthermore an excellent reactivity (N = 7; 9.5%), extensive driving experience (N = 7; 9.5%) but also a defensive driving style (N = 6; 8.1%) were mentioned as important characteristics of a good driver.

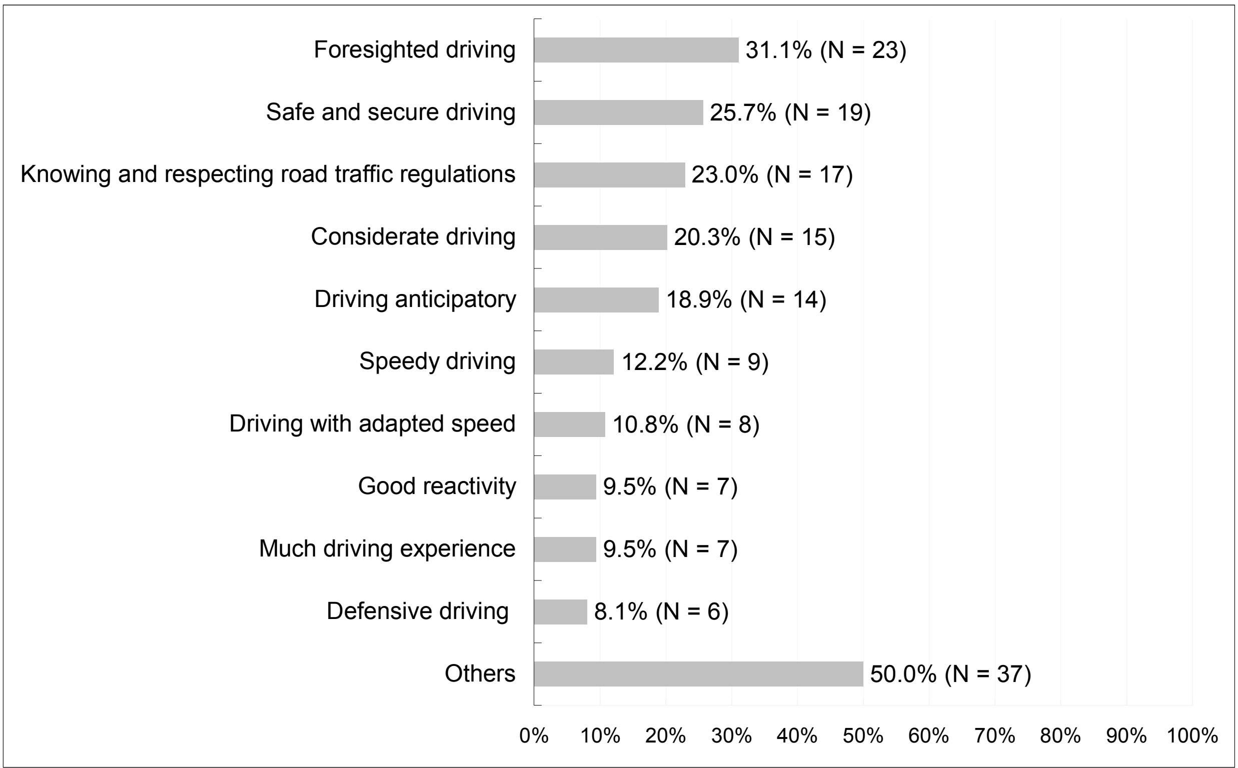
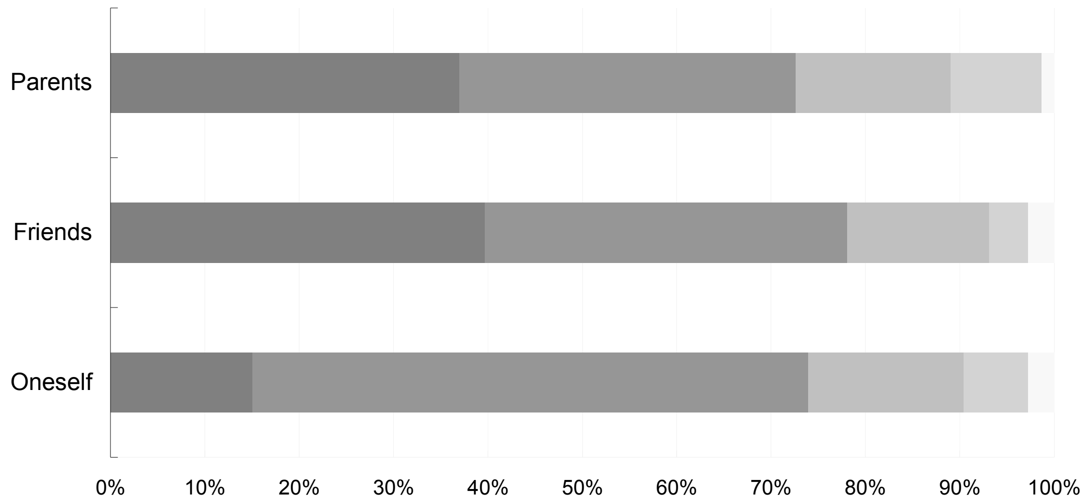


Figure 77: Top ten characteristics of a good driver (frequency in %; N = 73); multiple answers possible

Other questions aimed at finding out what participants think about their own driving style. Participants were asked to tell what their parents and friends think about their driving behaviour as well as how they would describe their behaviour themselves. The results are shown in figure 78. Nearly 40% of the respondents believe very strongly in a good assessment by their parents and friends. Another 35% were quite sure to impress parents and friends with a “good" driving style. Overall, approximately three quarters of the respondents assumed that parents and friends perceive them as good drivers. The self-assessment of the driving style revealed a similar picture. Again, about 75% of the participants believe themselves to be performing well on the road. If one takes a closer look at the two categories “strongly agree” and “agree” there is a slight difference between how people judge themselves and what, in their opinion, parents and friends think of their driving style. Just 15% of the participants were strongly confident about their driving behaviour; the remaining 60% were quite sure concerning this issue. About 25% of the young drivers do not consider themselves to be particularly good drivers. On average participants experienced themselves as good drivers (mean = 2.03; SD = 1.03) and they assumed that parents (mean = 1.92; SD = 0.98) and friends (mean = 2.23; SD = 0.89) share their attitude.



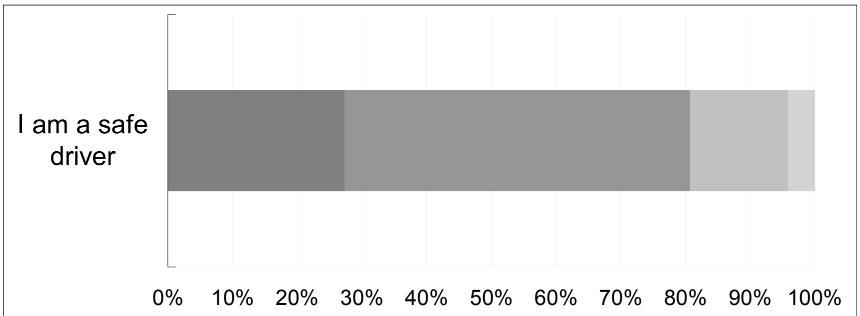
	Parents	%	Friends	%	Oneself	%
(1) Strongly agree	27	36.5	29	39.2	11	14.9
(2) Agree	26	35.1	28	37.8	43	58.1
(3) Undecided	12	16.2	11	14.9	12	16.2
(4) Disagree	7	9.5	3	4.1	5	6.8
(5) Strongly disagree	1	1.4	2	2.7	2	2.7

N = 73

Parents	Friends	Oneself	
2.03	1.92	2.23	Mean
1.03	0.98	0.89	SD

Figure 78: Estimation of participants about how parents and friends assess their driving behaviour as well as self-assessment

Not only did the respondents think that they are good drivers, but safe drivers, too (mean = 1.96; SD = 0.77). About 80% agreed on the statement “I am a safe driver”; 27% even agreed strongly.



	I am a safe driver	%
(1) Strongly agree	20	27.0
(2) Agree	39	52.7
(3) Undecided	11	14.9
(4) Disagree	3	4.1
(5) Strongly disagree	0	0.0

N = 73

I am a safe driver	
1.96	Mean
0.77	SD

Figure 79: Self-assessment concerning safe driving behaviour

7.3.2. Road safety

Young drivers were asked what road safety actually implies. According to the respondents, the most important aspect with respect to road safety is to adhere to traffic rules and regulations (N = 24; 32.4%). Further aspects that were quoted, however by considerably fewer respondents, were mutual respect (N = 13; 17.6%), not to endanger oneself or other road users (N = 11; 14.9%) as well as the avoidance of accidents (N = 10; 13.5%). Furthermore young drivers regarded an anticipatory (N = 8; 10.8%), secure (N = 8; 10.8%) and well adapted driving style in accordance with road and weather conditions (N = 6; 8.1%) as important for traffic safety. In the participants´ opinion also infrastructural measures (N = 6; 8.1%), the ability to rely on other road users (N = 5; 6.8%) and the need to concentrate on the traffic (N = 4; 5.4%) are components of the concept of road safety. Further answers can be found in annex I.

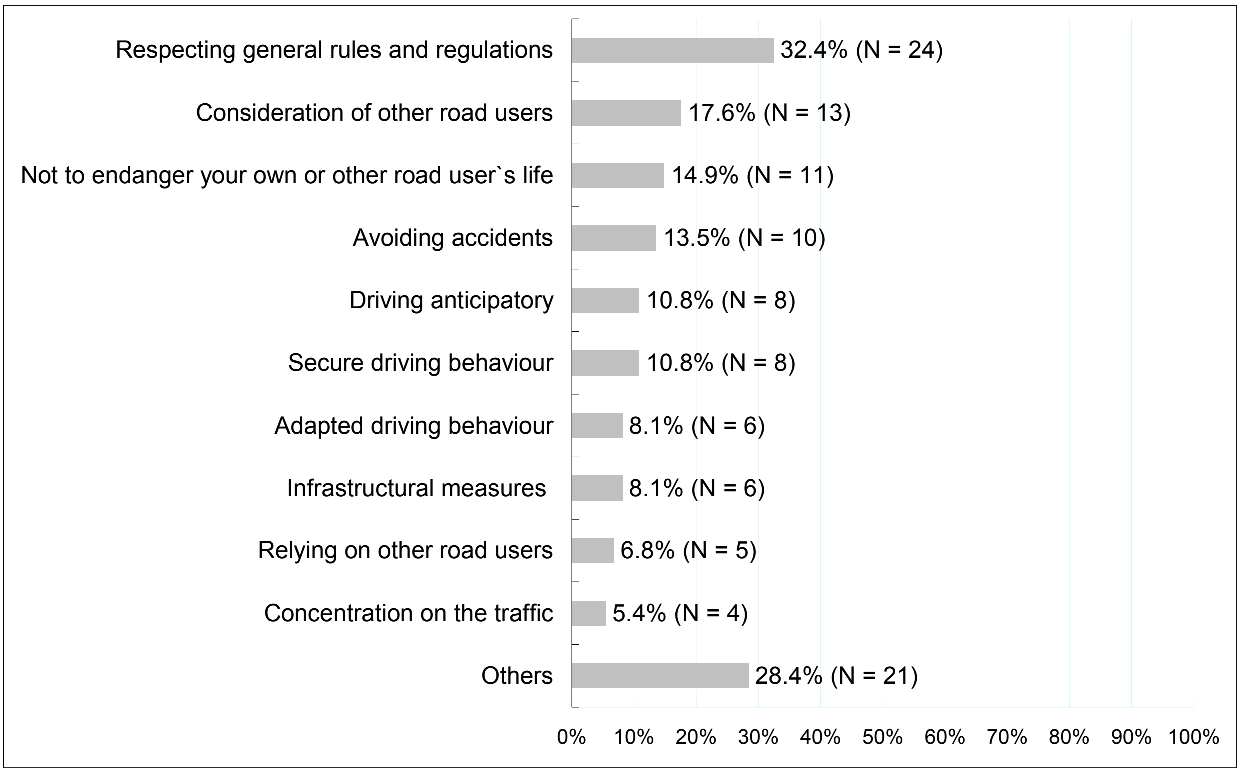
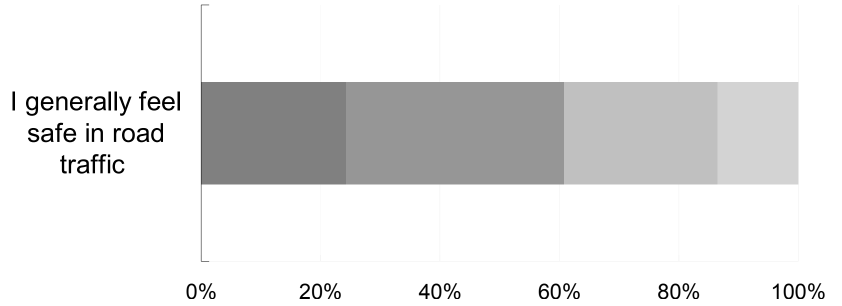


Figure 80: Top ten answers with regard to traffic safety (frequency in %; N = 71[9]); multiple answers possible

About 60% of the young drivers generally felt safe in traffic; 25% felt indifferently. 10 participants (13.5%) disagreed and therefore experienced traffic as being dangerous.

[9] N describes the total amount of answers given by the participants. Missing values are due to „I don´t know!“ answers or no answers, at all.



I generally feel safe in road traffic		%
(1) Strongly agree	18	24.3
(2) Agree	27	36.5
(3) Undecided	19	25.7
(4) Disagree	10	13.5
(5) Strongly disagree	0	0.0

N = 73	
I gen. feel safe in road traffic	
2.28	Mean
0.99	SD

Figure 81: Feeling of safety in road traffic

The behaviour of other car drivers might be a possible reason why at least some of the young drivers do not feel safe in traffic. The ten main behaviour patterns of a dangerous driver according to the respondents were disregard of traffic regulations (N = 26; 35.1%), ruthlessness (N = 24; 32.4%), speeding (N = 24; 32.4%), aggression (N = 19; 25.7%), being drunk while driving (N = 11; 14.9%), tailgating (N = 10; 13.5%), distraction (N = 9; 12.2%), overestimation (N = 8; 10.8%), unsafe driving behaviour in general (N = 7; 9.5%) as well as hectic behaviour, impatience or nervousness (N = 6; 8.1%). Additional driving behaviour patterns that were considered unsafe can be found in annex I.

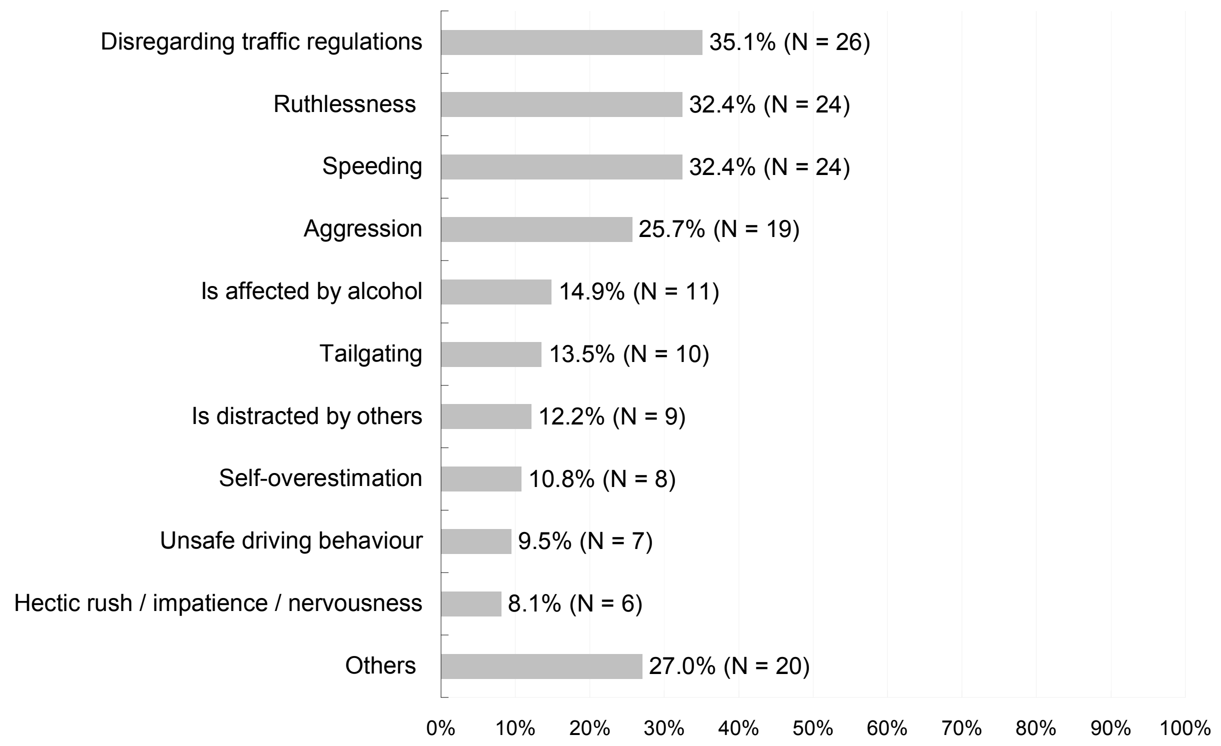


Figure 82: Top ten property of a driver who endangers others (frequency in %; N = 74); multiple answers possible

87.8% of the respondents (N = 65) considered traffic regulations to be important for traffic safety. 8 young drivers (10.8%) thought that regulations sometimes are necessary. Participants were asked how they would improve traffic safety themselves. Nearly half of them mentioned infrastructural measures (N = 34; 45.9%). About one third of the respondents would increase the promotion of other means of transport (N = 28; 37.8%) or would implement trainings (N = 26; 35.1%). 19 young drivers (25.7%) mentioned new technologies. 17 participants (23.0%) suggested an uprating of the severity of punishment as well as an uprating of controls. 14 people (18.9%) would like to re-ascribe responsibility to the driver. Stricter driving tests (N = 13; 17.6%), speed reduction by limits (N = 12; 16.2%) as well as constructional speed-limits (N = 10; 13.5%) were recommended as well. 9 respondents (12.2%) would try to improve traffic safety by raising awareness and 5 participants (6.8%) suggested to implement a new driving test.

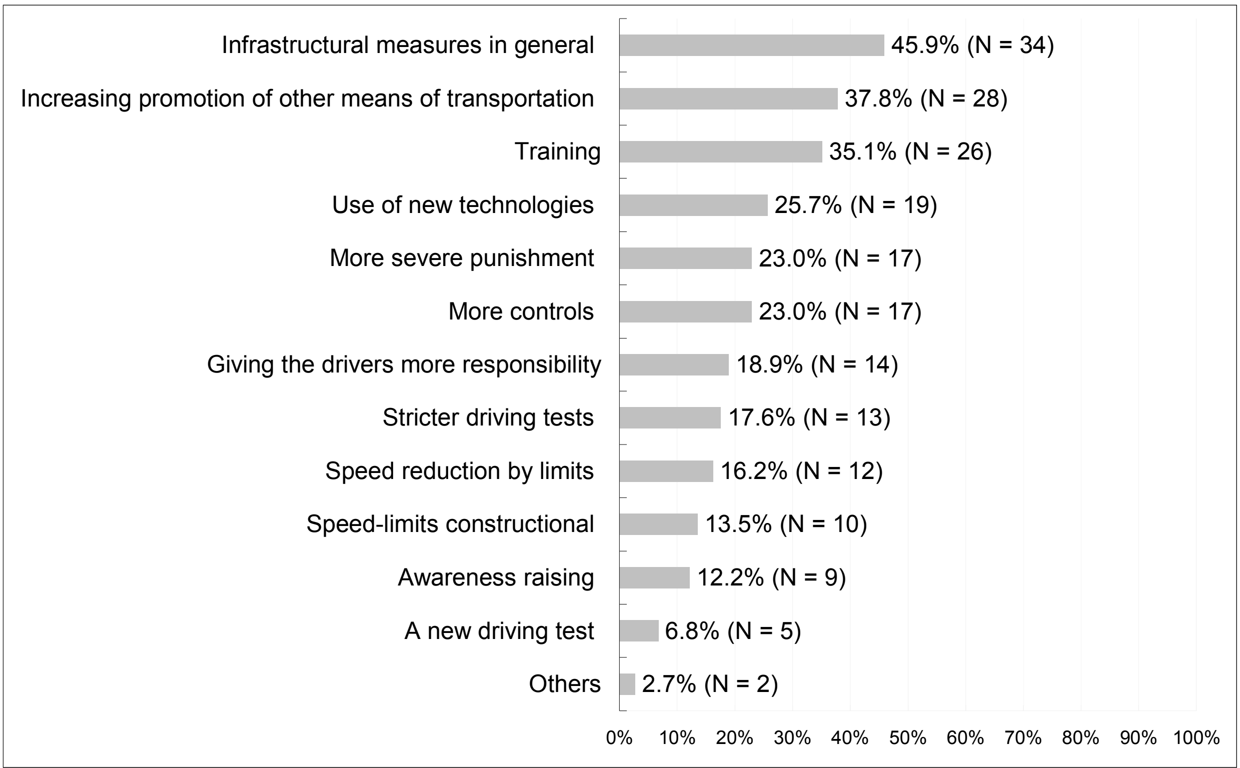


Figure 83: Mentioned measures to improve traffic safety (frequency in %; N = 67); multiple answers possible

Another question concerning safety aimed at the different travel modes as well as the perception of safety connected with these modes. More than half of the young drivers responded that they felt safest when travelling by public transport (N = 40; 54.1%), about 40% (N = 30) felt safe as pedestrians and still 13.5% (N = 10) did not feel endangered as cyclists. About half of the participants felt safe as car drivers as well (N = 35; 47.3%).

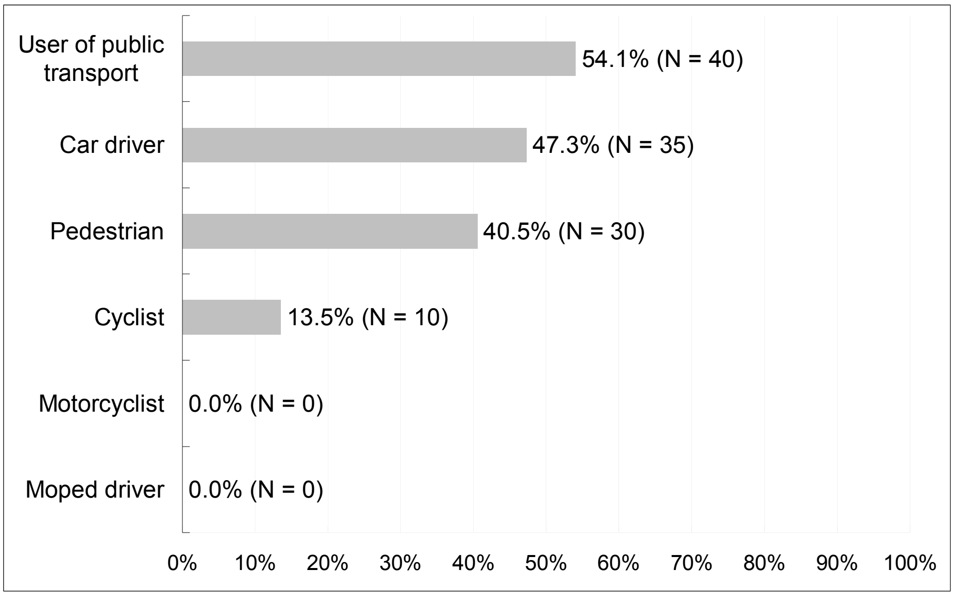


Figure 84: Perception of safety depending on different travel modes (frequency in %; N = 74); multiple answers possible

Most of the respondents identified cyclists as the most endangered group in traffic (N = 59; 79.7%), followed by moped drivers (N = 43; 58.1%) and motorcyclists (N = 40; 54.1%). Again, about half of the young drivers identified pedestrians as a highly endangered group (N = 35; 47.3%). Only one participant considered the use of public transport risky (1.4%). More than 90% of the young drivers did not perceive the situation of car drivers as dangerous, only 9.5% had a different opinion (N = 7).

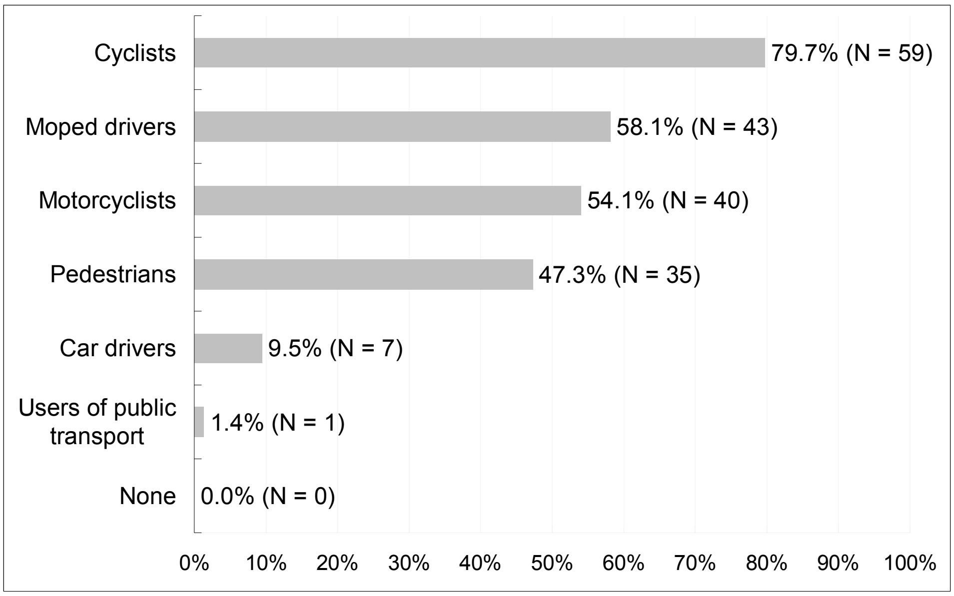


Figure 85: Most endangered road user groups (frequency in %; N = 74); multiple answers possible

Two thirds of the young drivers (N = 50; 67.6%) were aware of their responsibility for safety in traffic. 25 of the respondents (33.8%) thought that all road users have to contribute in order to make traffic safer. About one quarter of the participants shared the opinion that the legislation (N = 18; 24.3%) and the police (N = 17; 23.0%) is accountable for traffic safety. Far fewer participants thought that either the road administrator (N = 6; 8.1%), the city and the municipality (N = 4; 5.4%) or the vehicle manufacturer (N = 2; 2.7%) are responsible for an increase of traffic safety.

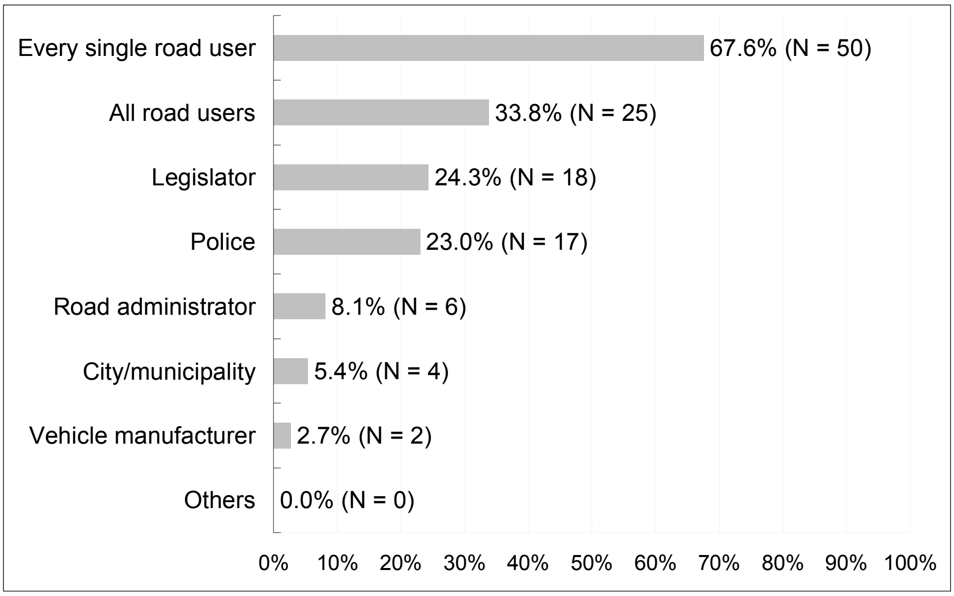


Figure 86: Responsibility for traffic safety (frequency in %; N = 74); multiple answers possible

7.3.3. Speed

The question about participants` spontaneous associations with respect to speed turned out to be quite interesting. The answers of the young drivers can be found in figure 87. Approximately 20% (N = 15) associated speed with danger and 10% (N = 8) with risk, 12.2% (N = 9) identified a “fun” component. Respondents also related speed to a faster arrival (N = 10; 13.5%) and getting on (N = 7; 9.5%). For some young drivers speed implied adrenaline (N = 7; 9.5%), freedom (N = 3; 4.1%), the violation of speed limits (N = 7; 9.5%), to drive in a race (N = 3; 4.1%) or on the motorway (N = 5; 6.8%). Far fewer participants had accidents, fear, discomfort or stress in mind (each: N = 2; 2.7%).

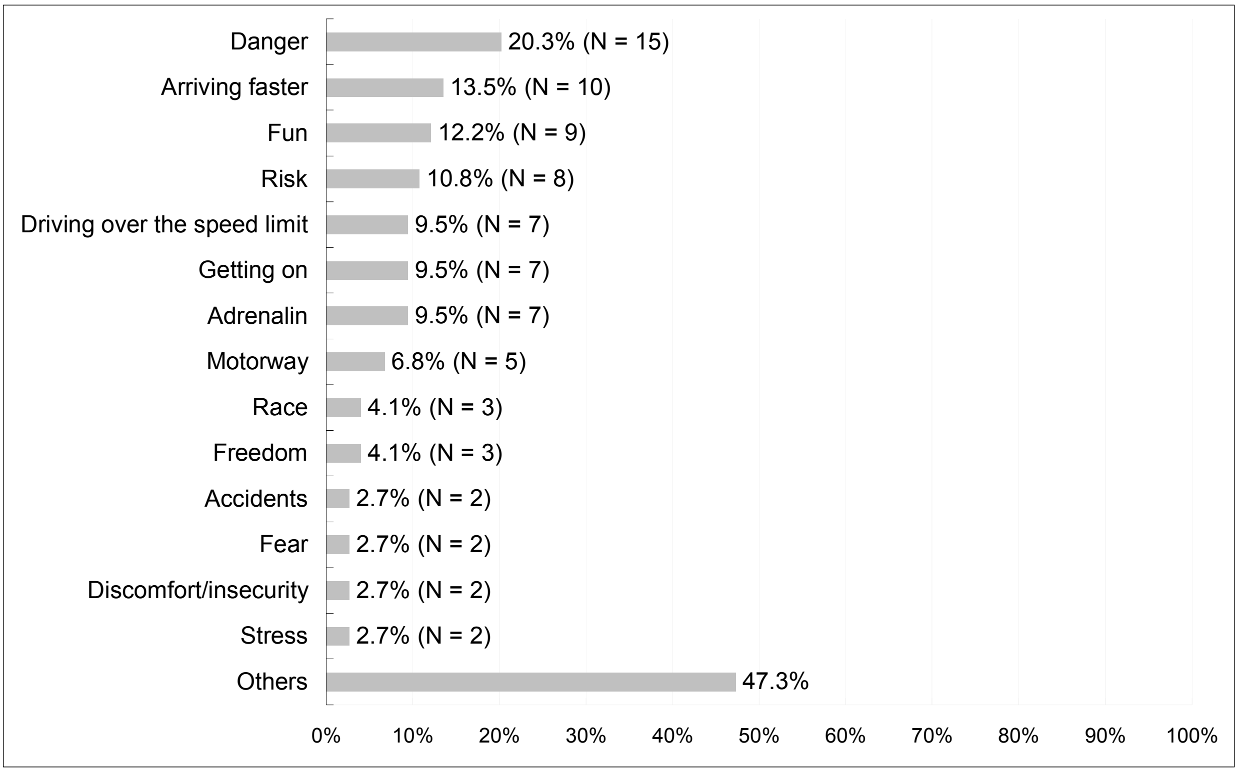
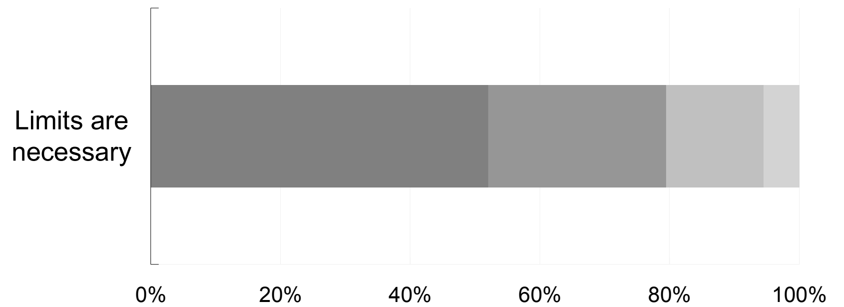


Figure 87: Associations with speed (frequency in %; N = 71); multiple answers possible

Almost 80% of the participants believed speed limits to be necessary; thereof 51.4% (N = 38) even strongly agreed (see figure 88). 11 young drivers (14.9%) were indecisive concerning this question and 4 (5.4%) actually disagreed. On average (mean = 1.74; SD = 0.91), respondents approved of speed limits. Positive impacts young drivers expected from speed regulations are primarily safety effetcs (N = 29; 39.2%) and a reduction of traffic accidents (N = 12; 16.2%; see figure 89). Almost 14% experienced speed limits to be fundamental to traffic regulation (N = 10) but also as a means to advise (N = 8; 10.8%) and guide (N = 8; 10.8%) car drivers. Furthermore respondents mentioned the protection of vulnerable road users (N = 6; 8.1%), the avoidance of self-overestimation (N = 4; 5.4%), the reduction of speed in dangerous zones (N = 3; 4.1%) as well as the reduction of serious accidents (N = 3; 4.1%) as positive impacts of speed limits. 3 to 5 people detected negative effects such as traffic jams (N = 5; 6.8%) and the feeling of anger (N = 3; 4.1%).



Limits are necessary		%		
(1) Strongly agree	38	51.4	**N = 73**	
(2) Agree	20	27.0	Limits are necessary	
(3) Undecided	11	14.9		
(4) Disagree	4	5.4	1.74	Mean
(5) Strongly disagree	0	0.0	0.91	SD

Figure 88: Acceptance of speed limits

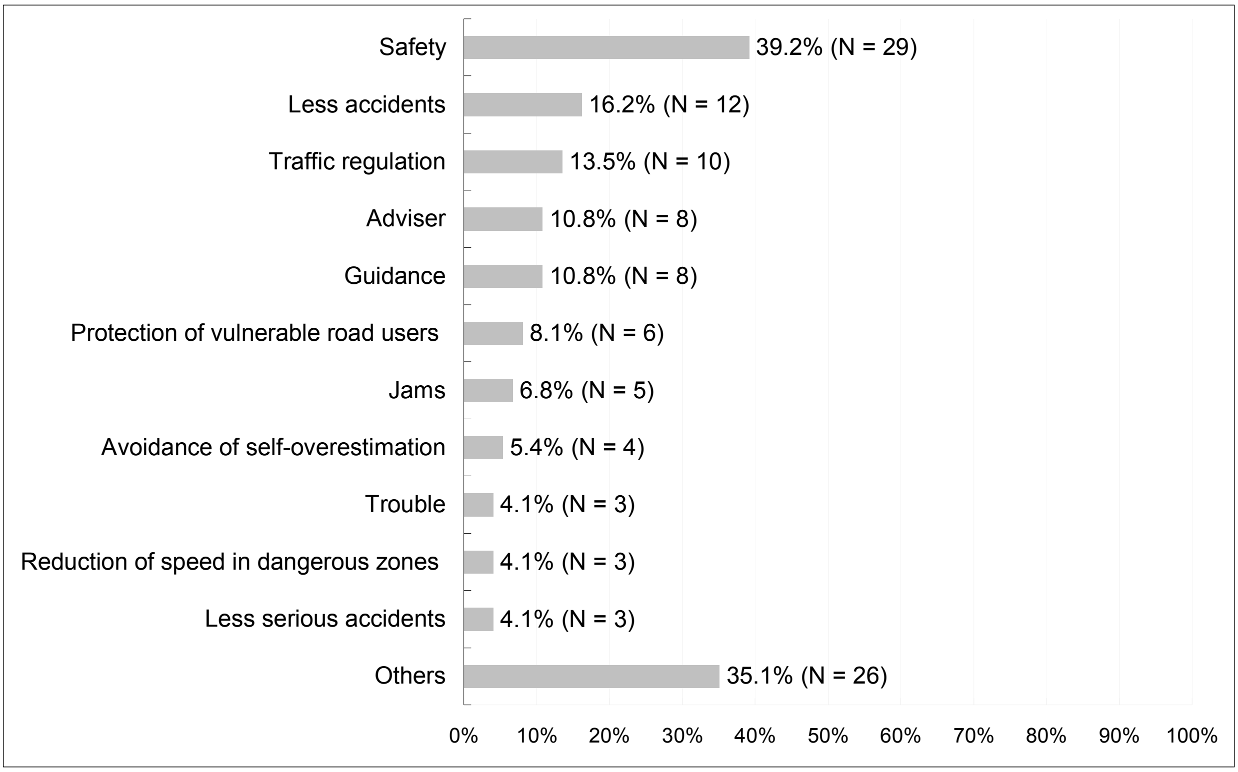
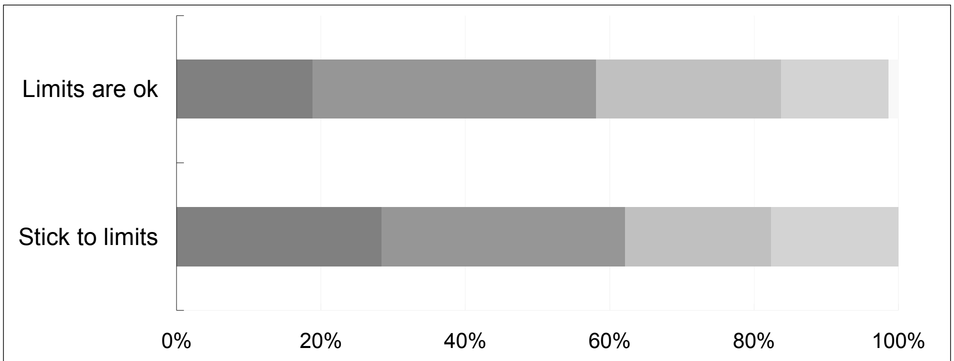


Figure 89: Consequences of speed limits (frequency in %; N = 72); multiple answers possible

About 60% of the young drivers agreed with the speed limits in their own country; thereof about 20% (N = 14) strongly. One quarter (N = 19; 25.7%) was undecided concerning the limits and approximately 15% (N = 11) were unsatisfied with the current limits. One participant (1.4%) even thought that speed limits are not necessary, at all. However, more than 60% (N = 46) indicated to comply with the limits; about 30% (N = 21) even agreed strongly with this statement. 15 people (20.3%) were not sure whether they should agree or not. 13 young drivers (17.6%) did not obey speed regulations, though.

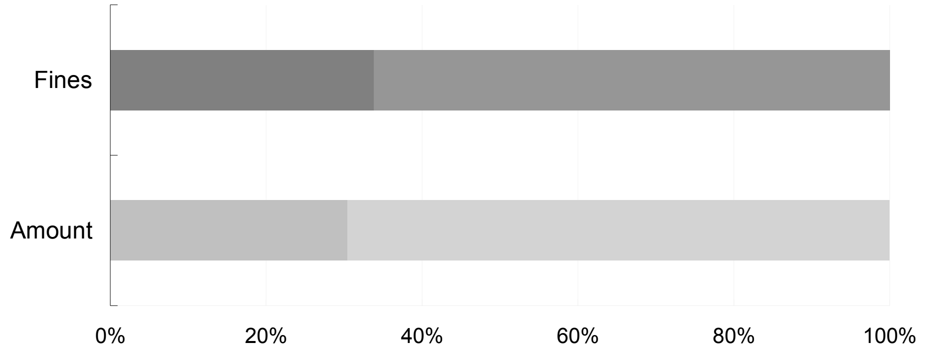


	Limits are ok	%	Stick to limits	%
(1) Strongly agree	14	18.9	21	28.4
(2) Agree	29	39.2	25	33.8
(3) Undecided	19	25.7	15	20.3
(4) Disagree	11	14.9	13	17.6
(5) Strongly disagree	1	1.4	0	0.0

N = 74		
Limits are ok	Stick to limits	
2.41	2.27	Mean
1.01	1.06	SD

Figure 90: Compliance with speed limits

The findings above are in some way reflected in the amount of fines participants have already received. One third (N = 25; 33.8%) of the participants already has had to pay a fine; about 70% of them (N = 16) even more than once.

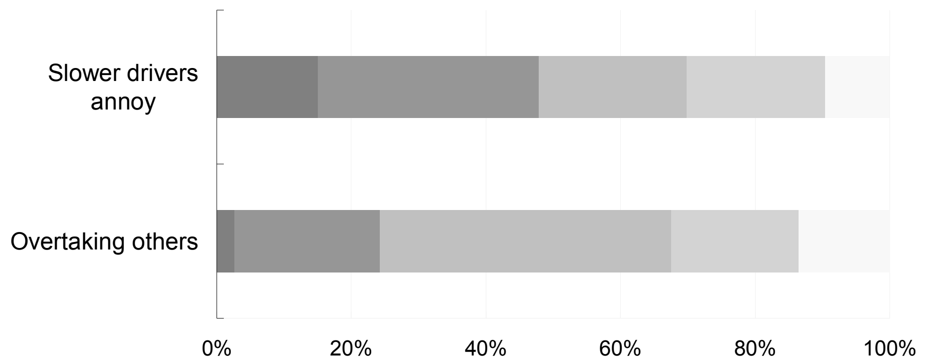


	Fines	%	Amount	%
Yes	25	33.8		
No	49	66.2		
1			7	30.4
> 1			16	69.6

N = 74/23		
Fines	Amount	
0.34	2.87	Mean
0.48	2.36	SD

Figure 91: Amount of fines respondents have already received

Another aspect of speed is how to deal with other road users. Young drivers were asked whether they would get upset if car drivers in front of them drove slowly. In addition they had to tell if they generally overtook a slow car driver or not. In figure 92 it is illustrated that about half of the participants were annoyed by others; 15% (N = 11) even strongly agreed. On the other hand, 7 young drivers (9.5%) did not consider slower cars ahead to be causing discomfort to them. Compared to the number of participants who were displeased by slow-going others, the share of those who would overtake them was quite low. Just one quarter of the young drivers agreed on the statement to often overtake others; thereof only 2.7% (N = 2) strongly. The majority seemed to be indifferent and about one third actually disagreed more or less strongly (N = 14; 18.9% and N = 10; 13.5%).



	Sl. dr. annoy	%	Overt. others	%
(1) Strongly agree	11	14.9	2	2.7
(2) Agree	24	32.4	16	21.6
(3) Undecided	16	21.6	32	43.2
(4) Disagree	15	20.3	14	18.9
(5) Strongly disagree	7	9.5	10	13.5

N = 73/74		
Sl. dr. annoy	Overt. others	
2.77	3.19	Mean
1.22	1.02	SD

Figure 92: Attitude towards slower drivers and frequency of overtaking

The most frequent situations when respondents overtake others are when a slower car driver is in front of them (N = 36; 48.6%), if the vehicle in front goes far below the speed limit (N = 7; 9.5%) or if the driver does not act confidently (N = 7; 9.5%). Furthermore respondents indicated to overtake on motorways (N = 12; 16.2%), on rural roads (N = 7; 9.5%) as well as in urban areas (N = 3; 4.1%) but only if there is a good opportunity (N = 11; 14.9%), if the view is good and unobstructed (N = 7; 9.5%) or if it is not dangerous (N = 5; 6.8%). 9 young car drivers (12.2%) mentioned overtaking due to time pressure.

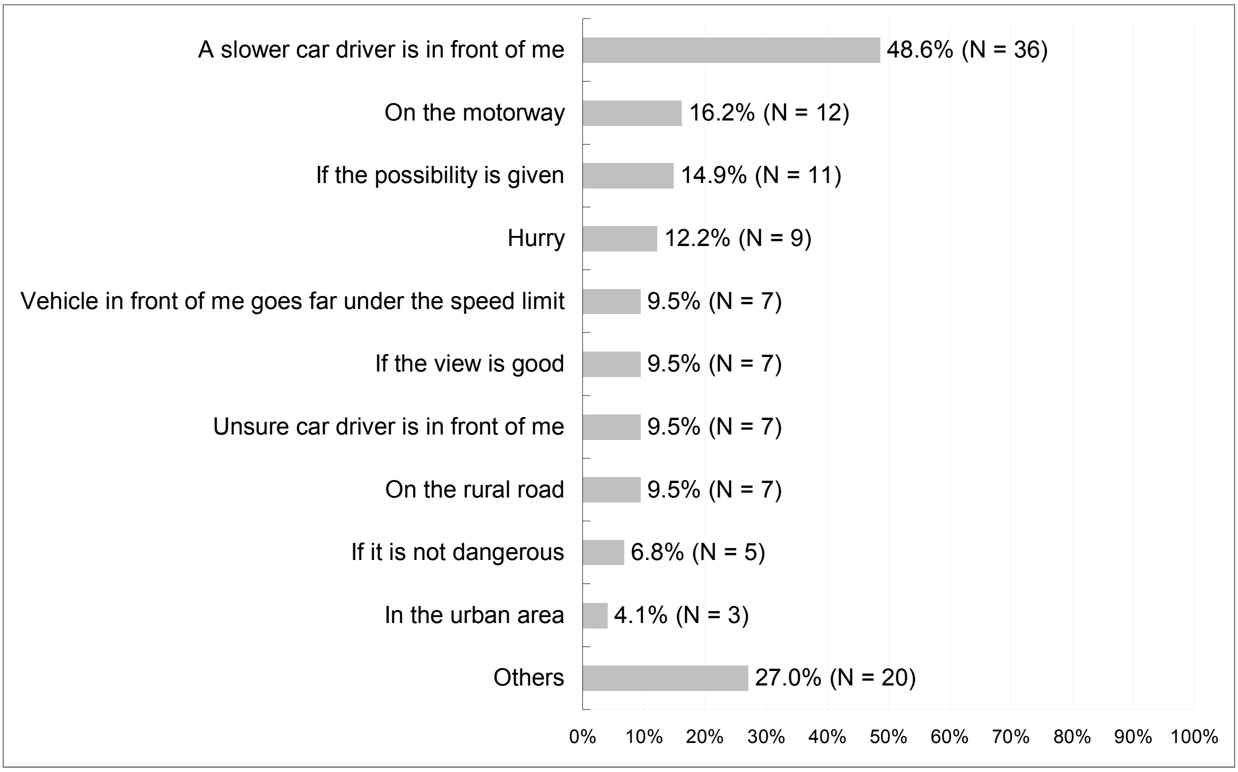
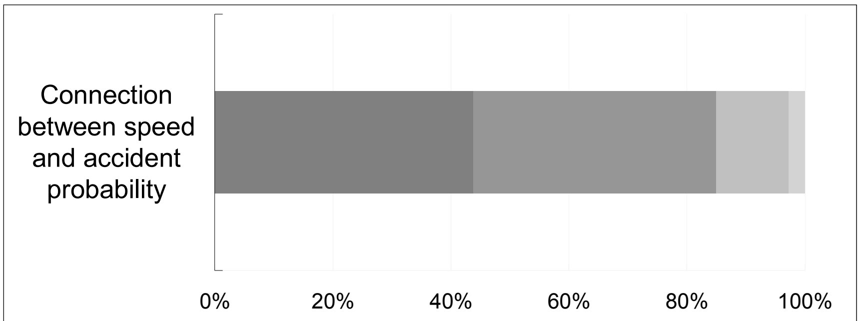


Figure 93: Question concerning participants' own speed behaviour (frequency in %; N = 72); multiple answers possible

32 participants (43.2%) thought that there is a strong relation between speed and the accident probability; 30 participants (40.5%) were aware of the problem.



	Connection btw. speed and accident	%
(1) Strongly agree	32	43.2
(2) Agree	30	40.5
(3) Undecided	9	12.2
(4) Disagree	2	2.7
(5) Strongly disagree	0	0.0

N = 73	
Conn. bw. speed and acc.	
1.74	Mean
0.78	SD

Figure 94: Estimation of accident risk due to speed

7.3.4. ISA

Although respondents did not have the possibility to try ISA before answering the questionnaire, they could very adequately judge the possible advantages and disadvantages of such a system (see annex I for the extended list). Young drivers assumed that ISA informs the driver, which is reflected in the statements "making aware of speed limits" (N = 20; 27.0%), "clear information about permissible maximum speed" (N = 10; 13.5%), "feedback/reminder on speed limits" (N = 9; 12.2%) and "control in general" (N = 5; 6.8%). Furthermore ISA was assessed positively due to the possibility of speed regulation (N = 8; 10.8%). Respondents perceived an aspect of assistance of ISA. In their opinion, people would look less frequently at the speedometer (N = 7; 9.5%) and would be able to concentrate more on the traffic (N = 7; 9.5%). The system would prevent people from unintentional speeding (N = 5; 6.8%) and would support the driver (N = 5; 6.8%). 6 people (8.1%) thought that ISA would further increase the traffic safety.

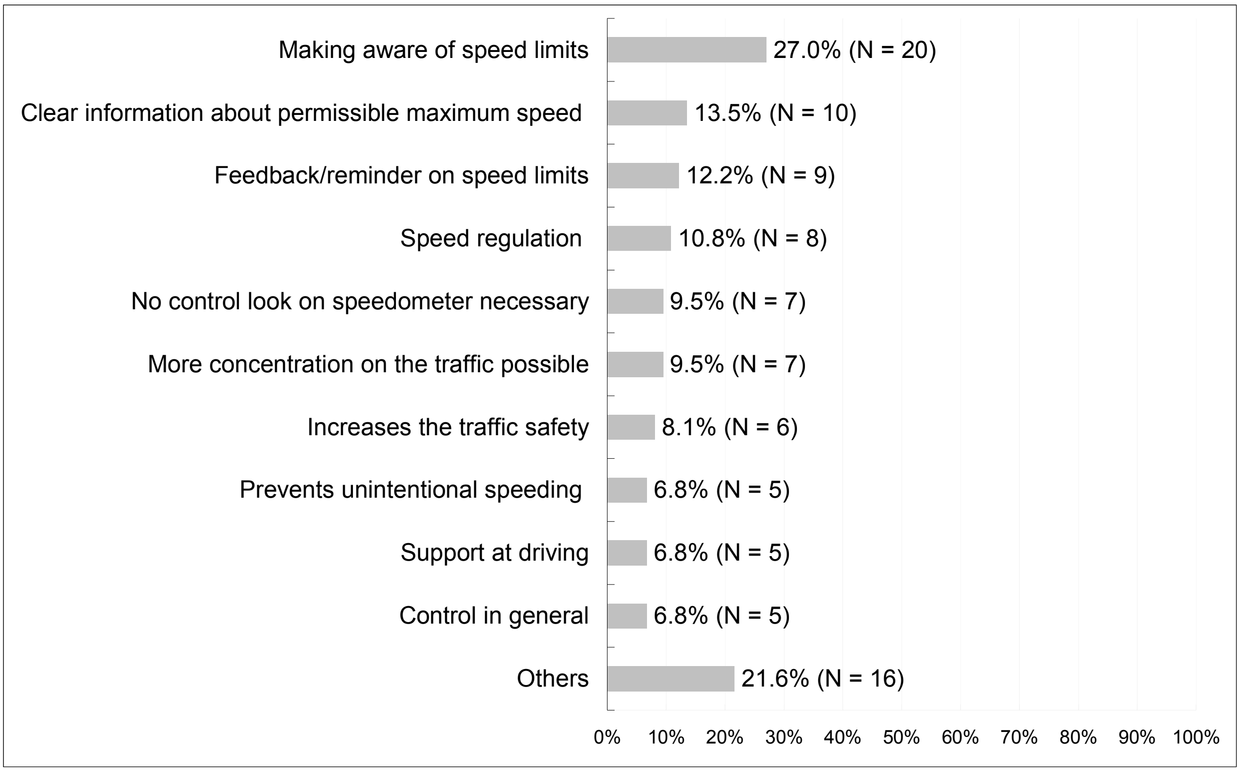


Figure 95: Top ten advantages of ISA (frequency in %; N = 71); multiple answers possible

Many of the unintended disadvantages, which were pointed out in the literature study (see sub-chapter 3.2), were mentioned by the young drivers as well. The participants expected that people might start to rely on the system (N = 10; 13.5%) to be the main disadvantage of such a technology. Further the system might be obstructive (N = 7; 9.5%) and restrictive (N = 7; 9.5%). Five participants mentioned that ISA might unsettle those drivers who were not used to it (6.8%). The same amount of respondents (N = 5; 6.8%) worried that those who wanted to drive too fast would do it despite the system. ISA might distract, annoy or patronise the driver. Missing up-to-dateness (N = 5; 6.8%) as well as a possible defect of the system (N = 4; 5.4%) caused some doubt.

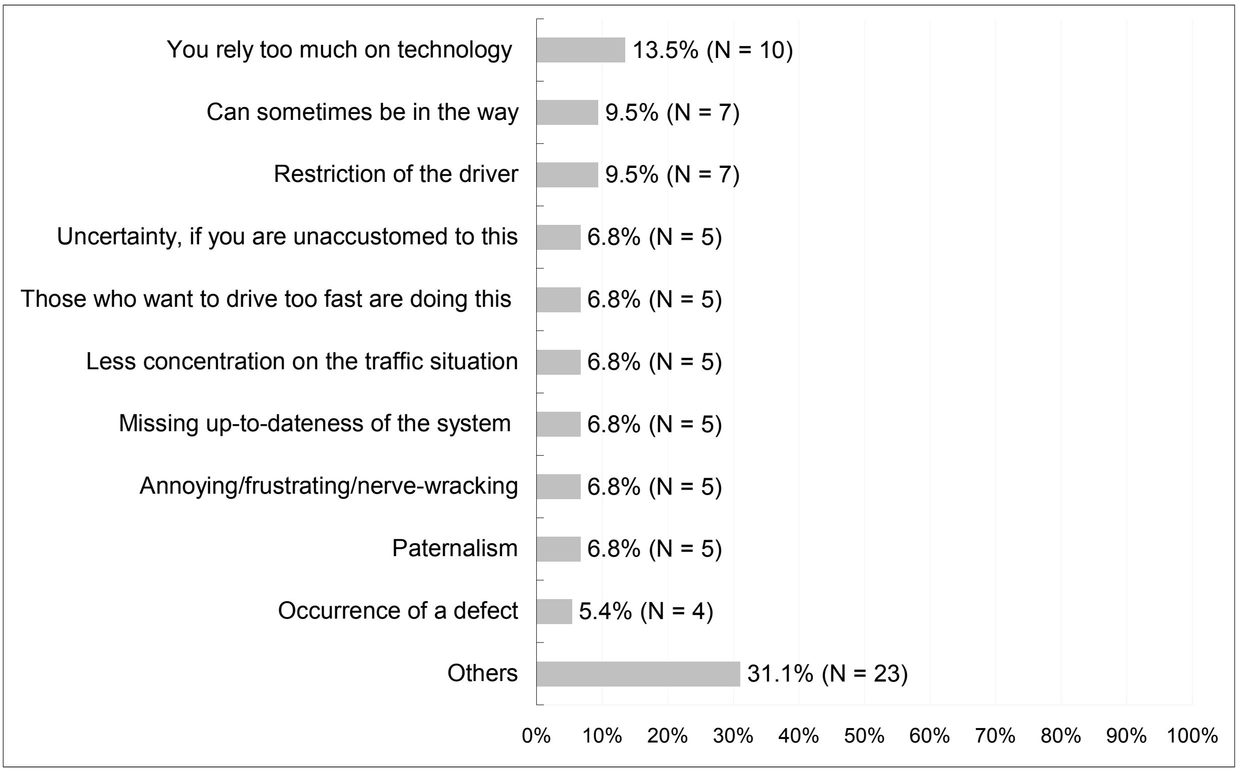


Figure 96: Top ten disadvantages of ISA (frequency in %; N = 61); multiple answers possible

Moreover participants were asked about the potential user groups of an ISA system. In young drivers´ opinions, especially novice drivers (N = 13; 17.6%), inexperienced (N = 3; 4.1 %) or insecure drivers (N = 6; 8.1%), younger people (N = 5; 6.8%), driving schools (N = 3; 4.1%), but also professional drivers (N = 8; 10.8%), older people (N = 10; 13.5%), women (N = 4; 5.4%), drivers who want to comply with the law (N = 7; 9.5%) or drive frequently in unknown areas (N = 6; 8.1%) could be potential users.

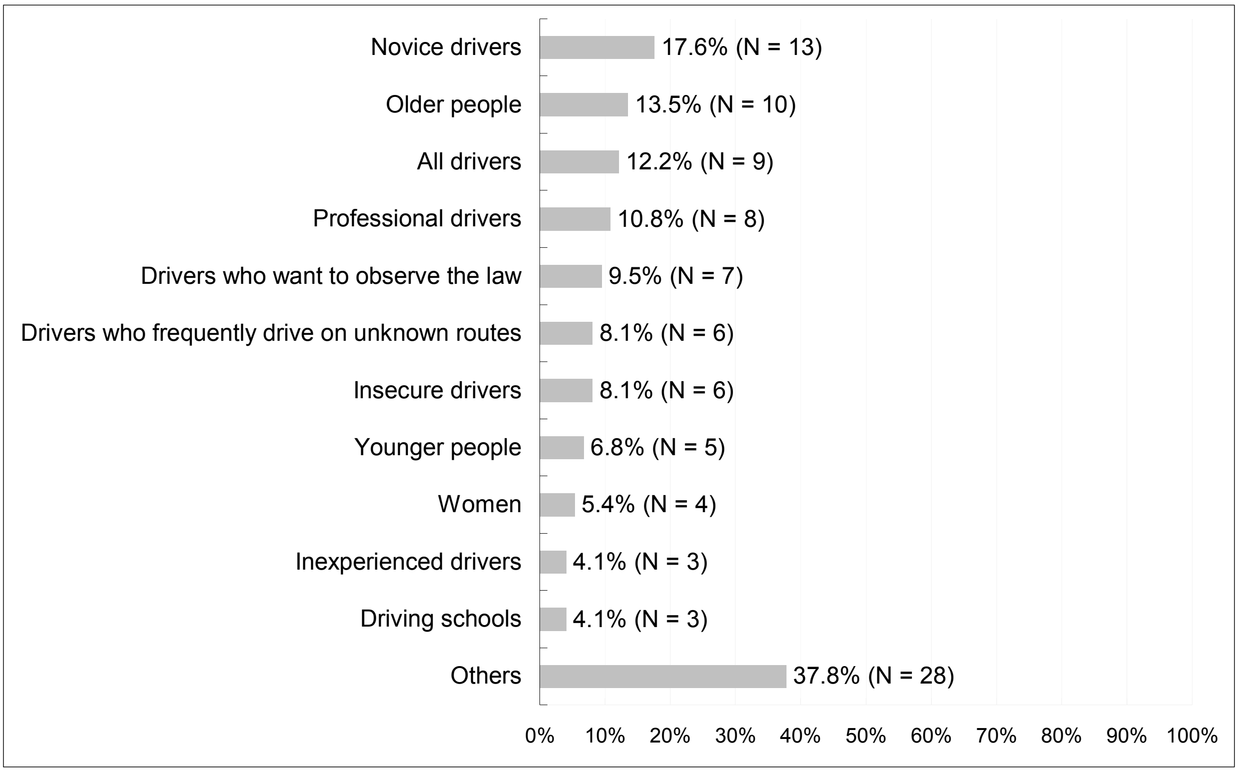
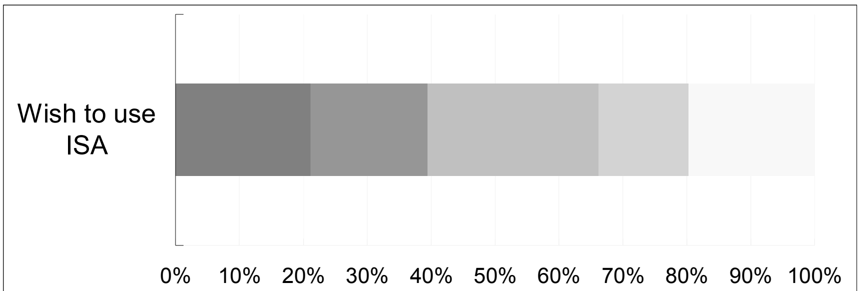


Figure 97: Top eleven user groups of ISA (frequency in %; N = 67); multiple answers possible

For this study it was quite important to know how willing young drivers are to use a system like ISA. As shown in table 98 about 40% of the participants (N = 28) would be willing to use ISA and 20% of them would be very interested in the system. One quarter (N = 19) was indifferent. About one third (N = 24) was not willing to give ISA a chance.



	Wish to use ISA	%
(1) Strongly agree	15	21.1
(2) Agree	13	18.3
(3) Undecided	19	26.8
(4) Disagree	10	14.1
(5) Strongly disagree	14	19.7

N = 71	
Wish to use ISA	
2.93	Mean
1.41	SD

Figure 98: Willingness to use an ISA system

The reasons why young drivers would like to use such a system or rather do without it can be found in figure 99 and figure 100. 8 participants (10.8%) indicated to favour ISA on the basis of it regulating their speed. That the system would draw attention to the current speed limit seemed to be a good argument for 7 respondents (9.5%). About 8% (N = 6) would like to use ISA since it supported the driving. 5 people (6.8%) liked the idea that no control look at the speedometer is necessary and that traffic safety could be increased. Information about permissible maximum speed (N = 4; 5.4%), avoidance of punishments (N = 3; 4.1%), feedback (N = 2; 2.7%), environmental aspects (N = 1; 1.4%) were further factors why young drivers appreciated the ISA system. The potential to increase the concentration on the traffic (N = 3; 4.1%) and to reduce the necessity of control looks at traffic signs (N = 1; 1.4%) seemed to be important for some as well.

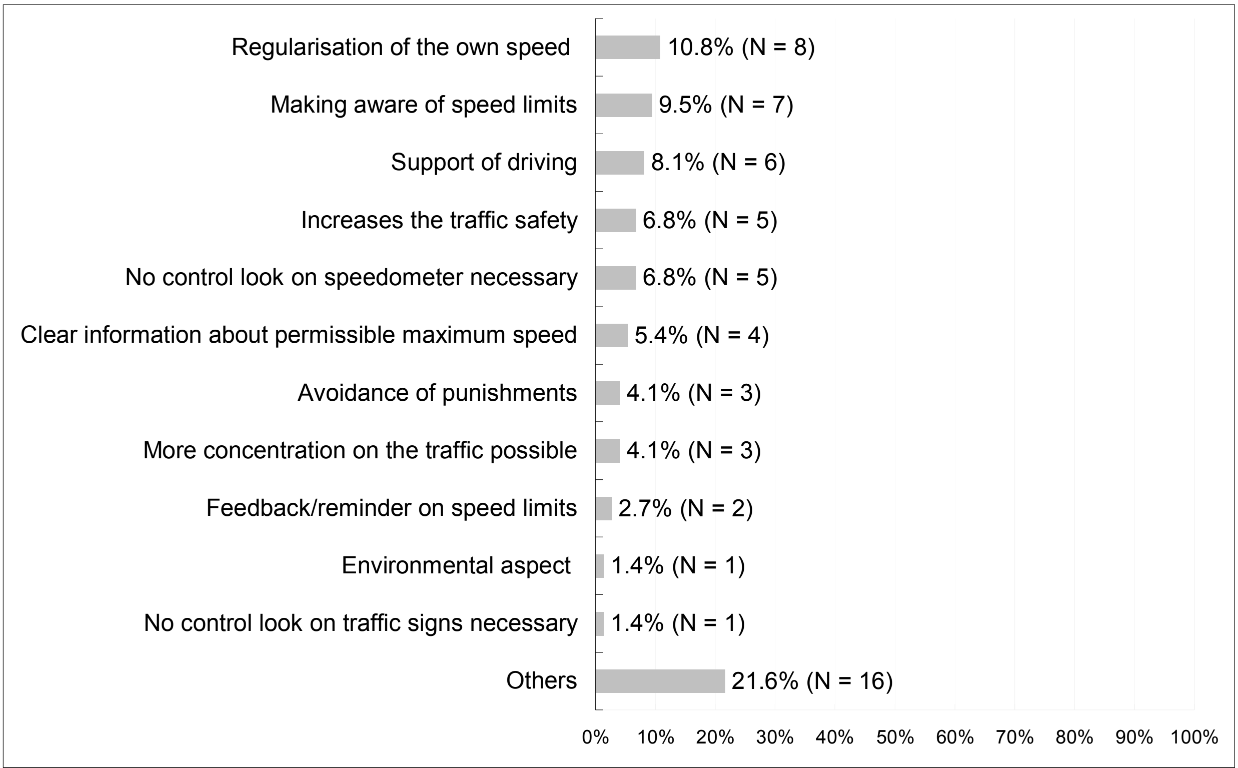


Figure 99: Reasons for using an ISA system (frequency in %; N = 46); multiple answers possible

8 respondents (10.8%) trusted in their own abilities and argued it would not be necessary to implement ISA in their vehicle. 3 young drivers (4.1%) were convinced that they usually did not speed. Further 7 participants (9.5%) generally like to exceed the speed limits and ISA would therefore disturb them. Some (N = 6; 8.1%) of the young drivers wanted to decide themselves how fast they were driving. 2 (2.7%) participants liked the feeling of having control over the car and 3 (4.1%) were worried about a possible defect of the system. 4 respondents (5.4%) were worried about the loss of freedom and 2 participants (2.7%) assumed ISA to be annoying or controlling. Rather few young drivers worried about the acquisition costs (N = 4; 5.4%) or environmental aspects (N = 1; 1.4%).

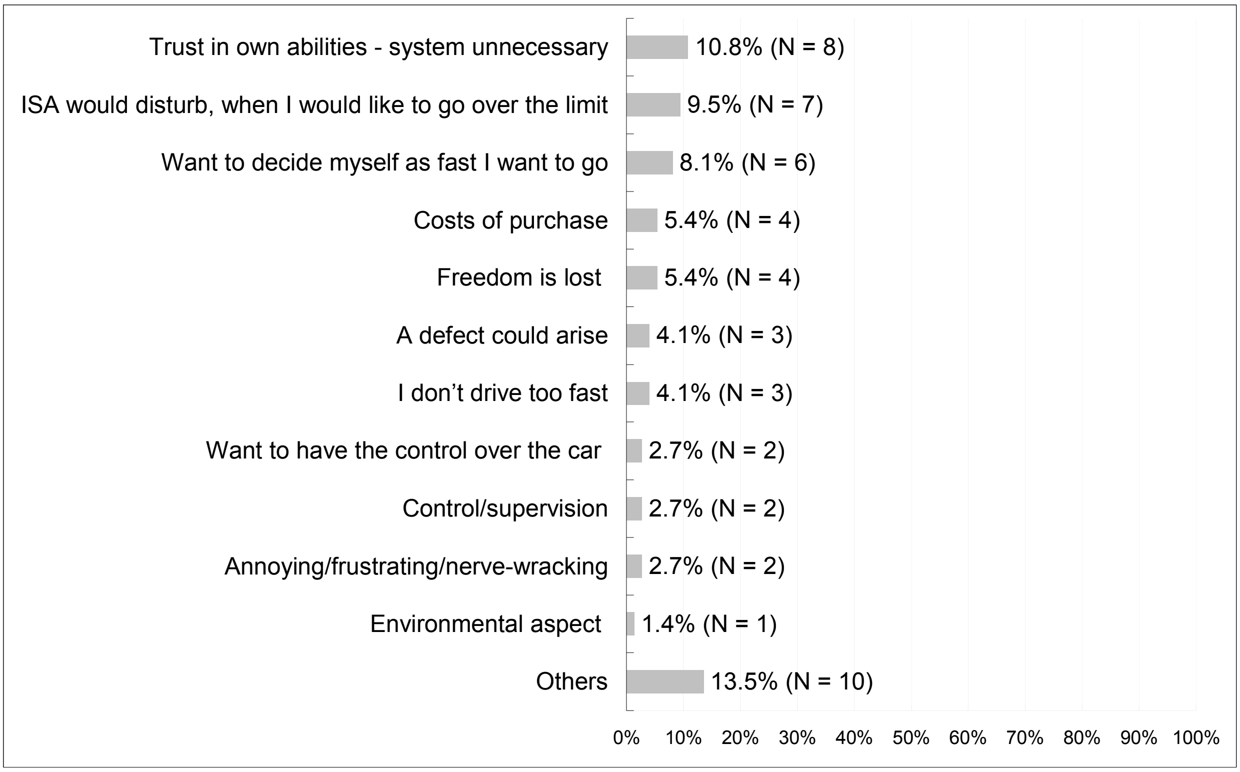


Figure 100: Reasons for not using an ISA system (frequency in %; N = 41); multiple answers possible

7.4. Findings of the Manchester Driver Behaviour Questionnaire (DBQ)

7.4.1. 6 groups – the result of a cluster analysis

The DBQ consists of 28 questions about habits and behaviour in traffic. An interpretation scheme for categorising the data, which was replied in a similar way in several studies so far (Freeman et al., 2007; Wishart et al., 2006; Lajunen et al., 2004; DfT, n.a.; Lawton et al., 1997; Özkan and Lajunen, 2005; Bener et al., 2008) already existed and, thus was used in the current study as well. As previously mentioned in the theoretical section about the DBQ (see sub-chapter 5.4.2), the answers could be assigned to four factors that are “Lapses”, “Errors”, “Viol (HC)” standing for “Highway code or normal violations” and “Viol agg” focusing on interpersonally aggressive violations. Table 40 to table 43 give an overview of the 4 factors and their corresponding questions.

Lapses	Attempt to drive away from the traffic lights in third gear.	Question 1
	Forget where you left your car in a car park.	Question 5
	Switch on one thing, such as the headlights, when you meant to switch on something else, such as the wipers.	Question 6
	Realise that you have no clear recollection of the road along which you have just been traveling.	Question 8
	Misread the signs and exit from a roundabout on the wrong road.	Question 12
	Hit something when reversing that you had not previously seen.	Question 20
	Intending to drive to destination A, you ‘wake up’ to find yourself on the road to destination B, perhaps because the latter is your more usual destination.	Question 21
	Get into the wrong lane approaching a roundabout or junction.	Question 23

Table 40: Factor “Lapses”

Error	Attempt to overtake someone that you hadn’t noticed to be signaling a right turn.	Question 4
	Fail to notice that pedestrians are crossing when turning into a side street from a main road.	Question 10
	On turning left, nearly hit a cyclist who has come up on your inside.	Question 14
	Queuing to turn left onto a main road, you pay such close attention to the main stream of traffic that you nearly hit the car in front.	Question 16
	Underestimate the speed of an oncoming vehicle when overtaking.	Question 19
	Miss ‘Give way’ signs, and narrowly avoid colliding with traffic having right of way.	Question 24
	Fail to check your rear view mirror before pulling out, changing lanes etc.	Question 25
	Brake too quickly on a slippery road, or steer the wrong way in a skid.	Question 27

Table 41: Factor “Error”

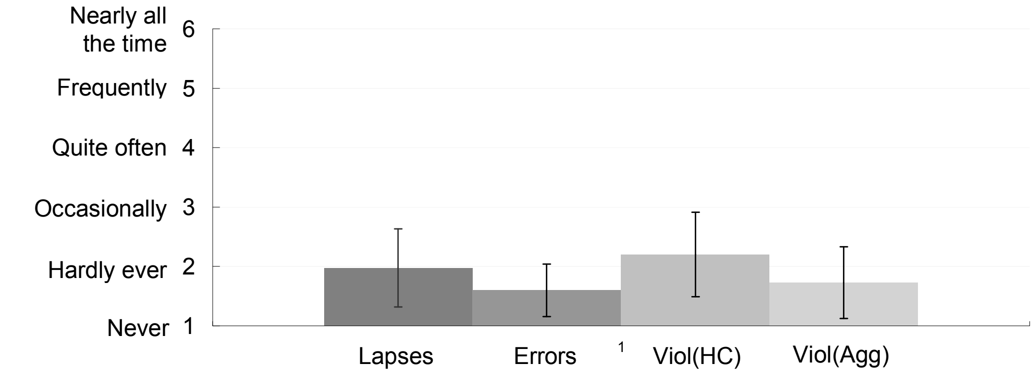
Viol (HC)	Overtake a slow driver on the inside.	Question 2
	Drive especially close to the car in front as a signal to its driver to go faster or get out of the way.	Question 3
	Cross a junction knowing that the traffic lights have already turned against you.	Question 9
	Disregard the speed limit on a residential road.	Question 13
	Drive even though you realise that you may be over the legal blood-alcohol limit.	Question 17
	Disregard the speed limit on a motorway	Question 28

Table 42: Factor “Viol (HC)” (**H**ighway **C**ode or normal violations)

Viol (agg)	Sound your horn to indicate your annoyance to another road user.	Question 7
	Become angered by another driver’s behaviour, and give chase with the intention of giving him/her a piece of your mind.	Question 11
	Pull out of a junction so far that the driver with right of way has to stop and let you out.	Question 15
	Have an aversion to a particular class of road user and indicate your hostility by whatever means you can.	Question 18
	Stay in a motorway lane that you know will be closed ahead until the last minute before forcing your way into the other lane.	Question 22
	Get involved in unofficial ‘races’ with other drivers.	Question 26

Table 43: Factor “Viol (agg)” (interpersonally aggressive violations)

For further analysis, indices were built, based on the DBQ factors. For every single participant the values within one factor were summed and averaged. The reliability of each factor is with Cronbachs α between 0.65 and 0.75 acceptable (see figure 101). Figure 101 gives an overview of the mean values of the four factors. Those young drivers who participated in the present study seemed to assess themselves as quite skilled and emotionally balanced drivers. According to their self-assessment they never or hardly ever make mistakes (M_{Lapses} = 1.97, SD_{Lapses} = 0.66; M_{Errors} = 1.60, SD_{Errors} = 0.44) and hardly ever admit violations (M_{HC} = 2.20, SD_{HC} = 0.71; M_{Agg} = 1.73, SD_{Agg} = 0.60).



	Mean	SD	Cronbachs α	Normal distr.*
Lapses	1.97	0.66	0.745	✓
Errors	1.60	0.44	0.698	✓
Viol(HC)	2.20	0.71	0.665	✓
Viol(Agg)	1.73	0.60	0.652	✓

* One-Sample Kolmogorov-Smirnov Test non significant

N = 74		
Limits are ok	Stick to limits	
2.41	2.27	Mean

Figure 101: Means, standard deviation and Cronbachs α of the DBQ factors

A cluster analysis was expected to help to identify different groups of drivers that could be used for the further analysis. Therefore in a first step, a hierarchical cluster analysis was calculated with the Ward method. The results suggested a five or six cluster solution. With regards to the elbow criterion (see figure 102) as well as theoretical considerations it was decided to continue the analysis by applying six clusters.

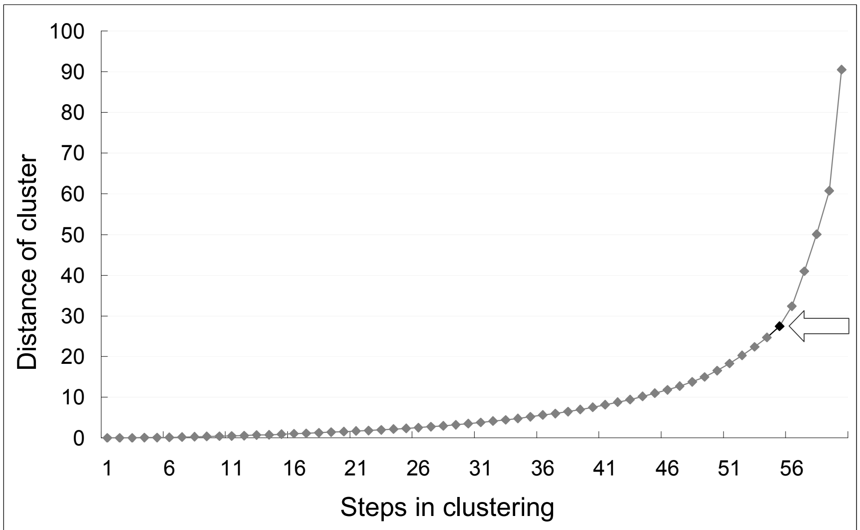


Figure 102: Elbow criterion

The different groups were labelled “Ideal driver”, “Angry driver”, “Rule breaker”, “Clumsy clot”, “Clumsy rowdy” and “Aggressive rowdy” (see table 44). The “Ideal driver” was characterised by admitting relatively few lapses, errors and violations. Participants that were assigned to the group of “Angry drivers” were those who mentioned more lapses and regular violations as well as aggressive violations. “Rule breakers” showed comparatively high values in the variable “ViolHC”, without noticeable differences to the mean values concerning the other variables. Those young drivers who mentioned a lot of lapses and errors were categorized as “Clumsy clots”. If respondents additionally had a high value in the variable “ViolHC” they were described as “Clumsy rowdies”. Finally, under the sub-group “Aggressive rowdy” those participants belong to, who violated laws frequently and often behaved erroneously in their opinion. However, one has to bear in mind that respondents hardly ever admitted lapses, errors or violations.

Cluster	N	Label	Lapses	Errors	ViolHC	ViolAgg
6	7	Ideal driver	1.21	1.23	1.26	1.10
5	12	Angry driver	1.66	1.24	1.93	1.78
2	16	Rule braker	1.81	1.58	2.79	1.67
1	14	Clumsy clot	2.37	1.77	1.58	1.42
4	4	Clumsy rowdy	3.53	2.22	2.96	1.88
3	8	Aggressive rowdy	1.97	1.88	2.96	2.92
Total	**61**		**1.97**	**1.60**	**2.20**	**1.74**

Table 44: Cluster means of the hierarchical analysis

To increase the consistency of each cluster a k-means analysis was carried out as well. The cluster means were used as starting points for the calculation. Table 45 illustrates only small changes within the clusters, so that the cluster description below still is valid and could be applied for further analysis.

Cluster	N	Label	Lapses	Errors	ViolHC	ViolAgg
6	11	Ideal driver	1.36	1.25	1.36	1.12
5	11	Angry driver	1.70	1.32	1.98	1.83
2	15	Rule braker	1.83	1.56	2.83	1.68
1	12	Clumsy clot	2.45	1.82	1.63	1.49
4	4	Clumsy rowdy	3.53	2.22	2.96	1.88
3	8	Aggressive rowdy	1.97	1.88	2.96	2.92
Total	**61**		**1.97**	**1.60**	**2.20**	**1.74**

Table 45: Cluster means of the k-means analysis

In the current work all clusters are interpreted. From a statistical point of view, clusters consisting of a high number of participants can be easily interpreted with respect to the content. The cluster consisting of a low number of participants ("Clumsy rowdy") has to be handled with care. On the one hand, it can be assumed, however, that in case of a big sample this cluster would also be filled with a sufficient amount of cases to make an interpretation with regard to the content possible. On the other hand, the cluster of the "Clumsy rowdies" might represent a risk group of car drivers, what would be an interesting result, though.

The next question to answer was how these clusters could be characterised in relation to nationality, gender, age, driving experience and duration of licence ownership. Do ideal drivers have more driving experience than the clumsy ones? Who are the angry drivers and who are the aggressive ones? A correspondence analysis was perceived as the best method to respond to these questions.

In order to find the most relevant categories, in a first step several Pearson's chi-square tests were calculated. The clusters differed significantly with regard to the nationality [χ^2 (df = 5, p = 0.042)] and with respect to the driving experience of the participants [χ^2 (df = 30, p = 0.031)]. Concerning gender [χ^2 (df = 5, p = 0.306)], age [χ^2 (df = 45, p = 0.159)] and the duration of the licence ownership [χ^2 (df = 195, p = 0.377)] no differences were evident. However, based on the literature (see chapter 3) it was decided to focus on the gender differences in combination with the driving experience of young drivers. To increase the amount of information both variables, gender and driving experience, were "cross-tabulated gender x driving experience".

The resulting variables "women with little driving experience", "women with extensive driving experience", "men with little driving experience" and "men with extensive driving experience" finally were visualised in relation to the six clusters (see figure 103). The x-axis represents the driving experience of the participants whereas the y-axis represents the gender. Lapses and errors, assigned to the "Clumsy clots" and "Clumsy rowdies", were mainly admitted by female drivers. Despite their driving experience male drivers more often can be located in the group of "ideal" or "angry" drivers. The cluster "angry" driver does not differ considerably from the "ideal" driver, except for the aggressive behaviour against other road users and thus represents drivers who are confident about their driving skills. Those groups who are characterised by a rude driving style as "Rule breakers", "Clumsy rowdies" and "Aggressive rowdies" consisted of drivers who mostly indicated a lot of driving experience.

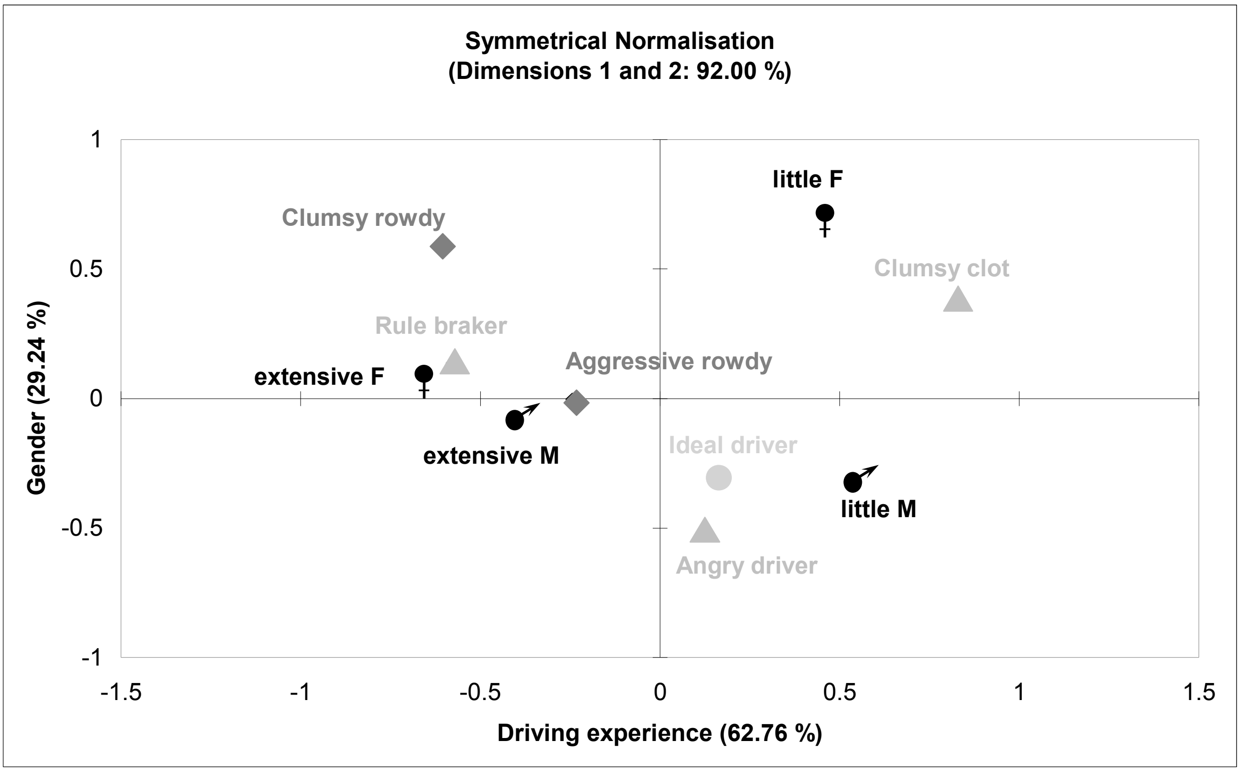


Figure 103: The relation between the gender, the driving experience and the six clusters visualised with a correspondence analysis

Concluding this chapter about the DBQ, six clusters were identified. These clusters were built upon the distinguishing values of each participant in the variables "lapses", "errors", violations against law regulations and violations based on aggressive behaviour towards other road users. The "Ideal driver" was characterised by intending to make few mistakes in traffic. Apart from the aggressive behaviour towards other road users a quite similar picture was found for the "angry driver". "Rule breakers" confessed to numerous "normal" violations and "Clumsy clots" quoted many lapses and errors, whereas "Clumsy rowdies" can be seen as a combination of both groups. Those participants who had the highest values in almost all variables were described as "aggressive rowdies". A correspondence analysis helped to illustrate the clusters afterwards. A clumsy driving style was mainly ascribed to women, whereas men were closer to the clusters including a good, almost ideal, driving behaviour. Furthermore, undesirable behaviour, as reflected by the groups of “Rule breakers” and rowdies, was most likely to be admitted by the more skilled participants. However, it has to be emphasised that all participants in general admitted only few lapses, errors or violations (see figure 101).

7.5. Findings of the “Type” questionnaire

7.5.1. 5 factors – the result of a principal component analysis (PCA)

The “Type” questionnaire included 28 questions about attitudes towards traffic. In order to structure these questions and to identify patterns behind them, a PCA using a varimax rotation was calculated with SPSS. Based on the Kaiser criterion, the “elbow” criterion and on considerations with regards to the content, five factors were extracted. Only variables with loadings equal to or greater than 0.40 were considered in the examination. An overview of the structure of the 5 factors “Risk”, “Fun”, “Control”, “Anxiety” and “Aggression” is given in table 46.

The first factor “<u>Risk</u>” accounted for 15.66% of the variance and consisted of 9 items. Variables constituting this factor dealt with competition (question 21), autonomy (question 6 and 28), thrill seeking (question 22 and 16), aggression and delinquency (question 23, 2 and 25) and some kind of obedience to the car (question 17). This interplay of parameters very well reflected the description of a risky driver, as given in the literature review at the beginning of this work.

The factor “<u>Fun</u>” accounted for 11.34% of the variance. Basically 5 variables formed this factor. 3 more variables (question 22, 16 and 7), however, had quite high loadings on this factor, and were therefore included as well. The factor “Fun” was related to freedom, relaxation and to the feeling of comfort and thrill seeking (question 22 and 16).

The third factor was labelled “<u>Control</u>” and included 6 questions. Again, at first just 5 variables built this factor but due to a relatively high factor loading in question 1 this variable was added as well. This factor explained 10.82% of the variance. The factor “Control” included the desire for independence (question 5) and for autonomy with regard to time. In addition, the belief in vehicle control under difficult weather conditions and physical strain (question 15 and 26), some kind of self-confidence (question 3 and 20) and the belief in traffic safety (question 1) described this factor.

The factor “<u>Anxiety</u>”, including 7 variables, accounted for 10.05% of the variance. This factor was about fear and indisposition (question 1 and 7), incertitude (question 18 and 4), obedience to traffic rules (question 24) but also focused on a smooth driving style (question 13 and 19).

“<u>Aggression</u>”, being the last factor, still explained 7.35% of the variance and consisted of 4 variables (including question 25). This factor reflected road rage (question 8 and 25) as well as verbal expression of anger (question 10) but also uneasiness with dependency (question 4).

In total, these 5 factors defined 55.23% of the variance (see table 47). Except for the factor “Aggression” the Cronbachs α-values were above 0.7, which is satisfactory.

		Risk	Fun	Control	Anxiety	Aggression	Communali
		Factor loading					
Risk	I enjoy to compete against other car-drivers on the road.	0.75	0.30	-0.11	-0.15	0.20	0.72
	Sometimes while driving my car I become so angry, that I calm down only after some minutes.	0.72	-0.17	-0.24	0.07	0.26	0.68
	I think, that the car driver is patronised by general speed limits.	0.69	0.11	0.23	0.07	0.00	0.55
	With respect to slow drivers you sometimes have to tailgate on the highway.	0.69	0.22	0.27	-0.11	-0.02	0.61
	I need a bit of a thrill while driving my car.	0.64	0.51	0.04	0.00	0.11	0.68
	In the road traffic there are too many rules and regulations.	0.64	0.04	0.27	0.05	-0.23	0.53
	Without car I feel like half a person.	0.57	0.38	0.35	0.00	0.18	0.62
	Occasionally I try to find out my driving limits while driving my car.	0.57	0.43	0.10	-0.31	0.24	0.66
	If one only drives on the left lane, you have to overtake him on the right.	0.52	-0.16	0.09	-0.19	0.45	0.55
Fun	Driving a car is connected for me with the feeling of freedom and independence.	0.18	0.66	0.12	-0.15	0.05	0.51
	Sometimes I feel like cruising.	0.04	0.64	0.07	-0.09	0.17	0.46
	I really like to drive a car.	0.07	0.62	0.30	-0.18	0.02	0.51
	I like to look around the country while driving.	0.24	0.52	-0.12	-0.37	0.06	0.49
	I often feel really comfortable in my car.	0.35	0.47	0.08	0.37	0.28	0.57
Control	I know my car inside out.	0.34	0.06	0.75	-0.08	0.01	0.69
	I have everything under control while driving my car.	0.23	0.33	0.65	0.09	-0.02	0.59
	I want to have the possibility to reach any place without depending on timetables.	0.26	-0.22	0.62	-0.25	0.13	0.58
	I like to drive under difficult weather conditions (e.g. snow, clear ice or heavy rain).	0.09	0.24	0.59	-0.23	0.08	0.47
	I do not like to drive long distances, e.g. far motorway journeys.	0.11	-0.07	-0.57	0.03	0.00	0.34
Anxiety	I like to drive without stress.	0.07	-0.04	-0.05	0.60	-0.19	0.40
	If it is busy and hectical on the road, I feel very unwell.	0.02	-0.38	-0.38	0.59	0.06	0.64
	In today's road traffic you get frequently scared.	0.01	-0.03	-0.40	0.59	0.06	0.51
	I adhere strictly to the traffic regulations while driving my car.	-0.31	-0.12	-0.11	0.57	0.09	0.46
	I prefer to 'glide' with my car on the road, without abrupt speed changes.	-0.01	-0.14	0.03	0.55	0.02	0.33
	I am able to relaxe while driving.	0.11	0.43	0.28	-0.51	0.12	0.55
Aggression	I often swear while driving.	0.10	0.21	-0.11	-0.13	0.78	0.69
	Sometimes I drive deliberately slowly when someone tailgates behind me.	0.05	0.13	0.07	0.01	0.69	0.50
	If I am co-driver it happens quite often that I want to kick the pedals.	0.10	0.10	0.22	0.45	0.55	0.57

Table 46: Pattern matrix of variables and factor scores

	Original variance	Variance after rotation	Cronbachs α
Risk	25.72	15.66	0.87
Fun	10.87	11.34	0.81
Control	7.41	10.82	0.75
Anxiety	6.14	10.05	0.71
Aggression	5.08	7.35	0.61
Total	55.23	55.23	

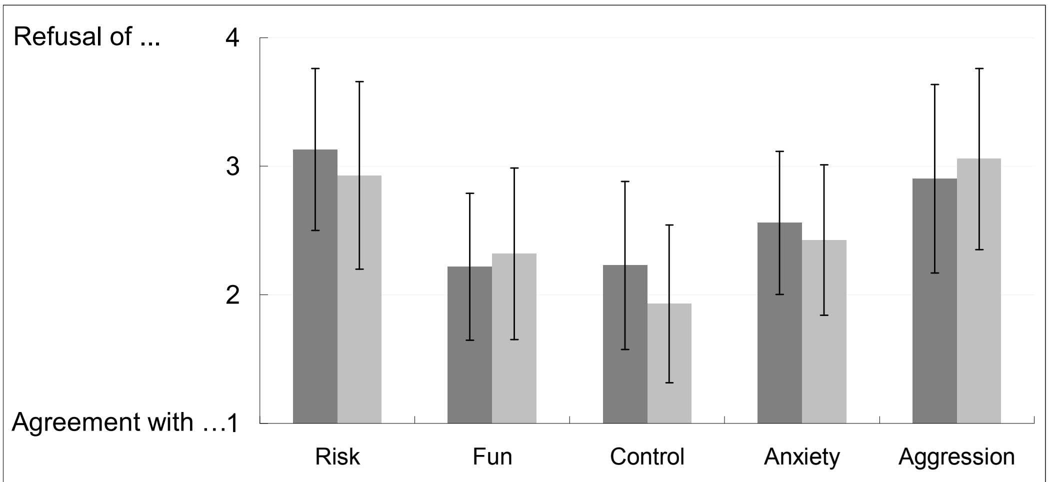
Table 47: Variances and Cronbachs α of the 5 factors

The next step was to determine who agreed most with the questions of the different factors. Hence, indices were calculated based on the results of the factor analysis. The scores of each relevant variable were summed up and subsequently averaged so as to create five new variables, representing the factors “Risk”, “Fun”, “Control”, “Anxiety” and “Aggression”. Like for the DBQ, it was investigated if participants respond differently to the five factors, depending on their gender, driving experience as well as on their age.

7.5.1.1. Sex

Keeping the provided findings of the literature in mind, concerning the five factors, it might be assumed that male drivers are more likely to agree with statements of the “Risk”, the “Fun”, the “Control” as well as the “Aggression” factor, whereas female drivers would be more likely to be anxious in traffic. Using an independent t-test, this assumption was supported only partly. On average male drivers (M = 2.93, SD = 0.73) had a “higher”[10] value in the factor “Risk” than female drivers (M = 3.13, SD = 0.63) but the difference was not significant (t(61) = 1.11, p = 0.270). The same was true for the “Control” factor. On average male participants (M = 1.93, SD = 0.61) experience more control while driving than female drivers (M = 2.23, SD = 0.65) do. Although the difference is not significant (t(60) = 1.79, p = 0.079) at least a tendency can be assumed. Further it was investigated if female drivers (M = 2.56, SD = 0.56) are on average more anxious than males are (M = 2.43, SD = 0.59). Again no significant difference could be calculated (t(60) = 0.87, p = 0.386). Contrary to the assumption mentioned above, male participants (“Fun” M = 2.32, SD = 0.67; “Aggression” M = 3.06, SD = 0.71) indicated to have less fun but also to behave less aggressively than female participants (“Fun” M = 2.22, SD = 0.57; “Aggression” M = 2.90, SD = 0.73). The differences were not significant (“Fun” t(61) = -0.61, p = 0.543; “Aggression” t(61) = -0.82, p = 0.414).

[10] Within the results a „higher” value means a greater agreement on the statements of the specific factor.

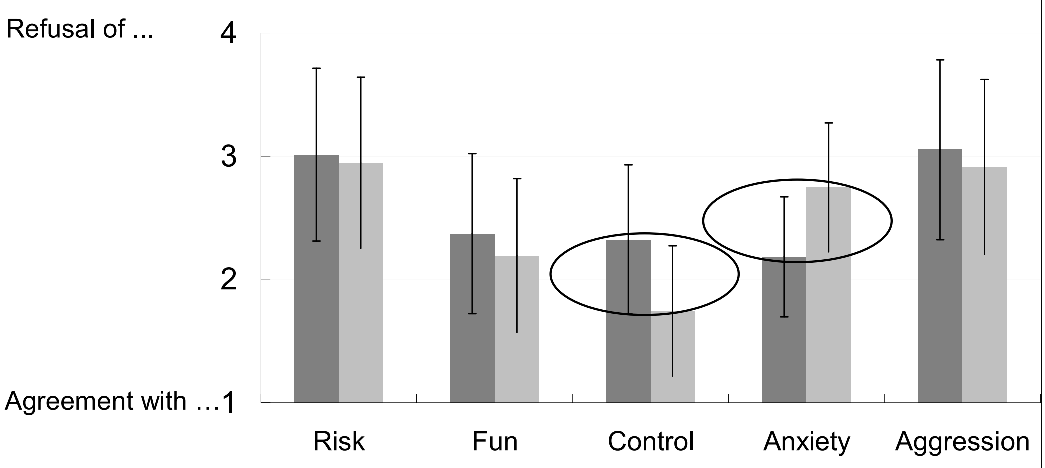


	Risk Mean	Risk SD	Fun Mean	Fun SD	Control Mean	Control SD	Anxiety Mean	Anxiety SD	Aggression Mean	Aggression SD
Female	3.13	0.63	2.22	0.57	2.23	0.65	2.56	0.56	2.90	0.73
Male	2.93	0.73	2.32	0.67	1.93	0.61	2.43	0.59	3.06	0.71

Figure 104: Illustration of sex differences (mean values; standard deviation) according to the 5 factors

7.5.1.2. Driving experience in kilometres

Another interesting examination is the role of driving experience regarding the 5 factors “Risk”, “Fun”, “Control”, “Fear” as well as “Aggression”. For calculation, on the basis of the values of the variable “driving experience”, two groups were formed, one with little experience (up to 10.000 kilometres) and one with extensive practice (more than 10.000 kilometres). The calculation of an independent t-test showed highly significant differences between both groups for the factor “Control” ($t(59) = 3.97$, $p = 0.000$) as well as the factor “Anxiety” ($t(59) = -4.33$, $p = 0.000$). Those drivers who have less practice in traffic (“Control” $M = 2.32$, $SD = 0.61$; “Anxiety” $M = 2.18$, $SD = 0.49$) experienced less control on the road and had higher values in the “Anxiety” factor than the more skilled drivers (“Control” $M = 1.74$, $SD = 0.53$; “Fear” $M = 2.75$, $SD = 0.52$). The factors “Risk”, “Fun” and “Aggression” were not that much affected by the experience of young drivers (“Risk” $t(59) = 0.38$, $p = 0.709$; “Fun” $t(59) = 1.10$, $p = 0.277$ and “Aggression” $t(59) = 0.75$, $p = 0.458$). However, on average, inexperienced drivers ($M = 3.01$, $SD = 0.70$) seemed to agree less on the risky behaviour items than drivers with an experience of more than 10.000 kilometres ($M = 2.94$, $SD = 0.69$). The same assumption can be presumed for responses concerning aggressive behaviour. It was noticed that less practice on average led to a less aggressive driving style, according the responses (“≤ 10.000 km“ $M = 3.05$, $SD = 0.73$ and “> 10.000 km“ $M = 2.91$, $SD = 0.71$). Furthermore participants with driving experience less than 10.000 kilometres ($M = 2.37$, $SD = 0.65$) agreed not that much on fun related questions than experienced drivers did ($M = 2.19$, $SD = 0.63$).

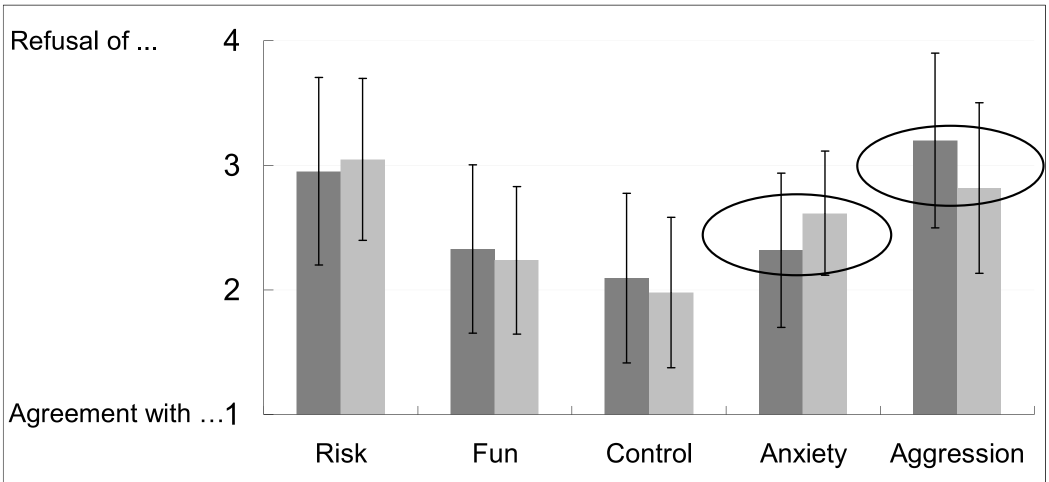


	Risk		Fun		Control		Anxiety		Aggression	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
≤ 10.000 km	3.01	0.70	2.37	0.65	2.32	0.61	2.18	0.49	3.05	0.73
> 10.000 km	2.94	0.69	2.19	0.63	1.74	0.53	2.75	0.52	2.91	0.71

Figure 105: Illustration of differences in driving experience (mean values; standard deviation) according to the 5 factors with accentuation of the significances

7.5.1.3. <u>Age</u>

The influence of age on the 5 factors was investigated as well. Two age groups were examined, participants between 18 and 20 years and those who were older. On average the older participants ($M = 2.24$, $SD = 0.59$) were identified as the group who enjoys driving more than the younger ones ($M = 2.33$, $SD = 0.68$), yet no significant difference was found ($t(61) = 0.57$, $p = 0.573$). Furthermore 18 to 20 year old participants ($M = 2.09$, $SD = 0.68$) did not experience that much control while driving than the older ones ($M = 1.98$, $SD = 0.60$). The difference was not significant ($t(60) = 0.71$, $p = 0.483$). As suggested in literature, younger drivers ($M = 2.95$, $SD = 0.75$) are more willing to take risks according to their answers, compared to the responses of older drivers ($M = 3.05$, $SD = 0.65$). This finding was not significant ($t(61) = 0.54$, $p = 0.592$), either. However, studying the differences between younger and older drivers two significances were found according to the factor "Anxiety" as well as to the factor "Aggression". 18 to 20 year old drivers ($M = 2.32$, $SD = 0.62$) were considerably ($t(60) = -2.09$, $p = 0.041$) more anxious in traffic than the older ones ($M = 2.62$, $SD = 0.50$). Furthermore, the answers of the younger participants ($M = 3.20$, $SD = 0.70$) indicated a significantly ($t(61) = 2.18$, $p = 0.033$) less aggressive behaviour in traffic than the answers of the participants older than 21 ($M = 2.82$, $SD = 0.69$).



	Risk Mean	Risk SD	Fun Mean	Fun SD	Control Mean	Control SD	Anxiety Mean	Anxiety SD	Aggression Mean	Aggression SD
18 - 20 y.	2.95	0.75	2.33	0.68	2.09	0.68	2.32	0.62	3.20	0.70
> 21 y.	3.05	0.65	2.24	0.59	1.98	0.60	2.62	0.50	2.82	0.69

Figure 106: Illustration of age differences (mean values; standard deviation) according to the 5 factors with accentuation of the significances

7.6. Results of the Evaluation of the group discussion

The designed training programme aimed at sensitizing young car drivers for traffic safety issues in general and speed behaviour in particular. A more thoughtful interaction with other road users was the intended objective. Whether this goal was achieved, was checked with a very basic feedback questionnaire (annex VII). Only the answers given on the question about how participants think to have profited from the group discussion will be presented, as the other questions concentrated more on how to improve the method. The answers of these questions were not very relevant. In Austria a total of 15 participants participated whereas in the Czech Republic 8 drivers attended the training. The Czech participants did not fill in this particular questionnaire.

Based on the answers of the Austrian sample it was concluded, that participants of the group discussion became more aware of the impact of speed and their responsibility in this regard. Furthermore the awareness of the impact of exceeding the speed limit by just 10 km/h was increased. Almost half of the participants developed a more thoughtful attitude towards other road users. Three of them also gained a more reflected perception of their own attitudes and behaviour. Moreover, young drivers started to think about the system function of road traffic. One of the young drivers liked to discuss the issue of traffic and traffic safety and another one planned to pay more attention to the traffic in the future. All in all, each of the participants thought to have learned a lesson through to the training.

7x	Do not forget the point of view of other road users and be more considerate about them
2x	Exceeding the speed limit just for 10km/h is too much
1x	Awareness concerning speed and speed variances
1x	Have to take care more concerning the driven speed
1x	Being aware of the system function of traffic
1x	Think more cross-linked
1x	Not condemn other road users
1x	Awareness, that also law-abiding people break traffic rules
1x	Reconsider the own attitudes
1x	Discussion about traffic and traffic safety
1x	Concentrate more on the traffic

Table 48: Answers to the question what young drivers have learned from the training

For a further analysis it was important to characterise the participants of the group discussion. It turned out that they did not vary significantly from the rest of the drivers concerning gender [χ^2 (df = 1, p = 0.378)], age [Fisher's exact test (p = 0.322)], duration of the ownership of the driving licence [Fisher's exact test (p = 0.655)], driving experience [Fisher's exact test (df = 6, p = 0.464)], nationality [χ^2 (df = 1, p = 0.838)], driving behaviour [Fisher's exact test (p = 0.415)] or attitude towards ISA [Fisher's exact test (p = 0.906)]. Furthermore no differences in the responses of the DBQ [χ^2 (df = 5, p = 0.541)] and the "Type" questionnaire with regard to the factor "Risk" [χ^2 (df = 2, p = 0.736)], "Fun" [χ^2 (df = 2, p = 0.208)], "Control" [χ^2 (df = 2, p = 0.397)], "Anxiety" [χ^2 (df = 2, p = 0.908)] or "Aggression" [χ^2 (df = 2, p = 0.471)] could be found.

7.7. Effect of ISA on the communication

7.7.1. Immediate effect of ISA

Hypothesis 1: The use of an ISA system will improve the communication between young drivers and other road users.

Based on the literature (Hjämdahl, 2004b) it was assumed that the use of an ISA system will improve the communication between young car drivers and other road users. In order to verify this hypothesis, a deeper analysis of the behaviour observation data of the first and the second step was necessary.

At the very beginning the question how communication is reflected by driving behaviour had to be answered. Taking a look on the variables of the behaviour observation sheet (see chapter 5.3.3.2), it could be argued that more or less all variables are related to communication behaviour. This is consistent with the first axiom of Watzlawick (n.a.) who postulated that "one cannot not communicate". Whatever behaviour is shown in traffic, it will necessarily be interpreted by others. A speeding driver for instance might be perceived as being in a hurry, or as a sensation seeker who wants to get a kick. Similarly a driver who decelerates belatedly at a crossing might be assessed as distracted, inattentive or aggressive by other road users. To verify hypothesis 1, the concept of communication was considered more closely. Exclusively those variables that are associated with an explicit interaction of the driver with other road users were considered. In particular the set of variables concerning overtaking and lane change behaviour, the distance to the car ahead, the behaviour towards vulnerable road users as well as the variable “insist on one’s own priority” were chosen. Furthermore the variable “usage of the indicator” was added because this type of behaviour is the one with the highest face validity in the context of communication.

An index was calculated including all variables related to the categories that have just been mentioned (see table 49). The number of observed errors within each particular set of variables of all sections were added together and averaged. Since there was a big variance between the observers, for the further calculation just those cases where the identical observer did the observation were taken into account. For the following results, it has to be taken into account that the higher the mean values are the more errors concerning communication behaviour occurred.

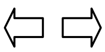
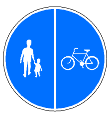
	Overtaking	Illegal		
		Dangerous		
		Unnecessary		
Distance to the road user ahead		Dangerous		
		Too short		
	Use of the indicator	Too short		
		Too late		
		Not at all		
Lane change		Too fast		
		Dangerous		
		Hesitant		
	Insist on one´s own priority			
	Vulnerable road-users		Pedest.	Cyclists
		Not realised		
		Ignores Zebra Crossing		
		Gives priority late		
		Is waiting at the roadside		
		Forces to stop		
		Hazards		

Table 49: List of variables integrated in the “Communication” index

A t-test for dependent variables showed a significant difference between the two conditions. While driving the ISA equipped car (M = 0.76, SD = 0.44) young drivers exhibited a significant better communication behaviour with other road users (t(41) = 2.71, p = 0.010) than without the system (M = 0.90, SD = 0.50). Nevertheless it would be wrong to conclude that the improvements of the communication style of young drivers are exclusively due to the use of ISA, as behaviour changes might occur over time anyway. However, hypothesis 1 does not need to be rejected but is rather supported by the results.

Based on the assumption that the impact of the ISA system might be different for various driver groups (Hjälmdahl, 2004b) further data analyses were conducted. For the variables **gender**, **age**, **duration of ownership**, driving **experience** and **nationality** variance analysis for repeated measures were calculated, as well. No significant differences were found for none of the variables; for more detailed information see annex VIII. To investigate the influence of the **attitudes** on the communication behaviour

towards the system, a new variable was calculated. The values of the responses with regard to the question “why participants would not like to use ISA” were summed and deducted from the sum of the values concerning the question why participants would like to use ISA. Hjälmdahl’s assumption was not supported by the results as no significance was detected.

At the very beginning of the study it was not quite clear what the results of the **“Type” questionnaire** will look like. A factor analysis turned out to be the best solution to describe the results of the “Type” questionnaire (see chapter 7.5). 5 independent factors “*Risk*”, “*Fun*”, “*Control*”, “*Anxiety*” and “*Aggression*” were extracted. As a next step, several ANOVAs were calculated in order to find out whether drivers with different attitudes show a different communication behaviour. For the factors “Fun”, “Control” and “Aggression” no significant changes in behaviour were identified between the groups. More precisely, concerning the factor “Fun” it did not make a difference if the participants enjoyed driving or not. Their communication behaviour did not change significantly while using the ISA system. The same holds true for the factors “Control” and “Aggression” but not for the factors “Risk” and “Anxiety”.

Factor “Risk”

It might be assumed that drivers who are more prone to risk have worse communication patterns than those who are less risk-affine. That conclusion is somewhat true for the participants of the study, as differences between the three groups exist in trend ($F_{2,39}$ = 2.92, p = 0.07). Drivers with a positive attitude towards risky behaviour (M_a = 1.04, SD = 0.55; M_b = 0.94, SD = 0.43) on average demonstrated a worse behaviour than those who had a neutral attitude (M_a = 0.90, SD = 0.49; M_b = 0.84, SD = 0.46). Both groups behave worse than those participants who disclaimed a risky driving style (M_a = 0.76, SD = 0.43; M_b = 0.53, SD = 0.34). However, no interaction effect was found ($F_{2,39}$ = 0.93, p = 0.40).

Descriptive statistics Factor "Risk"						
		N	Mean	SD	Min	Max
+	aCommu	17	1.04	0.55	0.22	2.48
	bCommu	17	0.94	0.43	0.39	2.20
~	aCommu	9	0.90	0.49	0.36	1.83
	bCommu	9	0.84	0.46	0.16	1.61
-	aCommu	16	0.76	0.43	0.12	1.88
	bCommu	16	0.53	0.34	0.16	1.52
One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant						

Risk (aCommu/ bCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.32	1.00	0.32	5.67	0.02
Time * Risk	0.11	2.00	0.05	0.93	0.40
Error(time)	2.23	39.00	0.06		
Tests of Between-Subjects Effects					
Risk	2.03	2.00	1.02	2.92	0.07
Error	13.56	39.00	0.35		
Sphericity Assumed					

Table 50: Descriptive statistics and results of the ANOVA for the index “Communication” related to the factor “Risk”[11]

[11] Those drivers who agree on risky driving behaviour were labelled with “+”, those who disagree where marked with “-“ and drivers who were indifferent have been described with “~”. This categorisation scheme was continued for all factors.

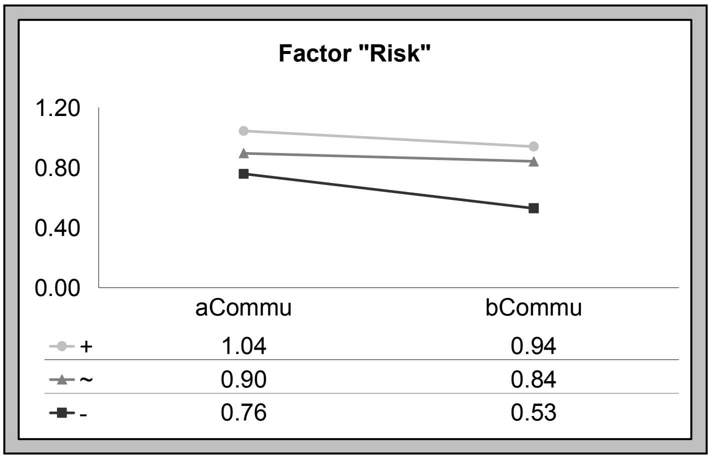


Figure 107: Changes of the communication behaviour over time depending on the attitude towards risk taking

Factor "Anxiety"

Depending on the level of anxiety, drivers tend to behave differently ($F_{2,38}$ = 2.97, p = 0.06; see also figure 108). Those participants who were scaled as quite balanced had the best results (M_a = 0.59, SD = 0.37; M_b = 0.49, SD = 0.29) and therefore communicated best with other road users. This group was followed by the drivers who were characterised as not anxious at all (M_a = 0.99, SD = 0.51; M_b = 0.94, SD = 0.49) and those who could be described as more anxious (M_a = 1.00, SD = 0.49; M_b = 0.76, SD = 0.38). The latter group showed the most improvement in their communication with other road users. An interaction effect was not found ($F_{2,38}$ = 1.33, p = 0.28).

Descriptive statistics Factor "Anxiety"		N	Mean	SD	Min	Max
+	aCommu	17	1.00	0.49	0.33	1.89
	bCommu	17	0.76	0.38	0.28	1.61
~	aCommu	8	0.59	0.37	0.12	1.04
	bCommu	8	0.49	0.29	0.16	1.00
-	aCommu	16	0.99	0.51	0.32	2.48
	bCommu	16	0.94	0.49	0.16	2.20
One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant						

Anxiety (aCommu/ bCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.32	1.00	0.32	5.61	0.02
Time * Anx.	0.15	2.00	0.08	1.33	0.28
Error(time)	2.18	38.00	0.06		
Tests of Between-Subjects Effects					
Anxiety	2.00	2.00	1.00	2.97	0.06
Error	12.82	38.00	0.34		
Sphericity Assumed					

Table 51: Descriptive statistics and results of the ANOVA for the index "Communication" related to the factor "Anxiety"

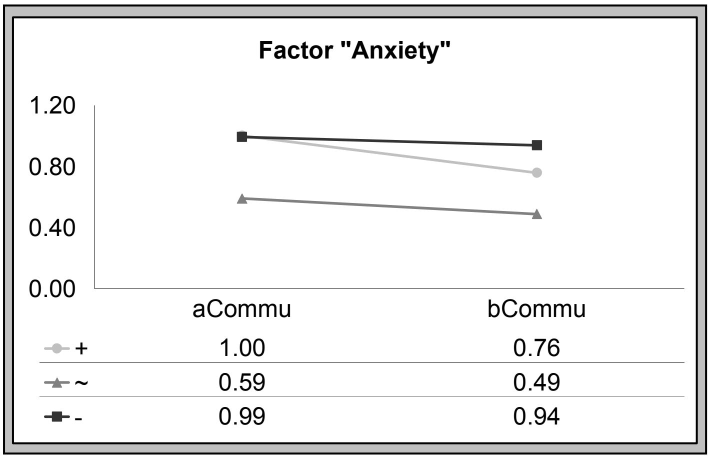


Figure 108: Changes of the communication behaviour over time depending on the amount of anxiety one perceives

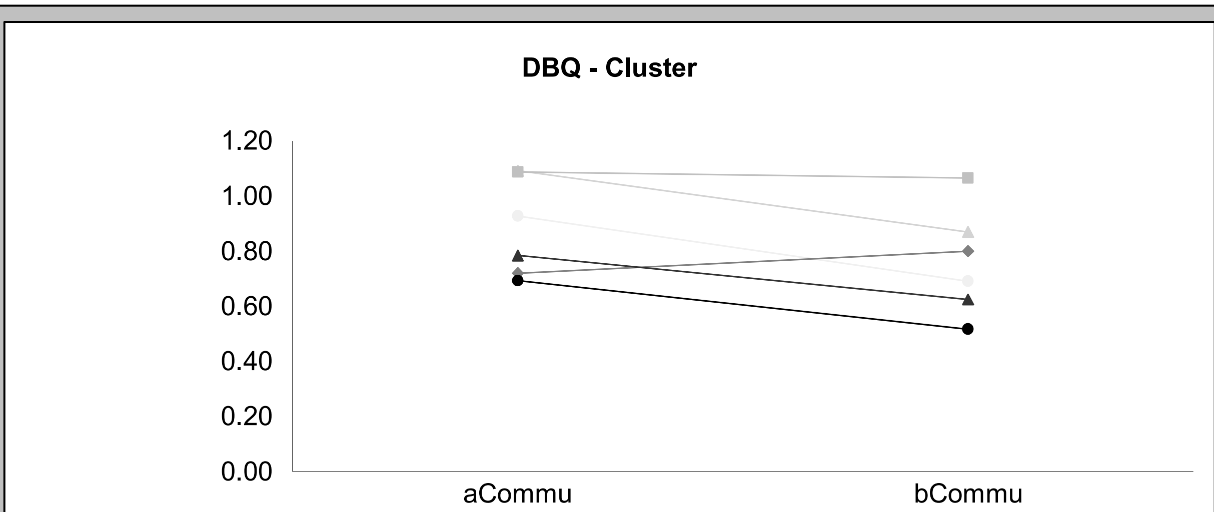
Hypothesis 1.8: The strength of the positive effect on the communication behaviour is different depending on the results of the **DBQ**.

Table 52 illustrates two cluster groupings and a intermediate cluster. One group of clusters with quite a good communication behaviour comprising the “Ideal drivers” (M_a = 0.69, SD = 0.38; M_b = 0.52, SD = 0.40), the “Clumsy rowdies” (M_a = 0.72, SD = 0.23; M_b = 0.80, SD = 0.51) and the “Angry drivers” (M_a = 0.78, SD = 0.45; M_b = 0.62, SD = 0.40) could be identified. The “Clumsy clots” (M_a = 0.93, SD = 0.48; M_b = 0.69, SD = 0.41) represent some kind of middle group followed by one group comprising the two clusters “Aggressive rowdies” (M_a = 1.09, SD = 0.71; M_b = 1.07, SD = 0.60) and “Rule breakers” (M_a = 1.09, SD = 0.59; M_b = 0.87, SD = 0.30) with bad interaction patterns. In almost all groups the communication behaviour improved over time. For the “Aggressive rowdies” the values remained stable on a very high value and the behaviour of the “Clumsy rowdies” deteriorated. However, for the last hypothesis again no significant behaviour changes of the six clusters could be detected ($F_{5,33}$ = 0.56, p = 0.73).

Descriptive statistics Cluster		N	Mean	SD	Min	Max
Clumsy clot	aCommu	9	0.93	0.48	0.12	1.83
	bCommu	9	0.69	0.41	0.16	1.61
Rule braker	aCommu	8	1.09	0.59	0.44	1.89
	bCommu	8	0.87	0.30	0.56	1.39
Aggr. rowdy	aCommu	6	1.09	0.71	0.56	2.48
	bCommu	6	1.07	0.60	0.48	2.20
Clumsy rowdy	aCommu	2	0.72	0.23	0.56	0.88
	bCommu	2	0.80	0.51	0.44	1.16
Angry driver	aCommu	6	0.78	0.45	0.22	1.36
	bCommu	6	0.62	0.40	0.16	1.32
Ideal driver	aCommu	8	0.69	0.38	0.28	1.67
	bCommu	8	0.52	0.40	0.16	1.33
One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant						

Cluster (aCommu/ bCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.23	1.00	0.23	4.05	0.05
Time * Cl.	0.16	5.00	0.03	0.56	0.73
Error(time)	1.85	33.00	0.06		
Tests of Between-Subjects Effects					
Cluster	2.12	5.00	0.42	1.08	0.39
Error	12.94	33.00	0.39		
Sphericity Assumed					

Table 52: Descriptive statistics and results of the ANOVA for the index “Communication” related to cluster



	aCommu	bCommu
Clumsy clot	0.93	0.69
Rule braker	1.09	0.87
Aggressive rowdy	1.09	1.07
Clumsy rowdy	0.72	0.80
Angry driver	0.78	0.62
Ideal driver	0.69	0.52

Figure 109: Changes of the communication behaviour over time depending on the cluster affiliation

7.7.2. Long-term effect of ISA

Hypotheses 2: A short-term use of ISA does not have a long-term effect on the drivers' communication behaviour.

Based on the findings of Schade (2000) concerning the stability of behaviour related to speed decisions as well as those of Hjälmdahl (2004a) and Várhelyi et al. (2004) about the speed choice without the ISA system, a positive long-term effect of ISA on the communication behaviour of young car drivers cannot be assumed after having used the system only once. In line with this assumption no significant change in interaction was found ($t(51) = 0.12$, $p = 0.905$) when comparing the averaged communication values of the first ride with those of the last ride. Furthermore, no differences in the behaviour changes concerning neither gender, age, duration of ownership, driving experience, nationality, high scores in one of the factors “Risk”, “Fun”, “Control”, “Anxiety” or “Aggression” nor belonging to a specific cluster were found. However, the communication behaviour of those drivers with an initially negative attitude towards ISA deteriorated exceedingly ($F_{2,46} = 6.65$, $p = 0.00$; $M_a = 0.60$, $SD = 0.37$; $M_d = 1.16$, $SD = 0.85$). Participants who were neutral concerning ISA even improved their interactions with other road users ($M_{a\sim} = 0.79$, $SD = 0.40$; $M_{d\sim} = 0.73$, $SD = 0.40$). The same effect, but to a larger extent, was found for drivers who positively assessed ISA ($M_{a+} = 0.93$, $SD = 0.53$; $M_{d+} = 0.72$, $SD = 0.54$).

Descriptive statistics Attitude towards ISA		N	Mean	SD	Min	Max
+	aCommu	17	0.93	0.53	0.12	1.89
	dCommu	17	0.72	0.54	0.24	2.44
~	aCommu	24	0.79	0.40	0.16	1.67
	dCommu	24	0.73	0.40	0.28	1.94
-	aCommu	8	0.60	0.37	0.20	1.17
	dCommu	8	1.16	0.85	0.36	2.78
One-Sample Kolmogorov-Smirnov Test is not significant						

Attitude (aCommu/ dCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.19	1.00	0.19	1.51	0.23
Time * Att.	1.69	2.00	0.84	6.65	0.00
Error(time)	5.83	46.00	0.13		
Tests of Between-Subjects Effects					
Attitude	0.21	2.00	0.10	0.29	0.75
Error	16.78	46.00	0.36		
Sphericity Assumed					

Table 53: Changes of the communication behaviour over time depending on the attitude towards ISA (before testing the system)

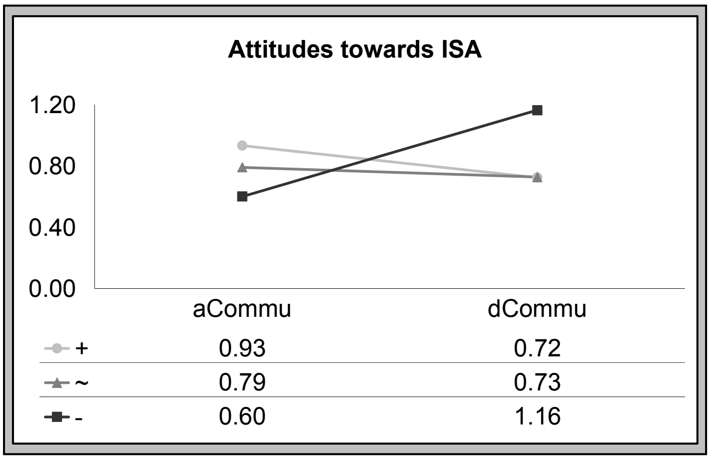


Figure 110: Changes of the communication behaviour over time depending on the attitude towards ISA

7.8. Effect of training on attitude and behaviour

Encouraged by the findings in literature it was assumed that a specific kind of training can change the attitude as well as the driving behaviour of adolescents and young grown-ups. To attain that goal, a training in the shape of a group discussion was developed as described in chapter 5.5. The question now is, if the training affected the young drivers in the desired way.

7.8.1. Effects of training on the attitude of young car drivers

Hypotheses 3: Training can change a negative attitude towards ISA and speed behaviour in general.

The “ISA” questionnaire showed that young drivers had a quite comprehensive view on what the system can accomplish and what limits the system has. Before participants had even tried the ISA system, they mentioned quite a lot of advantages and possible disadvantages. The training aimed at strengthening the opinion concerning advantages and at making people aware of the weaknesses of the system. In order to estimate, if a positive impact of the training on the attitude could actually be achieved, the answers of the questionnaires before the second ride (with the ISA equipped car) and after the third ride (with the driving school car) were compared with a variance analysis for repeated measures. Only questions related to speed and the ISA system were analysed. The values of all variables dedicated to one question were averaged. In order to interpret the results in the right way, one has to keep in mind that low means indicate agreement on a specific statement and high means signify rejection.

7.8.1.1. Attitude towards speed

In the second phase of the study young drivers in general quite agreed upon the **usefulness of speed limits** (M_{bNec} = 1.85 to 2.09, SD_{bNec} = 0.97 to 1.15). After the group discussion, the participants approved of the existence of speed limits even more, which was not the case for those young grown-ups who did not participate in the group discussion. Table 54 shows a different progress for the two groups ($F_{1,53}$ = 2.90, p = 0.09) but just in trend.

I think speed limits are necessary.

Totally correct ❐ ❐ ❐ ❐ ❐ Totally incorrect

Figure 111: Question about the necessity of speed limits

Descriptive statistics "Speed limits are necessary"		N	Mean	SD	Min	Max
No Training	bNec	33	1.85	0.97	1	5
	dNec	33	2.12	1.14	1	5
Training	bNec	22	2.09	1.15	1	5
	dNec	22	1.91	0.75	1	3

Levene's Test of Equality of Error Variances is not significant

Training (bNec/ dNec)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.05	1.00	0.05	0.12	0.73
Time * Tr.	1.36	1.00	1.36	2.90	0.09
Error(time)	24.91	53.00	0.47		
Tests of Between-Subjects Effects					
Training	0.01	1.00	0.01	0.00	0.95
Error	86.48	53.00	1.63		
Sphericity Assumed					

Table 54: Descriptive statistics and results of the ANOVA for the variable “Speed limits are necessary” related to participation in training

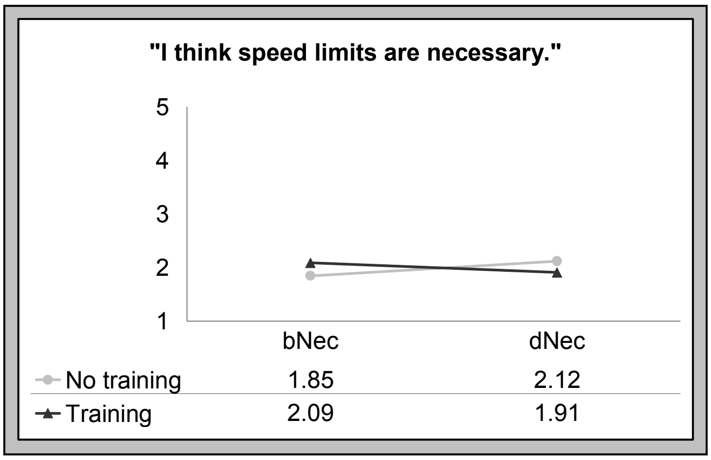


Figure 112: Changes of the attitude concerning the necessity of speed limits

Participants seemed to be fairly neutral concerning the **legal speed limits** in the particular country (M_{bLok} = 2.19 to 2.48, SD_{bLok} = 0.87 to 1.09). No changes in their attitudes could be found over time ($F_{1,52}$ = 0.52, p = 0.47), as well as due to the training ($F_{1,52}$ = 0.52, p = 0.47).

The speed limits in Austria are all right.

Totally correct ❒ ❒ ❒ ❒ ❒ Totally incorrect

Figure 113: Question concerning the agreement to the legal speed limits in the particular country

Descriptive statistics "Speed limits are all right"

		N	Mean	SD	Min	Max
No Training	bLok	33	2.48	1.09	1	5
	dLok	33	2.70	1.24	1	5
Training	bLok	21	2.19	0.87	1	4
	dLok	21	2.19	0.81	1	4

Training (bLok/ dLok)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.29	1.00	0.29	0.52	0.47
Time * Tr.	0.29	1.00	0.29	0.52	0.47
Error(time)	28.76	52.00	0.55		
Tests of Between-Subjects Effects					
Training	4.12	1.00	4.12	2.46	0.12
Error	86.93	52.00	1.67		
Sphericity Assumed					

Table 55: Descriptive statistics and results of the ANOVA for the variable “The speed limits in Austria/Czech Republic are all right” related to participation in training

In addition young drivers were asked which positive effects speed limits might have. However, apart from the **positive effects** listed in figure 114, also two possible negative effects were mentioned. The valuations of those two variables had to be changed to the opposite in order not to falsify the result. In the end young drivers moderately agreed with the positive consequences of speed limits (M_{bPB} = 2.31 to 2.41, SD_{bPB} = 0.42 to 0.65). The attitude of the participants did not change significantly over time ($F_{1,52}$ = 0.25, p = 0.62). Further the group discussion seemed to have no influence on the attitude, neither ($F_{1,52}$ = 0.02, p = 0.88).

In your opinion what are positive consequences of speed limits?

	Totally correct				Totally incorrect
Safety	❐	❐	❐	❐	❐
Guidance	❐	❐	❐	❐	❐
Adviser	❐	❐	❐	❐	❐
Fewer accidents	❐	❐	❐	❐	❐
Less serious accidents	❐	❐	❐	❐	❐
Reduction of speed in dangerous zones	❐	❐	❐	❐	❐
Protection of vulnerable road users	❐	❐	❐	❐	❐
Traffic regulation	❐	❐	❐	❐	❐
Jams	❐	❐	❐	❐	❐
Trouble	❐	❐	❐	❐	❐
Avoidance of self-overestimation	❐	❐	❐	❐	❐
Others _______________	❐	❐	❐	❐	❐

Figure 114: List of variables concerning the positive impact of speed limits

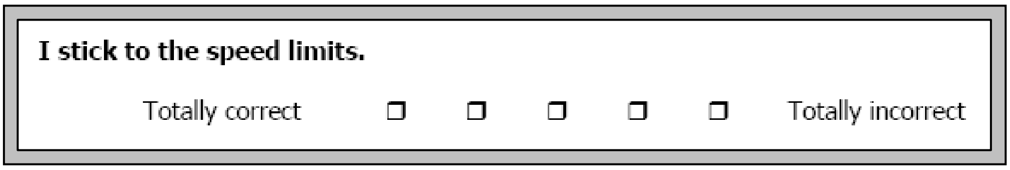
Descriptive statistics Perceived benefit of speed limits		N	Mean	SD	Min	Max
No Training	bPB	32	2.41	0.65	1	5
	dPB	32	2.37	0.72	1	5
Training	bPB	22	2.31	0.42	1	3
	dPB	22	2.29	0.38	2	3

One-Sample Kolmogorov-Smirnov Test is not significant

Training (bPB/ dPB)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.03	1.00	0.03	0.25	0.62
Time * Tr.	0.00	1.00	0.00	0.02	0.88
Error(time)	6.74	52.00	0.13		
Tests of Between-Subjects Effects					
Training	0.21	1.00	0.21	0.38	0.54
Error	28.99	52.00	0.56		
Sphericity Assumed					

Table 56: Descriptive statistics and results of the ANOVA for the perceived benefits of speed limits

In general participants agreed that they usually **stick to the legal speed limit** (M_{bCompl} = 2.43 to 2.55, SD_{bCompl} = 0.97 to 1.03). After the last ride they endorsed compliant behaviour even more strongly ($F_{1,52}$ = 4.11, p = 0.05). However, this effect can not be considered as a result of the training ($F_{1,52}$ = 0.02, p = 0.89) as table 57 shows.


I stick to the speed limits.

Totally correct ❐ ❐ ❐ ❐ ❐ Totally incorrect

Figure 115: Question concerning the compliance with the speed limits

Descriptive statistics Compliance with the speed limits		N	Mean	SD	Min	Max
No Training	bCompl	33	2.55	0.97	1	5
	dCompl	33	2.27	1.01	1	5
Training	bCompl	21	2.43	1.03	1	4
	dCompl	21	2.19	0.81	1	4

Levene's Test of Equality of Error Variances is not significant

Training (bCompl/ dCompl)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	1.67	1.00	1.67	4.11	0.05
Time * Tr.	0.01	1.00	0.01	0.02	0.89
Error(time)	21.18	52.00	0.41		
Tests of Between-Subjects Effects					
Training	0.25	1.00	0.25	0.17	0.68
Error	75.93	52.00	1.46		
Sphericity Assumed					

Table 57: Descriptive statistics and results of the ANOVA for the variable “I stick to the speed limits” related to participation in training

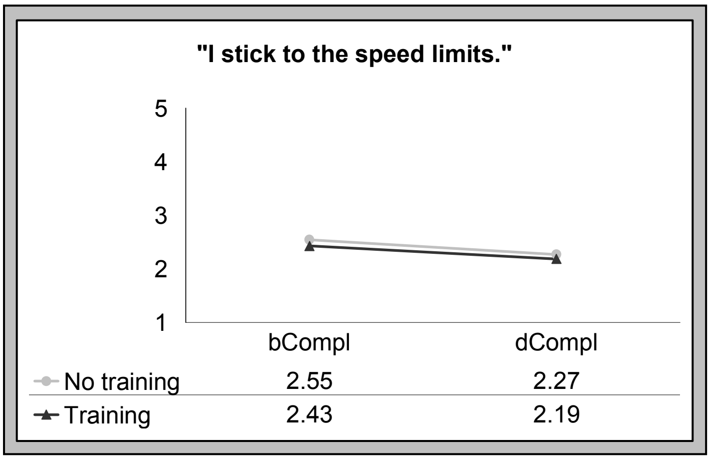
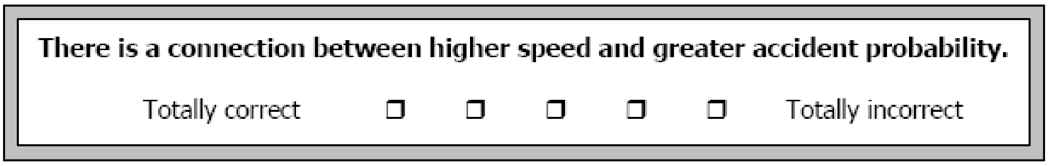


Figure 116: Changes in the compliance with speed limits

In general young grown-ups believed that there exists a **connection** between the driving **speed** and the probability to get involved in an **accident** (M_{bConn} = 1.70 to 1.73, SD_{bConn} = 0.77 to 0.83). Via the variance analyses it was found out that those drivers who did not participate in the group training, by trend developed a worse attitude towards speed as cause of accidents ($F_{1,53}$ = 2.75, p = 0.10).


There is a connection between higher speed and greater accident probability.

Totally correct ❐ ❐ ❐ ❐ ❐ Totally incorrect

Figure 117: Question concerning the connection between speed and accident probability

Descriptive statistics Connection between higher speed and greater accident risk						
		N	Mean	SD	Min	Max
No Training	bConn	33	1.70	0.77	1	5
	dConn	33	2.06	0.93	1	4
Training	bConn	22	1.73	0.83	1	4
	dConn	22	1.73	0.63	1	3

Levene's Test of Equality of Error Variances is not significant

Training (bConn/ dConn)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.87	1.00	0.87	2.75	0.10
Time * Tr.	0.87	1.00	0.87	2.75	0.10
Error(time)	16.82	53.00	0.32		
Tests of Between-Subjects Effects					
Training	0.61	1.00	0.61	0.61	0.44
Error	52.76	53.00	1.00		
Sphericity Assumed					

Table 58: Descriptive statistics and results of the ANOVA for the variable “There is a connection between higher speed and greater accident probability” related to participation in training

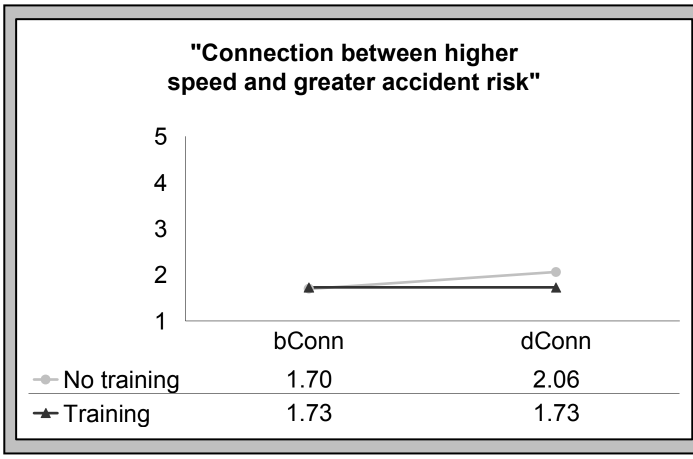
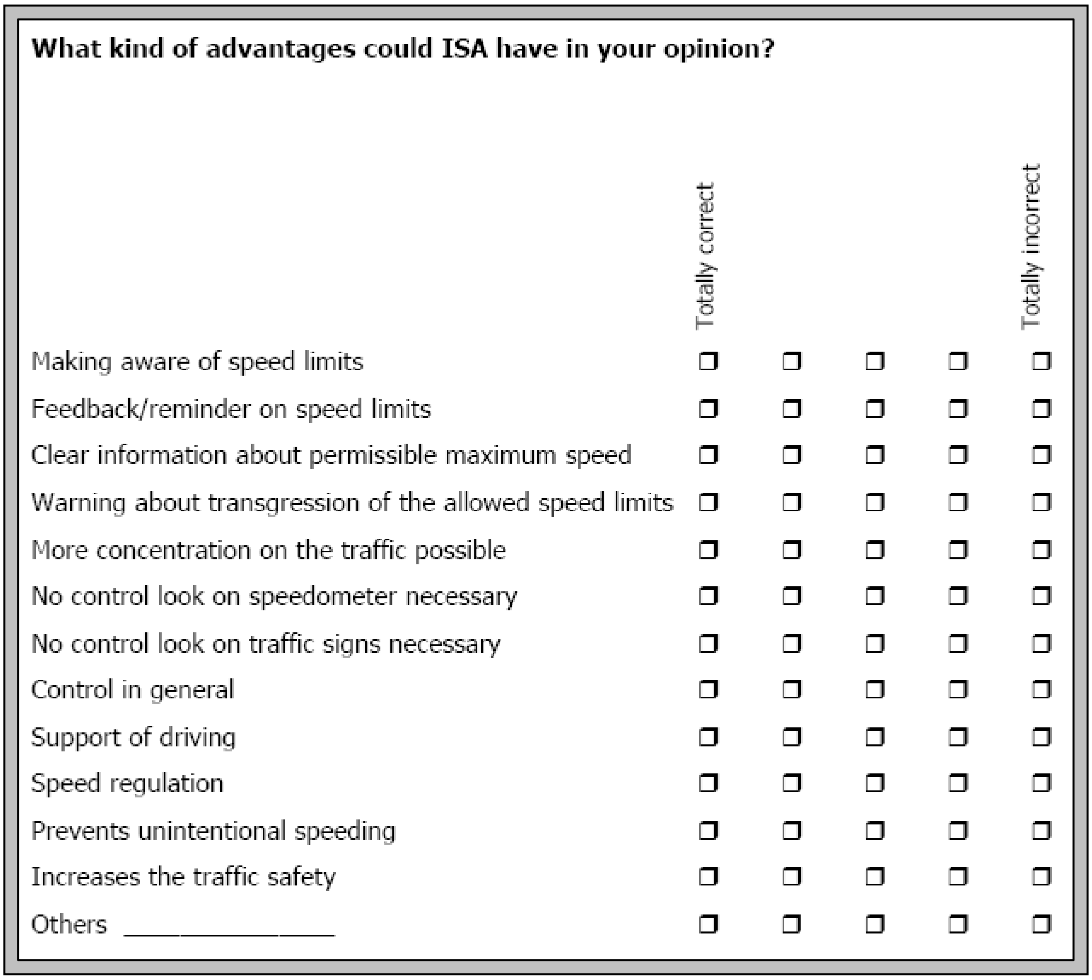


Figure 118: Changes in the attitude concerning a connection between speed and accident probability

7.8.1.2. <u>Attitude towards ISA</u>

Young drivers were to assess the **advantages of the ISA system**. The list of variables is illustrated in figure 119. All participants somewhat agree on the benefits of ISA ($M_{bAdv.}$ = 2.12 to 2.24, $SD_{bAdv.}$ = 0.49 to 0.68). However, the training did not have the power to enhance the positive opinion ($F_{1,51}$ = 0.36, p = 0.55).



What kind of advantages could ISA have in your opinion?

	Totally correct				Totally incorrect
Making aware of speed limits	❐	❐	❐	❐	❐
Feedback/reminder on speed limits	❐	❐	❐	❐	❐
Clear information about permissible maximum speed	❐	❐	❐	❐	❐
Warning about transgression of the allowed speed limits	❐	❐	❐	❐	❐
More concentration on the traffic possible	❐	❐	❐	❐	❐
No control look on speedometer necessary	❐	❐	❐	❐	❐
No control look on traffic signs necessary	❐	❐	❐	❐	❐
Control in general	❐	❐	❐	❐	❐
Support of driving	❐	❐	❐	❐	❐
Speed regulation	❐	❐	❐	❐	❐
Prevents unintentional speeding	❐	❐	❐	❐	❐
Increases the traffic safety	❐	❐	❐	❐	❐
Others ________________	❐	❐	❐	❐	❐

Figure 119: List of variables concerning the advantages the ISA system may have

Descriptive statistics "Advantages of ISA"		N	Mean	SD	Min	Max
No Training	bAdv.	31	2.24	0.68	1.00	4.17
	dAdv.	31	2.27	0.81	1.08	4.00
Training	bAdv.	22	2.12	0.49	1.25	3.33
	dAdv.	22	2.26	0.54	1.50	3.75

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Training (bAdv./ dAdv.)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.18	1.00	0.18	0.88	0.35
Time * Tr.	0.07	1.00	0.07	0.36	0.55
Error(time)	10.27	51.00	0.20		
Tests of Between-Subjects Effects					
Training	0.12	1.00	0.12	0.17	0.68
Error	34.42	51.00	0.67		
Sphericity Assumed					

Table 59: Descriptive statistics and results of the ANOVA for the index “Advantages of ISA” related to participation in training

Young drivers agreed on the advantages of the system, nearly as much as they agreed on the **disadvantages** ($M_{bDisadv.}$ = 2.39 to 2.56, $SD_{bDisadv.}$ = 0.62 to 0.65). In the concluding evaluation (step 4), all participants assessed the disadvantages even stronger than before the training had taken place ($M_{dDisadv.}$ = 2.24 to 2.34, $SD_{dDisadv.}$ = 0.50 to 0.68). The effect was highly significant ($F_{1,45}$ = 9.96, p = 0.00) and was even worse for the participants of the group discussion ($F_{1,45}$ = 5.59, p = 0.02), which is visualised in figure 121.

What kind of disadvantages could ISA have in your opinion?

	Totally correct				Totally incorrect
Too much control	❐	❐	❐	❐	❐
Paternalism	❐	❐	❐	❐	❐
Annoying/frustrating/nerve-wracking	❐	❐	❐	❐	❐
You rely too much on technology	❐	❐	❐	❐	❐
Restriction of the driver	❐	❐	❐	❐	❐
Occurrence of a defect	❐	❐	❐	❐	❐
Missing up-to-dateness of the system (construction sites, weather conditions, etc.)	❐	❐	❐	❐	❐
Less concentration on the traffic situation/distraction	❐	❐	❐	❐	❐
Those who want to drive too fast doing this in spite of such systems	❐	❐	❐	❐	❐
Can sometimes be in the way	❐	❐	❐	❐	❐
Uncertainty, if you are unaccustomed to this	❐	❐	❐	❐	❐
Purchase too expensive	❐	❐	❐	❐	❐
Others _______________	❐	❐	❐	❐	❐

Figure 120: List of variables concerning the disadvantages the ISA system may have

Descriptive statistics "Disadvantages of ISA"						
		N	Mean	SD	Min	Max
No Training	bDisadv.	25	2.39	0.65	1.00	3.75
	dDisadv.	25	2.34	0.68	1.00	3.58
Training	bDisadv.	22	2.56	0.62	1.33	3.75
	dDisadv.	22	2.24	0.50	1.25	3.25

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Training (bDisadv./ dDisadv.)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.81	1.00	0.81	9.96	0.00
Time * Tr.	0.46	1.00	0.46	5.59	0.02
Error(time)	3.67	45.00	0.08		
Tests of Between-Subjects Effects					
Training	0.03	1.00	0.03	0.04	0.84
Error	30.88	45.00	0.69		
Sphericity Assumed					

Table 60: Descriptive statistics and results of the ANOVA for the index “Disadvantages of ISA” related to participation in training

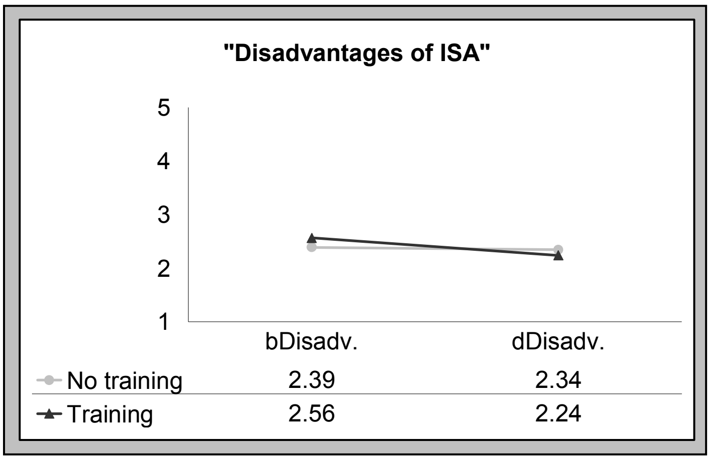


Figure 121: Changes of the assessment of disadvantages of the ISA system depending on the participation in the training

The participants were also asked **why** they **would like to use ISA**. This question aimed at getting to know the advantages participants imagine the system could have for them individually. At the same time it assesses if they would like to use ISA or not. Comparing table 59 with table 61 it can be noticed that young drivers were on average less enthusiastic about the system if they were more concerned by the question. The aim of the training to convince participants of the positive effects of ISA was not realised ($F_{1,46}$ = 0.39, p = 0.54; table 61).

I would like to use such a system because of:

	Totally correct				Totally incorrect
Regularisation of the own speed	❐	❐	❐	❐	❐
Making aware of speed limits	❐	❐	❐	❐	❐
More concentration on the traffic possible	❐	❐	❐	❐	❐
No control look on speedometer necessary	❐	❐	❐	❐	❐
No control look on traffic signs necessary	❐	❐	❐	❐	❐
Feedback/reminder on speed limits	❐	❐	❐	❐	❐
Clear information about permissible maximum speed	❐	❐	❐	❐	❐
Increases the traffic safety	❐	❐	❐	❐	❐
Support at the driving	❐	❐	❐	❐	❐
Knows rather about limits (in an unknown area)	❐	❐	❐	❐	❐
You rather respect permissible limits	❐	❐	❐	❐	❐
Avoidance of punishments	❐	❐	❐	❐	❐
Environmental aspects (lower fuel consumption, etc.)	❐	❐	❐	❐	❐
Others _______________	❐	❐	❐	❐	❐

Figure 122: List of variables concerning the reasons why participants would like to use the ISA system

Descriptive statistics "Usage of ISA"		N	Mean	SD	Min	Max
No Training	bUse	28	2.54	0.70	1.00	5.00
	dUse	28	2.47	0.87	1.00	4.31
Training	bUse	20	2.49	0.48	1.77	3.54
	dUse	20	2.52	0.67	1.23	3.62

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Training (bUse/ dUse)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.01	1.00	0.01	0.06	0.80
Time * Tr.	0.06	1.00	0.06	0.39	0.54
Error(time)	7.18	46.00	0.16		
Tests of Between-Subjects Effects					
Training	0.00	1.00	0.00	0.00	0.98
Error	39.01	46.00	0.85		
Sphericity Assumed					

Table 61: Descriptive statistics and results of the ANOVA for the index “Usage of ISA” related to participation in training

When participants were asked about the system’s **disadvantages** which might **personally affect them**, they were less critical with the system (see table 60 and table 62). However, the training did not have a significant effect on the attitude towards the weaknesses of the ISA system ($F_{1,45} = 0.95$, $p = 0.33$). Over time young drivers agreed significantly stronger on the weaknesses ($F_{1,45} = 5.71$, $p = 0.02$).

I would not want to use such a system because of:

	Totally correct				Totally incorrect
Annoying/frustrating/nerve-wracking	❒	❒	❒	❒	❒
I don't drive too fast	❒	❒	❒	❒	❒
Control/supervision	❒	❒	❒	❒	❒
Trust in own abilities - system unnecessary	❒	❒	❒	❒	❒
Want to have the control over the car	❒	❒	❒	❒	❒
Want to decide myself as fast I want to go	❒	❒	❒	❒	❒
A defect could arise	❒	❒	❒	❒	❒
ISA would disturb, when I (just) would like to go over the limit	❒	❒	❒	❒	❒
Freedom is lost	❒	❒	❒	❒	❒
Environmental aspects – needs more energy, fuel consumption	❒	❒	❒	❒	❒
Acquisition costs	❒	❒	❒	❒	❒

Figure 123: List of variables concerning the reasons why participants would not like to use the ISA system

Descriptive statistics "Non-usage of ISA"		N	Mean	SD	Min	Max
No Training	bNuse	27	2.75	0.63	1.36	4.18
	dNuse	27	2.64	0.65	1.45	3.82
Training	bNuse	20	2.73	0.64	1.55	4.27
	dNuse	20	2.46	0.23	1.00	3.00

One-Sample Kolmogorov-Smirnov Test is not significant

Training (bNuse/ dNuse)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.86	1.00	0.86	5.71	0.02
Time * Tr.	0.14	1.00	0.14	0.95	0.33
Error(time)	6.79	45.00	0.15		
Tests of Between-Subjects Effects					
Training	0.24	1.00	0.24	0.46	0.50
Error	23.11	45.00	0.51		
Sphericity Assumed					

Table 62: Descriptive statistics and results of the ANOVA for the index "Non-usage of ISA" related to participation in training

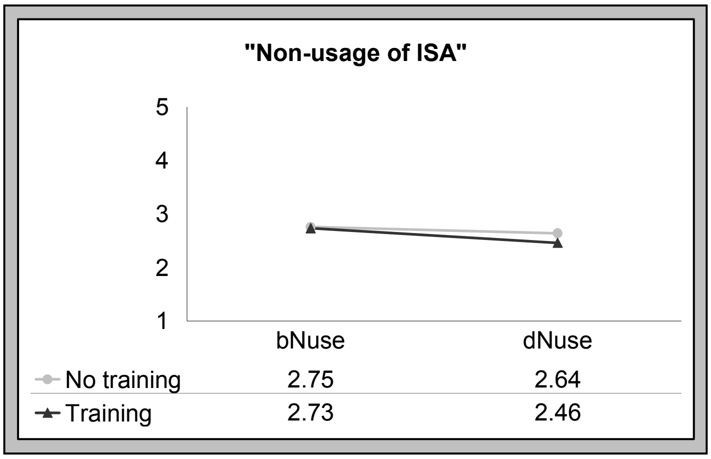


Figure 124: Changes of the assessment of disadvantages of the ISA system depending on the participation in the training

Based on the findings below it is not surprising that participants seemed not to be very keen on **using ISA** (M_{bWill} = 3.06 to 3.23, SD $_{bWill}$ = 1.29 to 1.34). Their attitudes were stable over time ($F_{1,52}$ = 0.66, p = 0.42) and no training effects could be verified ($F_{1,52}$ = 0.09, p = 0.76).

I would like to use such a system.

Totally correct ❑ ❑ ❑ ❑ ❑ Totally incorrect

Figure 125: Question about the willingness to use the ISA system

Descriptive statistics "Willingness to use ISA"		N	Mean	SD	Min	Max
No Training	bWill	32	3.06	1.29	1	5
	dWill	32	3.13	1.18	2	5
Training	bWill	22	3.23	1.34	1	5
	dWill	22	3.36	1.29	1	5

Levene's Test of Equality of Error Variances is not significant

Training (bWill/ dWill)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.26	1.00	0.26	0.66	0.42
Time * Tr.	0.04	1.00	0.04	0.09	0.76
Error(time)	20.23	52.00	0.39		
Tests of Between-Subjects Effects					
Training	1.06	1.00	1.06	0.37	0.54
Error	148.10	52.00	2.85		
Sphericity Assumed					

Table 63: Descriptive statistics and results of the ANOVA for the index “Willingness to use ISA” related to participation in training

Although a positive impact of the psychological group training on the attitude towards the ISA system was presumed, the training did not satisfy the expectations. On the one hand, the advantages of the system were not evaluated better after the training and on the other hand, those drivers who participated in the training agreed even stronger upon the weaknesses of ISA. Furthermore, the willingness to use the system was not augmented by the psychological group training. A possible reason why the training did not have the intended effect on the attitude of young drivers might be that the training imposed a more deliberate view on the ISA system in connection with traffic safety. Perhaps participants became even more aware of their own responsibility in the traffic system.

7.8.2. Effects of training on the driving behaviour of young car drivers

Hypothesis 4: Training has the potential to improve young drivers' behaviour for a long period of time.

In order to find out whether Hypothesis 4 can be maintained or rather has to be dismissed, behaviour variables had to be defined in a first step (see also sub-chapter 7.7.1). One possibility was to add all variables observed with the Wiener Fahrprobe to just one index[12] and then run a t-test. Following this approach, the averaged values of the first ride and the third ride had to be compared. The analysis showed a highly significant difference between both times of inquiry ($t(51) = -2.74$, $p = 0.008$). During the first ride with the driving school car, on average 4.32 (SD = 2.67) mistakes per section had been observed. In the last round, which was again a ride with a driving school car, on average 5.26 (SD = 2.71) mistakes had been registered.

Contrasting both groups against each other, no significant difference was found ($F_{1,48} = 0.08$, $p = 0.78$). The over-all behaviour of participants deteriorated significantly over time ($F_{1,48} = 5.78$, $p = 0.02$) irrespective of their participation in the training.

Descriptive statistics "Behaviour in general"		N	Mean	SD	Min	Max
No Training	aGen.	31	4.46	2.78	0.64	12.06
	dGen.	31	5.44	3.00	0.76	13.22
Training	aGen.	19	4.35	2.57	0.88	9.56
	dGen.	19	5.15	2.31	0.40	10.39

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Training (aGen./ dGen.)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	18.48	1.00	18.48	5.78	0.02
Time * Tr.	0.20	1.00	0.20	0.06	0.80
Error(time)	153.42	48.00	3.20		
Tests of Between-Subjects Effects					
Training	0.93	1.00	0.93	0.08	0.78
Error	563.99	48.00	11.75		
Sphericity Assumed					

Table 64: Descriptive statistics and results of the ANOVA for the index "Behaviour in general" related to participation in training

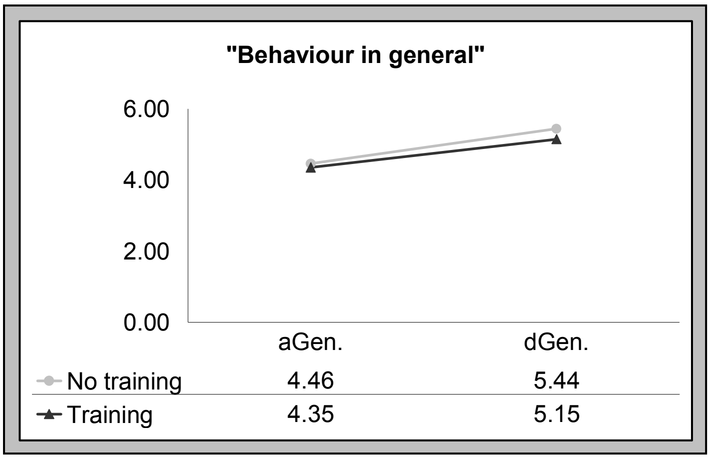


Figure 126: Changes of the general behaviour over time depending on the participation in the training

[12] That index included all variables except those concerning the speed observation, as those variables have been not very reliable which already was discussed in chapter 7.7.1.

To achieve a more elaborated result further analyses were carried out. Several indices were defined based on the classification used in the observation sheet. The procedure how to obtain these indices has already been described in sub-chapter 7.2. However, for a better understanding, the indices will be briefly described again. As has already been discussed for hypothesis 1, just those cases where the identical observer did the observation were compared. Speed behaviour itself was not considered because of difficulties in observation, as already mentioned above. Furthermore, the variables related to the overtaking behaviour were not considered in the further analysis and neither were events that did not occur very frequently.

However, **speed adaptation** was defined by the two variables “late” and “abrupt”. A variance analysis for repeated measures showed no significant difference between the two trials ($F_{1,48}$ = 0.24, p = 0.63). Further no interaction effects of time and training ($F_{1,48}$ = 1.41, p = 0.24) and no differences between both groups ($F_{1,48}$ = 1.59, p = 0.21) were identified.

Descriptive statistics "Speed adaptation"						
		N	Mean	SD	Min	Max
No Training	aSpAd	31	0.21	0.20	0.00	0.78
	dSpAd	31	0.25	0.18	0.00	0.72
Training	aSpAd	19	0.18	0.15	0.00	0.52
	dSpAd	19	0.16	0.18	0.00	0.60

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Training (aSpAd/ dSpAd)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.00	1.00	0.00	0.24	0.63
Time * Tr.	0.03	1.00	0.03	1.41	0.24
Error(time)	0.88	48.00	0.02		
Tests of Between-Subjects Effects					
Training	0.07	1.00	0.07	1.59	0.21
Error	2.25	48.00	0.05		
Sphericity Assumed					

Table 65: Descriptive statistics and results of the ANOVA for the index “Speed adaptation” related to participation in training

The index concerning the **behaviour towards vulnerable road users** was calculated with all variables of the observation sheet related to vulnerable road-users plus the behaviour at bus or tramway stops. As indicated in table 66 the behaviour improved significantly ($F_{1,48}$ = 7.59, p = 0.01) over time. Again, no training effects ($F_{1,48}$ = 0.27, p = 0.61) were identified.

Descriptive statistics "Behaviour towards vulnerable road user"						
		N	Mean	SD	Min	Max
No Training	aVuln.	31	0.06	0.08	0.00	0.28
	dVuln.	31	0.03	0.04	0.00	0.20
Training	aVuln.	19	0.09	0.09	0.00	0.39
	dVuln.	19	0.05	0.07	0.00	0.28

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Training (aVuln./ dVuln.)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.03	1.00	0.03	7.59	0.01
Time * Tr.	0.00	1.00	0.00	0.27	0.61
Error(time)	0.21	48.00	0.00		
Tests of Between-Subjects Effects					
Training	0.01	1.00	0.01	1.87	0.18
Error	0.24	48.00	0.01		
Sphericity Assumed					

Table 66: Descriptive statistics and results of the ANOVA for the index “Vulnerable road user” related to participation in training

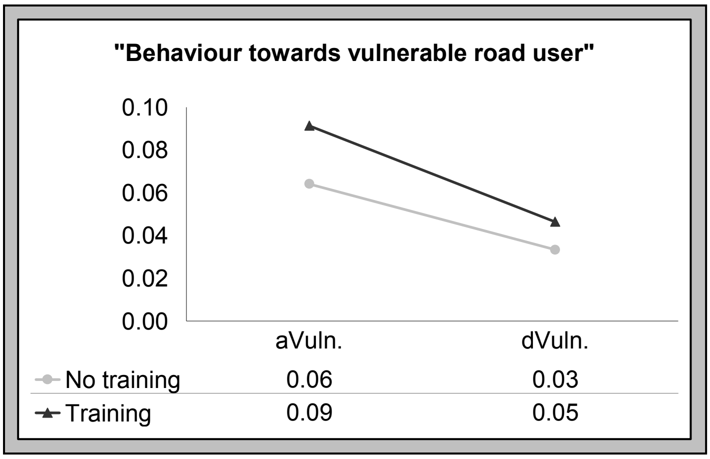


Figure 127: Changes of the behaviour towards vulnerable road users over time depending on the participation in the training

For the index “**Lane change/keeping behaviour**” all variables of table 67 were added. Although the behaviour changed significantly over time ($F_{1,48}$ = 7.55, p = 0.01), the training did not have an effect ($F_{1,48}$ = 0.05, p = 0.83). Both groups showed a worse lane changing/keeping behaviour during the last ride (M_a = 2.76 to 2.87, SD_a = 2.65; M_d = 3.82 to 3.87, SD_d = 2.01 to 2.62).

Lane change	Lane change before x/obstacles	Too late	
	Lane change after x/obstacles	Hesitant	
	Cross solid line		
	Lane change	Too fast	
		Dangerous	
		Hesitant	
	Lane keeping behaviour	Too far left	
		Too far right	
		Unsteady	

Table 67: List of variables integrated in the “Lane change/keeping behaviour” index

Descriptive statistics "Lane change/keeping behaviour"

		N	Mean	SD	Min	Max
No Training	aLckb	31	2.87	2.65	0.16	11.11
	dLckb	31	3.82	2.62	0.08	9.72
Training	aLckb	19	2.76	2.65	0.08	8.64
	dLckb	19	3.87	2.01	0.04	9.28

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Training (aLckb/ dLckb)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	25.14	1.00	25.14	7.55	0.01
Time * Tr.	0.15	1.00	0.15	0.05	0.83
Error(time)	159.82	48.00	3.33		
Tests of Between-Subjects Effects					
Training	0.01	1.00	0.01	0.00	0.97
Error	456.39	48.00	9.51		
Sphericity Assumed					

Table 68: Descriptive statistics and results of the ANOVA for the index “Lane change/keeping behaviour” related to participation in training

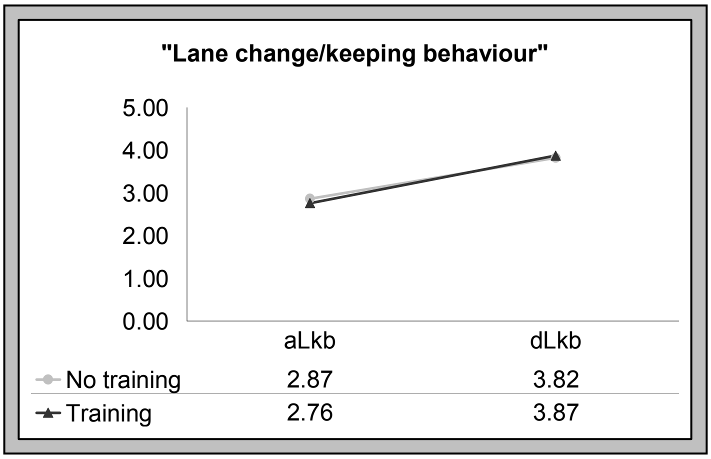


Figure 128: Changes of the lane changing/keeping over time depending on the participation in the training

If the following distance to the car ahead was dangerous or at least too short this was marked as an error as well. Both types of behaviour were used to calculate the index "**Following distance**". Table 69 illustrates that a significant difference between the first ride and the third ride could be found ($F_{1,48}$ = 4.78, p = 0.03); the behaviour of all of the young drivers deteriorated over time (M_a = 0.16 to 0.17, SD_a = 0.18 to 0.21; M_d = 0.26 to 0.30, SD_d = 0.32 to 0.43). The training did not influence the behaviour ($F_{1,48}$ = 0.23, p = 0.63).

Descriptive statistics "Following distance"

		N	Mean	SD	Min	Max
No Training	aFolDis	31	0.16	0.18	0.00	0.61
	dFolDis	31	0.30	0.43	0.00	2.06
Training	aFolDis	19	0.17	0.21	0.00	0.84
	dFolDis	19	0.26	0.32	0.00	1.11

Levene's Test of Equality of Error Variances is not significant

Training (aFolDis/ dFolDis)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.31	1.00	0.31	4.78	0.03
Time * Tr.	0.02	1.00	0.02	0.23	0.63
Error(time)	3.14	48.00	0.07		
Tests of Between-Subjects Effects					
Training	0.01	1.00	0.01	0.09	0.77
Error	6.05	48.00	0.13		
Sphericity Assumed					

Table 69: Descriptive statistics and results of the ANOVA for the index "Following Distance" related to participation in training

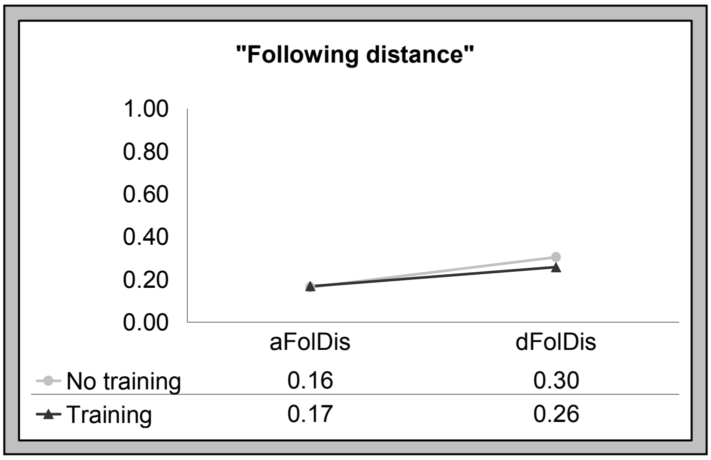


Figure 129: Changes over time of the index "Following Distance" depending on the participation in the training

The **use of the indicator** was characterized by a too short usage, a too late usage or no usage at all. A trend to use the indicator more often during the third ride was observed ($F_{1,48}$ = 2.88, p = 0.10). Once more the training seemed not to be the reason for this improvement ($F_{1,48}$ = 0.39, p = 0.53; see table 70).

Descriptive statistics "Use of the indicator"		N	Mean	SD	Min	Max
No Training	aIndic.	31	0.51	0.31	0.08	1.28
	dIndic.	31	0.47	0.28	0.16	1.22
Training	aIndic.	19	0.51	0.31	0.16	1.39
	dIndic.	19	0.40	0.34	0.00	1.22

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Training (aIndic./ dIndic.)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.14	1.00	0.14	2.88	0.10
Time * Tr.	0.02	1.00	0.02	0.39	0.53
Error(time)	2.39	48.00	0.05		
Tests of Between-Subjects Effects					
Training	0.04	1.00	0.04	0.26	0.62
Error	6.62	48.00	0.14		
Sphericity Assumed					

Table 70: Descriptive statistics and results of the ANOVA for the index “Use of the indicator” related to participation in training

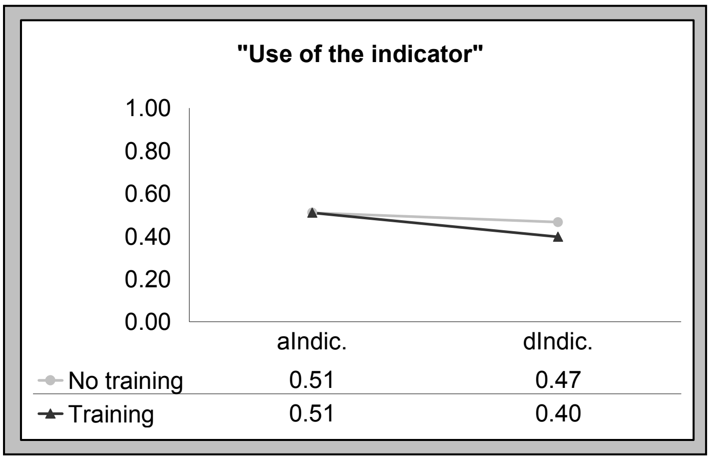


Figure 130: Changes of the usage of the indicator over time depending on the participation in the training

The index concerning the **eye glance behaviour** consists of the two variables “glance over shoulder” and “insufficient eye glance behaviour”, which originally were part of the lane change/keeping behaviour. Although the training seemed to have no influence on the eye glance behaviour ($F_{1,48}$ = 1.30, p = 0.26), a highly significant positive effect over time was calculated ($F_{1,48}$ = 13.35, p = 0.00). Taking a closer look at table 71, one can notice a more extensive decrease concerning eye glance mistakes for the group who participated in the training (M_a = 0.51, SD = 0.22; M_d = 0.33, SD = 0.22). Participants without training also improved their eye glance behaviour (M_a = 0.55, SD = 0.27; M_d = 0.46, SD = 0.25), but not to the same extent.

Descriptive statistics "Eye glance behaviour"		N	Mean	SD	Min	Max
No Training	aEgb	31	0.55	0.27	0.08	1.00
	dEgb	31	0.46	0.25	0.04	1.17
Training	aEgb	19	0.51	0.22	0.16	0.92
	dEgb	19	0.33	0.22	0.00	0.78

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Training (aEgb/ dEgb)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.45	1.00	0.45	13.35	0.00
Time * Tr.	0.04	1.00	0.04	1.30	0.26
Error(time)	1.60	48.00	0.03		
Tests of Between-Subjects Effects					
Training	0.16	1.00	0.16	1.87	0.18
Error	4.19	48.00	0.09		
Sphericity Assumed					

Table 71: Descriptive statistics and results of the ANOVA for the index "Eye glace behaviour" related to participation in training

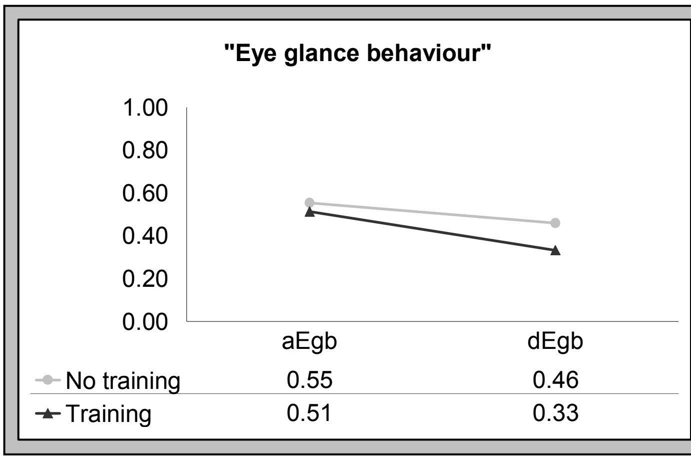


Figure 131: Changes of the eye glance behaviour over time depending on the participation in the training

To calculate the index "**Yielding behaviour**" three variable sets were considered, namely the behaviour of one who has to give way or of one who has to stop as well as whether one sticks to one's priority. The variance analysis for repeated measures resulted in a highly significant change concerning the yielding behaviour of participants ($F_{1,48} = 8.60$, $p = 0.01$). Moreover the training had a positive influence on young drivers; the yielding behaviour improved significantly ($F_{1,48} = 5.13$, $p = 0.03$) as shown in table 72.

Descriptive statistics "Yielding behaviour"		N	Mean	SD	Min	Max
No Training	aYiel	31	0.06	0.06	0.00	0.20
	dYiel	31	0.05	0.06	0.00	0.20
Training	aYiel	19	0.09	0.05	0.00	0.16
	dYiel	19	0.05	0.04	0.00	0.11

One-Sample Kolmogorov-Smirnov Test is not significant

Training (aYiel/ dYiel)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.02	1.00	0.02	8.60	0.01
Time * Tr.	0.01	1.00	0.01	5.16	0.03
Error(time)	0.09	48.00	0.00		
Tests of Between-Subjects Effects					
Training	0.01	1.00	0.01	1.36	0.25
Error	0.19	48.00	0.00		
Sphericity Assumed					

Table 72: Descriptive statistics and results of the ANOVA for the index "Yielding behaviour" related to participation in training

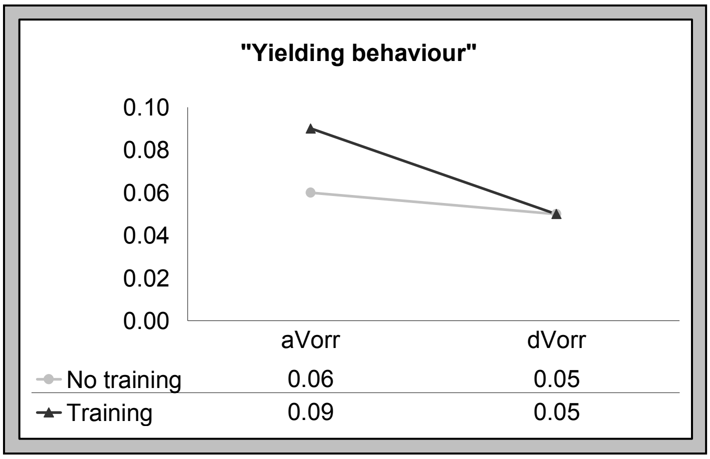


Figure 132: Changes in yielding behaviour over time depending on the participation in the training

Apart from standardised variables, also non-standardised ones were observed with the Wiener Fahrprobe (chapter 7.7.1). The index concerning the behaviour before crossings regulated by traffic lights is based on such a non-standardised variable. The variable was marked as soon as a driver realised a “yellow” traffic light too late or ignored a “red” one. However, no significant changes were found ($F_{1,48}$ = 1.33, p = 0.26). Furthermore the training seemed to have no effect on the behaviour before crossings ($F_{1,48}$ = 0.00, p = 0.95).

Descriptive statistics Behaviour before crossings regulated by traffic lights						
		N	Mean	SD	Min	Max
No Training	aTraL	31	0.02	0.02	0.00	0.06
	dTraL	31	0.02	0.03	0.00	0.11
Training	aTraL	19	0.01	0.02	0.00	0.06
	dTraL	19	0.02	0.03	0.00	0.08

Levene's Test of Equality of Error Variances is not significant

Training (aTraL/ dTraL)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.00	1.00	0.00	1.33	0.26
Time * Tr.	0.00	1.00	0.00	0.00	0.95
Error(time)	0.03	48.00	0.00		
Tests of Between-Subjects Effects					
Training	0.00	1.00	0.00	0.97	0.33
Error	0.04	48.00	0.00		
Sphericity Assumed					

Table 73: Descriptive statistics and results of the ANOVA for the index “Traffic light” related to participation in training

The results for situations in which the driving instructor had to intervene in order to avoid a traffic accident or at least a dangerous situation was different to the behaviour before crossings. As presented in table 74, the training had a significant influence on the occurrence of threatening situations ($F_{1,48}$ = 4.81, p = 0.03). Young drivers without the training were more often involved in dangerous situations in the second ride, whereas the participants of the training managed to drastically decrease such events.

Descriptive statistics "Intervention by the driving instructor"						
		N	Mean	SD	Min	Max
No Training	aDrI	31	0.01	0.02	0.00	0.11
	dDrI	31	0.02	0.05	0.00	0.22
Training	aDrI	19	0.02	0.03	0.00	0.08
	dDrI	19	0.01	0.03	0.00	0.11

Training (aDrI/ dDrI)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.00	1.00	0.00	0.04	0.85
Time * Tr.	0.00	1.00	0.00	4.81	0.03
Error(time)	0.04	48.00	0.00		
Tests of Between-Subjects Effects					
Training	0.00	1.00	0.00	0.10	0.75
Error	0.09	48.00	0.00		
Sphericity Assumed					

Table 74: Descriptive statistics and results of the ANOVA for the index “Intervention by the driving instructor” related to participation in training

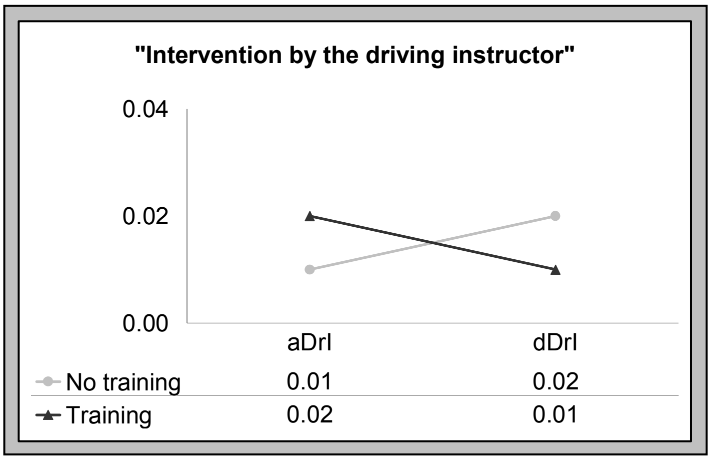


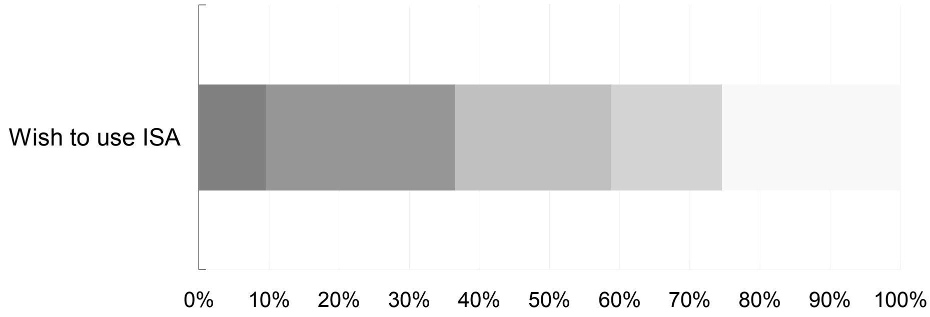
Figure 133: Changes in situations requiring intervention by the driving instructor depending on the participation in the training

8. Discussion

The current work was based on the fact that the main fatality reason for young drivers are traffic accidents (Pedan et al., 2002). Their risk getting involved in a crash is three times higher than for the rest of the population (KfV, 2004a, b). Furthermore poorly adapted speed was identified as the primary reason for traffic accidents among all drivers and particularly among the population of young drivers (Engström et al., 2003; ERSO, 2006; ROSPA, 2002; Clarke et al., 2001; etc.). However, speeding makes hazard detection more difficult and thus, provides a basis for crashes with other road users as no time for communication remains (GRSP, 2008; Van Beek et al., 2007; ATSB, 2008; Berger, 1996; etc.). With regard to the findings in literature that were just mentioned, the current study provides interesting results. The behaviour observation of novice and young drivers within the framework of the present study had shown that the second most frequent mistake during the first ride was to exceed the speed limit or to drive too fast in a particular traffic situation (29.4%). Participants did not obey the limits despite the fact that they had acknowledged the necessity of speed limits in the “ISA” questionnaire (N = 58; 78.4%) in order to guarantee traffic safety. One reason why participants might have neglected the speed regulations can be found in the “ISA” questionnaire as well. There, a speedy driving style was one of the top ten characteristics of a good driver. Speed was associated with a faster arrival, with fun and adrenaline as well as freedom. Furthermore, about half of the young drivers admitted to being annoyed by slower road users (N = 35; 47.3%). Based on those findings it is not surprising that almost 20% of the interviewed young drivers did not stick to the speed limits, probably also because they were not reasonable in their point of view (16.3%). Approximately one quarter of the respondents had already received a fine for speeding (N = 25; 33.8%); about 70% of them got more than one (N = 16). Apart from that, young drivers seemed to be very aware of the harmful part of the factor speed as they mentioned speeding as one of the top ten manners of a driver who endangers others. The responses of the participants with respect to the characteristics of a good driver like “safe and secure driving”, “considerate driving” or “driving with adapted speed” indicate that the participants are aware of the negative impact of high or inappropriate speed choice on traffic safety. Participants associated speed most frequently with danger (N = 15; 20.3%) but also with fear, discomfort, risk and accidents. Only two participants (2.7%) denied a relationship between the driven speed and a certain accident risk.

In literature several approaches to reduce speeding and consequently minimize the crash risk can be found (Stradling et al., 2003; ERSO, 2006). In the current study, the implementation of ISA in combination with a psychological group training was decided to be one of the most promising solutions. ISA was seen as device to reduce the speed in general as well as an instrument to improve the communication behaviour of the car driver with other road users. However, the taken decision is in accordance with the suggestions given by young car drivers. To improve traffic safety, respondents of the current study would prefer the implementation of infrastructural measures (N = 34; 45.9%), followed by an increased promotion of other means of transportation (N = 28; 37.8%). Furthermore, training measures (N = 26; 35.1%) and the use of new technologies (N = 19; 25.7%) were very popular.

The positive impact of ISA on the driving behaviour was already proven by several studies all over Europe as well as in Australia (Almqvist and Nygård, 1997; Besseling, 1999; Broekx et al., 2006; Carsten and Tate, 2001; Gynnerstedt et al., 1996; Lahrmann et al., 2001a, b; Päätalo et al., 2002; Regan et al., 2005a, b; and many more as discussed in sub-chapter 3.2). ISA had a consistently positive effect on the average speed as well as on the speed variation and thus, on the traffic safety. Besides, in all of the studies the acceptance of the system was good, which was not that much the case in the current study. Only about 40% of the participants (N = 28), who had not tried the system by the time of being interviewed, were willing to use ISA. 26.8% (N = 19) were indifferent and the rest of 33.8% (N = 24) was not willing to use it, at all. After having tried ISA the picture does not look that much different. As figure 134 shows, still just about 40% of the young drivers (N = 23) could imagine to use such a device. However, the amount of participants who would not be willing to use such a system increased to more than 40% (N = 26).



	Wish to use ISA	%
Strongly agree	6	9.52
Agree	17	26.98
Undecided	14	22.22
Disagree	10	15.87
Strongly disagree	16	25.40

N = 63

Wish to use ISA	
3.21	Mean
1.35	SD

Figure 134: Willingness to use an ISA system after having tried it (step 2)

Most of the people interviewed might not be interested in the system, as they envision themselves as good and safe drivers, which was true for almost 75 to 80% (N = 54 to 59). This finding was also reflected by the reasons why the young drivers would not like to use the system. Out of the eleven most common anticipated disadvantages of ISA on the own driving situation, two concerned some kind of confidence in the own abilities. 7 participants even called a spade a spade; they did not appreciate the system as it would disturb them when they would like to exceed the speed limit. Those who are willing to use ISA mentioned the feedback on the driving speed and the support while driving as the main advantages of the system.

Respondents seemed to have quite a realistic view on ISA. Asked about their global view on the system, they adequately estimated advantages as well drawbacks, which can also be found in the literature concerning devices in general (Ausserer et al., 2006). On the one hand ISA was described as a possibility to receive feedback about the legal speed limits, as support and assistance while driving as well as measure to increase traffic safety. On the other hand people worried about the restriction, distraction as well as annoyance ISA may cause. The young drivers, however, were most concerned about the dependence ISA might cause. People might rely too much on the system. Although the advantages outweighed the disadvantages, it turned out that the ISA system was only attractive as long as the young drivers were not talking about themselves. Using ISA for one's own purpose did not seem to be appealing.

The findings of the questionnaire can be described as ambivalent. Young drivers seemed to know about the dangers in road traffic as well as their capabilities to escape from them. Still, they represent the group with the highest accident risk. However, especially young drivers may also be the group with the biggest potential to change the behaviour in a sustainable way. Since behaviour, once learned, is fairly stable over time – which is especially true for speed behaviour (Schade, 2000) – the key aim of the current study was to investigate whether the driving behaviour of young drivers can be influenced positively (hypothesis 1), and even for a longer period of time (hypothesis 2).

Hypothesis 1: The use of an ISA system will improve the communication between young drivers and other road users.

The findings in literature (Almqvist and Nygård, 1997; as cited in Hjälmdahl, 2004a; or Young and Regan, 2002; Almqvist et al., 1997; Hjälmdahl, 2004a; Várhelyi et al., 2004) indicated a positive effect of ISA on the interaction of the driver with other road users. To investigate the influence of the system on the communication behaviour of the group of young car drivers, in a first step, specific variables of the observation data were summed to a “Communication” index, done for each single ride. Besides the overtaking and distance keeping behaviour, the use of the indicator, the lane keeping/changing behaviour, the behaviour towards vulnerable road users and those with right of way was build to the index. In a next step the values of the index based on the first ride with the driving school car, which defined the baseline of behaviour, were compared by means of a t-test to the “Communication” index of the second ride with the ISA equipped car. A significant difference between both conditions was found ($t(41) = 2.71$, $p = 0.010$). Thus, young drivers showed a better communication behaviour during the ISA condition compared to the first ride with the driving school car.

Of course, not only the ISA system but also other factors like the different type of car or the absence of an “official” driving instructor might have influenced the interaction behaviour of the drivers. Furthermore behaviour might have changed irrespective of the conditions and simply on the basis of the young drivers becoming more experienced over time. As those factors mentioned might have an impact too, it cannot be granted for sure that ISA had caused the behaviour change and conclusions have to be drawn carefully. However, based on the literature, it can be assumed that ISA had at least a small impact and that the results thus support hypothesis 1 to some extend.

The further analysis of the data by calculating a variance analysis indicated no significant differences in the behaviour changes according to gender, age, length of ownership of the licence, experience, nationality as well as the attitude towards ISA. Those results are not in line with the findings of Hjälmdahl (2004b) who identified young, male and less experienced drivers with a bad attitude towards the system as those who benefited less of the system. One reason might be that Hjälmdahl (2004b) concentrated not only on young drivers (18 to 25 years old) but on a broader group of drivers and thus the positive impact on younger driver was given less importance. Concerning the gender differences indicated by Hjälmdahls findings (2004b), it could be the case that male and female drivers vary in their behaviour only later in life, when the mannerism of youth is not in the forefront any longer.

Moreover Hjälmdahl (2004b) mentioned a less positive effect of the ISA system on the communication behaviour of drivers who admitted a more negative attitude towards the system. Although no statistically significant differences in the behaviour changes of proponents and opponents of the system were calculated ($F_{2,36} = 0.43$, $p = 0.65$; see annex VIII), some evidence for Hjälmdahls (2004b) findings exists.

Proponents of the system as well as participants who had neutral attitude towards ISA improved their communication behaviour while using it (see figure 135). On the other hand those participants, who did not like ISA from the beginning, did not benefit from the system. Looking at the figures from a different perspective, the various skill levels concerning the communication behaviour have to be considered as well. Especially those drivers who showed some difficulties in their interaction with other road users, at once appreciated the system most and profited most. Regardless of the point of view, this finding provided some evidence that ISA supports young drivers in their driving tasks.

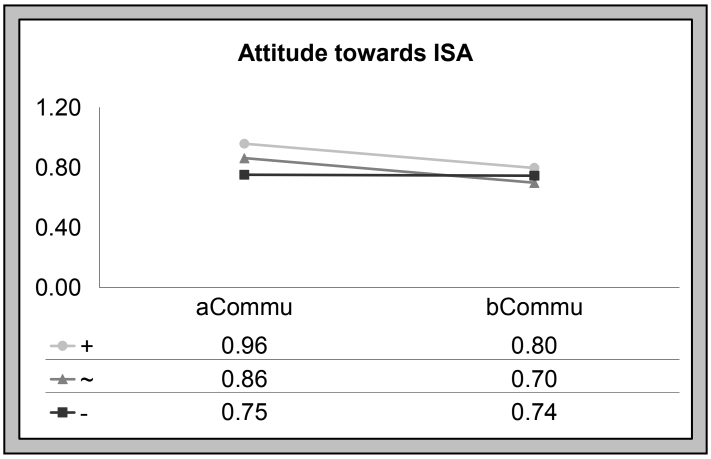


Figure 135: Changes of the communication behaviour over time depending on the attitude towards ISA

The results of the “Type” questionnaire indicated a similar tendency concerning the impact of ISA depending on the attitude towards the system as well as the perceived confidence in road traffic. Concerning the factor risk, the three groups were different in trend ($F_{2,39} = 2.92$, $p = 0.07$), although the behaviour did not change differently due to the ISA system ($F_{2,39} = 0.93$, $p = 0.40$). An especially positive impact of the ISA system on behaviour was found for respondents who did not agree on questions, reflecting a risky driving style (see figure 136). Drivers who had high or moderate values on the risk factor showed a worse communication behaviour and did not improve their interaction style that much while using the ISA system. For the factor fun a similar pattern but no significant results ($F_{2,39} = 1.53$, $p = 0.23$) were found. If driving a car was related to having fun, the communication with other road users was worse and did not improve as much as for those drivers who had a less fun oriented attitude towards traffic. Again, no significant results were found and the results just give a hint on the impact ISA has on various driver types.

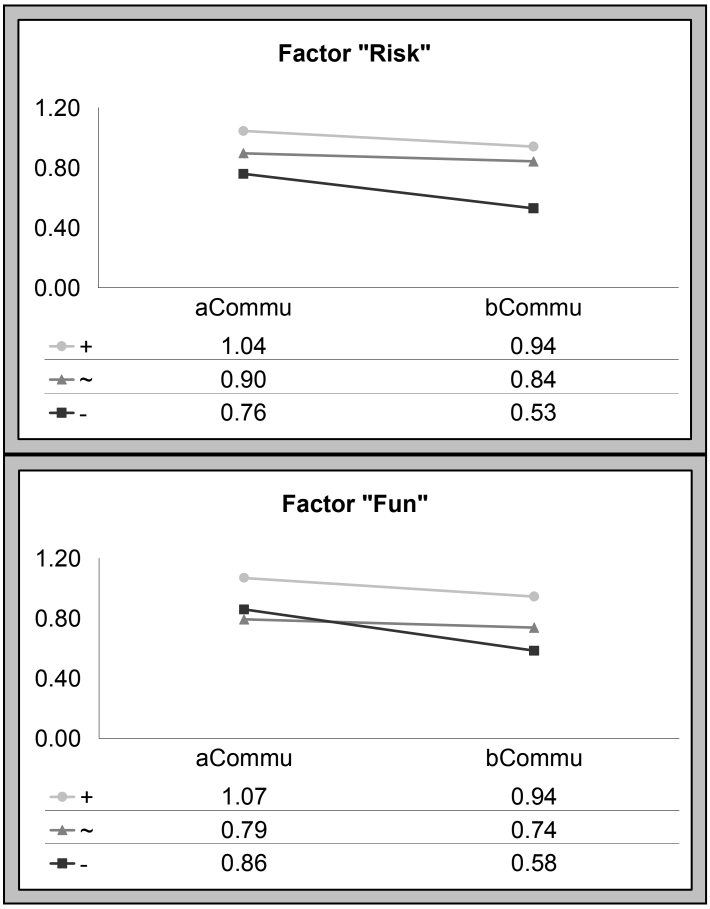


Figure 136: Changes of the communication behaviour over time depending on the attitude towards risk taking (left) and towards fun (right)

Conversely, the opposite was observed for the factor “Anxiety”. Participants who admitted to be anxious in traffic (high values on that factor) - mostly drivers younger than 21 (t(60) = -2.09, p = 0.041) and/or drivers with less experience (t(59) = -4.33, p = 0.000) - did not communicate well with other road users but profited most of the ISA system. Again, the results indicated three independent groups ($F_{2,38}$ = 2.97, p = 0.06), that did not change over time ($F_{2,38}$ = 1.33, p = 0.28). Although this result was not significant, it somewhat strengthens the function of ISA as a supporting system, especially for unconfident drivers.

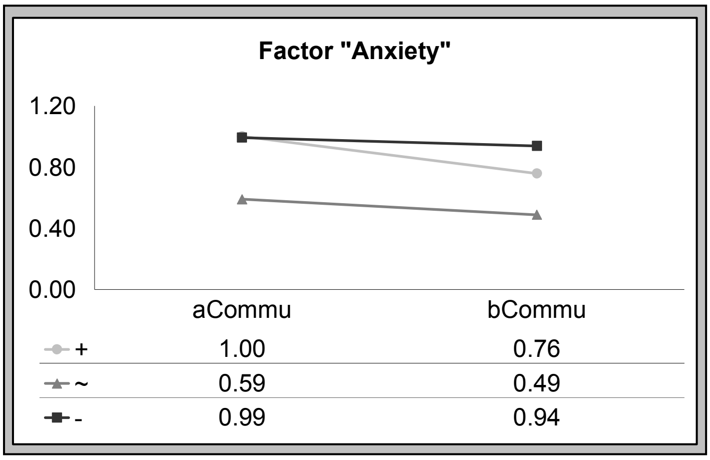
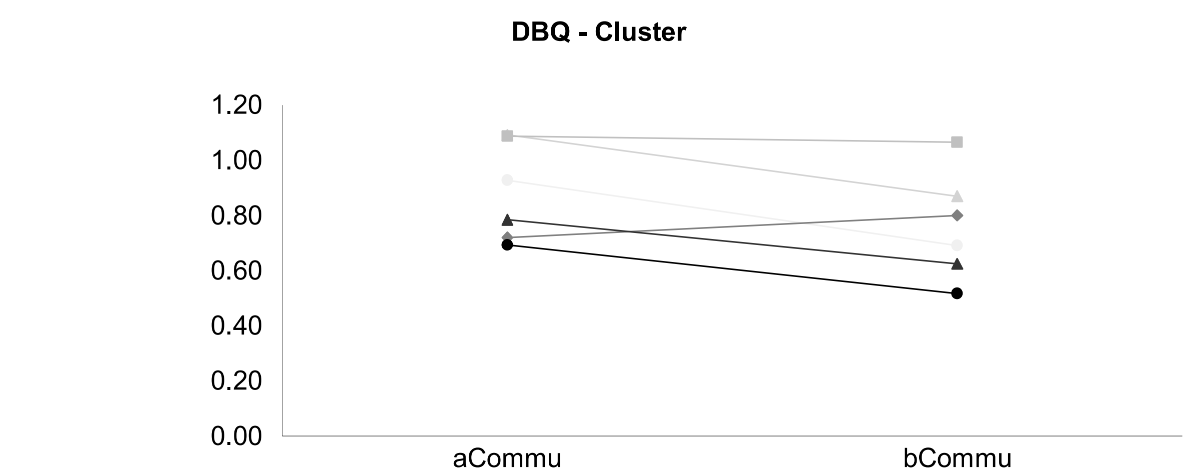


Figure 137: Changes of the communication behaviour over time depending on the amount of perceived anxiety

For the two remaining factors of the “Type” questionnaire, “Control” and “Aggression”, as already mentioned for the factor “Fun”, no significant changes in their communication behaviour were found while using the ISA system. Neither did significant behaviour changes occur when taking the clusters of the DBQ ($F_{5,33} = 0.56$, $p = 0.73$) into account. Regardless of the significance of the result, it was remarkable that especially “Rule breakers” and “Aggressive rowdies” – both groups comprising participants with an extensive driving experience – did not interact in a good way with other road users. The “Clumsy rowdies” somehow were an exception of the rule. Respondents assigned to that cluster also possessed a comprehensive driving experience but showed a better communication behaviour than the first two groups. However, figure 121 shows, that whilst for the “Clumsy rowdies” the communication behaviour deteriorated, it stayed more or less stable for the “Aggressive rowdies”. Thus it seems, that those participants who had relatively high values concerning highway violations and high values either concerning errors, lapses or violations against other road users, profited less from the ISA system.



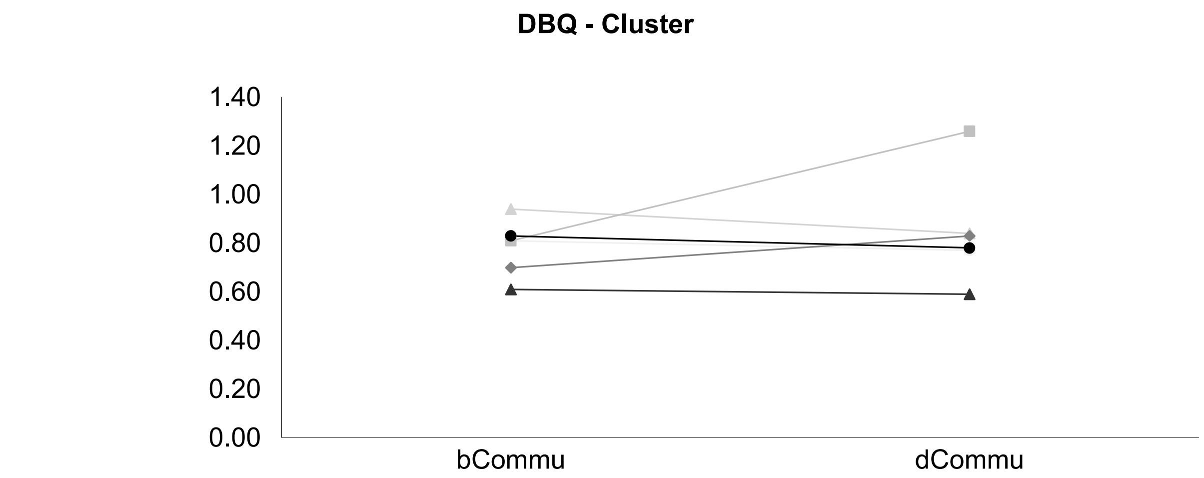
	aCommu	bCommu
Clumsy clot	0.93	0.69
Rule braker	1.09	0.87
Aggressive rowdy	1.09	1.07
Clumsy rowdy	0.72	0.80
Angry driver	0.78	0.62
Ideal driver	0.69	0.52

Figure 138: Changes of the communication behaviour over time depending on the cluster affiliation (a to b)

Hypotheses 2: A short-term use of ISA does not have a long-term effect on the drivers' communication behaviour.

Besides the short-term effect of ISA on the communication of young car drivers with other road users also the long-term effect was investigated. According to the findings of Hjälmdhal (2004b) drivers do not benefit from the system if not using it. Thus and because of the findings of Schade (2000) concerning the stability of speed related behaviour, it was assumed, that the positive effect of ISA will diminish after a few months not using the system. That assumption was proven by the results. The values of the “Communication” index (based on the behaviour observation data, as for hypothesis 1) of the first ride were compared to those of the third ride. No significant effects were found ($t(51) = 0.12$, $p = 0.905$).

Taking a closer look at the results based on the clustering first, a distinct characteristic became obvious for the "Aggressive rowdies" as well as the "Clumsy rowdies" compared to the other groups. Although the findings are not significant ($F_{5,41} = 0.72$, $p = 0.61$), figure 139 illustrates an increase of communication errors especially for the cluster "Aggressive rowdies" but also for those drivers who were assigned to the group of "Clumsy rowdies". In particular those participants who committed relatively many lapses, errors and violations seemed to become more "delinquent" the more driving experience and thus the more confidence they gained. As ISA is less effective for those groups as well, these might be the target groups for training measures to make them aware of their problematic driving behaviour.



	bCommu	dCommu
Clumsy clot	0.81	0.77
Rule braker	0.94	0.84
Aggressive rowdy	0.81	1.26
Clumsy rowdy	0.70	0.83
Angry driver	0.61	0.59
Ideal driver	0.83	0.78

Figure 139: Changes of the communication behaviour over time depending on the cluster belonging (b to d)

The most beneficial as well as the only statistically relevant finding was related to the attitude towards ISA. Depending on the estimation of the beneficial impacts of the ISA system, drivers behaved differently after few months of abstinence ($F_{2,46} = 6.65$, $p = 0.00$). Those young participants who had initially had a negative attitude towards ISA showed an increase in communication errors, whereas drivers with a neutral or even positive attitude improved their behaviour at least a bit. Not only the effect of the ISA system was less significant for proponents, but also the interaction behaviour deteriorated over time.

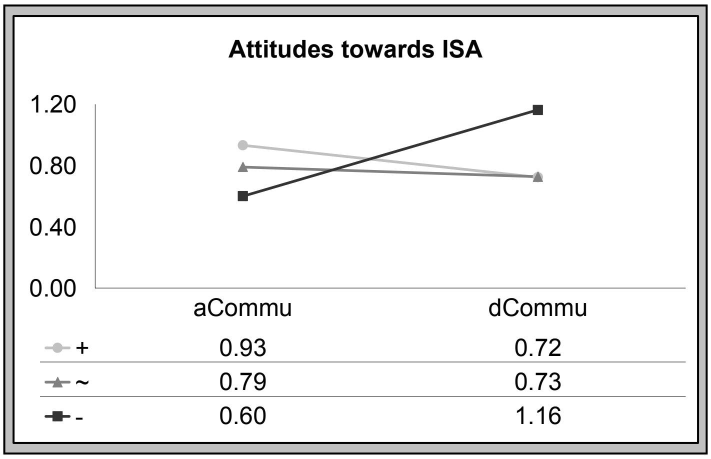


Figure 140: Changes of the communication behaviour over time depending on the attitude towards ISA

Regardless of their gender, the age, the duration of the ownership, the driving experience, the nationality as well as the values in the factors “Risk”, “Fun”, “Control”, “Anxiety” or “Aggression”, drivers did not improve their communication behaviour due to an one-time use of the ISA system. Though, in connection with the findings of hypothesis 1, the results provide some interesting hints. For instance the 18 to 20 year olds communicated worse during the last ride in comparison to the first ride, but especially compared to the ISA ride (see figure 141). Keeping in mind the positive effect of ISA on the behaviour of young and/or inexperienced drivers this finding goes in line with the assumed support character of the system.

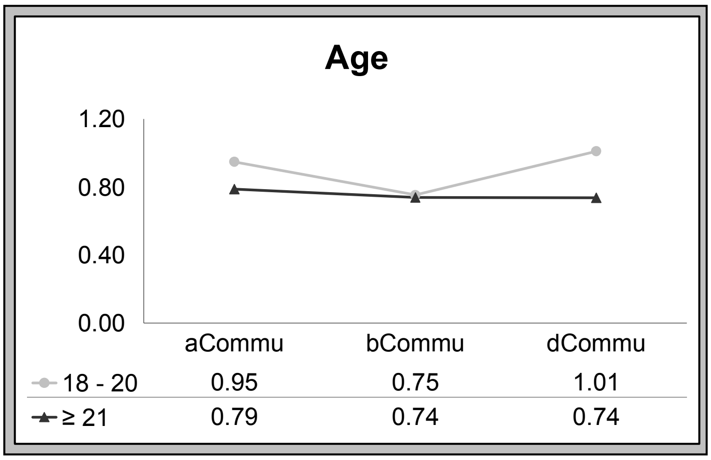


Figure 141: Changes of the communication behaviour over time depending on the age (N = 37)[13]

The effect was very similar for those drivers who disagreed on statements concerning a risky behaviour (“-“), or statements about driving just for fun (“-“). Again, their behaviour did not improve that much from the first to the last ride, but was much better while using the ISA system (see figure 142). Surprisingly this effect was true also for those participants who associated driving with having fun (“+”).

[13] For this calculation only those cases have been chosen, who had the same observer during all three rides. Thus, the values might be different from those, presented in earlier chapters.

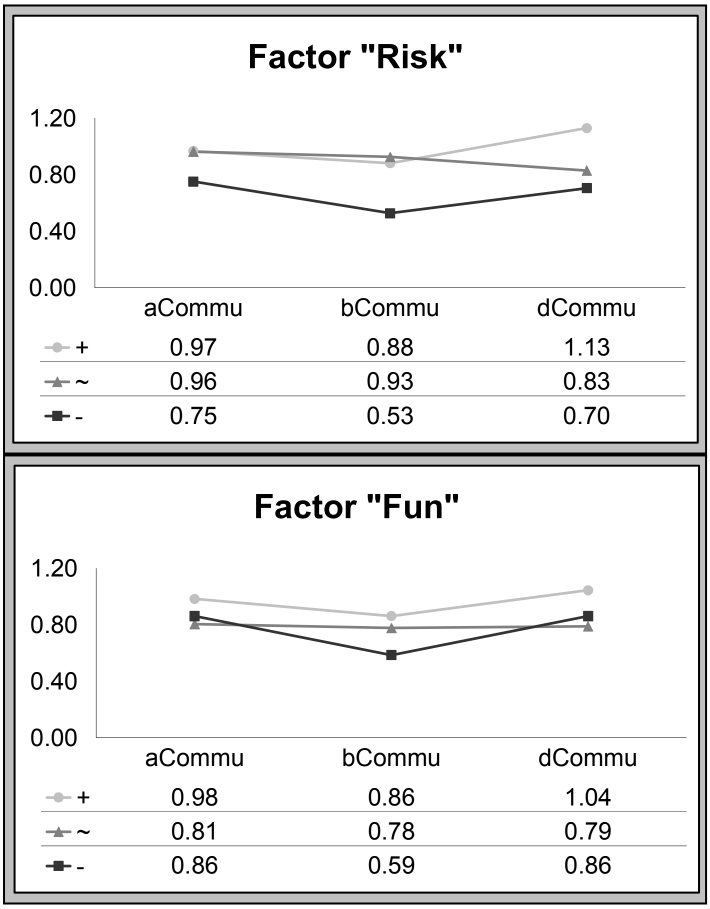


Figure 142: Changes of the communication behaviour over time depending on the agreement on a risky driving style (left) and depending on the attitude towards fun oriented driving (right) (N = 37)[14]

For the factor “Anxiety” the findings were less consistent. The communication behaviour of drivers who were afraid of road traffic (“+”), improved not only with the support of the ISA system (see figure 126) but also during the last ride. Those participants with high values in the factor “Anxiety” (“-“) were predominantly between 18 and 21 years old and/or less skilled driver. An explanation for changes over time might be the increase in driving experience in general and thus, a better interaction behaviour in traffic.

[14] See comment 10.

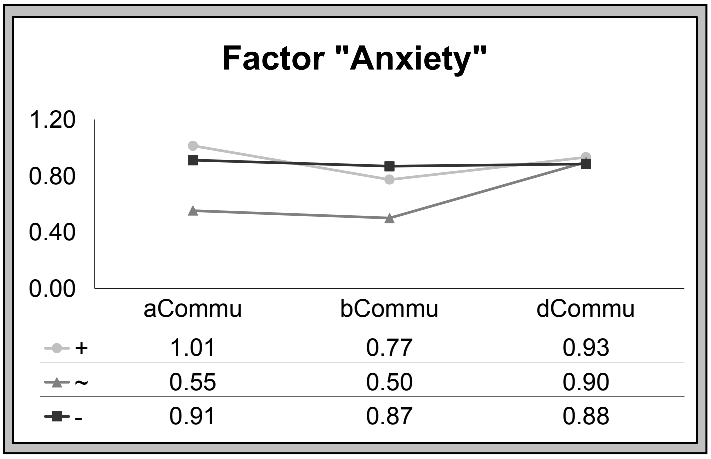


Figure 143: Changes of the communication behaviour over time depending on the anxiety (N = 36)[15]

In line with the assumptions found in literature, ISA did not have the power to influence the driving behaviour of young car drivers for a longer period of time after having used it just once. Nevertheless the assumption of a positive impact of the ISA system on the communication behaviour can be supported to some extend. Still conclusions must be drawn cautiously, as some interference factors might exist. However, ISA had a supporting effect especially on young and/or inexperienced drivers. Furthermore risk-averse participants as well as drivers who perceived a car in practical rather than in fun related term, profited most from the system. The findings allow the conclusion that anxious people benefit from the system as well, but just if they are inexperienced and thus less confident. Especially proponents of ISA as well as drivers, characterised as rowdies, did not improve their communication behaviour due to the system; on the contrary, their behaviour even deteriorated over time. As Hjälmdhal (2004b) has already pointed out, it seems as if those drivers who would need the system most, have the smallest advantage of it.

Based on the literature it was assumed that ISA improves the communication of young drivers with other road users just as long as they are using it. This has already been supported by the current results. Thus, a psychological group training was developed, to advance the impact of ISA for a longer period of time and to positively influence the attitudes as well as the general driving behaviour of the participants of the study. In the course of two sessions, young drivers discussed several topics related to traffic safety. The characteristics of the participants of the group discussion concerning gender, age, duration of ownership of the driving licence, driving experience, nationality, driving behaviour, attitude towards ISA as well as concerning the clusters based on the DBQ and the factors resulting of the “Type” questionnaire did not differ from those of the rest of the sample.

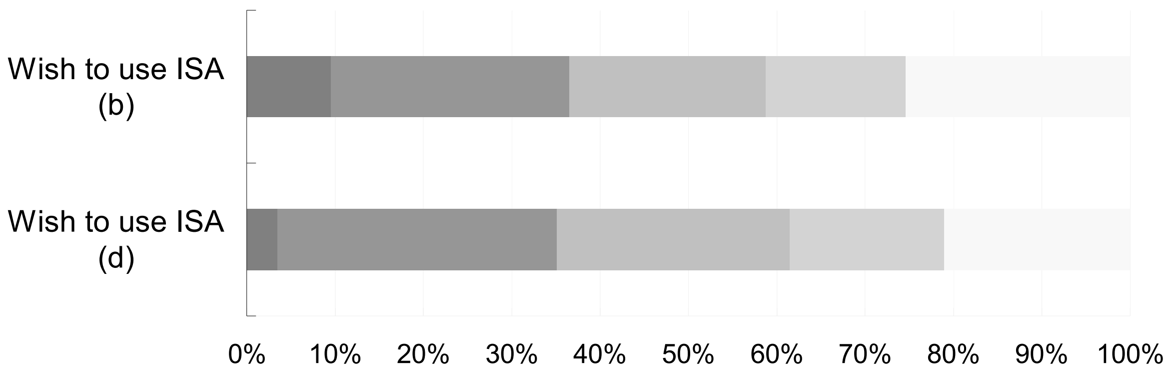
Hypotheses 3: Training can improve a negative attitude towards ISA and speed behaviour.

To investigate hypothesis 3, the data obtained by the “ISA” questionnaire have been consulted. The responses concerning speed and the ISA system given after the second ride (with the ISA equipped car) have been compared with those responses given after the last ride (with the driving school car) by means of a variance analysis for repeated measures.

[15] See comment 10.

Although the training did not have an effect on the acceptance of the current speed regulations in the particular country ($F_{1,52}$ = 0.52, p = 0.47), nor on the perceived benefits of the speed limits ($F_{1,52}$ = 0.02, p = 0.88), in trend only participants of the discussion strengthened their opinion concerning the necessity of speed limits ($F_{1,53}$ = 2.90, p = 0.09) and the correlation between speed and accident risk ($F_{1,53}$ = 2.75, p = 0.10). After the last ride, all of the young drivers indicated to adhere more to the legal limits as they did before ($F_{1,52}$ = 4.11, p = 0.05). As not only participants of the group discussion expressed this kind of behaviour, which is desired from a road safety point of view, some other factors might have caused a change in their opinion. Even though no long-term impact of ISA on the communication behaviour was found, the use of the system might have raised awareness of speeding. Another explanation for the better compliance with speed limits is, that not the ISA system but the participation in the study itself might have changed participants'' opinions. Furthermore the phenomenon of social desirability might have caused that effect.

However, the positive effect on the compliance with speed limits was not reflected by the willingness to use ISA ($F_{1,52}$ = 0.66, p = 0.42), neither for the participants of the group discussion ($F_{1,52}$ = 0.09, p = 0.76) nor for the rest of the sample. As has already been mentioned further above, about one third of the young drivers were in favour of the ISA system, approximately one quarter was indifferent and about 40% did not want to use the system.



	Wish to use ISA (b)	%	Wish to use ISA (d)	%
Strongly agree	6	9.52	2	3.51
Agree	17	26.98	18	31.58
Undecided	14	22.22	15	26.32
Disagree	10	15.87	10	17.54
Strongly disagree	16	25.40	12	21.05

N = 63/57

Wish to use ISA b	d	
3.21	3.21	Mean
1.35	1.21	SD

Figure 144: Willingness to use an ISA system after trying it (step 2/b) and after the last ride (step4/d)

The <u>advantages</u> of ISA in general, as well as the advantages why one would like to use the system, were estimated quite positively even after the last ride, irrespective of the participation in the training; no significant changes over time occurred ($F_{Adv\ 1,51}$ = 0.88, p = 0.35; $F_{Use\ 1,46}$ = 0.06, p = 0.80).

Nevertheless, all young drivers significantly agreed more on the <u>disadvantages</u> of the ISA system ($F_{1,45}$ = 9.96, p = 0.00) at the end of the study. This was especially the case for the participants of the group discussion ($F_{1,45}$ = 5.59, p = 0.02). A similar picture emerged concerning the reasons why young drivers would not like to use ISA. After the last car ride, participants were less willing to use ISA themselves than directly after the ISA-ride ($F_{1,45} = 5.71$, $p = 0.02$). This effect was bigger for the training group, even though the result was not significant ($F_{1,45} = 0.95$, $p = 0.33$). Young drivers in general seem to give priority to the drawbacks of the ISA system after a longer period without it. An explanation why particularly participants of the group discussion were affected by that phenomenon could be an increased awareness of their own responsibility concerning traffic safety. It might be the case that especially those young drivers recognized the necessity to actively accept their responsibility rather than to rely on a system. Another explanation for the unexpected outcome could be the short duration of the discussion. Those trainings, considered to be effective according to literature, lasted by far longer than the group discussion carried out within the framework of this study (see sub-chapter 3.3).

Although a positive impact of the group discussion on the attitude towards the ISA system was presumed, the training did not satisfy the expectations. On the one hand the advantages of the system were not valuated better after the training and on the other hand, those drivers who participated in the training agreed even stronger upon the weaknesses of ISA. Furthermore, the willingness to use it was not augmented by the group discussion. A possible reason why the training did not have the intended effect on the attitude of young drivers, or rather on their responses, might be that the training imposed a more deliberate view on the ISA system in connection with traffic safety. Perhaps participants became even more aware of their own responsibility in road traffic. If this assumption is true, the behaviour of those drivers who attended the group discussion must have improved. The improvement should be reflected in changes of their driving and communication behaviour over time. This question was investigated with hypothesis 4.

Hypothesis 4: Training has the potential to improve young drivers' behaviour for a long period of time.

Besides enhancing the attitude of young car drivers, the training was carried out in order to intentionally improve the driving behaviour of this target group. That goal was achieved, at least to some extent. Even though no impact on the speed adaptation ($F_{1,48} = 1.41$, $p = 0.24$), the behaviour towards vulnerable road users ($F_{1,48} = 0.27$, $p = 0.61$), the lane change and keeping behaviour ($F_{1,48} = 0.05$, $p = 0.83$), behaviour concerning to following distance ($F_{1,48} = 0.23$, $p = 0.63$), the use of the indicator ($F_{1,48} = 0.39$, $p = 0.53$), the eye glance behaviour ($F_{1,48} = 1.30$, $p = 0.26$) as well as the behaviour before traffic-light regulated crossings ($F_{1,48} = 0.00$, $p = 0.95$) was achieved, the training had some effect on the driving behaviour. The yielding behaviour improved significantly after the training ($F_{1,48} = 5.13$, $p = 0.03$). Even more important was the finding that those participants who had had the chance to take part in the group discussion got less involved in dangerous situations afterwards. This was concluded as significantly less interventions of the driving instructor ($F_{1,48} = 4.81$, $p = 0.03$) were noted afterwards. So it seems that after the training interactions with other car drivers changed for the better. Moreover did young drivers in general behave more preferable in the interaction with vulnerable road users during the last ride ($F_{1,48} = 7.59$, $p = 0.01$), showed a better lane change and keeping ($F_{1,48} = 7.55$, $p = 0.01$) as well as following behaviour ($F_{1,48} = 4.78$, $p = 0.03$), they used the indicator more often in trend ($F_{1,48} = 2.88$, $p = 0.10$) and performed a much better eye glance behaviour ($F_{1,48} = 13.35$, $p = 0.00$). It has to be assumed that the improvement is based on reasons other than the training effect, as for instance the ride with the ISA equipped car, which was carried out between both rides, that were considered in that calculation. This assumption is encouraged by the findings of hypothesis 1, in which it was proven that adolescents showed a more considerate driving style while using the ISA system.

Briefly summarising the discussion chapter, as found in literature, speeding was a big issue among young drivers participating in the current study. Although most of the young drivers estimated speed limits as an important measure for traffic safety, the attitudes towards speed were wide-ranging and varied from fun to fear. Exactly these attitudes seemed to be pretty important with regard to ISA. Drivers, who associated driving with having fun and who agreed on risk taking questions, did not improve their communication behaviour while using ISA as the other drivers did. On the contrary, aggressive drivers, who do not mind to take risks, seemed to become more ruthless the more driving experience they gained. For anxious participants ISA was found to be a great support when dealing with the driving task and especially in the interaction task as long as they were less experienced. However, young drivers had quite a realistic view on what ISA can accomplish and where its limits are. Maybe that is the reason why only about 40% of the participants would like to use ISA. The training did not have the power to change their attitude in this regard, though. The group discussion in general was not that effective concerning an attitudinal change but rather influenced the driving behaviour positively to some extent. Participants of the group discussion showed a much better yielding behaviour after the training, and much more importantly, were involved less frequently in dangerous situations.

9. Critical remarks and future prospects

The current PhD thesis started as an ambitious project. The aim was to deliver knowledge on how the traffic safety of young drivers can be increased by technical devices and by psychological training measures. Hence, one more evidence for the effectiveness of ISA was found. Like in many other studies, some constraints had to be accepted due to limitations in human, time-related and financial resources.

1. First of all, it has to be mentioned, that the presented study design was already an adapted one. Table 75 gives an overview of the study design structured in four steps as has already been described in chapter 5.1. as well as the original and the actual time schedule. The whole process was estimated to take about one year. Immediately after the first ride it was planned to observe participants while driving the ISA equipped car, followed directly by the psychological group training. For the investigation of a long-term effect of the training, at least four months were planned to pass by before the last ride. Due to common reasons (delay do to other duties, tasks that are more time consuming than planned, etc.), the <u>time schedule</u> was changed a little bit, which is visualised in table 75. In the end, the study lasted for about 16 months instead of 12 and the psychological group training was implemented two months later than planned.

	Steps of the study	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Step 1 (a)	Drive in a driving school car		Plan														
	Fill in "ISA" questionnaire			Reality													
Step 2 (b)	Drive an ISA equipped car on an extra route to get used to the system																
	Drive an ISA equipped car on the original route				Plan												
	Fill in "ISA" questionnaire																
	Fill in DBQ			Real.													
	Fill in "Type" questionnaire																
Step 3 (c)	Participate in the pschological group training						P.										
	Fill in "ISA" questionnaire																
	Fill in DBQ																
	Fill in "Type" questionnaire								Real.								
	Fill in "Training" evaluation																
Step 4 (d)	Drive in a driving school car																
	Fill in "ISA" questionnaire											Plan					
	Fill in DBQ														Reality		
	Fill in "Type" questionnaire																

Table 75: The four steps of the study in relation to the planned (dark grey) and the actual (light grey) time schedule

2. Table 75 also illustrates a minor change in the <u>study design</u> with regard to the <u>questionnaires</u>. As the participants were too exhausted by all the different questionnaires in step 2, one questionnaire had to be skipped. The Manchester Driver Behaviour questionnaire was chosen to be eliminated because it concentrates on actual driving behaviour. It was assumed that the responses of this questionnaire

might vary more significantly over time than the answers for the "Type" questionnaire and thus results would not have been equally reliable.

3. With regards to the "ISA" questionnaire it has to be mentioned that additional analyses would have been possible, if the same version of the instrument had already been used after the first ride instead of the second ride. Thus, in further studies the development of such an instrument should start earlier.
4. Moreover, in order to keep the group quite homogenous, it was planned to focus on novice drivers between 18 and 20 years of age with not more than 10.000 kilometres of driving experience in total. However, the test driver selection was quite different for Austria and the Czech Republic. Since it was not possible to attract enough, especially Austrian, novice drivers of the age of 18 to 20 with less than 10.000 kilometres driving experience, the target group was changed slightly. The age limit was widened to include drivers between 18 and 25 years, regardless of their driving experience. Hence, the focus of the study was adapted towards young car drivers, not only novice drivers in particular, which turned out to be advantageous for the study, as this decision rendered the results more meaningful.
5. As the behaviour observation was the most important source of information for answering hypothesis 1, 2 and 4, the training of the observers should have been emphasized even more, in order to receive valid results from all of them. For future research it would be recommended to strictly follow the suggestions of the authors of the Wiener Fahrprobe (Risser and Brandstätter, 1985) who suggest a training sequence of several days.
6. Furthermore it would have been very interesting to investigate the impact of the ISA system on the speed behaviour. Observation turned out to be not the most adequate method to record this specific type of behaviour. An additional technical device (e.g. black box) could solve this problem very easily by recording the speed of each given time and position.
7. The finding of Hjälmdhal (2004a) that ISA is effective just as long as it used was supported by the results. However, the findings would have been even more meaningful, if the drivers had had the possibility to use the system for a longer period of time instead of trying it for just a one-hour car ride.
8. A feasible explanation why the psychological group training, implemented in the current study, did not have the designated effect on the attitude of the participants concerning ISA might be the relatively short duration, causing a more deliberate view on the system in connection with traffic safety. As shown in some studies discussed in sub-chapter 3.3 a longer lasting, more intense training has the potential to improve the attitude of young drivers with regard to traffic safety issues.
9. Finally, one of the most important defaults of the current study probably is the missing of a control group, comprising young drivers who did not use the ISA system. Thus, results concerning ISA have to be interpreted carefully. For further studies it would be interesting to compare two groups of drivers, one group using an ISA system and one, at the same stage of the study, driving a car without the system implemented.

Although the realisation in practice was sometimes challenging and thus some allowances with regard to the study design had to be made, and the results cannot be considered to be representative for all Austrian and Czech young drivers between 18 and 25 years of age, the current study provides some interesting insight into the effects of an ISA system as well as the impact of a training on young drivers.

Future research should take the chance and take into account the limitations of the current work mentioned above in order to allocate a further piece to the puzzle of traffic safety of young drivers.

10. Recommandations

The effects of ISA on the driving behaviour have been studied for almost 20 years. In all the studies mentioned in sub-chapter 3.2, ISA was considered to be an effective device for speed management for car drivers. Also the findings of the current work indicate a positive effect of ISA, even on the group of young car drivers. However, not all of the young drivers were affected in the same way. Especially for those drivers who admit a risk-affine attitude as well as those who drive for fun, no impact of the ISA system was found. On the other hand, it seemed that in particular anxious drivers profit most from the system as it provides some support in the driving task. Thus, to make people use the ISA system, it needs to be promoted differently for different groups of drivers, also considering a rather low acceptance among young drivers. Even though the participants could not be convinced of the positive effects of ISA by training measures, the driving behaviour improved to some extent. It is worthwhile to engross another thought concerning the supporting aspect of the ISA system. As ISA seemed to have an assisting effect especially on young and/or inexperienced drivers, the most reasonable consequence would be to place ISA as early in the driving education as possible. Thus, drivers would be supported in the driving task and at the same time learn to choose an appropriate speed for different situations. However, the main challenge of road traffic safety work probably is to keep a good balance between increasing the safety of all road users and not limiting one's independence in order to avoid reactance of individuals against traffic safety measures.

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See also

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Annex I: ”ISA“ questionnaire

Question 1.4		N	% of cases
1	Foresighted driving	23	31.1%
2	Driving anticipatory	14	18.9%
3	Safe and secure driving	19	25.7%
4	Considerate driving	15	20.3%
5	Defensive driving	6	8.1%
6	Non-aggressive driving	4	5.4%
7	Speedy driving	9	12.2%
8	Accident-free driving	4	5.4%
9	Knowing and respecting road traffic regulations	17	23.0%
10	Knowledge of the own vehicle	2	2.7%
11	Control of the own vehicle	4	5.4%
12	Much driving experience	7	9.5%
13	Driving with adapted speed	8	10.8%
14	Good reactivity	7	9.5%
15	Sense of responsibility	2	2.7%
16	Paying attention while driving a car	3	4.1%
17	Giving passengers the feeling of security and comfort	2	2.7%
18	The ability to drive different vehicles	2	2.7%
19	Avoiding to endanger your own or other person`s life	1	1.4%
20	Others	37	50.0%

Table 76: Characteristics of a good driver (frequency in %)

Question 2.1		N	% of cases
1	Respecting general rules and regulations	24	32.4%
2	Respecting traffic signs	1	1.4%
3	Respecting speed limits	3	4.1%
4	Not driving your car if you feel negatively affected	2	2.7%
5	Consideration of other road users	13	17.6%
6	Not to endanger your own or other road user`s life	11	14.9%
7	Adapting the manner of driving according to road and weather conditions	6	8.1%
8	Traffic controls	2	2.7%
9	Concentration on the traffic	4	5.4%
10	Avoiding accidents	10	13.5%
11	Infrastructural measures	6	8.1%
12	Secure driving behaviour	8	10.8%
13	Speed limits	1	1.4%
14	Driving anticipatory	8	10.8%
15	Relying on other road users	5	6.8%
16	No aggressive way of driving	2	2.7%
17	Others	21	28.4%

Table 77: Intents of traffic safety (frequency in %)

Question 2.5		N	% of cases
1	Speeding	24	32.4%
2	Tailgating	10	13.5%
3	Is affected by fatigue	3	4.1%
4	Is affected by alcohol	11	14.9%
5	Is affected by medicine	0	0.0%
6	Is affected by drugs	1	1.4%
7	Is affected by others	1	1.4%
8	Is distracted by smoking	3	4.1%
9	Is distracted by making a call	4	5.4%
10	Is distracted by talking with co-drivers	1	1.4%
11	Is distracted by others	9	12.2%
12	Unsafe driving behaviour	7	9.5%
13	Ruthlessness	24	32.4%
14	Aggressivity	19	25.7%
15	Disregarding traffic regulations	26	35.1%
16	Self-overestimation	8	10.8%
17	Doing unnecessary/dangerous overtaking-manoeuvre	4	5.4%
18	Not having an overview of the traffic situation	4	5.4%
19	Doing dangerous driving manoeuvres	4	5.4%
20	Hectic rush/impatience/nervousness	6	8.1%
21	Uncontrolled manner of driving	4	5.4%
22	Driving not adapted to the traffic situation	5	6.8%
23	Lack of knowledge of a place	3	4.1%
24	Others	20	27.0%

Table 78: How a driver who endanger others behave (frequency in %)

Question 4.1		N	% of cases
1	Making aware of speed limits	20	27.0%
2	Feedback/reminder on speed limits	9	12.2%
3	Clear information about permissible maximum speed	10	13.5%
4	Warning about transgression of the allowed speed limits	1	1.4%
5	More concentration on the traffic possible	7	9.5%
6	No control look on speedometer necessary	7	9.5%
7	No control look on traffic signs necessary	2	2.7%
8	Control in general	5	6.8%
9	Support of driving	5	6.8%
10	Speed regulation	8	10.8%
11	Prevents unintentional speeding	5	6.8%
12	Increases the traffic safety	6	8.1%
13	Others	16	21.6%

Table 79: Advantages of ISA (frequency in %; N = 71)

Question 4.2		N	% of cases
1	Too much control	2	2.7%
2	Paternalism	5	6.8%
3	Annoying/frustrating/nerve-wracking	5	6.8%
4	You rely too much on technology	10	13.5%
5	Restriction of the driver	7	9.5%
6	Occurrence of a defect	4	5.4%
7	Missing up-to-dateness of the system	5	6.8%
8	Less concentration on the traffic situation	5	6.8%
9	Those who want to drive too fast doing this in spite of such systems	5	6.8%
10	Can sometimes be in the way	7	9.5%
11	Uncertainty, if you are unaccustomed to this	5	6.8%
12	Purchase too expensive	2	2.7%
13	Others	23	31.1%

Table 80: Disadvantages of ISA (frequency in %; N = 61)

Question 4.3		N	% of cases
1	Younger people	5	6.8%
2	Older people	10	13.5%
3	Novice drivers	13	17.6%
4	Seniors	2	2.7%
5	Professional drivers	8	10.8%
6	Driving schools	3	4.1%
7	Women	4	5.4%
8	Men	1	1.4%
9	Sensible drivers	1	1.4%
10	Safe drivers	2	2.7%
11	Considerate drivers	2	2.7%
12	Insecure drivers	6	8.1%
13	Drivers who want to observe the law	7	9.5%
14	Drivers who do not want to pay a punishment	2	2.7%
15	Drivers who frequently ignore speed limits	2	2.7%
16	Drivers who frequently drive on unknown routes	6	8.1%
17	Inexperienced drivers	3	4.1%
18	Parents of novice drivers	1	1.4%
19	All drivers	9	12.2%
20	Others	28	37.8%

Table 81: Top eleven user groups of ISA (frequency in %; N = 67)

Annex II: “Eye catcher” and “Informative” placard (in German)

Lust, mal was Neues auszuprobieren?

Jetzt hast du die Chance!

Du bist zwischen 17 und 25 Jahre alt, hast deinen Führerschein schon gemacht oder zumindest die theoretische Prüfung bestanden?

Dann hast du im Rahmen einer wissenschaftlichen Studie die Möglichkeit kostenlose Fahrstunden in Anspruch zu nehmen und später als eine/r der ersten in Österreich ein neuartiges System (ISA) aus Schweden auszuprobieren. Dieses hilft dir mittels Satellitennavigation (GPS) zu erkennen, wo du dich gerade auf der Strecke befindest und zeigt dir an, wie schnell du dort fahren darfst.

Zur Studie gehört auch ein 4-stündiges Gruppentraining, das jedoch nicht jede/r absolvieren muss. Nach einem Jahr hast du dann nochmals die Möglichkeit, gratis eine Stunde lang mit einem Fahrschulwagen zu fahren – du könntest dies als Vorbereitung auf deine 2. Perfektionsfahrt nutzen!

Deine Vorteile:

- 2 GRATIS Fahrstunden Juni/Juli 2006 und ca. April 2007
- ev. 1 Stunde in einem VOLVO mit ISA im August/September 2006
- Gewinnspiel (Preise: Fahrsicherheitstrainings bei VOLVO)
- 5 Euro für jede Stunde als Dankeschön

Wenn du dich angesprochen fühlst und du offen bist für neue Technologien bzw. diese auch ausprobieren möchtest dann melde dich unter:

01/504 15 46-18

Ich freue mich auf deine Mitarbeit!

Christine Turetschek
(Projektleiterin)

Annex III: “ISA“ questionnaire (phase 1)

CODE:

ISA-Questionnaire

General

Sex ☐ Female ☐ Male

Age ____ Years

Current job
- ☐ Apprentice — Future job ______________
- ☐ Employed — Actual job ______________
- ☐ Lerner — Type of school ______________
- ☐ Student — Field of study ______________
- ☐ Unemployed

Obtained groups ☐ A ☐ B ☐ C ☐ D ☐ E ☐ F

Date of acquirement
- ☐ A ___ Month ___ Year
- ☐ B ___ Month ___ Year
- ☐ C ___ Month ___ Year
- ☐ D ___ Month ___ Year
- ☐ E ___ Month ___ Year
- ☐ F ___ Month ___ Year

Driven kilometres since obtaining the driver's licence (under 5.000; 5.000 to 10.000; 10.000 to 20.000; 20.000 to 50.000; 50.000 to 100.000 or more than 100.000)

__________ A

__________ B

__________ C

__________ D

__________ Others

1/7

In the following different statements are presented to you. Please decide as spontaneous as possible how far you agree!

My parents think that I am a good driver.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

My friends think that I am a good driver.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I am a good driver.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

For me a good driver is characterised by:

____

____

____

I am a safe driver.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

2/7

Road safety

Road safety implies for me:

____

____

____

I generally feel safe in the road traffic.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I feel the most comfortable and secure as a (more than one answer is possible):

☐ Pedestrian because:____________________

☐ Cyclist because:____________________

☐ User of public transport because:____________________

☐ Moped driver because:____________________

☐ Motorcyclist because:____________________

☐ Car driver because:____________________

What kind of road users is the most endangered group in road traffic? (more than one answer is possible)

☐ None ☐ Pedestrians ☐ Cyclists

☐ Users of public transport ☐ Moped drivers ☐ Motorcyclists

☐ Car drivers

A car driver who endangers other road users is characterised by:

____

____

____

Are traffic regulations necessary in order to be able to guarantee road safety?

☐ Yes ☐ No ☐ Sometimes

What kind of measures would you take in order to increase road safety?

____

____

____

Who is responsible for the road safety? (more than one answer is possible)

____

____

____

Speed

Speed implies for me:

____

____

____

I think speed limits are necessary.

Totally correct ❐ ❐ ❐ ❐ ❐ Totally incorrect

In your opinion what are positive consequences of speed limits?

____

____

____

The speed limits in Austria are all right.

Totally correct ❐ ❐ ❐ ❐ ❐ Totally incorrect

I stick to the speed limits.

Totally correct ❐ ❐ ❐ ❐ ❐ Totally incorrect

Slower car drivers sometimes get on my nerves.

Totally correct ❐ ❐ ❐ ❐ ❐ Totally incorrect

I often overtake other car drivers.

Totally correct ❐ ❐ ❐ ❐ ❐ Totally incorrect

In the following situations I mostly like to overtake:

____

____

____

I already got punished because of speeding.

❐ No ❐ Yes – How many times? __________

There is a connection between higher speed and greater accident probability.

Totally correct ❐ ❐ ❐ ❐ ❐ Totally incorrect

Intelligent Speed Adaptation - ISA

ISA consists of an accelerator pedal that is connected to a satellite navigation system which recognises how fast you may drive. The driver is informed by a resistance of the accelerator that he/she exceeds the speed limit. The driver can avoid the system at any time if he/she steps stronger on the accelerator pedal.

I already have heard of such a system.

❐ Yes ❐ No

What kind of advantages could ISA have in your opinion?

____

____

____

What kind of disadvantages could ISA have in your opinion?

____

____

____

What type of driver would like to use ISA in your opinion?

____

____

____

I would like to use such a system.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

Why/Why not?

____

____

____

Thank you!!!

Annex IV: "ISA" questionnaire

CODE:

ISA-Questionnaire

General

When did you receive your driving licence?
- ❑ A ____ Month ____ Year
- ❑ Al____ Month ____ Year
- ❑ B ____ Month ____ Year
- ❑ C ____ Month ____ Year
- ❑ D ____ Month ____ Year
- ❑ E ____ Month ____ Year
- ❑ F ____ Month ____ Year

Driven kilometres since the last interview
- ❑ 0 to 500
- ❑ 500 to 1000
- ❑ 1000 to 1500
- ❑ More than 1500

In the following different statements are presented to you. Please decide as spontaneous as possible how far you agree!

My parents think that I am a good driver.

Totally correct ❑ ❑ ❑ ❑ ❑ Totally incorrect

My friends think that I am a good driver.

Totally correct ❑ ❑ ❑ ❑ ❑ Totally incorrect

I am a good driver.

Totally correct ❑ ❑ ❑ ❑ ❑ Totally incorrect

1/14

For me a good driver is characterised by:

	Totally correct				Totally incorrect
Foresighted driving	❑	❑	❑	❑	❑
Driving anticipatory	❑	❑	❑	❑	❑
Safe and secure driving	❑	❑	❑	❑	❑
Considerate driving	❑	❑	❑	❑	❑
Defensive driving (no tailgating, no dangerous overtaking-manoeuvres, etc.)	❑	❑	❑	❑	❑
Non-aggressive driving	❑	❑	❑	❑	❑
Speedy driving	❑	❑	❑	❑	❑
Accident-free driving	❑	❑	❑	❑	❑
Knowing and respecting road traffic regulations (respecting speed limits, no drunk-driving, etc.)	❑	❑	❑	❑	❑
Knowledge of the own vehicle	❑	❑	❑	❑	❑
Control of the own vehicle	❑	❑	❑	❑	❑
Much driving experience	❑	❑	❑	❑	❑
Driving with adapted speed under busy road and weather conditions	❑	❑	❑	❑	❑
Good reactivity	❑	❑	❑	❑	❑
Sense of responsibility	❑	❑	❑	❑	❑
Following/Thinking/Paying attention while driving a car	❑	❑	❑	❑	❑
Giving passengers the feeling of security and comfort	❑	❑	❑	❑	❑
The ability to drive different vehicles	❑	❑	❑	❑	❑
Avoiding to endanger your own life	❑	❑	❑	❑	❑
Avoiding to endanger other person's life	❑	❑	❑	❑	❑
Others ____________	❑	❑	❑	❑	❑

2/14

I am a safe driver.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

Road safety

Road safety implies for me:

	Totally correct				Totally incorrect
Respecting general rules and regulations	☐	☐	☐	☐	☐
Respecting traffic signs	☐	☐	☐	☐	☐
Respecting speed limits	☐	☐	☐	☐	☐
Not driving your car if you feel negatively affected	☐	☐	☐	☐	☐
Consideration of other road users	☐	☐	☐	☐	☐
Not to endanger your own or other road user's life	☐	☐	☐	☐	☐
Adapting the manner of driving according to road and weather conditions	☐	☐	☐	☐	☐
Traffic controls	☐	☐	☐	☐	☐
Concentration on the traffic	☐	☐	☐	☐	☐
Avoiding accidents	☐	☐	☐	☐	☐
Minimising risk	☐	☐	☐	☐	☐
Constructional measures (road, signposting, etc.)	☐	☐	☐	☐	☐
Secure driving behaviour	☐	☐	☐	☐	☐
Speed limits	☐	☐	☐	☐	☐
Driving anticipatory	☐	☐	☐	☐	☐
Being able to rely on other road users	☐	☐	☐	☐	☐
No aggressive way of driving	☐	☐	☐	☐	☐
Others ____________	☐	☐	☐	☐	☐

I generally feel safe in the road traffic.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I feel the most comfortable and secure as a (more than one answer is possible):

☐ Pedestrian because:______________________________

☐ Cyclist because:______________________________

☐ User of public transport because:______________________________

☐ Moped driver because:______________________________

☐ Motorcyclist because:______________________________

☐ Car driver because:______________________________

What kind of road users is the most endangered group in road traffic? (more than one answer is possible)

☐ None ☐ Pedestrians ☐ Cyclists

☐ Users of public transport ☐ Moped drivers ☐ Motorcyclists

☐ Car drivers

A car driver who endangers other road users is characterised by:

	Totally correct				Totally incorrect
Speeding	☐	☐	☐	☐	☐
Tailgating	☐	☐	☐	☐	☐
Is affected by					
fatigue	☐	☐	☐	☐	☐
alcohol	☐	☐	☐	☐	☐
medicine	☐	☐	☐	☐	☐
drugs	☐	☐	☐	☐	☐
others ____________	☐	☐	☐	☐	☐
Is distracted by					
smoking	☐	☐	☐	☐	☐
making a call	☐	☐	☐	☐	☐
talking with co-drivers	☐	☐	☐	☐	☐
others ____________	☐	☐	☐	☐	☐
Unsafe driving behaviour	☐	☐	☐	☐	☐
Ruthlessness	☐	☐	☐	☐	☐
Aggression	☐	☐	☐	☐	☐
Disregarding traffic regulations	☐	☐	☐	☐	☐
Self-overestimation	☐	☐	☐	☐	☐
Doing unnecessary/dangerous overtaking-manoeuvre	☐	☐	☐	☐	☐
Not having an overview of the traffic situation	☐	☐	☐	☐	☐
Doing dangerous driving manoeuvres (lane change without flashing, ignoring zebra crossings, etc.)	☐	☐	☐	☐	☐
Hectic rush/impatience/nervousness	☐	☐	☐	☐	☐
Uncontrolled manner of driving	☐	☐	☐	☐	☐
Driving not adapted to the traffic situation	☐	☐	☐	☐	☐
Lack of knowledge of a place	☐	☐	☐	☐	☐
Others ____________	☐	☐	☐	☐	☐

Are traffic regulations necessary in order to be able to guarantee road safety?

☐ Yes ☐ No ☐ Sometimes

What kind of measures would you take in order to increase road safety?

	Totally correct				Totally incorrect
More controls (speed, alcohol, drugs, motor vehicle conditions, etc.)	☐	☐	☐	☐	☐
Speed-limits constructional (refuge, sleeping policemen, etc.)	☐	☐	☐	☐	☐
Speed reduction by limits (traffic signs)	☐	☐	☐	☐	☐
More severe punishment	☐	☐	☐	☐	☐
Kind of punishment? ____________					
Infrastructural measures in general (Roundabout, less/more signs, clearer separation of cycle lanes and sidewalks, etc.)	☐	☐	☐	☐	☐
Training (theoretical/practical education)	☐	☐	☐	☐	☐
Anew driving test	☐	☐	☐	☐	☐
When? ____________					
Awareness raising (Advertising spots, posters, etc.)	☐	☐	☐	☐	☐
Increasing promotion of other means of transportation (public transport, bike, etc.)	☐	☐	☐	☐	☐
Use of new technologies which support the driver	☐	☐	☐	☐	☐
Stricter driving tests	☐	☐	☐	☐	☐
Giving the drivers more responsibility	☐	☐	☐	☐	☐
Others ____________ ☐	☐	☐	☐	☐	

Who is responsible for the road safety? (more than one answer is possible)

- ☐ Every single road user
- ☐ All road users
- ☐ Police
- ☐ Legislator
- ☐ Street administrator
- ☐ City/municipality
- ☐ Vehicle manufacturer
- ☐ Others ___________

Speed

Speed implies for me:

	Totally correct				Totally incorrect
Danger	☐	☐	☐	☐	☐
Fun	☐	☐	☐	☐	☐
Risk	☐	☐	☐	☐	☐
Freedom	☐	☐	☐	☐	☐
Adrenalin	☐	☐	☐	☐	☐
Stress	☐	☐	☐	☐	☐
Getting on	☐	☐	☐	☐	☐
Arriving faster	☐	☐	☐	☐	☐
Discomfort/insecurity	☐	☐	☐	☐	☐
Fear	☐	☐	☐	☐	☐
Motorway	☐	☐	☐	☐	☐
Driving over the speed limit	☐	☐	☐	☐	☐
Accidents	☐	☐	☐	☐	☐
Race	☐	☐	☐	☐	☐
Others ____________	☐	☐	☐	☐	☐

I think speed limits are necessary.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

In your opinion what are positive consequences of speed limits?

	Totally correct				Totally incorrect
Safety	☐	☐	☐	☐	☐
Guidance	☐	☐	☐	☐	☐
Adviser	☐	☐	☐	☐	☐
Fewer accidents	☐	☐	☐	☐	☐
Less serious accidents	☐	☐	☐	☐	☐
Reduction of speed in dangerous zones	☐	☐	☐	☐	☐
Protection of vulnerable road users	☐	☐	☐	☐	☐
Traffic regulation	☐	☐	☐	☐	☐
Jams	☐	☐	☐	☐	☐
Trouble	☐	☐	☐	☐	☐
Avoidance of self-overestimation	☐	☐	☐	☐	☐
Others ____________	☐	☐	☐	☐	☐

The speed limits in Austria are all right.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I stick to the speed limits.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

Slower car drivers sometimes get on my nerves.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I often overtake other car drivers.

Totally correct ❑ ❑ ❑ ❑ ❑ Totally incorrect

In the following situations I mostly like to overtake:

	Totally correct				Totally incorrect
A slower car driver is in front of me	❑	❑	❑	❑	❑
In the urban area	❑	❑	❑	❑	❑
On the rural road	❑	❑	❑	❑	❑
On the motorway	❑	❑	❑	❑	❑
Unsure car driver is in front of me	❑	❑	❑	❑	❑
If the view is good	❑	❑	❑	❑	❑
If the possibility is given	❑	❑	❑	❑	❑
If it is not dangerous	❑	❑	❑	❑	❑
Hurry	❑	❑	❑	❑	❑
Vehicle in front of me goes far under the speed limit	❑	❑	❑	❑	❑
Others _____________	❑	❑	❑	❑	❑

I most likely overtake the following vehicles (more than one answer is possible):

❑ Bicycle ❑ Moped ❑ Motorcycle ❑ Tractor
❑ Truck ❑ Driving school car ❑ Dust-cart ❑ Vehicle with a trailer
❑ Others ___________

I already got punished because of speeding.

❑ No ❑ Yes – How many times? __________

There is a connection between higher speed and greater accident probability.

Totally correct ❑ ❑ ❑ ❑ ❑ Totally incorrect

Intelligent Speed Adaptation - ISA

ISA consists of an accelerator pedal that is connected to a satellite navigation system which recognises how fast you may drive. The driver is informed by a resistance of the accelerator that he/she exceeds the speed limit. The driver can avoid the system at any time if he/she steps stronger on the accelerator pedal.

What kind of advantages could ISA have in your opinion?

	Totally correct				Totally incorrect
Making aware of speed limits	❑	❑	❑	❑	❑
Feedback/reminder on speed limits	❑	❑	❑	❑	❑
Clear information about permissible maximum speed	❑	❑	❑	❑	❑
Warning about transgression of the allowed speed limits	❑	❑	❑	❑	❑
More concentration on the traffic possible	❑	❑	❑	❑	❑
No control look on speedometer necessary	❑	❑	❑	❑	❑
No control look on traffic signs necessary	❑	❑	❑	❑	❑
Control in general	❑	❑	❑	❑	❑
Support of driving	❑	❑	❑	❑	❑
Speed regulation	❑	❑	❑	❑	❑
Prevents unintentional speeding	❑	❑	❑	❑	❑
Increases the traffic safety	❑	❑	❑	❑	❑
Others _____________	❑	❑	❑	❑	❑

What kind of disadvantages could ISA have in your opinion?

	Totally correct				Totally incorrect
Too much control	☐	☐	☐	☐	☐
Paternalism	☐	☐	☐	☐	☐
Annoying/frustrating/nerve-wracking	☐	☐	☐	☐	☐
You rely too much on technology	☐	☐	☐	☐	☐
Restriction of the driver	☐	☐	☐	☐	☐
Occurrence of a defect	☐	☐	☐	☐	☐
Missing up-to-dateness of the system (construction sites, weather conditions, etc.)	☐	☐	☐	☐	☐
Less concentration on the traffic situation/distraction	☐	☐	☐	☐	☐
Those who want to drive too fast doing this in spite of such systems	☐	☐	☐	☐	☐
Can sometimes be in the way	☐	☐	☐	☐	☐
Uncertainty, if you are unaccustomed to this	☐	☐	☐	☐	☐
Purchase too expensive	☐	☐	☐	☐	☐
Others ______________	☐	☐	☐	☐	☐

What type of driver would like to use ISA in your opinion? (more than one answer is possible)

☐ Younger people
☐ Older people
☐ Novice drivers
☐ Seniors
☐ Professional drivers (truck, bus, public transport, taxi etc.)
☐ Driving schools
☐ Women
☐ Men
☐ Sensible drivers
☐ Safe drivers
☐ Considerate drivers
☐ Insecure drivers
☐ Drivers who want to observe the law
☐ Drivers who do not want to pay a punishment
☐ Drivers who frequently ignore speed limits
☐ Drivers who frequently drive on unknown routes (foreign countries)
☐ Inexperienced drivers
☐ Parents of novice drivers
☐ All of them

Which age group would like to use ISA? (more than one answer is possible)

☐ 18 to 25	☐ 25 to 35	☐ 35 to 45
☐ 35 to 45	☐ 45 to 55	☐ 55 to 65
☐ 65 to 75	☐ Over 75	

I would like to use such a system.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I would like to use such a system because of:

	Totally correct				Totally incorrect
Regularisation of the own speed	❑	❑	❑	❑	❑
Making aware of speed limits	❑	❑	❑	❑	❑
More concentration on the traffic possible	❑	❑	❑	❑	❑
No control look on speedometer necessary	❑	❑	❑	❑	❑
No control look on traffic signs necessary	❑	❑	❑	❑	❑
Feedback/reminder on speed limits	❑	❑	❑	❑	❑
Clear information about permissible maximum speed	❑	❑	❑	❑	❑
Increases the traffic safety	❑	❑	❑	❑	❑
Support at the driving	❑	❑	❑	❑	❑
Knows rather about limits (in an unknown area)	❑	❑	❑	❑	❑
You rather respect permissible limits	❑	❑	❑	❑	❑
Avoidance of punishments	❑	❑	❑	❑	❑
Environmental aspects (lower fuel consumption, etc.)	❑	❑	❑	❑	❑
Others _____________	❑	❑	❑	❑	❑

I would not want to use such a system because of:

	Totally correct				Totally incorrect
Annoying/frustrating/nerve-wracking	❑	❑	❑	❑	❑
I don't drive too fast	❑	❑	❑	❑	❑
Control/supervision	❑	❑	❑	❑	❑
Trust in own abilities - system unnecessary	❑	❑	❑	❑	❑
Want to have the control over the car	❑	❑	❑	❑	❑
Want to decide myself as fast I want to go	❑	❑	❑	❑	❑
A defect could arise	❑	❑	❑	❑	❑
ISA would disturb, when I (just) would like to go over the limit	❑	❑	❑	❑	❑
Freedom is lost	❑	❑	❑	❑	❑
Environmental aspects – needs more energy, fuel consumption	❑	❑	❑	❑	❑
Acquisition costs	❑	❑	❑	❑	❑

Thank you!!!

Annex V: Manchester Driver Behaviour Questionnaire (2002)

CODE:

Questionnaire for the ISA-study

Manchester Driver Behaviour Questionnaire (2002)

How often do you do each of the following? Circle the response most appropriate for you.

1. Attempt to drive away from the traffic lights in third gear.

   Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

2. Overtake a slow driver on the inside.

   Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

3. Drive especially close to the car in front as a signal to its driver to go faster or get out of the way.

   Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

4. Attempt to overtake someone that you hadn't noticed to be signalling a right turn.

   Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

5. Forget where you left your car in a car park.

   Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

6. Switch on one thing, such as the headlights, when you meant to switch on something else, such as the wipers.

   Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

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7. Sound your horn to indicate your annoyance to another road user.

   Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

8. Realise that you have no clear recollection of the road along which you have just been travelling.

   Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

9. Cross a junction knowing that the traffic lights have already turned against you.

   Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

10. Fail to notice that pedestrians are crossing when turning into a side street from a main road.

    Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

11. Become angered by another driver's behaviour, and give chase with the intention of giving him/her a piece of your mind.

    Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

12. Misread the signs and exit from a roundabout on the wrong road.

    Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

13. Disregard the speed limit on a residential road.

    Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

14. On turning left, nearly hit a cyclist who has come up on your inside.

    Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

2/4

15. Pull out of a junction so far that the driver with right of way has to stop and let you out.

Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

16. Queuing to turn left onto a main road, you pay such close attention to the main stream of traffic that you nearly hit the car in front.

Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

17. Drive even though you realise that you may be over the legal blood-alcohol limit.

Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

18. Have an aversion to a particular class of road user and indicate your hostility by whatever means you can.

Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

19. Underestimate the speed of an oncoming vehicle when overtaking.

Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

20. Hit something when reversing that you had not previously seen.

Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

21. Intending to drive to destination A, you 'wake up' to find yourself on the road to destination B, perhaps because the latter is your more usual destination.

Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

22. Stay in a motorway lane that you know will be closed ahead until the last minute before forcing your way into the other lane.

Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

23. Get into the wrong lane approaching a roundabout or junction.

Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

24. Miss 'Give way' signs, and narrowly avoid colliding with traffic having right of way.

Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

25. Fail to check your rear view mirror before pulling out, changing lanes etc.

Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

26. Get involved in unofficial 'races' with other drivers.

Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

27. Brake too quickly on a slippery road, or steer the wrong way in a skid.

Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

28. Disregard the speed limit on a motorway.

Never ☐ ☐ ☐ ☐ ☐ ☐ Nearly all the time

Thank you!!!

Annex VI: "Type" Questionnaire

CODE:

Questionnaire for the ISA-study

What kind of driver am I?

In today's road traffic you get frequently scared.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

With respect to slow drivers you sometimes have to tailgate on the highway.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I know my car inside out.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

If I am co-driver it happens quite often that I want to kick the pedals.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I want to have the possibility to reach any place without depending on timetables.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I think, that the car driver is patronised by general speed limits.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I am able to relax while driving.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

1/4

Sometimes I drive deliberately slow when someone tailgates behind me.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

Sometimes I feel like cruising.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I often swear while driving.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

Driving a car is connected for me with the feeling of freedom and independence.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I like to look around the country while driving.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I like to drive without stress.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I really like to drive a car.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I like to drive under difficult weather conditions (e.g. snow, clear ice or heavy rain).

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

Occasionally I try to find out my driving limits while driving my car.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

2/4

Without a car I feel like a half person.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

If it is busy and hectic on the road, I feel very unwell.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I prefer to 'glide' with my car on the road, without abrupt speed changes.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I have everything under control while driving my car.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I enjoy to compete against other car-drivers on the road.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I need a bit of a thrill while driving my car.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

Sometimes while driving my car I become so angry, that I calm down only after some minutes.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I adhere strictly to the traffic regulations while driving my car.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

If one only drive on the left lane, you have to overtake him on the right.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I do not like to drive long distances, e.g. far motorway journeys.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

I often feel really comfortable in my car.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

In the road traffic there are too many rules and regulations.

Totally correct ☐ ☐ ☐ ☐ ☐ Totally incorrect

Thank you!!!

Annex VII: Feedback-Questionnaire

Post-group-discussion questionnaire

The atmosphere in the group was relaxed:
(5 = I agree entirely; 1 = I disagree entirely)

Totally correct ❑ ❑ ❑ ❑ ❑ Totally incorrect

Following methods I liked the best (more than one answer is possible):

❑ Group discussion

because____

❑ Working in small groups

because____

❑ Individual work

because____

❑ Lecture

because____

❑ Others:

because____

1/2

What I found particularly interesting was:

____

____

____

The group discussion left me with following impressions:

____

____

____

I'd have liked to see more of:

____

____

____

The following could have been left out:

____

____

____

The following could be improved:

____

____

____

2/2

Annex VIII: Hypothesis 1

Gender

Descriptive statistics Gender		N	Mean	SD	Min	Max
Female	aCommu	14	0.84	0.46	0.28	1.83
	bCommu	14	0.72	0.47	0.16	1.61
Male	aCommu	28	0.93	0.52	0.12	2.48
	bCommu	28	0.78	0.43	0.16	2.20

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Gender (aCommu/ bCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.34	1.00	0.34	5.90	0.02
Time * Gen.	0.01	1.00	0.01	0.09	0.77
Error(time)	2.33	40.00	0.06		
Tests of Between-Subjects Effects					
Gender	0.11	1.00	0.11	0.29	0.59
Error	15.48	40.00	0.39		
Sphericity Assumed					

Table 82: Descriptive statistics and results of the ANOVA for the index "Communication" related to gender

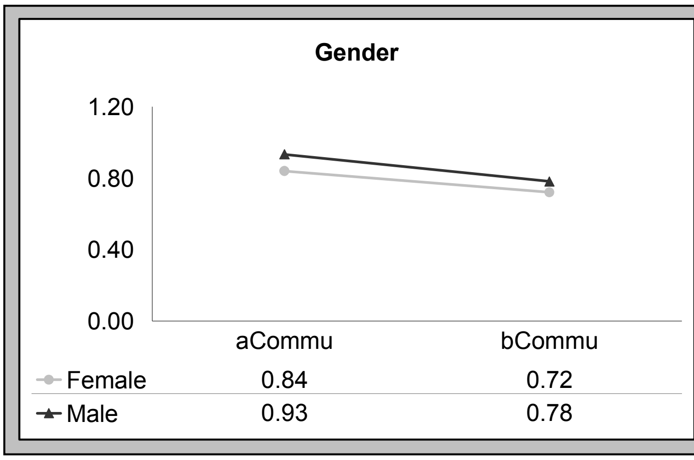


Figure 145: Changes of the communication behaviour over time depending on the gender

Age

Descriptive statistics Age		N	Mean	SD	Min	Max
18 - 20	aCommu	22	0.94	0.41	0.22	1.89
	bCommu	22	0.75	0.35	0.28	1.61
≥ 21	aCommu	20	0.87	0.59	0.12	2.48
	bCommu	20	0.78	0.52	0.16	2.20

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Age (aCommu/ bCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.40	1.00	0.40	7.07	0.01
Time * Age	0.05	1.00	0.05	0.84	0.37
Error(time)	2.29	40.00	0.06		
Tests of Between-Subjects Effects					
Age	0.01	1.00	0.01	0.03	0.87
Error	15.59	40.00	0.39		
Sphericity Assumed					

Table 83: Descriptive statistics and results of the ANOVA for the index "Communication" related to age

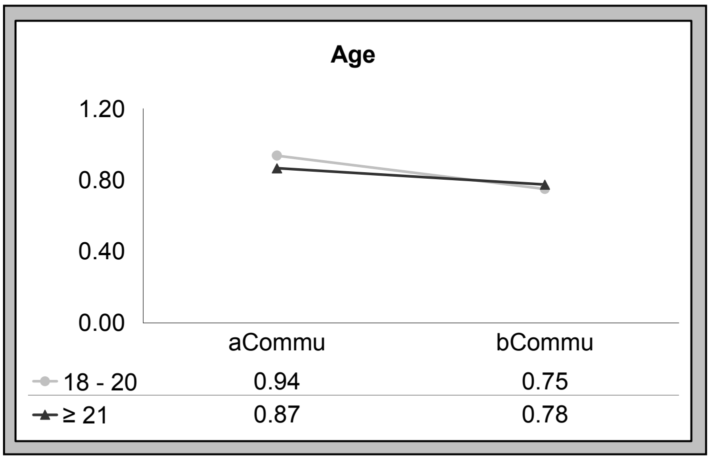


Figure 146: Changes of the communication behaviour over time depending on the age

Duration of ownership

Descriptive statistics Acquisition		N	Mean	SD	Min	Max
≤ 6 m	aCommu	9	0.75	0.32	0.22	1.11
	bCommu	9	0.57	0.28	0.16	1.00
> 6 m	aCommu	33	0.94	0.53	0.12	2.48
	bCommu	33	0.81	0.46	0.16	2.20

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Ac. (aCommu/ bCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.34	1.00	0.34	5.86	0.02
Time * Ac.	0.01	1.00	0.01	0.15	0.70
Error(time)	2.33	40.00	0.06		
Tests of Between-Subjects Effects					
Ac.	0.66	1.00	0.66	1.76	0.19
Error	14.94	40.00	0.37		
Sphericity Assumed					

Table 84: Descriptive statistics and results of the ANOVA for the index “Communication” related to time of acquisition

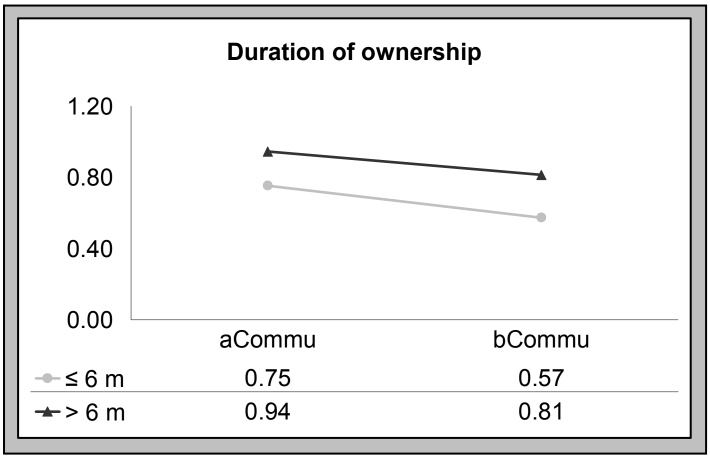


Figure 147: Changes of the communication behaviour over time depending on the duration of ownership

Driving experience

Descriptive statistics Experience		N	Mean	SD	Min	Max
≤ 10.000	aCommu	17	0.98	0.43	0.22	1.89
	bCommu	17	0.75	0.36	0.28	1.61
> 10.000	aCommu	23	0.90	0.54	0.12	2.48
	bCommu	23	0.79	0.50	0.16	2.20

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Exp. (aCommu/ bCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.52	1.00	0.52	9.22	0.00
Time * Exp.	0.07	1.00	0.07	1.19	0.28
Error(time)	2.14	38.00	0.06		
Tests of Between-Subjects Effects					
Exp.	0.01	1.00	0.01	0.02	0.88
Error	14.75	38.00	0.39		
Sphericity Assumed					

Table 85: Descriptive statistics and results of the ANOVA for the index “Communication” related to driving experience

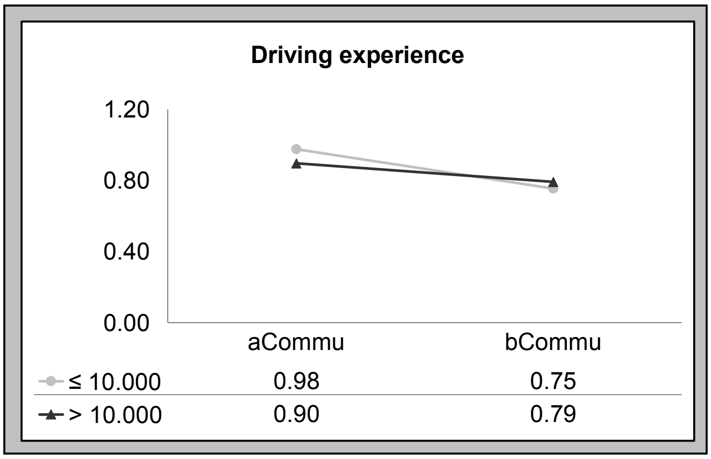


Figure 148: Changes of the communication behaviour over time depending on the driving experience

Nationality

Descriptive statistics Nationality		N	Mean	SD	Min	Max
AUT	aCommu	23	0.85	0.55	0.12	2.48
	bCommu	23	0.72	0.49	0.16	2.20
CZ	aCommu	19	0.96	0.43	0.22	1.89
	bCommu	19	0.81	0.38	0.28	1.61

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Nat. (aCommu/ bCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.42	1.00	0.42	7.20	0.01
Time * Nat.	0.00	1.00	0.00	0.04	0.85
Error(time)	2.33	40.00	0.06		
Tests of Between-Subjects Effects					
Nat.	0.22	1.00	0.22	0.57	0.45
Error	15.38	40.00	0.38		
Sphericity Assumed					

Table 86: Descriptive statistics and results of the ANOVA for the index “Communication” related to nationality

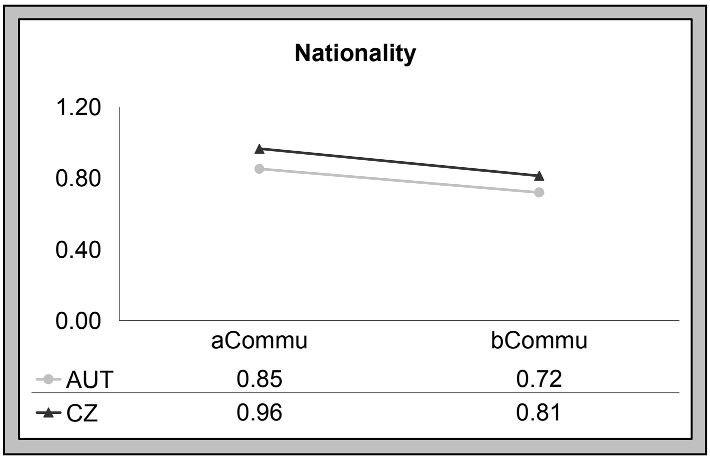


Figure 149: Changes of the communication behaviour over time depending on the nationality

Attitude towards ISA

Descriptive statistics Attitude towards ISA						
		N	Mean	SD	Min	Max
+	aCommu	14	0.96	0.60	0.12	1.89
	bCommu	14	0.80	0.52	0.16	1.61
~	aCommu	20	0.86	0.31	0.32	1.67
	bCommu	20	0.70	0.25	0.16	1.33
-	aCommu	5	0.75	0.39	0.22	1.17
	bCommu	5	0.74	0.39	0.39	1.17
One-Sample Kolmogorov-Smirnov Test is not significant						

Attitude (aCommu/ bCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.17	1.00	0.17	2.75	0.11
Time * Att.	0.05	2.00	0.03	0.43	0.65
Error(time)	2.24	36.00	0.06		
Tests of Between-Subjects Effects					
Attitude	0.20	2.00	0.10	0.36	0.70
Error	10.15	36.00	0.28		
Sphericity Assumed					

Table 87: Descriptive statistics and results of the ANOVA for the index “Communication” related to the attitude towards ISA (before testing the system)

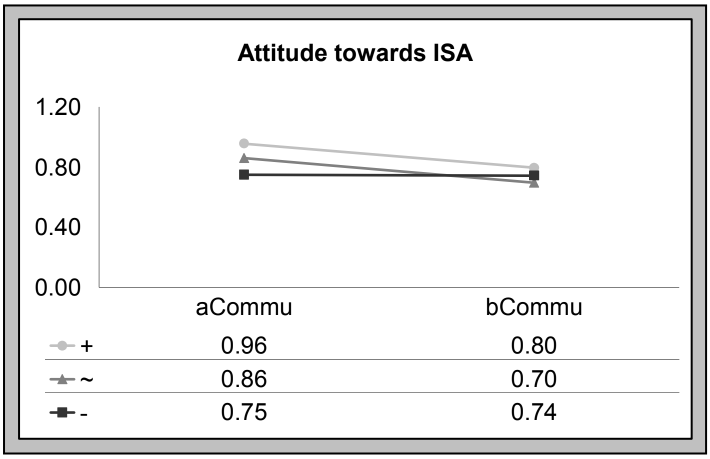


Figure 150: Changes of the communication behaviour over time depending on the attitude towards ISA (before testing the system)

"Type" questionnaire – Factor "Fun"

Descriptive statistics Factor "Fun"		N	Mean	SD	Min	Max
+	aCommu	14	1.07	0.49	0.33	2.48
	bCommu	14	0.94	0.44	0.48	2.20
~	aCommu	16	0.79	0.33	0.22	1.67
	bCommu	16	0.74	0.36	0.16	1.52
-	aCommu	12	0.86	0.65	0.12	1.89
	bCommu	12	0.58	0.47	0.16	1.61
One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant						

Fun (aCommu/ bCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.48	1.00	0.48	8.58	0.01
Time * Fun	0.17	2.00	0.09	1.53	0.23
Error(time)	2.17	39.00	0.06		
Tests of Between-Subjects Effects					
Fun	1.29	2.00	0.64	1.76	0.19
Error	14.31	39.00	0.37		
Sphericity Assumed					

Table 88: Descriptive statistics and results of the ANOVA for the index "Communication" related to the factor "Fun"

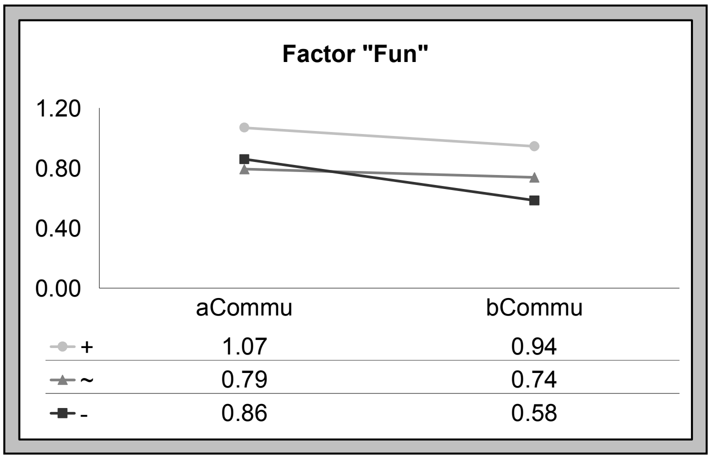


Figure 151: Changes of the communication behaviour over time depending on the attitude related to the factor "Fun"

"Type" questionnaire – Factor "Control"

Descriptive statistics Factor "Control"		N	Mean	SD	Min	Max
+	aCommu	13	1.02	0.54	0.36	2.48
	bCommu	13	0.91	0.52	0.16	2.20
~	aCommu	13	0.92	0.44	0.32	1.89
	bCommu	13	0.72	0.40	0.16	1.39
-	aCommu	15	0.83	0.51	0.12	1.88
	bCommu	15	0.71	0.38	0.16	1.61
One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant						

Control (aCommu/ bCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.42	1.00	0.42	6.84	0.01
Time * Con.	0.03	2.00	0.01	0.21	0.81
Error(time)	2.31	38.00	0.06		
Tests of Between-Subjects Effects					
Control	0.56	2.00	0.28	0.75	0.48
Error	14.27	38.00	0.38		
Sphericity Assumed					

Table 89: Descriptive statistics and results of the ANOVA for the index "Communication" related to the factor "Control"

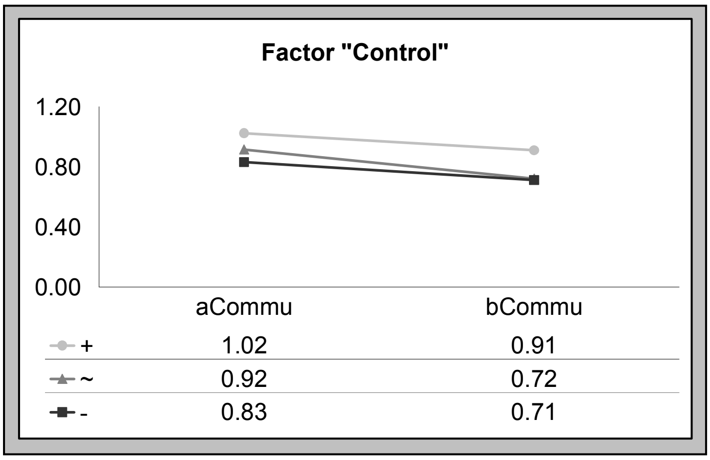


Figure 152: Changes of the communication behaviour over time depending on the attitude related to the factor “Control”

“Type” questionnaire – Factor “Aggression”

Descriptive statistics Factor "Aggression"						
		N	Mean	SD	Min	Max
+	aCommu	17	1.00	0.44	0.36	1.89
	bCommu	17	0.77	0.32	0.16	1.39
~	aCommu	15	0.74	0.31	0.22	1.67
	bCommu	15	0.70	0.35	0.28	1.52
-	aCommu	10	0.98	0.75	0.12	2.48
	bCommu	10	0.83	0.70	0.16	2.20
One-Sample Kolmogorov-Smirnov Test is not significant						

Agg. (aCommu/ bCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.38	1.00	0.38	6.86	0.01
Time * Agg.	0.16	2.00	0.08	1.41	0.26
Error(time)	2.18	39.00	0.06		
Tests of Between-Subjects Effects					
Aggression	0.59	2.00	0.29	0.76	0.47
Error	15.01	39.00	0.38		
Sphericity Assumed					

Table 90: Descriptive statistics and results of the ANOVA for the index “Communication” related to the factor “Aggression”

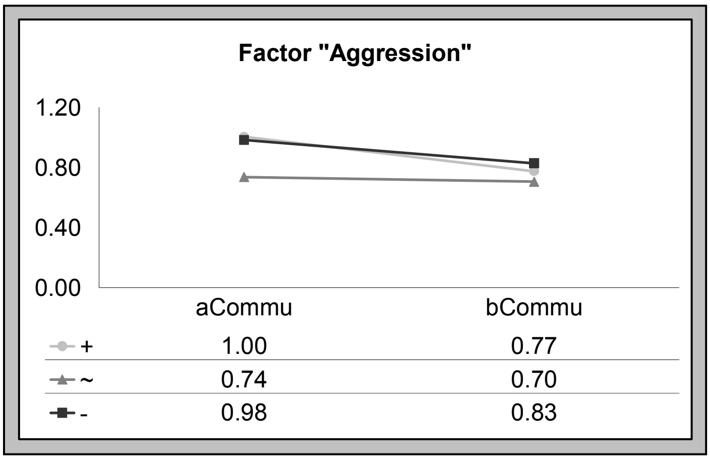


Figure 153: Changes of the communication behaviour over time depending on the attitude related to the factor “Aggression”

Annex IX: Hypothesis 2

Gender

Descriptive statistics Gender		N	Mean	SD	Min	Max
Female	aCommu	19	0.74	0.44	0.16	1.83
	dCommu	19	0.72	0.49	0.00	1.92
Male	aCommu	33	0.84	0.45	0.12	1.89
	dCommu	33	0.84	0.60	0.24	2.78

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Gender (aCommu/ dCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.00	1.00	0.00	0.02	0.88
Time * Gen.	0.00	1.00	0.00	0.02	0.89
Error(time)	8.03	50.00	0.16		
Tests of Between-Subjects Effects					
Gender	0.28	1.00	0.28	0.80	0.38
Error	17.78	50.00	0.36		
Sphericity Assumed					

Table 91: Descriptive statistics and results of the ANOVA for the index “Communication” related to gender

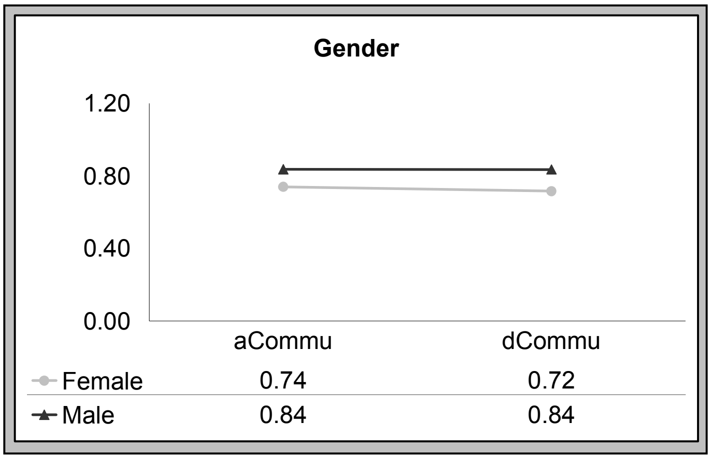


Figure 154: Changes of the communication behaviour over time depending on the gender

Age

Descriptive statistics Age		N	Mean	SD	Min	Max
18 - 20	aCommu	28	0.88	0.45	0.16	1.89
	dCommu	28	0.92	0.63	0.28	2.78
≥ 21	aCommu	24	0.71	0.43	0.12	1.88
	dCommu	24	0.65	0.44	0.00	1.92

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Age (aCommu/ dCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.00	1.00	0.00	0.03	0.86
Time * Age	0.07	1.00	0.07	0.46	0.50
Error(time)	7.96	50.00	0.16		
Tests of Between-Subjects Effects					
Age	1.24	1.00	1.24	3.68	0.06
Error	16.82	50.00	0.34		
Sphericity Assumed					

Table 92: Descriptive statistics and results of the ANOVA for the index “Communication” related to age

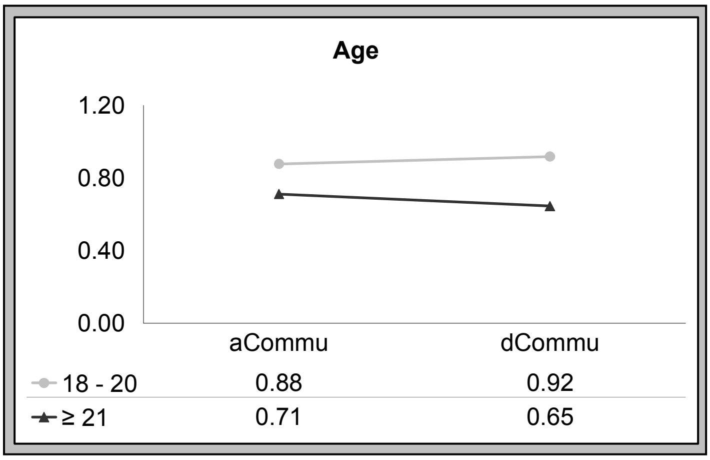


Figure 155: Changes of the communication behaviour over time depending on the age

Duration of ownership

Descriptive statistics Acquisition		N	Mean	SD	Min	Max
≤ 6 m	aCommu	11	0.76	0.29	0.22	1.11
	dCommu	11	0.69	0.24	0.33	1.00
> 6 m	aCommu	41	0.81	0.48	0.12	1.89
	dCommu	41	0.82	0.62	0.00	2.78

One-Sample Kolmogorov-Smirnov Test is not significant

Ac. (aCommu/ dCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.02	1.00	0.02	0.10	0.75
Time * Ac.	0.02	1.00	0.02	0.15	0.70
Error(time)	8.01	50.00	0.16		
Tests of Between-Subjects Effects					
Ac.	0.15	1.00	0.15	0.41	0.53
Error	17.92	50.00	0.36		
Sphericity Assumed					

Table 93: Descriptive statistics and results of the ANOVA for the index “Communication” related to time of acquisition

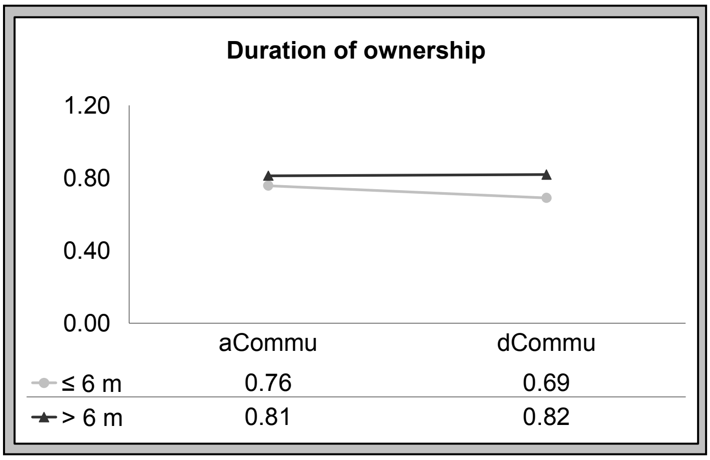


Figure 156: Changes of the communication behaviour over time depending on the duration of ownership of the licence

Driving experience

Descriptive statistics Experience		N	Mean	SD	Min	Max
≤ 10.000	aCommu	26	0.81	0.49	0.16	1.89
	dCommu	26	0.82	0.60	0.33	2.78
> 10.000	aCommu	25	0.81	0.40	0.12	1.88
	dCommu	25	0.76	0.54	0.00	1.94

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Exp. (aCommu/ dCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.00	1.00	0.00	0.03	0.87
Time * Exp.	0.02	1.00	0.02	0.15	0.70
Error(time)	8.00	49.00	0.16		
Tests of Between-Subjects Effects					
Exp.	0.02	1.00	0.02	0.05	0.82
Error	17.93	49.00	0.37		
Sphericity Assumed					

Table 94: Descriptive statistics and results of the ANOVA for the index “Communication” related to driving experience

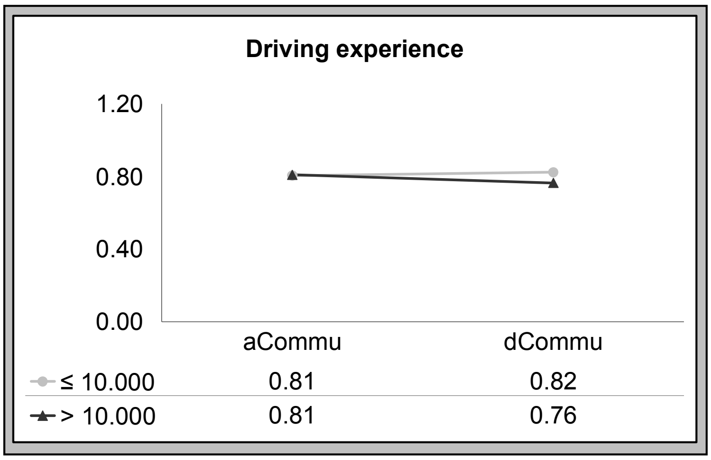


Figure 157: Changes of the communication behaviour over time depending on the driving experience

Nationality

Descriptive statistics Nationality		N	Mean	SD	Min	Max
AUT	aCommu	29	0.69	0.40	0.12	1.88
	dCommu	29	0.66	0.44	0.00	1.92
CZ	aCommu	23	0.94	0.46	0.22	1.89
	dCommu	23	0.96	0.66	0.28	2.78

One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant

Nat. (aCommu/ dCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.00	1.00	0.00	0.01	0.94
Time * Nat.	0.02	1.00	0.02	0.14	0.71
Error(time)	8.01	50.00	0.16		
Tests of Between-Subjects Effects					
Nat.	1.99	1.00	1.99	6.19	0.02
Error	16.07	50.00	0.32		
Sphericity Assumed					

Table 95: Descriptive statistics and results of the ANOVA for the index “Communication” related to nationality

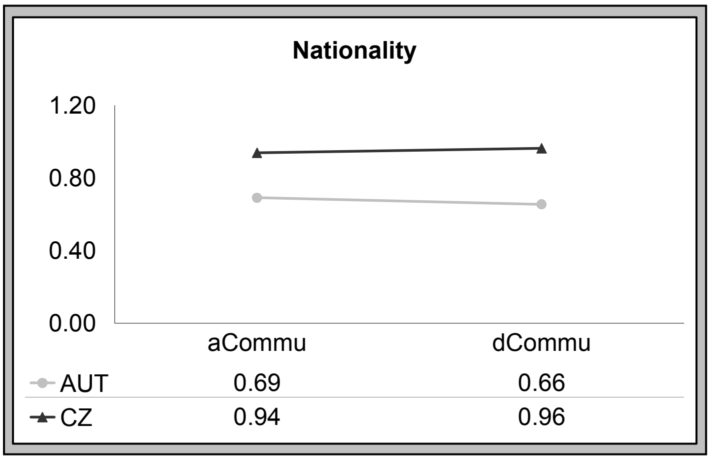


Figure 158: Changes of the communication behaviour over time depending on the nationality

"Type" questionnaire – Factor "Risk"

Descriptive statistics Factor "Risk"		N	Mean	SD	Min	Max
+	aCommu	16	0.89	0.46	0.22	1.889
	dCommu	16	1.09	0.75	0.28	2.78
~	aCommu	12	0.89	0.51	0.36	1.83
	dCommu	12	0.65	0.55	0.00	1.92
-	aCommu	21	0.73	0.38	0.12	1.88
	dCommu	21	0.67	0.32	0.28	1.48
One-Sample Kolmogorov-Smirnov Test is not significant						

Risk (aCommu/ dCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.03	1.00	0.03	0.17	0.68
Time * Risk	0.73	2.00	0.36	2.42	0.10
Error(time)	6.93	46.00	0.15		
Tests of Between-Subjects Effects					
Risk	1.60	2.00	0.80	2.32	0.11
Error	15.84	46.00	0.34		
Sphericity Assumed					

Table 96: Descriptive statistics and results of the ANOVA for the index "Communication" related to the factor "Risk"

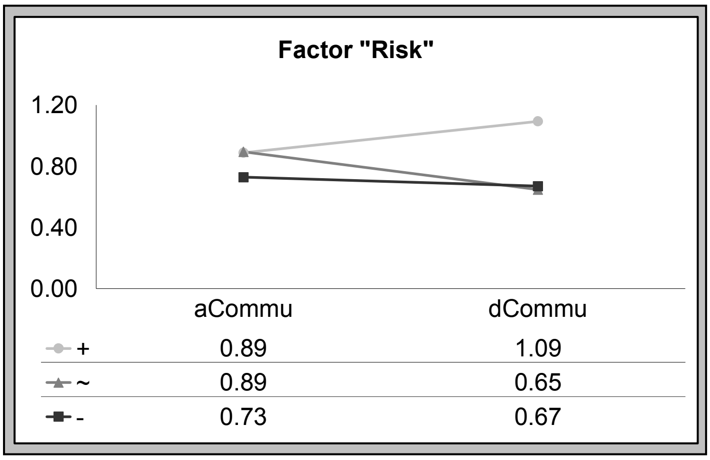


Figure 159: Changes of the communication behaviour over time depending on the attitude related to the factor "Risk"

"Type" questionnaire – Factor "Fun"

Descriptive statistics Factor "Fun"						
		N	Mean	SD	Min	Max
+	aCommu	15	0.86	0.37	0.33	1.44
	dCommu	15	0.98	0.73	0.28	2.78
~	aCommu	21	0.78	0.35	0.22	1.67
	dCommu	21	0.67	0.37	0.00	1.60
-	aCommu	13	0.84	0.64	0.12	1.89
	dCommu	13	0.81	0.63	0.28	2.44
One-Sample Kolmogorov-Smirnov Test is not significant						

Fun (aCommu/ dCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.00	1.00	0.00	0.01	0.93
Time * Fun	0.23	2.00	0.11	0.71	0.50
Error(time)	7.43	46.00	0.16		
Tests of Between-Subjects Effects					
Fun	0.62	2.00	0.31	0.85	0.43
Error	16.82	46.00	0.37		
Sphericity Assumed					

Table 97: Descriptive statistics and results of the ANOVA for the index "Communication" related to the factor "Fun"

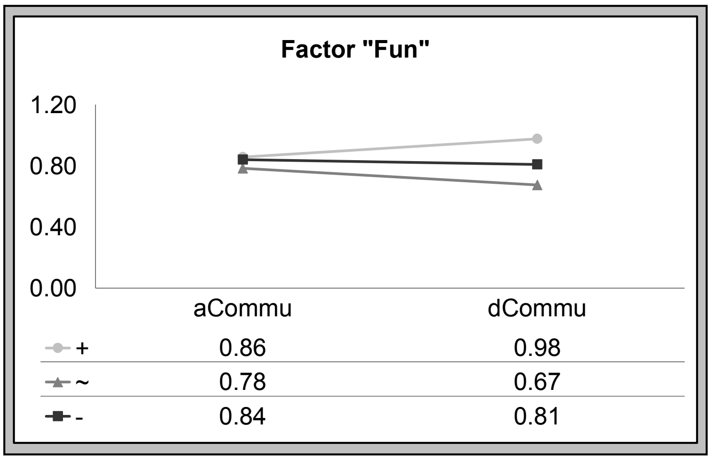


Figure 160: Changes of the communication behaviour over time depending on the attitude related to the factor "Fun"

"Type" questionnaire – Factor "Control"

Descriptive statistics Factor "Control"						
		N	Mean	SD	Min	Max
+	aCommu	13	0.82	0.35	0.33	1.44
	dCommu	13	0.92	0.55	0.00	1.94
~	aCommu	18	0.86	0.46	0.32	1.89
	dCommu	18	0.80	0.72	0.24	2.78
-	aCommu	18	0.78	0.49	0.12	1.88
	dCommu	18	0.73	0.42	0.28	1.92
One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant						

Control (aCommu/ dCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.00	1.00	0.00	0.01	0.92
Time * Con.	0.12	2.00	0.06	0.37	0.69
Error(time)	7.54	46.00	0.16		
Tests of Between-Subjects Effects					
Control	0.21	2.00	0.10	0.28	0.76
Error	17.23	46.00	0.37		
Sphericity Assumed					

Table 98: Descriptive statistics and results of the ANOVA for the index "Communication" related to the factor "Control"

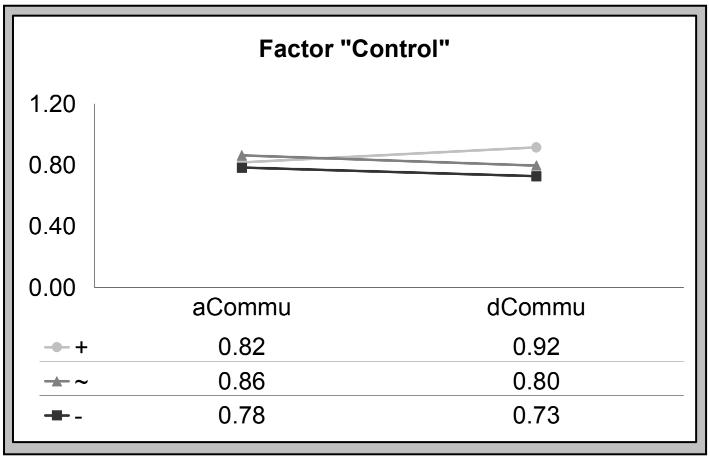


Figure 161: Changes of the communication behaviour over time depending on the attitude related to the factor “Control”

“Type” questionnaire – Factor “Anxiety”

Descriptive statistics Factor "Anxiety"		N	Mean	SD	Min	Max
+	aCommu	22	0.96	0.49	0.33	1.889
	dCommu	22	0.81	0.65	0.28	2.78
~	aCommu	9	0.49	0.33	0.12	1.00
	dCommu	9	0.72	0.49	0.00	1.48
-	aCommu	18	0.82	0.35	0.32	1.44
	dCommu	18	0.84	0.54	0.24	1.94
One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant						

Anxiety (aCommu/ dCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.02	1.00	0.02	0.15	0.70
Time * Anx.	0.49	2.00	0.24	1.56	0.22
Error(time)	7.18	46.00	0.16		
Tests of Between-Subjects Effects					
Anxiety	1.00	2.00	0.50	1.40	0.26
Error	16.44	46.00	0.36		
Sphericity Assumed					

Table 99: Descriptive statistics and results of the ANOVA for the index “Communication” related to the factor “Anxiety”

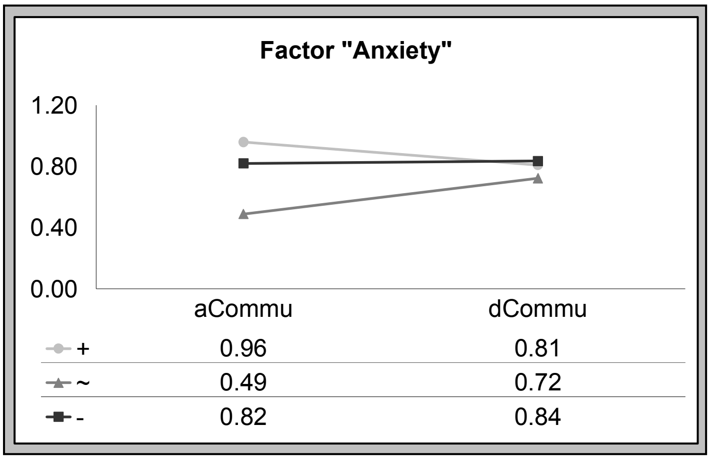


Figure 162: Changes of the communication behaviour over time depending on the attitude related to the factor “Anxiety”

"Type" questionnaire – Factor "Aggression"

Descriptive statistics Factor "Aggression"		N	Mean	SD	Min	Max
+	aCommu	18	0.97	0.45	0.36	1.889
	dCommu	18	0.99	0.77	0.00	2.78
~	aCommu	20	0.72	0.35	0.22	1.67
	dCommu	20	0.57	0.27	0.24	1.33
-	aCommu	11	0.77	0.54	0.12	1.83
	dCommu	11	0.92	0.51	0.28	1.94
One-Sample Kolmogorov-Smirnov Test is not significant						

Agg. (aCommu/ dCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.00	1.00	0.00	0.01	0.94
Time * Agg.	0.32	2.00	0.16	0.99	0.38
Error(time)	7.35	46.00	0.16		
Tests of Between-Subjects Effects					
Aggression	2.10	2.00	1.05	3.15	0.05
Error	15.34	46.00	0.33		
Sphericity Assumed					

Table 100: Descriptive statistics and results of the ANOVA for the index "Communication" related to the factor "Aggression"

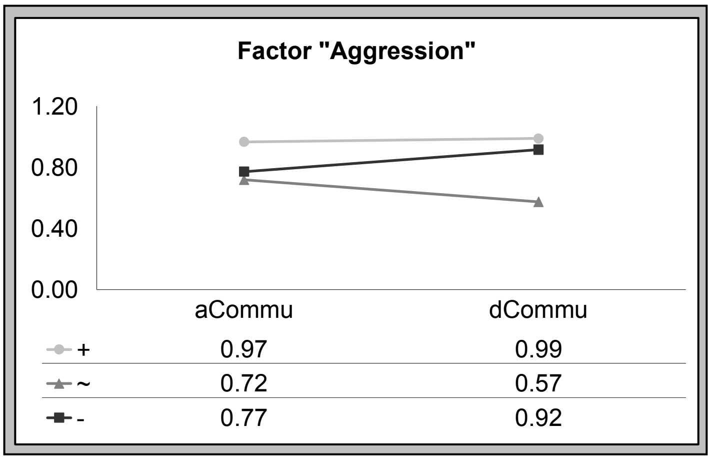


Figure 163: Changes of the communication behaviour over time depending on the attitude related to the factor aggression

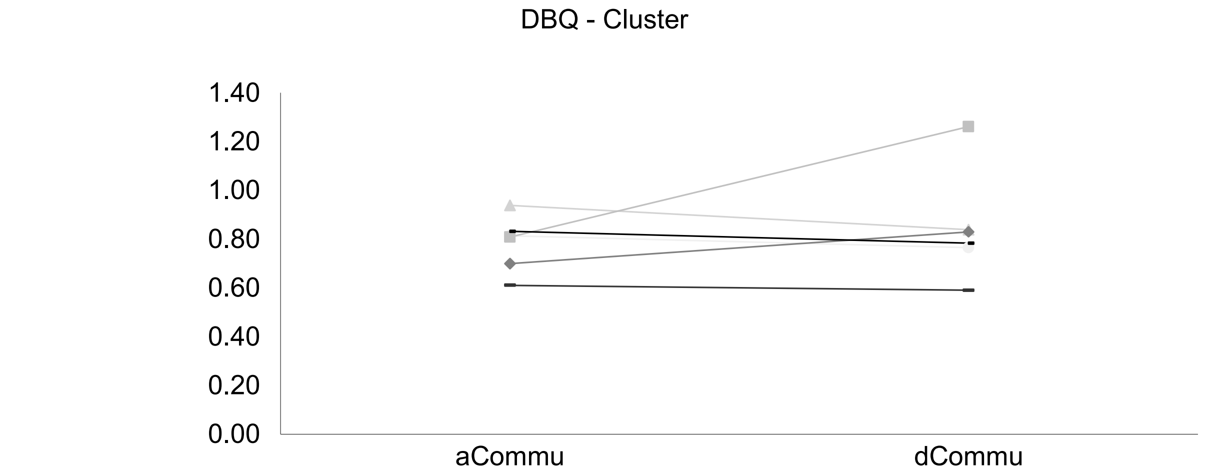
DBQ questionnaire – Cluster

Descriptive statistics Cluster		N	Mean	SD	Min	Max
Clumsy clot	aCommu	11	0.81	0.51	0.12	1.83
	dCommu	11	0.77	0.37	0.28	1.33
Rule braker	aCommu	11	0.94	0.56	0.40	1.89
	dCommu	11	0.84	0.61	0.36	2.44
Aggr. rowdy	aCommu	5	0.81	0.22	0.56	1.17
	dCommu	5	1.26	1.02	0.32	2.78
Clumsy rowdy	aCommu	4	0.70	0.15	0.56	0.88
	dCommu	4	0.83	0.73	0.44	1.92
Angry driver	aCommu	7	0.61	0.45	0.22	1.36
	dCommu	7	0.59	0.41	0.00	1.00
Ideal driver	aCommu	9	0.83	0.45	0.32	1.67
	dCommu	9	0.78	0.56	0.28	1.94
One-Sample Kolmogorov-Smirnov Test and Levene's Test of Equality of Error Variances are not significant						

Cluster (aCommu/ dCommu)	Type III Sum of Squares	df	Mean Square	F	Sig.
Tests of Within-Subjects Effects					
Time	0.08	1.00	0.08	0.44	0.51
Time * Cl.	0.62	5.00	0.12	0.72	0.61
Error(time)	7.07	41.00	0.17		
Tests of Between-Subjects Effects					
Cluster	1.28	5.00	0.26	0.65	0.66
Error	16.07	41.00	0.39		

Sphericity Assumed

Table 101: Descriptive statistics and results of the ANOVA for the index “Communication” related to cluster



	aCommu	dCommu
Clumsy clot	0.81	0.77
Rule braker	0.94	0.84
Aggressive rowdy	0.81	1.26
Clumsy rowdy	0.70	0.83
Angry driver	0.61	0.59
Ideal driver	0.83	0.78

Figure 164: Changes of the communication behaviour over time depending on the attitude related to the cluster belonging

Lebenslauf

Mag.ª Christine Turetschek

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Ausbildung und beruflicher Werdegang

03/04/01 bis dato	FACTUM OHG, Verkehrs- und Sozialanalysen (www.factum.at)
04/10/01 bis dato	Doktoratsstudium – Soziologie (Universität Wien)
03/10/29 – 05/05/18	Ausbildung zur Verkehrspsychologin (INFAR)
03/10/29 – 05/05/18	Ausbildung zur Nachschulungstrainerin (INFAR)
95/10/01 – 03/10/29	Magisterstudium – Psychologie (Universität Wien)
91/09/-- – 95/05/31	Bundesoberstufenrealgymnasium Mistelbach