

ABSTRACT

This handbook is a compressed version of the Slovak monograph Road Transport Psychology (Kucek, 2023). The author presents road transport psychology as a complex system with its multiple internal connections and links to external systems. He derives its structure from the original model of the road transport system. The Handbook presents important insights that the psychological discipline has arrived at, but unlike a monograph, it does not devote attention to a more detailed description and explanation of the information processes underlying driving, and it does not provide references to research, commentary, or polemical opinions. This is of course to the detriment of an understanding and more thorough acquisition of knowledge, but on the other hand it facilitates a mapping view of the psychology of road traffic.

Keywords: psychology - road transport - risk – traffic safety - road user psychology - clinical transport psychology

Peter Kucek

BRIEF ROAD TRANSPORT PSYCHOLOGY



NOVIDEA, s. r. o.

Peter Kucek

**BRIEF ROAD TRANSPORT
PSYCHOLOGY**

© Peter Kucek, 2025

Autor:
PhDr. Peter Kucek
© Peter Kucek

Translation from the Slovak original - Peter Kucek: Stručná psychológia cestnej dopravy, Novidea, 2025.

The English translation of the work is published in electronic form by Novidea s. r. o.
Copyright © **NOVIDEA s. r. o.**

All rights reserved. No part of this monograph may be reproduced without the prior consent and written permission of the copyright owner.

NOTICE

The english translation of Brief Road Transport Psychology from the Slovak original is not a professional translation and the text has not been subjected to qualified language checking and editing.

CONTENTS

PREVIEW.....	9
I. MODEL OF THE ROAD TRANSPORT.....	11
II. THE SUBJECT OF TRAFFIC PSYCHOLOGY.....	13
III. METHODOLOGICAL PLATFORM.....	14
3.1. Theory.....	14
3.2. System.....	14
System dynamics.....	15
System approach.....	17
IV. ROAD TRAFFIC CULTURE.....	19
4.1. Definition of culture.....	19
4.2. Structure of road transport culture.....	19
4.3. Models of culture.....	21
V. HUMAN-AUTOMOBILE SYSTEM COMPLEX.....	23
5.1. Driver and automated vehicle.....	24
VI. ROAD TRAFFIC ACCIDENTS.....	27
VII. RISK IN ROAD TRANSPORT.....	28
7.1. Definition of risk.....	28
7.2. Perception of risk.....	29
7.3. Concepts of risk in road transport.....	29
Social and cultural theories of risk.....	29
Risk as feelings and emotions.....	30
Psychometric risk model.....	31
A model of rational approach to risk-taking.....	31
Motivational models of risk.....	32
Economic model of risk and risk compensation.....	32
Risk in road transport from a system theory perspective.....	33
7.4. Marginals of risk.....	33
7.5. Safety concept and resilience engineering.....	34
VIII. DRIVER PERFORMANCE AND EFFICIENCY.....	36
8.1. Errors.....	37
Detection and probability of errors.....	37
Error management and a systems approach to safety.....	38
IX. THE PSYCHOLOGICAL ESSENCES OF DRIVING.....	39
9.1. Information processes.....	39
9.2. Perception.....	41
Visual perception.....	41
Perception of pace.....	43
Motion and speed perception.....	44
Cornering and overtaking.....	45

Visual occlusions.....	46
Other sensory modalities.....	47
Ego-relational framework of perception.....	48
9.3. Reaction time.....	48
Perception of time to contact.....	49
9.4. Memory and learning.....	50
9.5. Thinking, intelligence, wisdom.....	52
9.6. Attention.....	53
9.7. Situational awareness.....	53
9.8. Emotions.....	54
Anxiety, apprehensions and fear.....	55
Anger and rage.....	55
Guilt and shame.....	56
Pleasure, joy and happiness.....	56
9.9. Motivation.....	56
9.10. Decision-making.....	58
9.11. Set, mental setting and style.....	58
 X. PERSONALITY.....	 60
10.1. Personality structure.....	60
10.2. Personality typology.....	61
 XI. KEY PERSONALITY FACTORS AND PSYCHOLOGICAL STATES ASSOCIATED WITH RISKY DRIVING AND ACCIDENTS.....	 64
11.1. Susceptibility to accidents.....	64
11.2. Skills and abilities.....	65
11.3. Attitudes.....	65
Changing attitudes.....	67
11.4. Values.....	68
11.5. Exhaustion.....	69
Sleepiness.....	69
Fatigue.....	69
Monotony.....	70
Resistance to fatigue.....	70
11.6. Load and stress.....	71
Multitasking and secondary workload.....	72
11.7. Sensation seeking.....	73
11.8. Aggression.....	74
Provocation and inhibition of driver aggression.....	75
Aggressive behavior in the context of personality, age and sex.....	75
Social and cultural determinants of aggression.....	76
Psychological assessment of aggression and aggressiveness.....	76
11.9. Locus of control.....	77
11.10. A type behaviour.....	77
11.11. Sex and gender.....	78
Gender differences in risky traffic behaviour and accident rates.....	78
11.12. Age.....	79
Young drivers.....	79
Risky driving and road accidents among young drivers.....	80
Peer influence on adolescent driving.....	80

Senior drivers.....	81
Risky driving and accident rates among seniors.....	81
Self-assessment and self-regulation of older drivers.....	82
XII. DRIVING UNDER THE INFLUENCE OF ALCOHOL AND OTHER PSYCHOTROPIC SUBSTANCES.....	83
12.1. Alcohol.....	83
Alcohol and driver performance.....	85
Driver attitudes towards drink driving.....	85
Measures against drink driving.....	86
12.2. Cannabinoid substances.....	86
Effect of cannabis on driving.....	87
12.3. Opiates.....	88
12.4. Non-medical stimulant drugs.....	88
Cocaine.....	88
Methamphetamine drugs.....	89
12.5. Psychedelics.....	90
12.6. Medical drugs.....	90
Amphetamines.....	91
Tranquilizers and hypnotics.....	91
Antidepressants.....	91
XIII. THE MOST VULNERABLE ROAD TRANSPORT USERS.....	92
13.1. Pedestrians.....	92
13.2. Cyclists.....	94
13.3. Motorcyclists.....	95
XIV. DRIVING MODELS.....	97
XV. PROFESSIOGRAPHIC ANALYSIS OF THE DRIVER'S ACTIVITY.....	109
15.1. Professiographic method.....	109
15.2. Job analysis.....	109
15.3. Psychological profессиography drivers.....	110
15.4. Competence-based approach in profессиography.....	110
XVI. ASSESSING THE MENTAL CAPABILITY OF DRIVERS.....	112
16.1. Psychodiagnostics.....	112
16.2. Psychodiagnostic approach	114
16.3. Basic determinants of psychodiagnostics.....	114
Diagnosed person.....	115
Psychodiagnostic.....	115
Psychodiagnostic methods.....	116
16.4. Mental capability of the driver.....	117
XVII. EDUCATION AND RE-EDUCATION OF DRIVERS.....	119
17.1. Driver behaviour change programmes.....	120
17.2. Types of behavioural modification courses.....	121
17.3. Theoretical conceptions of behaviour change.....	121
17.4. Metodology, organisation and professional management of BMC.....	124

XVIII. CLINICAL TRAFFIC PSYCHOLOGY - special section.....	126
18.1. Dementia.....	126
18.2. Vascular and traumatic stroke.....	127
18.3. Epilepsy.....	127
18.4. ADHD.....	128
18.5. Pervasive developmental disorders.....	129
18.6. Anxiety disorders and pathological mood.....	129
18.7. Post-traumatic stress disorder.....	130
18.8. Personality disorders.....	131
18.9. Addictions.....	131
18.10. Schizophrenia.....	132
18.11. Diabetes, hepatopathy and cardiovascular disease.....	133
18.12. Movement disability due to traumatic injury spinal cord and limb amputations.....	133
18.13. Kinetosis and simulator sickness.....	134
18.14. Visual disturbances.....	134
18.15. Sleep and wakefulness disorders.....	135
18.16. Painful disorders and conditions.....	135
18.17. Obesity.....	136
XIX. FORENSIC TRANSPORT PSYCHOLOGY.....	138
Expert traffic psychological examination.....	138
LITERATURE.....	140

PREVIEW

This handbook is a compressed version of the Slovak monograph *The Road Transport Psychology* (Kucek, 2023).^{*} The size of the monograph is reduced to about one-fifth in this handbook.

The author presents road transport psychology as a complex system with its multiple internal connections and links to external systems. He derives its structure from an original model of the road transport system. The handbook presents important insights that the psychological discipline has arrived at, but unlike a monograph, it does not devote attention to a detailed description and explanation of the information processes underlying driving, and it does not provide references to research, commentary, or polemical opinions. This is of course to the detriment of an understanding and more thorough acquisition of knowledge, but on the other hand it makes easier a mapping view of the psychology of road traffic. The study of the handbook presupposes at least a basic knowledge of general psychology.

The concise handbook is suitable for those who want to get a comprehensive notion of what road transport psychology covers and what problems it solves.

^{*} If you would like to receive the English full-text electronic version of this monograph free of charge, please let us know your e-mail address to which we can send it to you. Please send your request to our email address <novidea@novidea.sk>

I. MODEL OF THE ROAD TRANSPORT SYSTEM

The real road transport system is so complicated that we need to simplify it in order to understand it. We replace it with another, more comprehensible representation, a model that is its analogy. It is not possible to create a complete comprehensive model of road transport, only an approximate one, whose components and the relationships between them are vague, so that it conveys only a rough picture of reality. Traditionally, the model of the road transport system Driver-Vehicle-Environment (DVE) has been applied in traffic psychology theory (Figure 1.1).

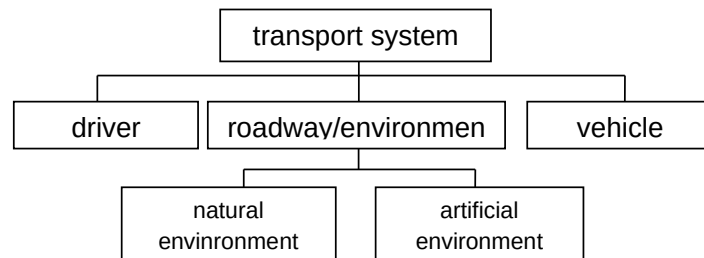


Figure 1.1 Schematic of the DVE transport system - driver, vehicle and environment

The concept of roadway is too specific and the concept of environment too general to express the complexity of the man-made and natural environment. The DVE model does not sufficiently differentiate between natural and artificial environments and does not define the category of road users, who are part of nature as animals but also part of the social system. These shortcomings are overcome by **the HoNaC model** (Figure 1.2).

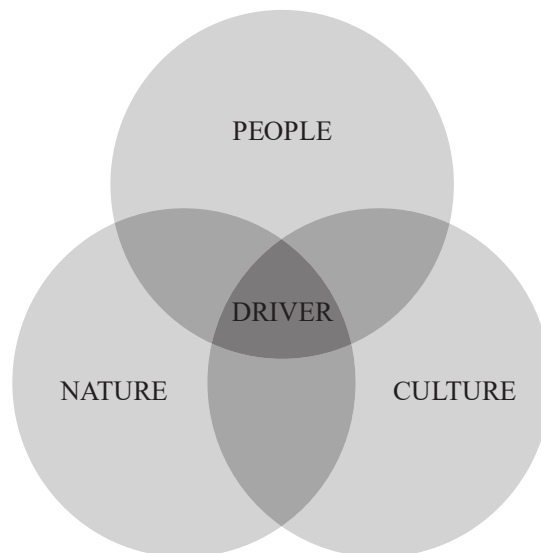


Figure 1.2 Homini-natura-cultura model of the road transport system.

The transport system is a complex of closed (artificial, technical) and open (human, nature, society, culture) subsystems that form an internally and externally interactive and integrated whole. Internally, it is divided into three cardinal systems: 1. *people*, (Latin

'homines') i.e. drivers and road users, 2. the natural environment (*natura*) and 3. the artificial and cultural environment (*cultura*).

The natural environment is everything that creates the natural conditions for the existence of organisms, including humans. It includes living components, organisms (biosphere) and non-living components, air (atmosphere), water (hydrosphere), soil (pedosphere) and rocks (lithosphere). Nature is matter, energy, and phenomena that have not been created by intentional human activity. What man has created is an artificial environment. His creations are both material and immaterial, and their existence is governed by different principles than nature, but they are intricately interconnected. This non-natural complex can be referred to by the collective term *culture*. It is an environment that exists only because man exists. Its immanent part is the social world and the vast complex of man's technical creations, whether they are cars or road buildings and associated technical equipment. The automobile is a product of man and has become an important part of culture. It is in the closest connection to man, the driver, and together they form the systemic complex traditionally referred to as man-machine.

Humans belong inseparably to both the natural and cultural environment, forming an environment together. In this environment, people carry out a range of activities within a set of rules, norms, patterns of behaviour and values. The driver occupies a specific position in the HoNaC model, defining himself among other people in the transport system by his mission and tasks. He or she has a central regulatory position in the traffic system, but it can equally be occupied by a pedestrian or a cyclist. It depends from which homocentric perspective this system is considered.

An essential characteristic of a transport system is that the disruption or failure of any of its elements has consequences for the whole system. Most of the threatening changes take place in an obvious way (increasing traffic density, worsening weather, road wear and tear), while some changes take place in a more subtle or even larval way (permeability of some information channels, weakening or shifting of the democratic behaviour of road users). Humans are the main source of unforeseen variations and disruptions to the smooth functioning of the system. Both man and the weather are difficult to predict and can surprise us, but the weather, unlike man, does not make mistakes. And it is it, as the most error-prone subsystem, that occupies a control position over the whole system.

The HoNaC model of the transport system allows us to deal with subsystem interactions in a more comprehensive way and thus to address issues that we would have difficulty exploring and explaining in the terms of a standard DVE model, such as civilisation-driven changes in people's attitudes to road transport, changes in driving induced by automation, or different levels and patterns of transport risk-taking in different communities.

II. THE SUBJECT OF TRAFFIC PSYCHOLOGY

The object of interest of traffic psychology, as of all other psychological disciplines, is the human psyche, in this case with a focus on its functioning in the conditions of the road traffic system. Road transport psychology is an applied psychological discipline, its mission is to solve practical problems and tasks.

Man in the transport system is an active element, and the study of his activity is essential for an objective knowledge of all the psychic phenomena that are exercised in this system, whether they are operator or control activities, object-oriented or interaction-oriented activities, non-verbal or verbal, activities manifested in his external behaviour or taking place within him. Every driver, when he drives, is doing a job. The driver's work is realised in the intrapsychic power space, where the dispositional and actual potential of his abilities and skills, emotions and motives is exercised, as well as in extrapsychic contexts, induced by contact with the material road environment and with road users.

Man in the transport system realizes his intentions and activities in conditions of different states of the external and his internal environment. Therefore, the interest of traffic psychology is attracted by the problems of activation, vigilance, focus, emotional state, psychological tension, information, time and other stress, fatigue, as well as the state of health of drivers. As it also deals with the disturbed and diseased psychological states of the human agent in transport, it uses the knowledge of medicine and clinical psychology. Since road transport safety is related to the material and technical conditions in which transport activities are carried out, road traffic engineering psychology, which studies the psychological aspects of road and car design, traffic processes and road traffic management, also has an important place. The knowledge of traffic psychology is applied in the design of technical equipment and structures, working conditions and working methods in order to achieve their optimum level with regard to the psychological capacity of road transport participants.

A key topic addressed in traffic psychology is *safety*. The reliability of the transport system will never be absolute. There will always be faults and malfunctions that compromise its functioning. We have made great progress in the technical reliability of vehicles and roads, but little progress in the reliability of road users. Contributing to the solution of this problem is the mission and challenge of traffic psychology.

The reliability of a person in the transport system is determined by his disposition and acquired psychosomatic equipment and current state, which are reflected in many ways in his experience, behaviour and work performance depending on the external material and non-material conditions, structure and organisation of the environment in which he operates. In this respect, two important, closely interrelated *tasks of traffic psychology* come to the fore : *the psychological analysis of driver performance, with a focus on identifying the causes and eliminating accidents, and learning about and influencing drivers' fitness to drive effectively and to function safely in the road traffic environment.*

III. METHODOLOGICAL PLATFORM

3.1. Theory

To solve certain problems, we choose the appropriate methods. However, even the best method will do us no good if we have defined the problem incorrectly. The advantage of cognition is that we are not starting from scratch. We build on complexes of known knowledge, on what can be regarded as true and correct. We have experience and theory at our disposal.

Knowledge is constantly growing and to keep track of it, we need to keep it organized. Based on their similarities, we sort them into groups, classify and categorise them. If we have established categories (e.g. diagnoses, mental processes, personality types, intelligence tests), we can classify the observed or considered object into the appropriate set, to frame it. The classifications are the basis for the formation of theories. *Theories are hypotheses about what is true*, considerations that are yet to be proved. **Definitions** are derived from theories. *A definition is a theory in an abbreviation*. An incorrect definition of something is a projection of an incorrect theory or a misunderstanding of it.

The function of theory is not only to explain what is, but also to predict the future and generate new insights into the problem. No existing conception contains all the necessary information, and each new theory contributes to filling such gaps. If something is a theory, it is never completely proven, nor is it completely true. A theory as a hypothesis, therefore, is not definitive, and may change if we arrive at something more true. Only the future will usually tell what is actually true. A theory is verified by putting it into practice.

All the axioms and calculations that we want to apply in elucidating the workings of the psyche are limited by the fact that we are largely measuring indirectly, vicariously, with rating scales, and therefore very approximate, often without due certainty that we are measuring what we think we are measuring. In psychology, we consider scientific facts to be what is supported by the required level of probability of their validity. However, even a highly significant correlation cannot be recognized as deterministic, nor can we accept it as unconditionally guaranteed.

3.2. System

Contemporary science has incorporated systems theory into its foundations. The car, transport, man, psychology, justice, police are systems. *A system is a whole that consists of many components that together form a specific construction, are interconnected in many ways, and the whole of this construction is related to other constructions that exist outside of it*. Both the internal interconnections of the elements and the external relationships have their own regularities. If they are disturbed, the functionality of the system is impeded or collapses. Those who understand the system can identify the causes of its failure and make corrections. The more complex the system, the more difficult it is.

Every system has a certain arrangement of elements and, in a more complex system, of its levels, subsystems, none of which is independent of the others. Their organisation is hierarchical, they are in a relationship of superiority and inferiority. The vertical hierarchy of the personality system begins with the innate constitution and culminates in self-consciousness. The horizontal hierarchy is related to the formation of personality over time. The somatic, physiological, psychological, social, and cultural systems, among others, are combined in man. To know a person, it is not enough to know only some of

his subsystems. If we try to explain personality by a particular subsystem, which we would recognize as the most essential, we will at best arrive at an incomplete, but more likely a false picture. The general regularity of a system is its *complexity*.

We distinguish between **closed and open systems**. Closed systems are deterministic, every happening in them necessarily has a cause and effect. They can be described by physical and mathematical models and explained by classical physics and the laws of thermodynamics. In a closed system, energy neither arises nor ceases, it only changes form (combustion produces heat, we use it to turn a generator and produce electricity, and this is converted into light, mechanical power or, again, heat). In open systems, energy is weakened in the course of transformations. Energy needs to be replenished if their functionality is to be preserved. All processes on earth and in the universe are moving towards a more disordered state. Systems degenerate and **entropy** increases. The latter is defined as the degree of disorder in a system.

Living organisms, and therefore humans, are open systems. They exchange substances and energy with their environment and cannot be described by physical laws. Although human behaviour and human personality are determined by multiple influences, they are not mechanically conditioned, and so we cannot calculate the force exerted by the psychic "body", the personality, on its "movement", on its behaviour. We cannot put exact numbers corresponding to reality into the equation; we cannot measure personality and behavior in an exact way. Psychophysicists W. Wundt, E. H. Weber, G. T. Fechner, and others who have tried to do so, although unsuccessful, have nevertheless discovered essential facts about man.

In contrast to deterministic systems, psyche, personality, and behavior are **stochastic systems** in which *chance* plays a significant role. Chance is an uncontrollable agent. The influence of chance produces accidents as well as new ideas; chance is part of both destruction and the construction of new solutions and progress. Transformations in stochastic systems are ambiguous; it is impossible to determine exactly what the outcome of a cause will be; we can only think of outcomes as probable.

System dynamics

Every living organism, open system, is immanent movement, change. The system resists change because it is intrinsically specifically interconnected, and change disrupts the status quo. The law of open systems is that they maintain themselves or evolve towards a stable state. Bertalanffy called this **homeostasis**. A mental system is characterized by a continuous dynamics of states and therefore it is better to speak of *dynamic equilibrium*.

Open systems are characterised by their non-linearity, so changes in them tend to be sudden and unexpected, accompanied by chaotic behaviour. What is essential is the recognition that small changes can induce large consequences. Diverse behaviours over time exhibit certain regularities, from which we can establish paradigms of system behaviour. *The basic principle of system dynamics is that all behaviour is a consequence of the structure of the system, i.e. the way its elements are composed and interconnected. Structure is the cause of both good and bad functioning of a system.* Even if a system functions well, it does not mean that it is valuable. Fascism and the Mafia are examples of very complex, highly functional, but not so moral systems.

Every action in the system causes a reaction, causes have effects. If we only react to individual stimuli or events, we are in an *open loop*, the conclusion of which is open, and in all likelihood the movement in this loop will be repeated over and over again. Both humans and communities tend to favour practices that are more encoded in them, i.e. they try to solve problems in an open loop ("extinguish" problems) and think linearly in a non-

linear world of systems. In a *closed-loop* feedback model, each element acts on the next in the loop. The action we take changes the system, and we have to redefine the problem and adapt the new solution accordingly. If we don't, we will be moving in a vicious circle (virtuous circle) of an open loop, doing the same thing over and over again without effectively solving the problem. *Feedback loops regulate future behavior depending on the accomplishment of an action in the past, allowing natural systems to be self-regulating.*

When a person is enriched by feedback, it either confirms him, reinforces him in the original responsiveness, or vice versa, he learns, changes the responsiveness. There are *two types of feedback loops: positive, reinforcing* loops, which add the outcome of the solution process to the input and reinforce it with each loop revolution, and *negative loops*, which inhibit change and stabilize or weaken the system (balancing feedback). The loops are constantly interacting, the system is strengthened, stabilized or weakened, destabilized, and *shifts of dominance* occur. Loops are interconnected by non-linear links, behaviour does not follow a straight line relationship and is therefore difficult to predict. *Dynamic systems are indeterminate.* Even if we know what can happen, we do not know what will happen in particular. In transport, we know why accidents may happen, but there is permanent uncertainty about when, where and what accidents will happen.

The essence of system dynamics are accumulations and flows. Phenomena, events, things are constantly accumulating, *accumulating* over time. We solve one problem and another one pops up; as soon as we have thoroughly cleaned everything, the dust starts accumulating again; we have commissioned a new parking lot, but it will quickly be as crowded as any other in the city; what we have learned is still not enough, knowledge is added and copied. The accumulation values tell us what state the system is in at any given time. Accumulations don't stop because you can't stop time. These are the registered levels of the system - stocks of goods in the shop, products in the warehouse, savings in the banks, accidents on the road, knowledge in the sciences.

Flows are action variables. Without flows, accumulations would never change, behavior would have no dynamics. Without empirical and scientific knowledge, knowledge would not accumulate. The degree of knowledge attained is the accumulation that induces flows. The flows represent the activity of the system, they depend on the values of the accumulation, but never on the values of the other flows. Accumulations change through flows, and flows depend on accumulations. Therefore, there is always a variation of both in any system.

Accumulations are changing, but not immediately. They have memory and change only through flow, which takes time. Delay delays the effects from the causes, thus obscuring causal relationships and complicating knowledge of system dynamics. Hence the error that we associate things close in space and time, attributing cause to what is closer. It often takes a long time for the system to change and for the problem to grow to the point where we notice it. The longer the delay, the more difficult the solution tends to be (curing disease, dealing with crime, corruption).

A new, systemic approach of an interdisciplinary nature is represented by **complexity theory**. It relies on the principle of simple rules even for extremely complex systems. The point of exploring complexity is to get hold of a principle that makes something knowable and controllable. The goal is to abstract a paradigm from a large amount of data without committing oversimplification.

Complexity theory accounts for the chaotic behaviour of systems, but also for the fact that it has hints of orderliness. Chaotic systems behave in a very complicated, unpredictable way, but they do not exhibit total disorder; they bear some indications of orderliness, but not determinism. Even chaos has some order. The pioneer of chaos

theory, the meteorologist and mathematician Edward Lorenz, discovered in weather modelling that a small variation in initial values can cause fundamental changes in the resulting weather. A small, inconspicuous atmospheric gust, such as the flap of a butterfly's wings, can cause turbulence several hundred kilometres away in the form of a tornado.

Deterministic chaos has a certain order embedded in it, in which all phenomena are dependent on the elements of the system. Theoretically, this chaos is predictable if we could keep track of each element and its interactions with other components of the system, but this is practically impossible. To be able to reliably predict a person's behavior, we would need to know all the data about him accurately, to have all the information about the initial state. This is not possible, and so his evolution over time will always appear to some extent to be random. Road conditions also vary to varying degrees between the pole of orderliness and predictability and the pole of chaos. Here, too, initial conditions are crucial for chaotic situations. Given the same initial parameters, the transport system will behave the same way in the future, but exactly the same conditions never occur in road transport, and the butterfly effect applies, so that a slight change at the start can provoke a huge and hardly predictable difference in its final state.

Evolution and technical progress are accompanied by an increase in complexity and a specific phenomenon can be observed in them: *complexity thresholds*. They did not evolve linearly, but after a certain build-up of complexity there was a "jump" to a new, higher level. This is true not only in the evolution of animal species, but also in the evolution of other systems, the web, society, education or transport systems. We have to expect that a complex system will turn into an even more complex one. Simple systems have a short lifespan; they will be surpassed by more complex, more perfect systems. Congested traffic at simple intersections collapses and so they are replaced by roundabouts and multi-level intersections. But they all work on a simple principle, the right-of-way rule for vehicles coming from the right.

In order to induce a change in the structure of the system, it is necessary to introduce disturbances or new components large enough to induce new reactions. These reactions begin to compete with the previous functioning of the system. It depends on the resistance of a particular system whether it can withstand them or whether a developmental reversal occurs. The evolutionary process starts from a bifurcation point, at which the influence of fluctuations increases non-linearly above the threshold of stability and the system branches out, like a river that splits in a flood and no longer returns to its original channel, but flows in two new divergent branches. Bifurcation occurs in at least two streams, one in which the system continues to evolve in the 'old channel' and the other in a qualitatively new form. The lifespan of the old is more likely to be lower. But the outcome is unpredictable and future developments can only be predicted indefinitely. Currently, the bifurcation of transportation by manually operated and autonomous cars has begun.

Complex systems have a hierarchical structure. Each of the subsystems is subordinate to the higher authority of the parent system. In studying the driver as a subsystem in a complex road transport system, we consider its superordinate systems of culture, nature, society, and in a descending direction we can proceed through its neurocerebral system, the neurons, down to the elementary level, which is not definitively bounded by elements such as molecules or DNA, but only by our knowledge of what lies even deeper beneath.

System approach

A system approach to understanding the psyche means that we understand this entity as a dynamic complex that is always more than all of its elements and characteristics put

together; as a combination of orderliness and randomness, as a time-varying, dynamic system responding adaptively to external systems, to their influences, and to the effects of its own behavior. The systems approach is to bring order to the opaque complexity of human psychic existence and to derive its structure on this basis, respecting that non-linear regularities of functioning apply in this system.

IV. ROAD TRANSPORT CULTURE

4.1. Definition of culture

Very broadly, culture can be defined as all the tangible and intangible creations of man. Culture is the product of man, which is seen as the antithesis of nature. Culture and nature coexist but do not intermingle. *Culture is all the material and spiritual products that man has transformed and created over the course of generations.* These are transmitted in every society to the next generations in the process of socialization, in which education plays a dominant role. Culture has its content and form. In two cultures we find a similar structure of their components, but they can be very different in their form.

Culture is a universal human phenomenon, but there is no universal culture, only a variety of many cultures. *A culture develops in a particular community and time, it is unique because its people faced certain material, social, political and economic circumstances in their time and coped with them in ways, some of which they have retained in their cultural consciousness.* They are often applied by members of the culture even though the reasons for which they were created have passed and their pioneers are long dead. These historical forms are overlaid with new ones, but many are reasserted spontaneously and unconsciously and may influence people's current thinking and actions or are cultivated merely as formal traditions that reinforce their cultural identity. If a culture does not fulfil its meaning and mission, it will disappear, but it may leave a legacy for future generations and other cultures.

Culture permeates a person's entire life. Everything he does as a social being he does at the same time as a being born into a culture, growing up and working in it. Culture manifests itself in the individual by that part of his behaviour which respects and reflects what a given cultural community has in common, what its members share in common. Culture makes people behave, act, and even think in predictable ways in certain situations and areas. *From a psychological point of view, culture is the framework, the schemas in the intent of which people perceive and interpret the world around them, events and their behaviour.* In an anthropological sense, culture is a kind of agreed-upon behaviour and a convention-based way of life for a community. Culture is not acquired genetically, but absorbed and learned. Socialization results in the internalization of cultural schemas to such an extent that the individual, even alone, behaves as if he were under the supervision of others. This is the ideal measure of a desirable transport culture.

The larger the community of people that make up a given culture, the more likely *subcultures* are to operate within it. These are formed on a territorial, ethnic and urban basis, according to gender, age, occupation, class and social affiliation. The culture that is inherent in the broadest strata of its members is termed dominant. The dominant culture may be described as the national culture. It is the carrier of the basic cultural patterns of the members of a nation, it induces and determines various stereotypes, ideas and attitudes in them, it co-creates their individual value systems, it teaches them certain forms of behaviour and solutions to problems. It always and everywhere strongly influences the culture of road transport.

4.2. Structure of road transport culture

Understanding road transport culture means answering the question of what it consists of and how it is organised, what is the "anatomy" and interrelationship of its building

blocks and the space in which cultural processes take place in the flow of time. All its individual *features* (e.g. speed limits, road quality, mandatory or optional winter tyres, honking, the predominant types of vehicles, the behaviour of participants towards each other, the decoration of cars, cleanliness, etc.)) are grouped into coherent units, *cultural complexes* (traffic rules, driving discipline, road transport infrastructure, traffic education, road traffic management, etc.) that form *cultural configurations* (safety, ethics, economics, road transport ecology). Each culture also lacks something, has *cultural gaps* (e.g. an inadequate and poor quality road network hinders the development of trade and tourism, the building of industrial centres and the development of employment) and may exhibit cultural incompetence (e.g. road users do not understand traffic regulations, society does not have the capital and skilled people to build and maintain roads).

In road traffic culture there is always something that is immediately observable (explicit culture) and something that is hidden to the senses, which we can only deduce from external manifestations (implicit culture). In order to describe and understand a culture, we need to recognise its main determinants, which are **typical beliefs, prejudices and attitudes, customs, habits, customs and traditions**, and last but not least, such fundamental and hardly recognisable factors as **values, paradigms and beliefs**. Cultural values are shared abstract ideas about what is good, right and desirable; they are the basis for specific social norms. When people have beliefs about certain values and goals, they control and condemn themselves and each other if they do not think and act correctly. It is the control system that works best. Every church is built on faith and therefore does not have a police force to check whether its members are praying, fasting, keeping God's commandments. However, faith in democratic, decent and disciplined behaviour on the roads is considerably weaker in comparison, and so we have to employ a vast control and repressive apparatus.

Comparative cross-cultural research has shown that different accident rates across countries are related to the developmental level of the cultural community. The culture of road transport in economically less developed countries with a strongly rooted traditional national culture is manifested by the behaviour of its participants, which in many cases puts visitors from more civilised parts of the world to astonishment. In countries such as Pakistan, the Philippines, Polynesia or India, people retain traditional ways of behaving that are in many ways incompatible with modern road transport culture, which is reflected in high road accident rates. Russia's national culture is rooted in plutocratic forms of government and traditionally massive alcohol consumption, which determines its road traffic culture in a markedly negative way.

In contrast, countries with a high standard of living and an advanced national culture are characterised by a favourable road transport culture. Such are the northern European countries of Sweden, Norway, Denmark and Finland. Members of these cultures are not competitive, they do not fight, they help those in need, they care about the common good. Similarly, national culture is reflected favourably in the behaviour of road users in Japan, which has long ranked among the countries with the lowest crime rates in the world. The Japanese are disciplined and intrinsically motivated to drive considerately and safely.

There are specific functional systems in culture that determine its expression and scope. In particular, the *culture of discipline* and the *culture of safety* play an important role in the culture of road transport. Both are well noticeable in the behaviour of the participants. They could be described as a great general habit that manifests itself in many attitudes, habits and customs of road transport participants.

It is evident that there are cross-cultural differences in driver behaviour. At the same time, there is also a tendency for cultures to converge. The process of globalisation and the adaptation to technical progress in most countries of the world are leading to the

transnationalisation of many characteristics of national cultures, which is also evident in the culture of road transport. It is not a question of forcibly suppressing national characteristics, but of embellishing those that have been asserted in the process of development and are proving to be the most suitable for the viability of road transport culture. Imitation, homogenisation of road transport cultures contributes to its safety.

4.3. Models of culture

The study of culture is aided by its models. Geert and Jan Hofstede (2007) are the authors of a popular comparative dimensional model of national culture, which they have applied to compare cultures in samples of thousands of people in dozens of countries. They identified types of culture along six dimensions, but they did not move beyond the hypothesis stage: 1. small - large power distance, 2. individualism - collectivism, 3. masculinity - femininity, 4. uncertainty avoidance - non-avoidance, 5. short-term - long-term orientation, 6. indulgence - restraint.

Hofstede's model and other dimensional models of culture are not directly applicable to the description of road transport culture. The mapped national culture only tells by inference about the subculture of road transport. Better observable and relevant are its other characteristics, for example, that everyone is in a hurry, pushing ahead, taking every appropriate and inappropriate opportunity to overtake, there is tension in front of traffic lights, and drivers with their foot on the gas are waiting to see when they can pull ahead. Or, conversely, there is a calm atmosphere, with drivers yielding the right of way and being obviously considerate of weaker road users.

In modelling a typology of road traffic culture, we have the same problem as in the typology of personality. It consists in plotting the relevant orthogonal dimensions. They have to capture what is most essential in road transport culture and at the same time they have to measure these characteristics reliably. These could be the following three dimensions:

The first dimension is "*tolerance vs. competition*," which is largely tied to the manifest behavioral level of culture. In a tolerant culture, transport participants treat each other in a permissive, friendly and cooperative manner. At the opposite pole, competitive behaviour is evident, which can escalate to aggressiveness and aggression.

The second is the dimension, "*performance orientation vs. relaxed driving*". The performance orientation is manifested by drivers' strong bias for fast progress, impatience and irritability when obstacles and delays occur.

The third dimension, "*disciplined vs. undisciplined*," captures compliance with traffic laws, rules, and positive norms. Conscious discipline belongs to the fundamental, ideological-value level of culture.

Based on these three dimensions, we arrive at eight types of road transport culture (Figure 4.1):

Proactive culture - is characterised by efficiency, discipline and decency, but also has a more exciting and hurried nature.

Harmonious culture - is characterized by orderliness, discipline and decency. Participants are tolerant of obstacles to progress in the ride and of weaker participants, avoiding conflicts.

Performance culture - rules and regulations are respected, but self-performance, not collaboration, is at the forefront. Drivers assert themselves in order to achieve their goals in full compliance with traffic regulations. More dynamic traffic brings dangerous situations.

A culture of egoism - participants pursue their own interests and convenience and are not tolerant and helpful to others. They usually respect the rules because they don't want to get in trouble. They don't expect kindness from others, but they don't show it to them either.

Immature, lively culture - participants transport themselves in different ways, behave in a quite friendly way. Traffic regulations are not taken seriously, but this does not bother anyone. Traffic looks chaotic, but it works because certain unwritten but established principles and manners are applied, even from the pre-motorisation era of transport.

Benevolent culture - everyone has plenty of time and if there are any problems, they take it easy and act friendly. Drivers modify their cars to their liking and take lightly both technical standards and traffic regulations.

Aggressive culture - fighting, oppression of others and arrogant behaviour are common. Rules are broken or adapted to suit one's own goals and ambitions.

Showmen culture - drivers like to show off. They demonstrate their real or pretended social and personal status through their vehicles and behaviour. They compete with each other not in performance but in mannerisms. In this comparison, they have a need to do their best.

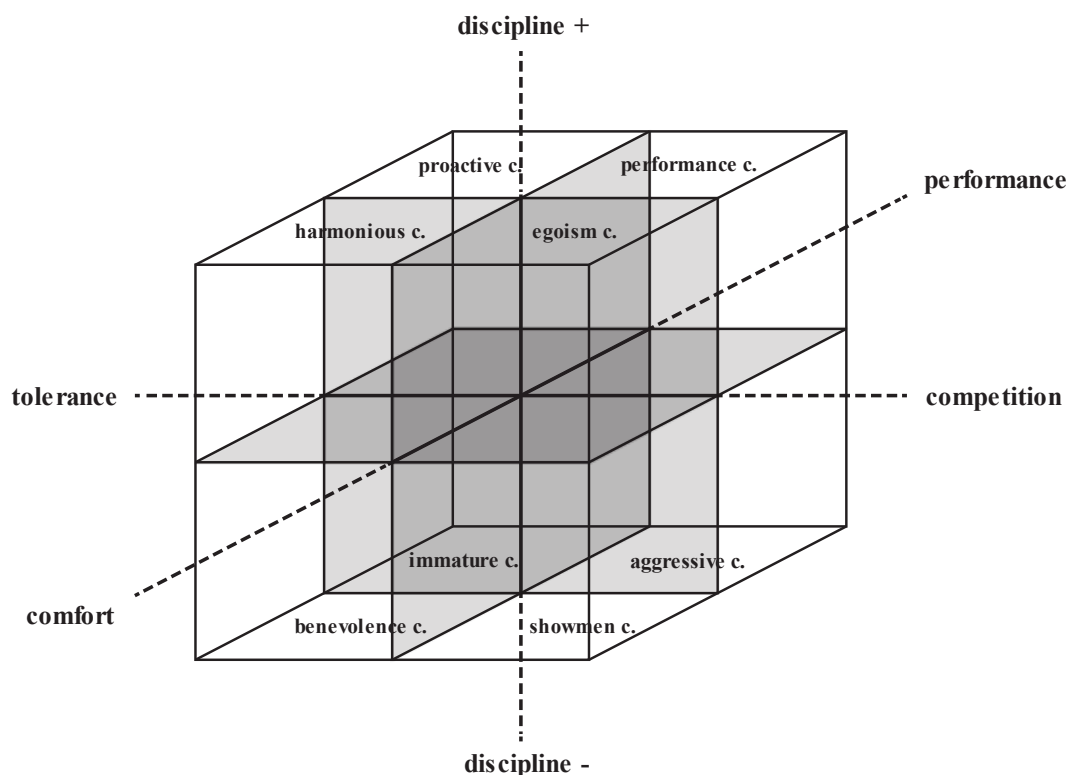


Figure 4.1 Three-dimensional model of road transport culture typology

V. HUMAN-AUTOMOBILE SYSTEM COMPLEX

Man as a natural system forms a common, interconnected system with the automobile as a technical system, which is not the sum of these two subsets, but a system with greater complexity. The driver interacts with the mechanical system by providing inputs and observing outputs without needing to know how the system behaves within itself. It interacts with the machine through an interface. Interaction analysis focuses on **the system and mental models**. The system model represents everything that the system can do and the mental model represents what the user knows about it.

In the driver-car system, the human has a dominant position and control function. The adequacy, accuracy, speed and reliability of the control, and thus the functioning of the entire system, depend on him. *Reliability is generally defined as the probability that the system will perform adequately over time under given operating conditions.* Due to the stochastic determinism of this open system, its reliability is limited and unstable. We have to take into account random influences that may compromise its reliability at any moment. The reliability of a transport system derived from accidents is incomplete and imprecise, only very approximate. The technical reliability of a car assessed autonomously, without human control, can be assessed much more accurately. The driver has limits to his performance and reliability. His lower reliability is most often manifested by cognitive gnostic errors.

The reliability of the system is stated with respect to its *average lifetime*. The largest number of failures is at the beginning and at the end of the lifetime. The highest number of failures is at the very beginning and at the very end of the car's life. Also, the driver makes the most mistakes when he is a beginner and then in old age.

The reliability and safety of the transport system can be improved by applying **homogenisation**. This is a process that induces homogeneity in certain aspects and areas that are relevant to the reliability and safety of the system. In the road transport system, this practically means that not just any cars can drive on the roads, but only those that meet the specified technical standards; all drivers must comply with uniform rules of the road, all vehicles must have their lights on not only at night, but also during the day, and so on. *Homogenisation of driver behaviour contributes to road safety by enabling drivers to correctly anticipate the behaviour of other road users, contributing to their correct decision-making and dampening their competitive behaviour.*

The properties and processes taking place in complex technological systems cannot be observed directly by the operator with his senses. The driver is in contact with the technical system of the car via an intermediate link, the Human-Machine Interface (HMI). The interface is a defined space and device in which the interaction between the driver and the technical system takes place (Figure 5.1). The interface in the car is physically formed by the dashboard with indicators and switches, and in this century by default also by the display. Associated with the interface are the pedals, control levers and steering wheel, which are also gradually taking on a communicative significance (signalling through their vibration). Communication via the interface is bidirectional. The development of the interface design pursues the goal of making the interface efficient, user-friendly and pleasant. An illustrative example is the enrichment of the interface control with voice and gestures, which reduces the perceptual and cognitive load on the driver. The evolution of interface design is strongly influenced by the increasing share of virtual information. Technologies that involve the fusion of real and virtual worlds, mixed reality, are taking root in the car interface system.

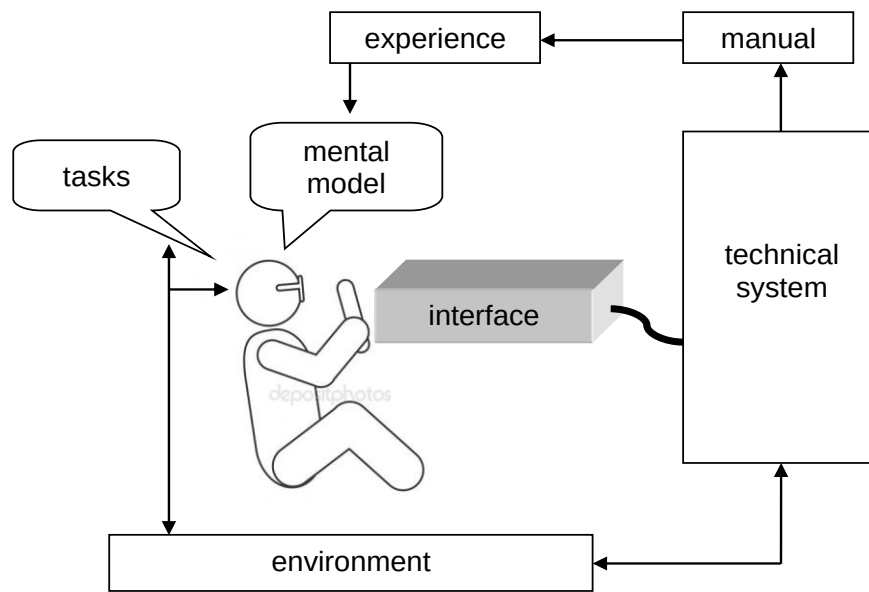


Figure 5.1 Driver-car system model

Interface designers must take into account the natural functioning of the operator, how the person perceives, thinks, their emotions, motivations, experiences. Interface design has been significantly influenced by *the concept of affordances and the concept of Ecological Interface Design (EID)*

Based on the concept of affordances, the principle of purposefulness and intuitiveness is applied. For the design of each object, its purpose, what it can be used for, is essential. There are doors to go through the wall, handles to open the closure, buttons to push, levers to move sideways, knobs to turn, plugs to tuck in a socket, etc. It's clear at a glance. *Intuitive design solutions* allow us to see directly and correctly what we can do with the thing. When devices become more intuitive, they are also more useful and their operation is more reliable.

The essence of the EID concept is not to force the processing of information to a higher level than is appropriate to the demands of the task. The interface is intended to make the abstract properties and processes of complex technical systems directly perceptible, so that their control is effortless for operators and more efficient in the results of their actions than handling information with greater cognitive demand. It is not in the interest of the cause that the driver receives all possible information, but only that which is truly valuable and beneficial to his safe and non-competitive driving. EID makes a complicated technical system easy for the driver to understand. Even in a technically very complex car, he can create a mental model of its system and operate it at a level that he would only reach without such support by acquiring quite extensive specialist knowledge and after longer driving experience.

5.1. Driver and automated vehicle

The National Highway Traffic Safety Administration (NHTSA) has distinguished and defined five levels of vehicle automation (NHTSA, 2018):

L1 involves the automation of one or more control functions independently of each other. The driver has control and responsibility for their operation.

L2 involves the automation of at least two functions in combination. The driver may hand over control to the automation or share it together.

L3 is an automatic with limited self-driving. The driver remains available for occasional checking.

L4 represents full automation of vehicle control. The automated steering is carried out under certain circumstances and the driver does not need to be involved in the steering.

L5 FAD (Full Self-driving Automation) refers to a vehicle that is driven autonomously, without any intervention or supervision from the driver or anyone else in the vehicle. Automated cars are connected to each other and to the surrounding infrastructure.

Depending on the levels of automation, the role of the driver varies from active driving at L1, through the position of supervisor at L2 to L4, to passive observer at the highest level, L5.

Automation is increasingly entering the driver-car system, and the driver is increasingly tasked with monitoring process status indicators without interfering with them. The driver is not thorough and persistent in monitoring. Driver assistance systems help him in routine driving operations, relieve him of monotonous tasks and make it easier for him to deal with difficult and unexpected situations. Higher-end assistance systems take over some of the vehicle control functions. The problems related to the performance of the operator of an automated system are that he or she is more or less removed from the control of the technical equipment, which can be referred to as out-of-the-loop performance. Being out of the feedback loop in driving can lead to difficulties in situations where he is required to intervene and when he is required to take manual control.

Increasingly, systems are entering the car and the transport system that offer a more effective way and level of protection against traffic hazards than humans are equipped with biologically. These are assistance systems which, in order to increase driving safety, take over some of the control of the vehicle, or at least warn the driver of the loss of control. They are part of an *Intelligent Transport System* (ITS), which is a set of measures to improve transport performance, comfort and safety of driving and traffic. ITS includes systems referred to as **Driver Assistance Systems (DAS)** or Advanced Driver Assistance Systems (**ADAS**), In-Vehicle Information Systems (**IVIS**). IVIS convey information to the driver related to driving (navigation, on-board computer) but also not directly related to driving (mobile phone, audio devices). They assist but do not interfere with driving.

The English signature of assistance systems is the most commonly encountered. Warning systems alert the driver when certain specific safety limits are reached, such as lane departure warning (LDW), or are designed to detect driver fatigue and send warning signals (DMS). ADAS of a higher automation category take over some vehicle control functions, such as following the vehicle in front (ACC, adaptive cruise control). Some ADAS intervene autonomously in driving and take over a function fully, such as crash imminent braking (CIB) or electronic stability control (ESC), while others only warn the driver of an impending collision by warning of lane departure warning (LDW) or forward collision warning (FCW) when the driver has crossed a safety limit. Some are not really safety systems, but contribute to safety by relieving the driver from the monotonous or laborious task of keeping the vehicle in the lane (LKAS, lane keeping assist system). The mission of all DAS is to improve driving safety, but each of them has only certain capabilities to do so, no single DAS is a one-size-fits-all.

The principle requirement for the design of warning systems is that the warning should be the right information, in the right form, at the right time and for the right task. Warnings should be a rare event. Otherwise they are more likely to escape attention and reduce their salience in the driver's perceptual field. Late warnings are ineffective or inefficient and annoying. Early warnings may trigger even more unnecessary reactions (false alarms) or be missed at the time the action is to be taken. Warnings given at inappropriate times and incorrect warnings reduce the credibility of the IVIS, complicate effective adaptation to the system, create unwanted secondary burdens and can seriously reduce driving safety. If the warning system is untrustworthy, the driver will focus on information from standard perceived sources and the IVIS will distract and annoy him.

Situations when the system reacts in a way the operator did not expect, when the operator is surprised and reacts in a confused way, are usually referred to as *automation surprises*. It has been evident for some time that the development of automation must follow the path of humanisation. Ways are being sought to develop automation in such a way that humans can understand it well, can adapt to it in a way that is natural to them, can be in harmony with it, can cooperate with it without any great demands on specialist knowledge and higher mental functions, and can work with an automated system at the level of their skills.

Driver adaptation to automation is a normal and productive phenomenon, as long as it does not reach extremes of dependence and abuse of automation, or, at the other pole, refusal and non-use of automation when it is justified and desirable. People in general show many reservations and inhibitions about automation, and even if they do not have them or overcome them, this does not mean that they accept automated devices. Traffic psychology studies the issues of *acceptance and trust of automation*, adaptation to automation, the process of error management in human-automation interaction, and thus also contributes to the prediction of the future of automation in road traffic. In the development of automation, it should strive for its "human face", so that it is not some form of dictatorship towards man, so that it has characteristics that make it related to man and not a foreign element in his life, he can understand it and communicate with it comfortably and comprehensibly. It cannot be humanly kind, value-oriented, pro-social or empathetic. If she were a copy of man, she would make deliberate mistakes as he does, be competitive and aggressive. Feeling, intuition, imagination, and creativity would remain the domain of the human. Automation is not subject to emotion, ambition, the desire to compete and win, and it has other virtues that humans do not have, which is why humans need it.

VI. ROAD TRAFFIC ACCIDENTS

Traffic accident statistics generally show a downward trend, thus indirectly documenting that better and safer cars and roads reduce both the frequency and severity of accidents in the transport system. The statistics confirm that the international differences in road accident rates are related to the safety measures that countries have established as generally binding. Following the introduction of compulsory seat belt wearing, the reduction of speed limits and more stringent penalties for drink-driving, the number of fatal accidents has fallen significantly. However, it is not possible to deduce from accident statistics whether and how road users' behaviour is improving. *No statistic captures the specificity of an accident, it does not tell us why and how a particular accident happened*

It is justified to pay systematic attention to the state of road accidents, to ask why there are so many accidents, why some are more frequent and others less frequent, why they differ in their consequences, why they persist. The questions "why?" and the answers "why" are the essence of causal analysis, which is a methodological tool for investigating road safety.

Every accident has its cause, sometimes obvious, sometimes less obvious or even difficult to detect. *A common feature of the causes of traffic accidents is that the proper and safe operation of traffic has been violated.* Not every such violation leads to an accident, i.e. to an event which is definitive in the sense of a certain adverse consequence, damage or injury. Human error cannot be equated with an accident. Human error is merely a connecting link in the chain of events which led to the accident. There are very many cases where a malfunction has occurred but the accident has not happened. These are the so-called *near misses*.

Accident analysis consists of creating an *accident scenario* that plots the initial state of the system, the sequence of events, identifies the triggering event and reconstructs the emergency manoeuvre. *The accident storyline is always unique.* It is rare that any accident would have only one cause. Almost every accident is the result of a causal convergence of multiple causes that have a chain-like character. One cause triggers others and these in turn trigger others. Causal chains are sought and the findings are generalised, on the basis of which accident probabilities are clarified and preventive measures are proposed. The statistics and analysis of accidents have thus drawn attention to speed, which in turn has been reflected in the introduction of safety measures to limit it. Similarly, the visibility of cars, which has resulted in the obligation to have daytime running lights, driver fatigue, which has been countered by the introduction of compulsory driving breaks, and so on.

Accident rate is one of the characteristics of the transport system. It is not a stable variable either for drivers or in the road environment. Responsibility for traffic safety is shared by drivers, together with society, with the designers of vehicles and roads, with those who maintain them, with those who set traffic rules and enforce them, with the organisations that set safety policy. Even in the most safety-friendly conditions, drivers will make mistakes and some will result in accidents.

The use of accident causation data as a criterion of driver success or riskiness is methodologically suboptimal in psychological research, but we rarely use better ones. Most of our previous knowledge about drivers' behaviour and personality in relation to their actual or potential riskiness has been gained in research projects constructed in this way.

VII. RISK IN ROAD TRANSPORT

7.1. Definition of risk

Risk does not exist independently of our minds and cultures. The concept of risk was invented by humans in order to better think about uncertainties and dangers. Risk is a social construct. Each historical epoch and stage is always characterised by a specific complex of risks.

The concept of risk is abstract because it does not reflect what is right now. What is not yet, but could be, can be expressed as events and their consequences, and whether they could occur can be expressed as probability: *risk is a certain measure of the likelihood that an undesirable, harmful event, an accident, will occur*. Probability can be determined mathematically as the proportion of relevant events to all possible events, which results in a number between 0 and 1. By calculating probability, we can determine how likely something is to happen and we can statistically derive the expected accident rate, but we cannot determine to whom, when, where, what and with what consequences an accident will happen. The fundamental flaw of the probability concept in defining risk is that it does not represent real probabilities, but only estimates of them.

In addition to the term of *risk*, the term of **hazard** is often used. Hazard is defined as a risky activity (a way of driving, having fun, acting) and risk as a concept in people's minds. From a psychological perspective, risk is usually understood as *inappropriate behaviour or as conditions that induce unsafe behaviour or harmful behavioural consequences*. However, the outcome of risky behaviour is not always clear in advance. There are conditions where the likelihood of negative consequences is greater, other times less, in very extreme cases bordering on near certainty that an undesirable event will or will not happen. These conditions are determined both externally (technical condition of the vehicle, physical conditions on the road, conflicts between participants) and internally (somatic and psychological conditions, the condition of the driver, his reactivity). Risk is an uncertain and volatile phenomenon.

We distinguish between **objective and subjective risk**. Objective risk can be defined as the probability of occurrence and severity of an adverse event. The objective probability of being involved in an accident is usually determined in a post-hoc manner from the analysis of accident data and is therefore sometimes referred to as *statistical risk*. Subjective risk is a psychological category, the expectation of a hazardous event where the subject may or may not have an opinion about its severity and the likelihood of occurrence. It is a subjective estimate of the (objective) probability of a collision and is an output of the driver's cognitive process. The concept of risk is not normative. What is and what is not a risk is relative; different people may take different risks and each person is free to decide whether to take them.

The transport system is and will remain risky, but the level of risk is changing. Since the invention of the car, the risk of traffic accidents has increased year by year, although the risk of technical failure of the car has, on the contrary, gradually decreased. Even if the development of road safety is on a positive trend, the ideal state of absolute safety and accident-free operation is hampered by the fact that its controlling link, man, is imperfect and the transport system is stochastic.

7.2. Perception of risk

The feelings that risk evokes in a person are of fundamental importance, they are related to emotions and judgements about him. We do not have a specific receptor to perceive risk, but use all five senses at our disposal and internal memory and cognitive resources to do so. A sensation is a non-objective and non-differentiated impression about a particular individual sensory quality of a stimulus. Risk perception takes place at a higher qualitative level than sensation; it is conscious. If a driver perceives a risk, he or she more or less evaluates it and thus goes beyond a sensorimotor response.

People choose different levels of risky action in different situations. They are differently inclined to take risks, which is conditioned by their different risk appetite and tolerance. **Risk perceptiveness** is a human characteristic that is formed on the basis of personality dispositions and characteristics acquired through upbringing and experience. Risk perceptiveness is applied depending on what the risk is and the state in which the individual is in (fatigue, agitation, stress). The driver preferentially perceives as a risk what he anticipates as dangerous. He or she is more sensitive to what he or she anticipates than to what may or may not be a risk, which he or she first needs to assess. There are more accidents on sections of road that drivers perceive as safe than on sections that they perceive as unsafe, which encourages them to drive more attentively and cautiously. The perception of danger or subjective risks depends on the extent of drivers' experience of different types of hazards and their awareness of the situation.

Risk perceptiveness overlaps with **risk tolerance**, represents the degree to which risk is acceptable or unacceptable in terms of the desired state of safety. Accepted risk is not equivalent to safety. It is a subjective assessment of the risk that a subject is willing to bear and take. The higher the estimated probability of a risk event and the higher the expected severity of its consequences, the lower the risk acceptability.

It is important to distinguish between **riskiness** and **risk-taking behaviour**. Risk behaviour refers to the specific behaviour of a driver in a particular hazardous situation and riskiness refers to the more persistent tendency of a person to get into risky situations. Riskiness is conditioned by the individual's disposition, experience and self-concept, a more or less realistic assessment of his or her own driving ability.

When risks are known, people have clearer ideas about their acceptability, but not definitively, because their attitudes are influenced by the urgency of the threats. **Threat** is an expression of the actual proximity of a risk event. It is the state of the environment that makes such an event more likely to occur. The distinction between risk and threat is not strict. Threat is essentially the actuality of the risk.

Subjective **uncertainty** is involved in the perception of risk. Risk and uncertainty are intertwined but not identical. While uncertainty refers to possible outcomes that are unknown, risk represents a kind of uncertainty that involves the real possibility of loss. Uncertainty may not in itself constitute risk, but it is an essential component of risk. The less confident one feels, the greater the subjective risk. Risk may exist objectively, uncertainty only in one's feelings and in one's mind.

7.3. Concepts of risk in road transport

Social and cultural theories of risk

Each person is intrinsically linked to his or her social environment, and this imprints his or her individual perception and tolerance of risk. If a person lives in an environment characterised by gambling, he or she will be more inclined to minimise risks. When people assess a risk, they base their assessment to some extent on its objective

characteristics as well as on a reference point, which is the 'average' assessment of that risk in their society and wider culture. We need to take into account the communication chain by which risk information gets from the source to the percipients. Along the way, they can be amplified or amplified. As a result of *social amplification*, some risks come to the public's attention more and others less. A mechanism of cognitive dissonance is at work in social amplification.

Comparisons of different communities have confirmed that there are differences in preferences and perceptions of risk depending on their history and cultures. Anthropologist M. Douglas and political scientist A. Wildavsky (1982) are the authors of the cultural theory of risk, according to which cultures differ in which risks they attach importance to and which they tend to ignore. Douglas created a "group-grid" typology. She defined four lifestyles with their own patterns of risk perception by the dimension of social inclusion and the dimension of structuration (grid) of the social environment:

Individualistic style - characterized by a rejection of that which limits one's freedom and a perception of risk as opportunity. Individualists need to put themselves at risk to some degree in order to affirm their self-worth.

The hierarchical lifestyle professes a natural order and fidelity to established rules, which eliminates risks.

The egalitarian lifestyle does not accept a hierarchical group structure. The egalitarian is strongly influenced by the norms of the group. If the group professes risky behavior, he also takes risks.

Fatalists see social space as predeterminedly structured. They are not concerned with risks because if they are, they are inevitable; if accidents and mishaps are to happen, they will happen.

Cultural theory is reductionist. A society's culture and cannot be portrayed by values on two dimensions that are captured by imperfect, narrowly profiled questionnaires.

Risk as feelings and emotions

Emotions are the evaluation of feelings and sensations in the polarity pleasant - unpleasant. Such an evaluation underlies centripetal responses (underestimation and enjoyment of risk) or centrifugal responses (overestimation and fear of risk), but not inattention and ignorance of risk. A pioneering and often cited study is Taylor's experiments (Taylor, 1964), in which he found that drivers' skin-galvanic resistance rose to levels up to 50 times higher during perceived risks than they exhibited at rest without driving.

Loewenstein (2001) established the risk-as-feelings hypothesis. He distinguished two categories of emotions: *anticipatory* emotions, which are immediate visceral reactions to risk and uncertainty, such as fear, anxiety, and dismay, and *anticipated* emotions, which are also immediately experienced because the subject expects to experience them in the future in conjunction with the consequences that the risk may entail.

An important contribution to risk perception is the concept of the neurobiologist Damasio (1994), who attributes to emotions a crucial role in homeostatic regulation and has shown that through them the human organism adaptively responds to risks. He experimentally compared the card gambling behaviour of healthy persons with that of persons with a damaged neural apparatus of emotions, namely the ventromedial region of the prefrontal cortex. Subjects with CNS damage were insensitive to risks and made erroneous decisions despite retained intelligence and knowledge. According to Damasio's conception, risk monitoring is provided by the body with its physiological and neurological apparatus that evokes emotions and sensations and informs consciousness of adverse outcomes associated with an activity.

An emotionalistic approach cannot address the issue of perception and tolerance of traffic risks comprehensively. However, it is reasonable to accept that emotions, especially negative ones, are an important determinant of drivers' risk perception and safe driving behaviour

Psychometric risk model

Slovic, Fischhoff, and Lichtenstein (1982) took a psychometric approach to risk. They measured risk perceptions with nine 7-point scales designed to capture their main characteristics. They established the following tribal dimensions: 1. voluntary vs. involuntary risk taking, 2. its consequences are immediate vs. delayed, 3. it is known vs. unknown to the percipient, 4. it is scientifically known vs. unknown, 5. it is chronic vs. catastrophic, 6. it is nonthreatening vs. frightening, 7. it is benign vs. severe, 8. it is fair vs. unfair, and 9. it is controllable vs. uncontrollable. Such psychometric measurement of risk yields individual and group profiles that provide an illustrative picture of what conditions the perception of certain risks.

The authors of the psychometric approach investigated people's perceptions of risk in their various activities and threats (gambling, smoking, nuclear power, driving, playing sports) and by factor analysis arrived at two basic factors of risk perception: *scariness* (dread) and *novelty*. Dreadiness is defined by loss of control over the situation, feelings of fear and the perceived threat of disaster. Novelty conditions the perception of risk in that something is unfamiliar, unobservable, and its devastating consequences are delayed.

Concerns are an important determinant and predictor of risk reduction. Greater concern was accompanied by greater risk sensitivity. Fear does not have the same effect.

The application of the psychometric model methodology usually finds that individuals differ in their perceptions of the same risk issues and can trace differences in individual perceptions of the same risks, but does not answer the question of why people experience the issues under consideration as risky.

A model of a rational approach to risk-taking

Starr (1969) identified one important source of the disparity between objective and subjectively perceived risk, which is the expected benefit and the asymmetry between **gains and losses**. A person is more willing to take a risk if there is something in it for him. If there is no benefit to be gained but only harm, he will not want to take it unless he has to, involuntarily, in which case he will perceive it aversively and as greater. Although risk is always something threatening in principle, it often involves, in addition to possible harm and injury, possible gain from overcoming it. The ratio of these two motives tends to be imbalanced. By default, but not always, the loss motive is stronger than the gain motive.

O'Neill (1977) proposed a *maximum utility model*, according to which the driver has certain stable goals and chooses to maximize the expected value of these goals. If some of these goals can be achieved more efficiently through risk-taking behavior, he chooses that alternative. The driver will drive at a higher speed, risk overtaking, run red lights to gain time, but also wishes to avoid penalties and accidents. Balancing the target gains with the need to avoid losses derives the choice of his driving style and behaviour. O'Neill builds on the assumption that the driver is rational and acts on the basis of an assessment of the likelihood of an accident.

Kahneman and Tversky (1973) pointed out the large differences between risk perception depending on whether it rests on a calculated or intuitive probability. People use a heuristic approach to evaluate risk to a large extent, random and intuitive solutions, which have the advantage of shortening and simplifying the problem-solving process, but

on the other hand it can also more easily lead to inadequate conclusions. Drivers tend to form a judgement about risk based on a few pieces of information, even superficial ones, all the more so as they are often in conditions of time pressure or emotional stress. Prejudices and heuristics lead to wrong decisions that can result in accidents.

Motivational models of risk

Man is naturally motivated not to feel threatened, not to be exposed to danger. Näätänen and Summala (1974) called this *subjective risk monitoring*. If a risk appears or could occur, the driver reacts to eliminate it, e.g., by not overtaking, reducing speed, changing lanes, etc. This is the essence of their **zero-risk theory**. Zero risk is a zone in which the driver does not experience hazards, i.e. he does not perceive any hazards or, even if he does, the level of hazards is so low that he tolerates them. Of key importance in the concept of zero risk are the margins, the *safety margins*. They represent the distance to the limit of danger that the driver does not want to cross. If he does, he experiences danger. The driver has a dispositional incentive to stay within the margin of safety, the *comfort zone*, where he or she feels emotionally at ease.

Wilde (1982) is the author of **the risk homeostasis theory**. He also accepts its label called *risk compensation*. According to Wilde, risk belongs to the psychological nature of man and is an inherent part of his life. Not only can he not avoid risk, but he needs it. Each person has a '*target level of risk*' and measures risk on his or her own '*risk thermostat*'. Risk homeostasis is analogous to the self-regulating unconscious way in which the body maintains temperature. If the perceived risk exceeds a target level, it will act to reduce it and, conversely, if it perceives the risk to be lower, it will tend to raise it to its target level and take more dangerous actions. As the risk in his environment is constantly changing, he is thus constantly moving away from his target level of risk and is driven to return to it, either by reducing or increasing his risk-taking behaviour. The target risk level is set by the driver based on the expected benefit of losses from risky and cautious behaviour.

Fuller (1984) is the author of **the concept of threat avoidance**, which is in many ways related to the above concepts, but unlike them, the task performed by the driver is central to it. Drivers do not get behind the wheel with a clear idea of the target risk, but are more likely to have an idea of the acceptable difficulty of the task. There is an intrinsic motivation for the driver to drive in such a way as to maintain the task difficulty at an optimal level so as not to expose themselves to risk, or to maintain a performance margin and manage any risks that suddenly arise.

Economic model of risk and risk compensation

Peltzman (1975) examined road accident data in the USA and found that continuously implemented safety measures had no effect on the prevalence of fatal road accidents, but were reflected in higher driving rates. Peltzman developed an economic model of risk, according to which a driver's safety efforts are determined by the maintenance of a balance between reducing risk and increasing disutility costs. The individual will seek to maximize utility. Peltzman formulated *the risk compensation hypothesis*: if efficient safety devices are applied in cars, the intensity cost of driving will decrease (more safety in the car will reduce the probability of accident, injury and death), the risk cost of driving intensity will decrease, which will be reflected in an increase in consumption, i.e., driving intensity will increase. Risk compensation is one aspect of the general process of utility maximisation. This can be illustrated by the example of the installation of anti-lock braking systems (ABS) in cars, the effect of which is to shorten stopping distances, enabling the driver to brake more efficiently. But he intuitively senses that he can drive

faster this way. The primary purpose of ABS (safer braking) will be overridden by the secondary purpose that the driver derives from it (faster driving) and the original safety effect will be negated. The driver's risk marginals will be adjusted and the risk will not be reduced despite the safer brakes.

J. G. U. Adams (1985) has emerged as the most forceful proponent of the risk compensation model. He did not accept that safety precautions could significantly reduce accident rates and argued that in risky environments people behave more cautiously and have fewer accidents where safety precautions are weak. For example, he objects to a measure to stop traffic when children are getting on and off a school bus, because he believes this leads to them becoming careless. He opposes the spatial segregation of cars, cyclists and pedestrians and prefers them to share the same road because, in his view, they can regulate their own traffic behaviour and interaction in a civilised way. Safety measures, on the contrary, reinforce their carelessness and propensity to take risks.

Risk in road transport from a system theory perspective

The transport system, with its inherent risks, is very complex, with a large number of interconnected elements. Knowledge of these elements is not enough, because the whole is always more than their sum. The transport system is an open system whose safety is maintained by the homeostatic principle. It regulates its functioning by a feedback mechanism and adaptive functioning is established on the basis of simple rules.

The dynamics of the transport system are based on flows and accumulations. Risk phenomena and events in the transport system are flows that are constantly accumulating over time. One flow does not affect another flow, but it affects the accumulation. The road transport system is affected by flows of speed, acceleration and braking, overtaking, etc. These accumulate in the style of driving, which induces flows that accumulate in accidents but not in injuries. It is only the accident that induces the fluxes that accumulate, resulting in injuries of varying severity. So we can model the occurrence of an accident based on certain flows, but we cannot model the occurrence of injuries based on the same flows. We can derive these from the accumulations, which is the accident. Only the latter can provoke flows that result in injuries. The causal relationship is unambiguous: certain circumstances are the cause of an accident and only this consequence is the cause of another consequence, an injury. Respecting and identifying this causal relationship is fundamental to the understanding and research on risk and accidents.

7.4. Marginals of risk

Humans and animals are dispositionally equipped with an instinct for self-preservation and seeking safety. They have encoded within them a certain circumscribed zone of safety. The driver is equipped with a system of safety thresholds, the marginalia of risk. As long as the danger signal or risk is below the threshold, the driver accepts the situation and is not motivated to make any corrections in driving.

In the illustrative representation (Figure 7.1), each perceived risk is represented by an imaginary point on the roadside that bounds the driver's subjective safety zone. Such risk marginalia form a continuous edge of the safety zone that has no fixed shape but is intrinsically maintained. If a risk comes to the fore as particularly threatening, its marginals may move a little deeper into the safety zone; the driver does not tolerate it as much as usual. Changing the position of one marginal risk will change the boundary of the safety zone.

The shape of the edge of the safety zone is also shaped by the centrifugal and centripetal force exerted on it by the centre of gravity of the safety zone. The relaxed, relaxed state induces a sense of driving comfort in the driver, while at the same time reducing his alertness and going beyond his standard safety marginalia. The relaxed state can easily become somnolent. When a driver is overwhelmed by strong performance motivation, his safety zone swings in the opposite direction. His marginals of safety may shift into the zone of objective danger. He feels safe even though the objective conditions are not. If the introduction of a safety measure reduces the objective risk of not braking, the braking distance marginal will change, which is more likely to induce changes in the speed and distance marginals.

We cannot pinpoint, describe and measure psychological safety marginalia. Reflections on the safety zone and its margins will always take the path of abstraction and be hypothetical. This, understandably, translates into problems with testing models of traffic risk

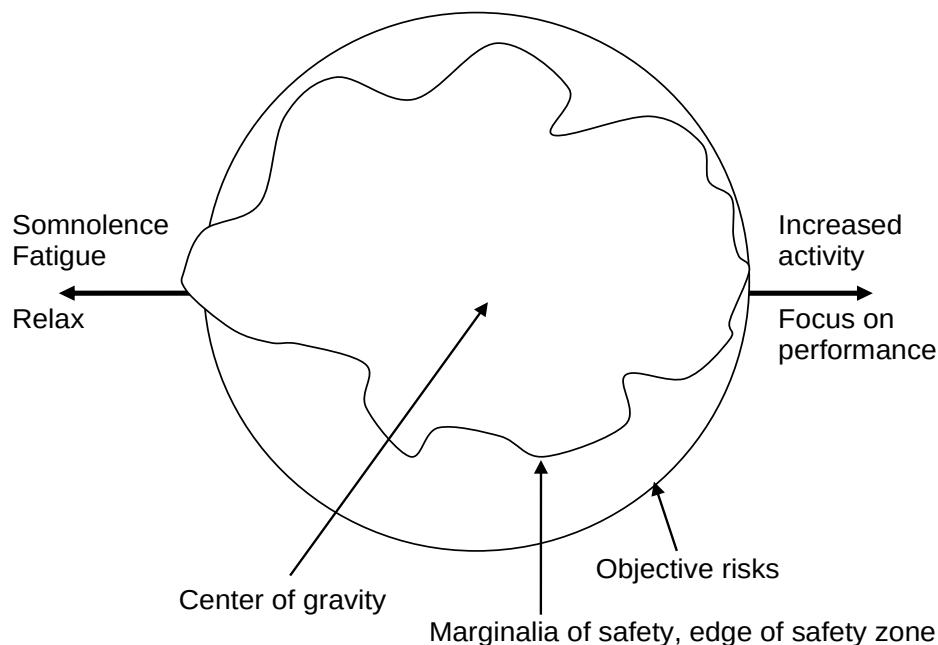


Figure 7.1 Risk perception and tolerance model

7.5. Safety concept and resilience engineering

Safety and risk are related, but they are two different phenomena. The term safety is traditionally associated with circumstances where something has gone wrong or could go wrong and endanger, with the concepts of mistakes, accidents, accidents, mishaps. Safety is a state in which we are not threatened by risks, or can control them. *Objective safety is beyond human consciousness; it is a property of objective reality.* It exists whether people are aware of it or not. In contrast, *subjective security is a manifestation of an individual's lived experience, a psychological phenomenon, a person's ability to perceive and be aware of it.* Subjective safety refers to the feelings that traffic situations and conditions arouse in the driver, the extent to which he or she feels that they are or are not safe. These

feelings are conditioned by his awareness, perception and acceptance of risk, his experience, his characteristics, his current condition and the influence of other people.

Hollnagel (2002) distinguished two categories of conceptions of safety, *safety I and II*. *Safety I* assumes that systems function reliably provided they are designed correctly, are carefully maintained in operation, and people behave as they are expected to. *Safety II* assumes that things go well because people can adjust what they do to fit the conditions of the job, and do so at all levels of its execution, from the lowest to the highest levels of management and leadership.

Ecosystems are characterised by two properties, *stability and resilience*. Stability is the ability of a system to return to its original equilibrium state after it has been temporarily disturbed, and resilience is its ability to absorb change and still exist. Resilience requires the ability to design systems that can absorb and adapt to future and unexpected events. This is the mission of resilience engineering.

It is not enough to monitor and assess risks properly, but also to anticipate and exploit opportunities. Unlike traditional risk management, which relies on hindsight to look at risk events and consequences, resilience engineering looks for ways to optimize performance and improve an organization's ability to address potential risks. The best time to invest in road safety is when everything is working well.

VIII. DRIVER PERFORMANCE AND EFFICIENCY.

Driving is a **job**, even if you're just driving for fun. *Work is a conscious and purposeful activity.* This thesis is true even though the driver performs many actions unconsciously, in an automated way. The bottom line is that he performs certain tasks and must maintain control over his actions. The work of a driver cannot be programmed like that of a worker in a crawler production. The driver is autonomous and operates in dynamic working conditions that bring changes and unexpected situations, and it is up to him how he reacts. The driver manages his own activities. He performs certain performances from which we judge his performance. Some performance, such as reaction time, we can measure accurately, but we cannot measure a driver's performance in this simple way and we determine it by whether and how he has completed a task.

The issue of driver performance has a key position in traffic psychology. *Performance is the enduring psychosomatic endowment and readiness of an individual, which is conditioned by his or her mental processes, somatic and psychic dispositions and states, and is exerted by the influence of external conditions and the demands of the task being performed.* In the description of human performance, the approach in the intent of information processes and the notion of the driver as an information processor has come to the fore (Figure 8.1). The flow of information through the mental is very complicated and is managed less reliably and predictably than it is in technical systems. Information processes here rely on both sensory and personal resources, and failures can be attributed to sensory inputs, but also to the more difficult-to-identify influences of the process factors of attention, thought, memory, and emotion.

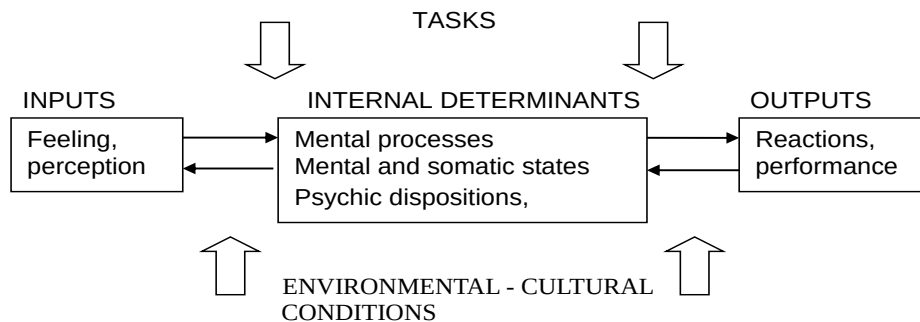


Figure 8.1 Basic driver performance model

By evaluating their performance and comparing themselves to others, drivers develop personal beliefs about *self-efficacy*, their own ability to cope with difficulties and challenges. It is reinforced by experienced successes and challenged by failures.

A driver's work performance is only a varying proportion of his overall performance, always working with some *margin of performance*. If he has a greater reserve, his potential and readiness to perform is greater and he retains the ability to work longer. In his work he does not usually need to give maximum performance and work at the limit of his performance reserve, but he has to give adequate performance in the long run. If work performance requires the depletion of more than 20 per cent of performance reserves, one has to exert more and more effort of will. Excessive depletion of performance reserves causes a decline in performance.

Driving is a self-regulated activity that relies on drivers' self-control and their ability to direct and adapt their behaviour to the driving circumstances. Those who do things also make mistakes. Drivers legitimately make them too.

8.1. Errors

In one thing all drivers are the same, none of them are flawless, they all make mistakes. The differences between them are why, how often and what mistakes they make. *An error is an event where a planned sequence of physical or mental actions fails to achieve the intended result, but it does not occur as a result of chance.* Good performances and mistakes stem from the same source; the difference is in the outcome. Every mistake has a cause, and the causes are manifold. We need to know and understand driver errors so that we can counter them.

Reason (1987; Reason et al., 1990) has contributed to a coherent conception and **taxonomy of human error**. The starting platform of his generic error modeling system (GEMS) is the distinction of errors into two categories, *conscious and unconscious errors*, which have different causes and also different ways of remediating them.

Conscious mistakes are actions that a person performs deliberately, knowing that he or she is doing wrong. They are referred to as violations or *misdemeanours*. They are violations of organizational or moral rules and cause offence to others. It is an obvious offence if a driver disregards a prohibition on entering or overtaking, but it is also an offence if he or she makes an obscene gesture to another driver, which is not literally forbidden by the traffic rules, but is a brazen act worthy of condemnation.

Unconscious mistakes are mistakes in which a person has no intention of breaking the rule and the norm. He acts with a good intention to achieve a goal, to accomplish a task, to do something right, but unknowingly commits an error. Unconscious, unintentional mistakes are classified according to their nature and possible countermeasures:

a) A *slip* is a type of error that occurs when a person is able and tries to perform the correct action but fails to do so, does it incorrectly, or "steps on the wrong foot". Usually this happens because of his inattention. Because he knows what and how he wanted to achieve, he does not need to train himself, but to be more careful.

b) A *lapse* is the omission of an act, an activity that should have been done. These are usually lapses of memory, but also inattention.

(c) A *mistake* is an error resulting from the performance of an incorrect action. Even if it is done perfectly, it is a mistake because another, correct action should have been taken.

Detection and probability of errors

Signal detection theory (Tanner and Swets, 1954) is concerned with how people respond to stimuli under conditions of uncertainty. A driver in fog not only reacts or fails to react automatically to an obstacle in front of him, but also makes decisions. His judgment is affected by the impaired perceptual conditions; he has no certainty whether the obstacle in front of him is or is not there. Because the subject determines the presence of the target stimulus based on incomplete information, his decision making is problematic. Table 8.1 shows four possible stimulus detection outcomes.

Table 8.1 Signal detection options

	the answer is yes	the answer is negative
the stimulus is present	<i>intervention</i>	<i>error</i>
the incentive is missing	<i>error - false alarm</i>	<i>correct refusal</i>

Error management and a systems approach to safety

Two approaches are applied in error management, personnel and system approaches. The personal approach focuses on individual mistakes and sees their causes in their inattention, forgetfulness, poor motivation. From the position that bad things happen to bad people, countermeasures are taken that attack the people who make the mistakes (blaming, intimidation, threats of sanctions). If something is done wrong, it goes without saying that someone is responsible and the guilty party must be identified and punished. The systemic approach to mistakes is based on the premise that *good performance and mistakes come from the same source*, the difference is in the outcome. It is not important who caused the error, but why organizational measures did not prevent the error. We cannot create the perfect driver, but we can create the conditions in which he or she operates and thus influence the occurrence of errors. Distinguishing between active failures and latent conditions is important for effective error management. Active failures are dangerous actions caused by people in direct contact with system elements, e.g. driving at high speed, failing to yield the right of way. Latent conditions arise from the decisions and performance of designers, builders, top management, e.g. lack of signage on a dangerous section of road, inappropriate road design, vehicle design error.

If we understand mistakes and understand them in a systemic way, we can predict them, prevent them and avoid them. However, we cannot do this perfectly, only with more or less probability. A lot depends on what kind of errors we are dealing with. We can predict constant errors much better than variable errors. An example of a constant error is drivers caught drink-driving late at night near bars and discos. The variable variance of such offences will be during the day at highway checks. If drivers make frequent wrong turns on a stretch of road, the error is constant and can be corrected by better turn signage.

Error management has four phases:

1. Detection - means realizing that something is not as it should be. It is better if we are able to realise that an error is occurring before it occurs.
2. Explanation - means understanding the cause and effect of the error.
3. Correction - on the basis of the explanation, correction and prevention can be carried out.
4. Integration - new knowledge and experience with the error and its correction is reflected in the mental model, which facilitates the detection and explanation of such an error in the future and is also a prevention to prevent the driver from committing such an error.

The main mission of any error management is to apply a comprehensive process that systematically identifies and anticipates incorrect operational behaviour that could lead to an accident. Since errors are a natural part of human functioning and people learn from errors, they should be a programmatic part of driver education and training. Understandably, we cannot have drivers experience the errors associated with real crashes as part of their training, at most in skid school. Near misses, situations where a malfunction has occurred but no accident has happened, can have an instructive, educational impact on drivers. They are a serious memento for drivers. For some they remain in the mind as traumatic memories, for others as a warning, but for many they quickly fade into oblivion.

IX. THE PSYCHOLOGICAL ESSENCES OF DRIVING

Driving relies on certain forms of observable and unobservable physical and mental activities of the driver. Although driving does not fall into the category of mental work, it is predominantly a mental activity in its nature. It involves and is made possible by the mental processes, states, personality dispositions and characteristics of the driver.

9.1. Information processes

Every human activity takes place as an information process. The basic scheme of the information process is *input - information processing - output* (Figure 9.1). On the input side are sensations from sensory receptors. The driver's ability to receive information is always limited, which is related to the type of transmission energy and to the adaptation of his receptors, the intensity, frequency and duration of the stimuli. The processing of information occurs through mental processes, perception, imagination, memory, thinking and learning. Psychological states and personality are involved. The outputs are motor, verbal, ideational and expressive responses. Information, whether encoded from the environment or from memory, regulates a person's actions.

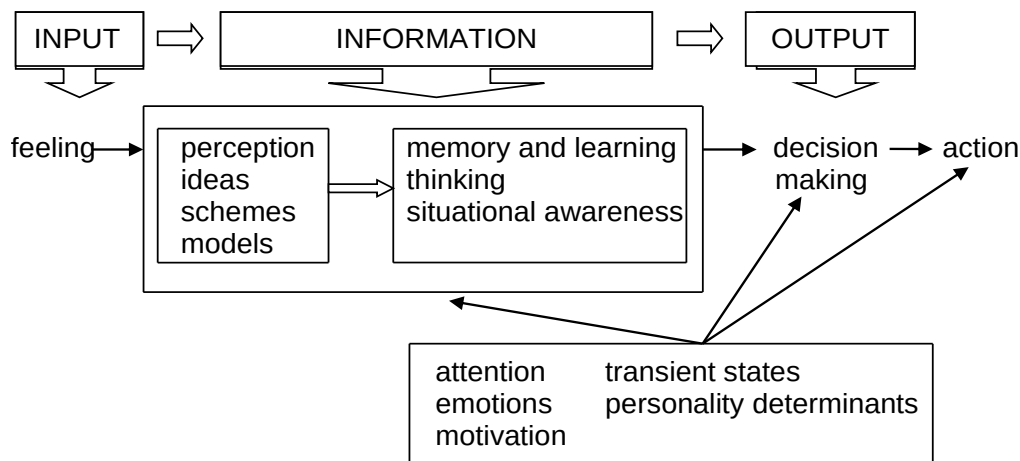


Figure 9.1 Contextual diagram of information processes

Information reception occurs in three stages: *detection*, *discrimination* and *interpretation*. **Detection** is the sensory ability to detect and register stimuli from the body and the environment, or to put it more specifically, to extract the signal from the noise. In order for a stimulus to act on a receptor, it must have a certain minimum intensity, it must reach an absolute threshold of sensation. The term **discrimination** in a narrower sense refers to the difference threshold, that is, the smallest difference in the intensity of a stimulus that we are still aware of as different. More comprehensively, discrimination refers to the perceptual ability to register differences in the multicomponent stimulus field just present. In the **interpretation** phase, the conversion of signals into information takes place. If it relies on comparison with a known or pointer-marked value, interpretation is straightforward and the meaning of the signal is immediately recognized. However, a significant part of the stimuli has to be processed by the driver in a more complex way, which requires more attention and time. The driver is

better equipped mentally to receive and process the information he is looking for and expecting than to receive information that warns him not to make a mistake. The reliability with which a driver can process information depends on a number of circumstances, the modality of the input, the method of encoding, the speed of presentation of the stimuli, and others.

Feelings are transformed through existing schemas that "tell" us how to make sense of them. The external environment provokes feelings in a person, but this stimulation is not sufficient to perceive the situation; it always acquires meaning within a framework. Feelings are transformed through existing schemas that "tell" how to make sense of them. **A schema is a mental framework for organizing knowledge.** The driver reacts reflexively to changes in the environment, to new stimuli. He applies schemata that allow him to identify objects by their shape, colour, size, function and to classify them according to such characteristics, for example as trucks, cars, sports cars, off-road cars and others, as objects and devices designed to power the car or those in the categories of lighting, signalling, seating, ventilation, etc.

Schneider and Shiffrin (1977) developed the concept of *controlled and automatic processes for detecting and processing information*. Controlled search is serial with limited matching speed and is attention intensive. It can be easily varied by the subject, but is highly dependent on the current mental load. Automatic detection requires less attention, is parallel in nature, is well learned, and benefits from the information store of long-term memory. Once learned, it is difficult to change and inhibit.

Automatic and controlled search while driving are two qualitatively different activities with different representation in the task hierarchy. In Rasmussen's SRK (skills, rules, knowledges) model this is the key paradigm. Rasmussen (1983 1990) proposed a stratifying, hierarchical abstraction as a useful framework for information processing. Each of its layers deals with the same system, but with the difference that different levels provide different models for observing the system. The choice of the level depends on the operator's experience and knowledge. Moving up the hierarchy from the bottom up clarifies the meaning of the goals to be achieved and from the top down explains what is done and how to achieve them. The internal interconnectedness of the levels and the movement from top to bottom and vice versa from bottom to top allow the driver to choose, according to the circumstances, the particular level of the hierarchy that is relevant for the achievement of the actual performance, while not losing sight of the main objective (see hierarchical model, chap. XIV).

In the process of learning about the world, one creates **mental models**. These represent the world and through them he then processes information about it and learns about it. The mission of the mental model is to represent and understand reality, its various phenomena. A model has the same structure as what it represents, e.g. the structure of a mental model of a car and the real form of the car, a model of an intersection and a real intersection, a model of a driving route and a real route. A mental model is always a subjective construct. When dealing with mental models of the driver, we have to bear in mind that they do not carry complete information about the matter in question, that they are incomplete, that they are a simplification of reality, and that they also distort it more or less by subjective insights, or by a lower level of knowledge and understanding, often by irrational attitudes and confabulations.

The highest level of psychological regulation, the **Self**, bears the greatest responsibility for drivers' behavior. It is from the awareness of the Self that a person's actions, decisions and evaluations, and the feelings of success and social prestige derived from them, spring. Consciousness is always consciousness of something; it has an object (I do something) but also a vehicle (I am the one who does it). Thanks to consciousness one forms an

image of oneself. Self-concept is an integral cognitive part of the self. A driver's self-concept is an essential factor in regulating his/her traffic behaviour, his/her interaction with the traffic environment and adaptation to its changes. On the basis of self-concept, he experiences satisfaction or dissatisfaction with himself and his self-esteem is formed.

9.2. Perception

Much of the sensory data is processed by the driver without the driver being aware of it, reflexively, automatically and effortlessly, which of course does not always mean that it is correct. He thinks and makes decisions based on the input data. This is the *realm of information processing, in which there is a bottom-up process*. The driver needs to learn to perceive moving cars on the road correctly, but also pedestrians, because he perceives them from the car from a different psychological perspective than he would if he were walking among them. He needs to acquire knowledge and experience of the responsiveness and movement of the car in order to be able to control it as well as possible and to be able to perceive and understand as well as possible how other objects in his field of vision are moving in relation to his movement with the car. It is not possible to create a perfect match between the driver and the movement of the car because the car's reactions depend on many factors, such as its load, driving, braking and centrifugal forces, tyre grip, friction, etc. The driver does not control the vehicle as naturally and immediately as his body does when walking.

Visual perception

Although all sensory modalities are systemically involved in driving, their representation is uneven. Vision plays the largest role. Driving is roughly 90%, a visual task and about half of the errors in controlling the vehicle are due to visual perception. The driver cannot perceive every visual stimulus clearly or process all visual stimuli. Only a small fraction of the constant barrage can reach the focal point of visual perception. The driver is constantly faced with the difficult task of distinguishing between redundancy and expediency of information. He does not view the environment chaotically. He applies selective attention in his perception, choosing stimuli that are significant.

A legitimate limitation in visual perception is the adaptation of the human eye, which has two distinct functional areas, the foveal and peripheral areas. The driver sees only what is in his field of vision, which includes the space projected on the retina of the eyes. He can increase his field of vision by eye movements and head movements. The highest *acuity of vision* is in the central part of the retina of the eye, the fovea centralis, where there is the greatest concentration of cones. Towards the sides, the cone density decreases and rods serving scotopic vision, the perception of different intensities of light, are added. The image of an object projected off the line of sight is perceived blurred, increasingly blurred, colour perception fades and at an angle above 45° vision becomes achromatic. Approximately 20° from the fovea is the maximum concentration of rods, and hence the greatest sensitivity to stimuli perceived in low light. This is the zone of twilight vision and the capture of moving objects outside the central vision.

The probability of object recognition is greatest when their image is fixed on the fovea and their retinal eccentricity decreases. Fixation times are relatively constant and under visual perception conditions have a duration of about 0.2 - 0.3 seconds during the day, but up to 0.5 seconds at night. Four fixations last approximately 900 msec. The driver can detect two to three objects per second with focused attention. His brain could process more, but the stated limits of the visual receptor do not allow this.

The area of the visual field from which information can be obtained by a brief glance without head and eye movement is referred to as the *functional visual field*. When examining the scene under observation, the driver moves his gaze from place to place, after a brief fixation the eyes make a single movement - a saccade to another place and fixate again for a moment. The saccadic movements are very fast (22 msec for short jumps and 40 msec for backward slips) and are sufficient to solve most visual tasks, but the observer does not acquire any other information during their execution until fixation.

Unlike saccadic eye movements, which shift the focus of gaze between objects, smooth tracking movements allow for longer, concentrated tracking of a single object. Without them, the position of the object would not be stabilized on the yellow spot and we would perceive it blurred. Such sharp tracking of an object's motion is only possible up to a speed of 30°/s, and after that the eyes begin to lag behind the object's position.

The human eye reacts in the binocular vision zone, swivelling 32° to either side, so the driver maintains sharp vision over a 60° range without turning his head. The width of the field of vision influences the perception of danger.

The faster the car is moving, the more objects pass through the driver's field of vision in a shorter time interval. The closer the objects are to the driver, the faster the information flow. From a certain threshold onwards, the driver is no longer able to register the stimuli and is no longer able to react to changes in the environment. As the driving speed increases, the driver's field of vision decreases. At a speed of 120 km/h it is reduced to 20°. At that point, he can best perceive what is more than 100 metres in front of him, but cannot see what is 10 metres in front of him.

Visual sensitivity is related to the intensity of light, the *illumination*, in addition to the field of vision. Accidents are more frequent when it is dusk to dawn, which means poorer lighting conditions for visual perception, similarly to rain and fog. A driver who illuminates the road with his headlights alone when driving at night finds it difficult to recognise even familiar surroundings. In favourable light conditions, drivers drive faster and more safely at the same time. For safe visual orientation, sufficient photons need to strike the retina of the eye and the light needs to be converted into nerve excitations, which is above 30 Lx. When driving at night, photons are scarce and vision is mediated by the cone function, to the detriment of visual acuity and colour recognition (illumination below 0.1 Lx).

Object detection through colour significantly supports its performance in the road environment, despite the fact that the reaction time to colour stimuli is both longer and more error-prone than to achromatic stimuli. Colour facilitates object detection, aiding in the separation and delineation of objects in the driver's field of view.

A distinction is made between **focal and ambient vision**. Focal vision is identical to central vision, with localisation in the range of 20 to 30° of the field of vision, with a predominance in its upper region. It is used for locating and recognizing objects when high visual acuity is required, such as when reading text. It is used for vehicle advancement, maintaining distances, overtaking and hazard detection. Ambient, lateral vision is within a range of up to 180° of the field of vision, with the lower part of the field of vision dominating, which is related to its importance for locomotion on the ground. Thanks to it, one retains stability and orientation even in conditions of poor visibility. Ambient vision includes peripheral vision. It is not sharp and mainly informs the observer about where objects are located and whether they are moving. Lack of attention significantly degrades focal vision, but not so much ambient vision, which takes place more automatically.

Drivers exhibit shorter reaction times to stimuli captured by focal vision than to stimuli in the ambient field of view, with reaction times extending almost to 3 seconds, even for experienced drivers, which is too long to recognize and react to a hazard.

A gaze focused on one place for a long time will cause the driver to deviate from a straight line and, moreover, a focused gaze is tiring and gradually becomes blurred. Experienced drivers spontaneously become visually preoccupied, looking around and glancing more frequently in the rear-view mirror, even when they do not intend to make a manoeuvre.

Even without realising it, the driver is not looking ahead in a completely random manner. He spontaneously or deliberately searches ahead with his gaze and reacts to external conditions by quickly directing and fixing his gaze on the most important, indeterminate or somehow attractive stimuli. Novice drivers have difficulty scanning the driving environment visually with purpose.

Perception of space

Although perception of space is a very complicated and demanding matter, drivers can estimate spatial givens automatically and quickly, orient and navigate in space with surprising confidence and reliability, but not absolute. A significant source of error in the perception of space is information that is tied to the observer's perspective. Distances, sizes, and directional characteristics of objects in space are generally perceived with ordinal-level precision, that is, the observer distinguishes what is more and less distant from him, what is larger and smaller, but without being able to determine exactly how much farther and how much larger. He is not familiar with the precepts of Euclidean geometry, but even so this is sufficient for him to orient himself safely in space

Perception is organized in a certain way, it applies the regularities revealed by gestalt psychology. The observer spontaneously searches for similarities and correspondences of perceived elements, which informs him that they belong together, they are part of a certain whole. The essence of perceptual organization is based on the extraction of an informationally significant whole (figure) from a less significant background. Under conditions of considerable similarity of figure and background, perceptual sensitivity decreases and perceptual error increases. For example, it is more difficult for a driver to distinguish a dark-clad pedestrian from a dark roadway.

Light rays striking the retina produce only a two-dimensional image in height and width, not in depth. From the retinal image, one cannot know what is closer and what is farther away, nor the actual size of the perceived objects. There are specific procedures given to man to manage this:

Binocular parallax is the most important indication of space perception. The disparity of projected images in the left and right eye decreases with increasing distance of objects.

The size of the projected image on the retina, which varies with the distance of the object from the eye. A more distant object is projected as smaller, and the observer perceives its distance from himself accordingly.

A linear perspective. The edges of a road, tunnel, or rail converge visually into the distance, even though they are actually parallel.

Overlap. We perceive an object that makes it impossible to see part of another object in the field of view as closer.

Atmospheric perspective. The air is not clear, but contains water molecules and dust particles, so that distant objects are not clear, their coloration loses saturation

Accommodation and vergence. The lens changes its curvature according to how far away the object being viewed is. The visual system picks up the change in tension in the

corresponding muscles, and this tells us about the smaller or larger distances of the objects being observed.

Problems arise in poor visibility conditions. In congested traffic, when driving in queues, the driver is unable to keep track of the distant area and focuses on checking the distance in the close radius of his vehicle. He regulates the safe position of his vehicle mainly according to the movement of the vehicle in front and to a lesser extent behind him. In dense fog, the perception of distances is limited to the brightness, angular size of the lamps of oncoming vehicles and the brake lights of the vehicle in front. Water particles in the air cause the driver to perceive objects as more distant

Motion and speed perception

If a driver observes a moving object on the road, this movement is reflected in the changing position of the stimulus on the retina of his eye, which he can evaluate. If he starts to track the moving object with his eyes, the shift of the stimulus on his retina stops, but he perceives its movement because the background, which is static in reality, starts to move in the opposite direction to the movement of his eyes.

During motion, there are extensive transformations of the retinal image, which is referred to as **optical flow**. If a person moves toward a stationary target, the image of all objects in his field of view rays from the point of view to the periphery. This point is the centre of the optical flow. The driver moves along a roadway with curves, avoids obstacles, overtakes, merges. At different moments, it evaluates different geometric situations, such as the radius of a turn or the width of the vehicle relative to the width of the lane. It uses the properties of optical flow. It chooses a reference point in front of it, which becomes the centre of the optical flow, and fixes its gaze on it. A beginner is more likely to choose a point close in front of the car, an experienced driver a convergent point on the horizon

The driver cannot calculate the speed of its own motion from the optical flux, but it can infer the time remaining in motion until it encounters the surface of the observed object. The accuracy of the velocity estimation depends on which parts of the visual field are stimulated. If ambient vision is also involved, the estimates are more accurate. Information from peripheral perception is more important for speed perception than frontal perception. In central vision, speed is underestimated. Speed perception is therefore more inaccurate on wide roads or in reduced visibility. Moreover, the driver's field of vision becomes increasingly reduced as speed increases and peripheral vision ceases to fulfil this purpose. Where there are houses and trees close to the roadside, the driver perceives his/her driving as faster and more dangerous than on roads in open spaces without more prominent objects and in dull zones.

Driving speed and safety are closely linked to the geometry of the roads. Drivers underestimate speed on wide roads and roads with straight versus winding design, when negotiating large radius versus sharp curves. With a speed limit of 30 km/h, road geometry has no effect on exceeding the speed limit. It mainly affects driving at higher speeds.

Errors in the perception of speed are manifested when changing it. Estimates are less accurate when speed is reduced than when it is increased. The greater the deceleration, the more erroneous is the estimate of the following speed and hence the braking distance. Drivers underestimate their speed if they decelerate or accelerate more gradually, when their vestibular sensations and perceptions are more subtle, and, conversely, overestimate it when they decelerate or accelerate more rapidly. If a driver slows down before a bend or when approaching a pedestrian crossing, his speed estimate tends to be underestimated and he is surprised that he was not able to brake safely. In conditions where all sensory

information is available simultaneously, speed estimates in the 50 to 80 km/h range are reasonably accurate.

The effect of adaptation is significantly involved in the perception of speed. When driving for a long time, the sensitivity to speed and to its deviations decreases. The longer the time of initial exposure to a particular speed, the more the estimate of the following speed is underestimated. If the driver drives at a constant speed for a longer period of time, it appears to him that he is slowing down. By the action of the contrast principle, he will inevitably underestimate his current speed if he has previously proceeded for a longer time at a greater speed. In order to maintain the sensation of constant speed, drivers increase their speed by 5 km/h when travelling at 50 km/h, by 15 km/h when travelling at 75 km/h and by up to 25 km/h when travelling at 110 km/h. Drivers unconsciously increase their speed in this way, especially on motorways, and are not very used to checking it by looking at the speedometer, so that the installation of an audible speed limit alarm is justified.

Cornering and overtaking

When entering a bend, the driver is guided not only by what he sees, but also by what he has already observed a few seconds before, from a greater distance before the bend, from a place where the bending road is out of his sight (Figure 9.2). By fixing his gaze on this location, obtains the information needed to plan the necessary speed and path in relation to the physical conditions of the environment. A driver entering a right-hand turn sees a smaller section of his lane but a larger section of the oncoming lane, and the amplitude of his view as he traverses the turn is smaller compared to a driver entering and traversing a left-hand turn, for whom the reverse is true. However, both are guided in their driving by information from this location, which gradually moves away from them as they go through the turn. As they pass it, they monitor their progress, gathering information for control, correcting, if necessary, what the information and guidance performance has induced. Before negotiating the turn, the driver selects a point of contact that lies at the point of the inside edge of the road in the turn. He shall not attempt to calculate the radius of the bend or the relative distances, but to maintain the angle between the vehicle's instantaneous heading and the moving point of contact.

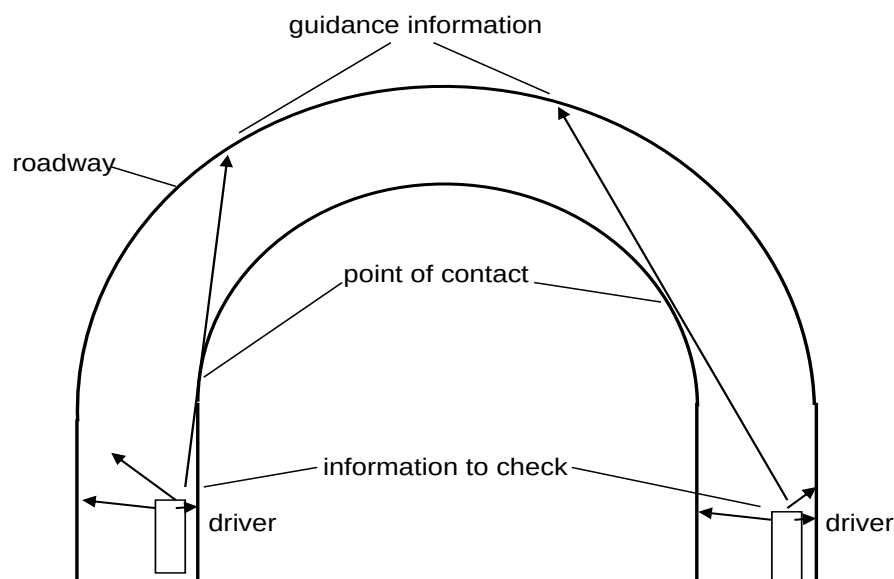


Figure 9.2 Visual information for right-hand and left-hand driving and control turn

In order to overtake safely, the driver must monitor the situation not only in front of him (oncoming vehicles in the left-hand lane) but also behind him. If he sees a vehicle in the left lane in the distance, he must estimate when it will be close enough to him that he will or will not be able to move into the left lane and overtake. If this vehicle is travelling at 130 km/h, it is advancing 36 metres every second. However, vehicles travelling in the left lane on the motorway are usually travelling faster, often at 150 km/h. The driver does not watch these vehicles permanently in the rear-view mirror, but usually at 15- to 20-second intervals, and so it happens that a vehicle appears unexpectedly at his side.

The lateral distance between vehicles travelling in lanes is about 1 metre. In the exterior rear-view mirror, the driver can see to the rear at an angle of 16° to 20° (Figure 9.3). The 20° angle is reached by leaning slightly forward. Above 21° , he no longer sees the overtaking vehicle in the rear-view mirror (position A). This zone is known as the *blind spot* (he can detect it with his peripheral vision, but only to a limited extent because he is looking in the rear-view mirror).

There are also significant demands on the driver to rejoin the right lane when completing an overtaking manoeuvre. If he can see the left front edge of the overtaken vehicle (position B), he can count on his driver seeing him. He can only move in front of him when he can see the whole of the front of the vehicle (C). At that point, he is 2.5 metres to the rear of the vehicle. However, if he were to reduce his speed in this manoeuvre (or the driver of the overtaken vehicle were to increase his speed), this distance would be reduced proportionally and a collision would be unavoidable.

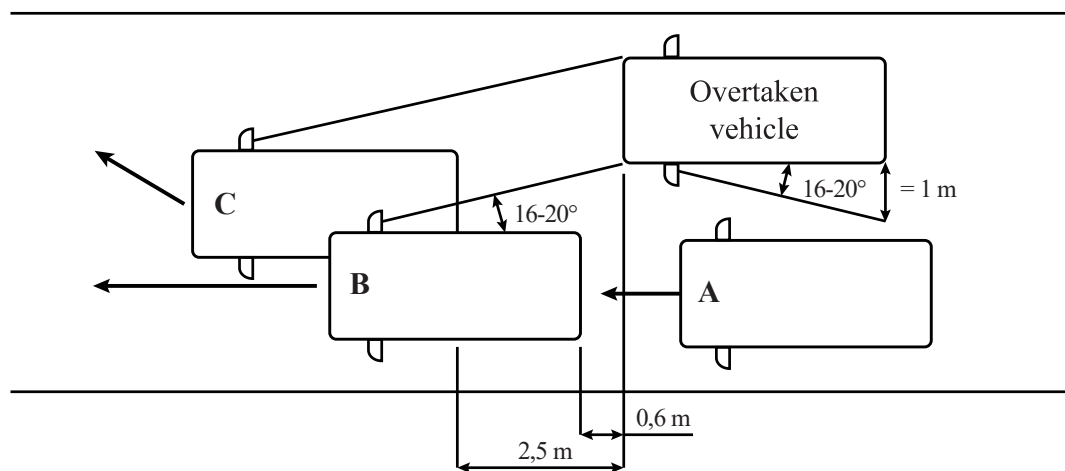


Figure 9.3 Overtaking

Visual occlusions

Diverse blocks of visual perception are a normal part of driving. Drivers often find themselves in situations where they do not keep their eyes on the road ahead for some time, averting their gaze to objects and scenes outside the lane or to the interior of the vehicle. Shifting one's gaze off the roadway is part of driving. If a driver takes his eyes off the road ahead while driving straight ahead, he is usually not at risk, but it depends on how long and under what conditions he continues to drive inertia. It is only right that a driver should take a few seconds to take in the situation of the roads crossing his path on the right and left before entering an intersection for a greater lateral distance. It is understandable that, if circumstances permit, he scans his surroundings without seeking the information necessary to steer the vehicle. It is more dangerous when he visually

searches for a vacant parking space or a shop or address on the side of the road while driving. There are more extreme situations in which visual perception is completely blocked, for example when an overtaking vehicle splashes mud or dirty water on the windscreen, so that the driver's vision is completely obscured. In this case, the occlusion may persist for some time after the wipers have been switched on. Similarly, a driver blinded by an oncoming vehicle continues to drive blindly. However, he or she is prepared for those few seconds of such driving because he or she has had the opportunity to view the situation on the road. As long as he continues to drive in a straight line with no obstructions in his lane, he is able to maintain his lane quite reliably thanks to his peripheral vision.

Standard one- to two-second occlusions, such as redirecting the view to the speedometer, rev counter, odometer or navigation screen, do not usually interfere with safe driving. Occlusions lasting more than 2 seconds are different. If the driver wants to continue driving, he basically has two options: leave his driving for that time to luck and fate or move forward based on the visual representation of the current driving path stored in the operational memory and benefit from intuition as well. Such a ride from memory is more hopeful than without it, but it has its great pitfalls. The visual memory scene is not perfect, as any one of us can test if he has to move in total darkness about his apartment, which, unlike the road, he has thoroughly mapped out and moved about in many times, and can be abundantly helped by touch and, more or less, by hearing, in addition to statokinetic perception. We have no such possibilities in a car. It doesn't pay to move a car blindly for a few seconds even in our own backyard.

Other sensory modalities

Hearing is the second busiest receptor for receiving information when driving. Drivers, pedestrians and cyclists acquire information about where they are and whether they are being approached by the sound that vehicles make. Drivers are protected from distracting and harmful noise in modern cars. However, they are largely deprived of the reception of external auditory information by the barriers created against external noise, e.g. they cannot hear when another car approaches from behind or to the side. If they have music playing loudly, they do not pick up the warning sounds either.

The importance of audible signalling increases in restricted visibility, but it also has an important associated mission in normal operating conditions, not only because the auditory analyser is very sensitive and its threshold of perception is lower than that of vision, but mainly because vision is very busy when driving and the driver may not pick up all the important visual information. Auditory stimuli are more perceptible than visual stimuli and the driver does not need to monitor them on the annunciator. Drivers respond more quickly and reliably to audible warnings than to visual warnings, or a combination of audible and visual warnings is the most appropriate signalling alternative.

Vestibular information is considerably less informative to the driver in a moving car than when walking, but it contributes to the driver's performance. **The sense of touch** also plays a significant role in driving, and is used to distinguish the shape and surface quality of controls, steering wheel, levers, pedals, switches and buttons. In conjunction with the kinesthetic analyser, the driver perceives the position of objects and their movement. The driver receives important information from receptors in the seat muscles and back about the forces acting on the vehicle when cornering, skidding, slippery surfaces or wind gusts. Driver perception and responsiveness to vibrotactile stimuli is faster than to visual cues, and its application in cars contributes to driving safety. The steering wheel is a very convenient place from which the driver can receive such signals

Ego-relational framework of perception

In vision-driven action, the observer uses a self-centered relational framework. In a narrower sense, this means that it specifies the position of objects in space relative to its own position. In a broader sense, ego-relationality expresses the fact that sensory impulses are refracted through a person's unique psychic interior. Each person creates his or her own unique perceptual reality, which involves personality variables. Whatever the conditions of perception, the resulting form of perception is determined by the observer's interpretation. It reflects his or her experience with the perceived stimuli, how he or she understands the perceived, and what his or her *perceptual orientation* is.

Although the driver perceives only a certain part of the environment available to his vision, he feels a more complex perception, as if he perceives the whole environment. He does not realise that what he perceives on the basis of current sensory inputs he supplements and completes with information from memory, experience and knowledge and according to his expectations. In essence, he sees more than his sight informs him. Perception here is top-down, conditioned by mental images that may or may not correspond to reality.

9.3. Reaction time

A constant challenge when driving is to react in time and manage your time, especially in connection with anticipating events in the next few seconds. How soon a car can stop from a certain speed and accelerate to the desired speed is limited not only by the laws of physics, but also by the time it takes for the driver's sensory organs, brain, nerves and muscles to trigger a reaction in the effector, to step on the pedal or to make another movement.

Reaction time (RT), as the time it takes for an excitation to travel in the nervous system from the receptor to the impulse for a motor response, cannot be measured, so *the reaction time is considered to be the time from the onset of a stimulus to the onset of a response*. The reaction time of a driver depends on several circumstances:

- *Modality, intensity and significance of the stimulus*. The fastest response is to the sound stimulus and to skin touch (140 ms), followed by the reaction time to light stimuli (180 ms). With increasing stimulus intensity, the reaction time decreases.

- *Simple and disjunctive, respectively complex RC*. Simple RC (response to one stimulus) can be up to 200 ms shorter than disjunctive RC (different responses to different stimuli).

- *The phase of the stimulus and the probability of its occurrence*. It takes a little longer to start a signal than to stop it. The driver reacts more quickly to the expected stimuli. Exceptions are unexpected stimuli, especially intense stimuli, to which the driver reacts reflexively. The RMS for an expected stimulus is around 900 ms, for an unexpected stimulus it rises above 1000 ms. Drivers respond fastest to visual stimuli that they expect to see in the centre of their vision.

- *The functional state of the receptors and the state of the organism*. RC is prolonged in impaired physical and psychological condition, in fatigue, illness, stress, intoxication, in advanced age.

- *Distraction and secondary burden*. In more complex driving conditions, when the driver has to pay attention to several things or has to respond to a stimulus that is currently beyond his attention, the RR increases by 30 percent or more.

- *Training and individual differences*. Reaction time is influenced by personality variables and driving experience.

In road transport, specific attention is paid to the **braking reaction time**, *which is the time required from the stimulus to the brake pedal being depressed with the pressure reaching 100N*. The driver needs the stimulus to act for at least 0.2 seconds to cause an excitation in the receptor, and then another 0.4 to 0.8 seconds for a simple reaction to take place. Such an RC within one second cannot be set as a standard value because it is influenced by the situational circumstances on the road. For braking, the *braking distance* is taken into account, *which* consists of the braking reaction time and the braking time until the vehicle comes to a standstill. It depends on vehicle speed and road surface (Table 9.1).

Table 9.1 Braking distance versus speed and road surface (after: Štikar, Hoskovec, Štikarová, 2003, p. 226)

speed	track during reaction time	braking distance dry for wet	braking distance dry for wet
30 km/h	8 m	5m 7m	13 m 15 m
50 km/h	14 m	12 m 20 m	26 m 34 m
80 km/h	22 m	31 m 50 m	53 m 72 m
100 km/h	28 m	48 m 80 m	76 m 108 m
120 km/h	33 m	70 m 111 m	103 m 144 m

Perception of time to contact

A critical event for a driver is when an obstacle appears in front of him. The time remaining for him as an observer to reach the object or for him to reach the object is referred to as Time-to-Contact (TTC). TTC plays a role not only in obstacle avoidance, but also in overtaking and manoeuvring, especially to the left, with respect to oncoming vehicles. The driver must determine whether he has enough time to move out of the path. TTC is not reaction time, although it is closely related to it, but it is even more closely related to perception. *It is information about when an object is at such a distance that a collision with it will occur*

The time to contact can be determined by the ratio of the visual angle of the object and the rate of change of its visual angle. This characteristic is denoted *tau* (τ). Determining the distance based on the size of the retinal image of the object causes distortion of the TTC. The driver estimates the time when the collision occurs as longer if the object is smaller and as shorter if the obstacle image is larger. Tau is an imperfect measure and is only valid for small angles.

There are several factors that influence TTC. One is a certain natural safety margin that the driver builds up in order to have enough time to avoid a collision. This manifests itself as a systematic 20 to 30% underestimation of TTC. The second factor is speed. The faster the driver moves the vehicle, the more he or she underestimates the time it will take to collide with an obstacle. The estimation of TTC is also affected by the structure of the environment. Drivers overestimate TTC and have smaller safety margins in visually poor environments (low visibility, at night, in desolate landscapes, on simulators). Within TTC, a distinction is made between TTC_{br} at the beginning of braking, which is the available time space for manoeuvring, and TTC_{min}, which is the time reached during the approach of two objects on a collision course. At the moment when the vehicle in front becomes visible to the driver, an increase in its TTC_{min} is induced, so that the driver builds up a sufficient safety margin. It is true that the smaller the TTC_{min}, the greater the risk of collision. In general, situations with a TTC of less than 1.5 seconds are critical.

Pedestrians make decisions when crossing the road based on the estimated speed of the approaching car and the estimated distance of the approaching car. They make their estimates using the TTC. Pedestrians usually cross the road in situations where vehicles are moving at 20-40 km/h, but sometimes at speeds higher than 50 km/h. They usually decide to cross the road when they have a time of 4 to 10 seconds before a car arrives at their level. It is very important for their safety if they estimate the TTC correctly.

9.4. Memory and learning

The driver compares the stimuli and situations he receives through his senses with the images produced by his memory and thus identifies their content and meaning. *Memory* is not a simple storehouse of information, but *is an active information processing system that contains the driver's knowledge, experiences and expectations, from which he forms expectations and extracts the basis for his decision-making*. The driver performs its tasks through both *implicit memory*, which relies on stored prior experiences that are recalled without deliberate effort, unconsciously (memories, skills), and *explicit memory*, in which re-cognition is deliberate and conscious ("I remember that..."). The more driving in certain conditions and situations requires the application of explicit memory, the more obvious the sense of effort experienced by the driver.

When driving a car, the driver needs to continuously remember current objects and scenes for a very short period of time. When he moves to a new place, these contents lose their meaning, he needs to register and remember new ones for a while. Optimal accuracy of *short-term memory* is reported at four to six elements, but an experienced driver can reliably recall a much larger number of unified visual elements during driving with short-term memory, which is strikingly different from an inexperienced novice driver.

Sensory encoding is applied in short-term memory, semantic encoding in long-term memory. *Semantic memory* allows the storage of information that is essential for language use. In contrast to semantic memory, *episodic memory* stores individual knowledge and its relationships in subjectively experienced time. The driver encodes a particular event that took place at a particular time, in a particular situation and conditions, in short, what he saw and experienced at that particular time. When he remembers at what pressure to inflate his tyres, he uses semantic memory; when he wants to remember where and when he last inflated them, he uses episodic memory.

Motor memory is crucial in driving. There is no driving without motor skills. A driver's work activity contains many motor actions and activities that he or she must remember. With short-term motor memory, there is a few seconds' duration of clues. We can recall information heard once after a long time, an episode experienced even after many years, but a motor action performed once quickly fades from memory. If it is learned, however, it is retained permanently. Even after many years, one does not forget to float or shift gears, to depress the clutch pedal synchronously.

The driver keeps the diagrams of the junction or roundabout in his mind and when he gets to them, he confronts the perceived reality with them. The more abstract the diagrams are, the more comprehensive they are and allow him to orient himself immediately to the new information. This happens largely automatically, without his conscious control. When he learns something new, he builds on already learned schemata. As long as the new information does not contradict them, he integrates it with them, which is referred to as consolidation. If, however, it does not fit into either of these schemata, he either rejects it or twists it to make it fit somehow, or, if it is serious and must be accepted, he revises the schemata he has hitherto applied, creating new ones.

Schemas make it easier for him to remember, but they also tend to hinder him when he has to accept incongruent information.

A specific type of episodic memory is *flashbulb memory*. It is a special memory mechanism that recalls a detailed record of experiences induced by a significant, surprising or even shocking event. For example, someone witnesses or is involved in a car crash, and this event becomes anchored in the memory as a vivid, relatively complete and accurate image that is resistant to forgetting. The characteristic of the memory of the moment is significant in terms of witness testimony.

Learning and long-term memory are related, but they cannot be equated. Long-term memory stores information without transforming it, which is different from learning, in which the subject restructures the input information. There is a difference between remembering traffic rules and learning them. *Learning as memorization with understanding* has a more lasting effect.

A person learns throughout his life and a driver learns throughout his driving experience, but most of all at the beginning. The nature of driving implies that its essential component is sensorimotor learning, the development of coordinated perceptual-motor structures that are necessary to control the movement of the vehicle. Intentional learning is aimed at achieving a level of acquisition of sensorimotor operations that ensures their reliable automated execution. However, driver learning cannot be limited to sensorimotor competences alone; it must also involve the acquisition of new knowledge that is necessary for driving. It needs to learn to react to situations not only mechanically, but to process the stimulus situation internally, to engage mediation processes, and to choose an appropriate response alternative based on an assessment of the situation. Cognitive learning is applied, the content of which is concepts, principles and problem solving. The driver needs to develop and adapt a mental model of driving and the road traffic environment in line with changes in the environment and people's lives. This requires him to apply his thinking skills, to be able to cognitively process situations based on the facts he knows and to learn new facts and ways of solving them. He is still learning to recognize the meaning of different stimuli and to adapt his reactions to their semantic content. It acquires abstract, generalized knowledge, new concepts and schemas. On the basis of cognitive learning, it is able to focus on the future, forming expectations and anticipating situations along the way. Learning is an essential component of its adaptability. Therefore, when assessing the mental fitness of drivers, we should not neglect their ability to learn.

The basic agents of learning are **reward and punishment**. Behaviour that is rewarded (appetitive behaviour) is reinforced and behaviour that is punished (aversive behaviour) is weakened. Punishment will not deter a driver from inappropriate behaviour if there is much to be gained through it. Many drivers reinforce inappropriate behaviour, such as very fast or competitive driving, because it gives them a satisfaction that outweighs the loss of the relatively unlikely punishment if they are caught by a police check. The effectiveness of punishment depends on a number of factors. For punishment to be effective, it must be sufficiently intense and unpleasant. The likelihood of punishment is also important. Drivers' misbehaviour is dampened to the extent that they expect to be punished for it. If the driver thinks that the probability of punishment is small, or if the probability of punishment and non-punishment are balanced, the deterrent effect of punishment is small. If police checks are infrequent, violations return to their previous level fairly quickly after the check. It is very important to create the supportive conditions to reinforce the desired behaviour, especially public opinion condemning undisciplined driver behaviour. In general, the certainty of punishment appears to be a more consistent deterrent than its severity.

The driver should not only be punished but also rewarded. If positive, disciplined behaviour is not rewarded, it is not reinforced. In road transport, punishments are easier to apply than rewards. It is unrealistic for police officers to stop drivers and praise them. Drivers need to learn to find rewards within themselves in the form of the satisfaction of driving safely, of pride in themselves, of meeting ethical standards.

9.5. Thinking, intelligence, wisdom

In his adaptation to the environment, man does not make do with the information he acquires through the senses, he must go beyond sensory cognition, to know the facts mediated by thinking, which is based on generalized knowledge, on concepts. Thinking is provoked by a problem, i.e., by a situation in which the goal is known and ways are sought to achieve it, but it cannot be achieved instinctively or by learned ways. A driver may avoid the obstacle in front of him in this way, but he should not overtake in this way. He needs to think and react with judgement, to consider the car in front of him and oncoming vehicles, to take into account his current speed and his acceleration possibilities, what time the overtaking path will require and to take into account other important circumstances.

Problem solving is always a conscious and deliberate activity. The search for a solution can take place at three levels. At the elementary level *by trial and error*. Thus, a driver may try to start a device he does not know and press different switches, or, when he wants to reach a destination in an unfamiliar city, he may try different access routes until he finds the right one. The higher level is *pictorial-visual thinking*, where he manipulates objects in his imagination, and the highest level is *conceptual-logical thinking*. In order to solve a problem, the driver needs to think logically, to reason according to the principles of formally correct thinking. He easily understands that he cannot continue driving if there is a lorry crossing the road in front of him, but he finds it harder to think about inertia in braking or centrifugal force. Even less elusive are indicators of the causality of social and psychological phenomena. It is often difficult to distinguish what is cause and what is effect. Nevertheless, the driver can acquire a sufficient amount of knowledge to enable him to understand the patterns of events and to anticipate events in driving the vehicle. Interaction with the traffic environment is mainly enabled by practical knowledge. Knowledge and schemas that have been formed on the basis of experience emerge more readily in his mind than theoretical ones. Schemas can be described as *general mental rules for solving problems* when driving a car.

Due to the nature of the environment and the rapid movement of the car, the driver must solve problems quickly. The process of analysis and synthesis would require a lot of time and so prefers uncomplicated solutions, built on simplification of the problem, **heuristics**. Essentially, these are solutions by guesswork. In *availability heuristics*, he applies what comes to mind first, guided by the feeling that it must be more important than what does not pop out of his mind so promptly. For *representativeness heuristics*, their solution consists of simply matching the problem to solutions of similar problems in another category. The more similar the current issue is to a particular representational phenomenon, the more tempting it is to solve according to that pattern. The pitfall of heuristics is that they can be overly simplistic.

Driving is a crucially practical activity, requiring mainly practical problem solving and an appropriate level of *practical intelligence*. Practical problems do not have clear-cut solutions. There are usually several possible solutions and success depends on a correct evaluation of their advantages and disadvantages. In road traffic conditions, it is not possible to 'prescribe' all the right solutions to drivers; they will always have to weigh up

the alternatives and understand the context that is set before them. While practical intelligence is a valuable underpinning of driving, enabling the driver to achieve the results they want to achieve, these may not be in line with the interests of the environment. Even a higher IQ does not guarantee that a driver can align his or her own interests with those of other participants.

People acquire specific knowledge in specific fields of their activity and work, which has a significant impact on their success. This is referred to as *tacit knowledge*. It refers to practical know-how that is not acquired through teaching and is rarely formally described. It is action-oriented, goal-oriented knowledge that is more related to the form of knowing how to do and solve something than to knowing what to do. Tacit knowledge distinguishes experts from novices, experienced drivers from novices, and is a better predictor of their success than their performance on intelligence tests. The ability to apply hidden knowledge to achieve the common good can be described as **wisdom**. When we state that a driver is behaving stupidly, we are not commenting on his intelligence, but rather only on the quality of the adaptability of his thinking and behaviour. Mistakes and unintentional errors need not be a sign of stupidity. Even intelligent and wise drivers will make mistakes. However, it is one sign of stupidity if they are unable or unwilling to learn from them adequately.

9.6. Attention

Lack of attention could be recognised, if not as a major, then to some extent as a contributory factor in every collision and accident. However, we cannot reliably distinguish and measure attention while driving. Attention does not have a specific content, but manifests itself in perception or thought. It is one aspect of all cognitive processes of consciousness. Attention mutes the influence of the whole range of stimuli that come upon a man from his outer and inner worlds, and enables him to attend only to those which are significant to him for some reason. He is thus more likely to be able to respond quickly and accurately to what he should or wants to respond to. If a driver overlooks a signal or obstacle on the road, these are serious errors, the causes of which may be external, in that these stimuli did not attract attention, or internal, in that the driver did not pay attention to them.

From the point of view of driver performance and road safety, all parameters of attention, *concentration*, *tensility*, *flexibility* and, last but not least, *distraction* by side activities, especially such an invasive activity as telephoning, are important. The driver's attention span is limited; the driver cannot pay attention to everything that is happening. In driving, which stimuli the driver focuses his attention on and which he ignores (*attentional selectivity*) plays a significant role. In attention, a filtering mechanism is applied, where only some of the stimuli and information from the barrage of stimuli penetrate into consciousness. It is referred to as *inattentional blindness* when drivers fail to notice stimuli relevant to task performance, and as *change blindness* when they fail to notice a visible change that has taken place, such as a traffic light turning red.

The justification of drivers' errors and accidents by their inattention is acceptable, but also considerably vague. We do not do mindfulness training for inattentive drivers, but we do try to influence their attitudes so that they are consciously attentive when driving.

9.7. Situational awareness

The term Situational Awareness (SA) appeared in the literature in the 1980s in connection with professional interest in the performance of military pilots. Empirical

evidence suggested that the survival of fighter pilots in combat was largely a matter of the extent to which they were aware of what was going on around them, from their ability to perceive and anticipate situations. The development of the theoretical concept of SA does not have a long history, and there remains confusion about what exactly SA is and its distinction from the concepts of attention and performance.

When a person is conscious (as opposed to unconscious), his mind is in a state where he is aware of the world around him and of himself. SA refers to consciousness in a narrower sense, as awareness of objective reality, of what is occurring and happening around the subject, not self-awareness and introspection. The behavior that generates SA must be directed toward an external goal.

The definition of SA (Endsley, 1995) is based on the delineation of three components of SA in the information processing process: 1. *Perception of* environmental features (detection and recognition of physical objects, people, events, system), dynamics, and the state of situational elements (current conditions, modes, activities, location). Situational awareness is dependent on the accuracy and range of perception, e.g., it is impaired when the driver is looking in the wrong direction, when exposed to occlusion, when he or she overhears signals at higher ambient noise levels, etc. 2. SA depends on the *understanding of* the meaning of the perceived stimuli with respect to the driving task. Here, the looked-but-failed-to-see phenomenon may occur. This component applies mainly at the manoeuvring level. 3. The third component of SA is *projection*. Perceived and understood conditions are projected into the near future, generating assumptions about the future behavior of the registered features. Decision making and action do not participate in situational awareness, but are conditioned by it. The driver's SA, with few exceptions, is not about thinking, but is an immediate recognition of what is already known to him, a recognition of key factors in the environment that are contained in his mental model. SA is transient in nature, the current SA replaces the previous one and is very quickly replaced by a new SA.

A state without situational awareness can be characterised as a state where the driver is unaware of the surrounding situation and unprepared for anything. A person in such a state should understandably not drive or enter the roadway. The road user may be relaxed, at ease, but should be prepared to pick up the necessary cues and signals of potential danger. However, he cannot be prepared unless he has knowledge of what constitutes the road traffic system, of the various events that take place in it, unless he has built up a mental model of it within himself. If he has one, if something significant is happening, especially something that could be threatening, he senses it, recognizes it and evaluates it, and if necessary, mobilizes and takes countermeasures. If the threat passes, it returns to a state of readiness.

9.8. Emotions

The driver's behaviour and actions accompany and influence his emotional experience. However, he is only aware of those emotions that reach a certain intensity. If he does not experience events with sufficient intensity, his emotional state is neutral, the situation appears to him to be going on normally and normally. The more intense emotions are of particular interest to experts because of their more likely adverse impact on driving. The highest levels of arousal are represented by **affects** that have a disorganising effect on behaviour and cognitive function. One of the most important prerequisites for adaptive behaviour in drivers is the **control of emotions**. The interconnectedness of emotion with personality is represented by **emotionality**, which is a personality trait given by an innate emotional constitution and shaped by upbringing and experience. A driver who lets his

emotions run free, unaware of their consequences for himself and others, is potentially a permanent danger in traffic.

In the 1970s, the concept of **negative affectivity** as a stable personality trait was introduced. Anxiety and neuroticism, as well as anger, fear, guilt, and nervousness, are central to this dispositional mood. People with negative affectivity have an unfavorable view of themselves and others, are skeptical, distrustful, and have poorer coping skills and thus may be more dangerous drivers.

Emotions cause a person to approach a risk through a shortened process of risk assessment, or allow him to react to a risk before he is aware of and identifies its cause, its source. In the concept of risk as a feeling, this process is referred to by the term **affective heuristics**. Such automatic application of a general and readily available emotional impression quickly tells the driver whether it is a good idea to continue or abort a manoeuvre, whether to brake or accelerate, to change lanes, to increase or decrease the distance. Emotional assessment of the situation can be tricky. Driving fast and dangerously, even having fun behind the wheel, can be emotionally desirable for the driver. Some people feel good even when driving in a slow-moving traffic jam; others feel anger, which can lead to a distorted perception of reality.

A significant component of emotionality and emotional control is **emotional intelligence**. When a driver is not aware of his or her feelings and cannot be adequately aware of them, he or she is powerless in the face of them. If he does not understand himself in this way, he cannot even distinguish and understand other people's emotions. An emotionally intelligent driver handles his emotions in a way that is appropriate to the situation. He can tame his annoyance, get rid of irritation, despondency and fears, and does not slip into aggression. Lack of emotional intelligence, let alone the absence of it, can be attributed to risk factors in driving.

Anxiety, worry and fear

Anxiety is irrelevant, it concerns the subject. The driver experiencing anxiety is not exposed to a specific threat, he does not know where, when and what bad thing will appear, he cannot avoid it or eliminate it. He feels helplessness and fears the loss of self-integrity. In a state of high anxiety, the driver cannot distinguish between stimuli of real danger and stimuli that are similar but not dangerous, irrelevant in terms of risk. Anxious individuals devote an unproductive amount of time to selecting alternatives, anticipating failure, and projecting fears of failure.

A person who is *worried* is worried about something that he can define rationally, that he is more or less clearly aware of. Worry activates the driver, promotes his readiness to react to danger, keeps him alert. By focusing on something specific, they selectively draw his attention and may thus weaken his receptivity to other threats. However, they do not disorganise his behaviour to the same extent as fear. It is better for a driver to fear real threats than to fear nothing.

Fear is the fear of something specific, of a particular threat and danger. It is good if the driver is afraid of an accident. However, it should not be so intense that it interferes with or even paralyses his performance. A specific emotional category is the **fear of driving**, which is a phobia that can develop after surviving a car accident.

Anger and rage

Anger is a biologically purposeful innate response to an obstacle in achieving a goal. In road traffic, a variety of obstacles arise for the driver, which it is neither appropriate nor acceptable to overcome with anger. Even more rejected is the escalated affect of anger, **rage** and **fury**. The semblance of rational control in the affective state is radically

weakened. Experiences of anger are often accompanied by impulsive reactive arousal and a decrease in receptivity to fear-provoking stimuli and a reduction in fear levels. In a state of anger, and especially in rage, one finds it difficult to control oneself. The more intense the anger, the more energy one feels within oneself and the greater the need for physical action, which translates into angry drivers reacting by speeding up and making rapid body and vehicle movements.

Guilt and shame

Remorse, remorse for wrongdoing, and shame of self are only human. They occur in man in situations where he has failed to live up to the standards, but not universally, not always, not even in everyone. Critical to their induction is the *consciousness of guilt*. Feelings of guilt are linked to the violation of those norms and principles that the driver not only knows, but has also accepted and internalized their value. There is always a rational component, an evaluation and critique of the self, inherent in the feeling of conscience, which is how bad conscience reaches the level of consciousness. The fool is not troubled by an evil conscience. The driver should.

Shame hinders personal expansion and, as a primary emotion, is a powerful supportive mechanism for socialization and non-conflictual interaction in traffic conditions. It is associated with feelings of fear, which inhibits behaviors that are socially rejected. However, it can also sometimes be associated with feelings of anger and resentment in an attempt to 'save face'. This is different from feelings of guilt, where such an association is unlikely. Drivers need to be educated to the desirability of feelings of shame, and this feeling should be reinforced in road traffic.

Pleasure, joy and happiness

If we ask drivers to tell us whether they are happy behind the wheel and what they actually experience then, they are very likely to talk about some of their driving pleasures, but not about happiness. In a narrower sense, happiness is mainly defined by its hedonistic content, i.e. a person's orientation towards the pleasurable experience of something and the avoidance of the opposite. The concept of happiness in a broader sense refers to the quality of life. The main characteristic of happiness here is not emotions, but values. The concept of **well-being** is closest to both the emotional and the value conceptions of happiness, in which happiness extends on a continuum from ordinary pleasures to a more complex state that is not as easy to achieve as pleasures and requires an investment of psychological energy. Driving is an activity that can contribute to, but equally undermine, well-being.

The conceptualization of driving as an *intrinsic* and *extrinsic activity* is crucial for understanding the position of pleasure in driving. An intrinsic activity has no goal other than to evoke joy in a person. Extrinsic activity has a purpose other than pleasure. It is used to accomplish some task and achieve some goal, and the bonus may be that one experiences joy in doing so. That is why so many people enjoy driving.

9.9. Motivation

The issue of driver motivation is essentially asking and answering the question *why?* Why drivers drive, why they do and behave in ways they shouldn't, and how to influence them to behave in desirable ways.

Motivation is a process of psychological regulation that determines the energization, focus, and persistence of behavior. The *activation* aspect explains why the driver actually does something, the *focus* aspect why he or she does what he or she does and not

something else, and the *persistence* aspect why he or she persists in certain activities and not in others. The issue of driver motivation to drive safely always has two aspects: what the driver has to do and what the driver wants to do. It is in the interest of optimal motivational effect that these components have a positive direction and do not contradict each other.

The driver's actions and behaviour behind the wheel of a car satisfy his or her basic physiological needs (e.g. the need for self-preservation, activity, sensory stimulation, exercise, physical well-being) and the need for safety and security. Satisfying these activates the satisfaction of higher ego-relational needs. It needs affirmation of its personal competence; it craves expressions of appreciation or even admiration.

The driver achieves different goals with different efforts. There is an inherent need to perform. In his *performance motivation*, two needs apply, the need to achieve success and the need to avoid failure. The one that dominates influences his evaluation of performance and task accomplishment. In doing so, doing something undemanding and where there is also certainty of achievement does not bring satisfaction. Greater satisfaction is provided by completing a difficult task, even if the probability of success is lower.

Meeting expectations and achievements, while they are the result of the driver's efforts, are intrinsic rewards for the driver. Intrinsic rewards are more motivationally effective for road safety than extrinsic rewards, which, although they play an important role in the driver's routine activities and compliance with road rules, do not engage the driver in safe driving to the same extent as intrinsic motives.

People differ in how demanding they are of themselves and the extent to which they need to set challenging goals. There are drivers who are not content to just take a leisurely drive, but spontaneously set higher performance goals. The effect of a driver's actions depends not only on whether he or she achieves the goals, but also on what goals he or she has set. He may set both good and bad goals, or he may set good goals but not meet them in the right way. He assigns value to goals based on the emotional satisfaction that is associated with their achievement. If he pursues multiple goals, these may come into conflict with each other, and some may rub up against each other. It is difficult to imagine a consistency between the motive of aggressive competition and the motive of safe driving.

During the motivational adjustment, the driver evaluates the incentive values of the goals, cognitively assesses the situational influences, possible outcomes, and consequences of taking actions. In this state, he or she processes a relatively wide range of information. After the decision, during the volitional adjustment, he processes information selectively and thinks about how to perform the action. Although it has already formed an intention, this may not be activated, e.g., when it assesses that the circumstances are not suitable to pursue the goal or when this intention conflicts with another intention. A driver's behaviour becomes risky when his or her inappropriate intention spills over into goal-directed behaviour.

According to Klebelsberg (1969), there are two opposing tendencies at work in the driver: the *performance tendency* and the *safety tendency*. The strengthening of one tendency is simultaneously reflected in the weakening of the other. A driver who is dominated by the safety tendency will prefer to discount his performance aspirations and goals, drive slower, allow himself to be overtaken, and cut time losses. Performance-oriented drivers take pride in their perceptual-motor skills, overestimate their driving abilities, have a riskier driving style, drive fast, and have a more emotional relationship with driving.

9.10. Decision-making

Decision-making is a process that is applied in a person's actions when he or she has a reason to do so. He cannot make a decision if he has no why and no what. Decision-making is preceded by problem identification and this is possible only on the basis of information acquisition and processing. The identification of the problem is followed by the phase of generating solution alternatives and assessing them. Based on the comparison, the most appropriate alternative is selected and becomes the basis for action. The driver is often faced with a lack of information or incomplete, unclear, or unreliable information when making a decision. He makes decisions in situations where he has no further information, but also in situations that are evolving and his information is changing. It would seem that the more information available to him, the more confident he would be in his decision-making, but this is only true up to a certain point, beyond which the intake of more information becomes unbearable, he risks being overwhelmed by information, and his certainty is less, not greater.

There are few situations in which a driver can make decisions without any uncertainty. Uncertainty is part of the decision-making process. Uncertain environments place increased demands on monitoring processes, and distinguishing between right and wrong decisions is made more difficult. Uncertainty is mainly caused by three types of situations: new, unusual and sudden. These are all situations that the driver normally encounters while driving. He or she is not prepared to deal with them and so is more likely to react emotionally.

We cannot expect the driver and other road users to make perfectly sensible decisions. They make decisions based on heuristics and prejudices, even if they have room for logical, inductive and deductive reasoning. They do not usually generate multiple choices and compare rational alternatives, but rather try to judge situations in hindsight based on previous knowledge and experience. By not comparing options, but choosing the option that best matches the relevant aspects of the situation, they are able to make a decision quickly.

Emotions also enter into the decision-making process. In order to induce positive emotions, a person tends to consider the chosen alternative as the best and restructure the mental representation of the current state of the situation to support his decision. In many of his decisions, the driver anticipates the disappointment and regret he would experience if he made the wrong choice. He is therefore more likely to choose the alternative that he expects to bring him satisfaction.

People by nature are more or less inclined to a certain style of decision-making. Some people need as much input as possible to make a decision, others need less, and even if they are offered more, they will still not pay attention to it. Someone is able to infer one or two solutions, the other needs to produce as many as possible. Drivers who base their decisions on a broader base of information and multiple output alternatives have difficulty making decisions and their decision making is more likely to be accompanied by feelings of uncertainty. Conversely, drivers with the opposite mind-set tend to make superficial and restrained decisions.

9.11. Set, mental setting and style

In the driver's behaviour and action, set is asserted as a kind of preliminary 'outline', a readiness to perform the act. At a lower level, it is a plan of impulsive behavior, automated and instinctive actions. At this level, it does not monitor reality comprehensively in all details, but only in those that fall within the framework defined by

the set. It is always pre-focused, and what it will perceive and what its motor responses will be depends on its set. Set exists independently of his consciousness. At the lowest, first-plan level, he reacts unconsciously, reacts in a first-plan way, he is not aware of everything he is doing and has to do, he automatically monitors the situation to a limited extent within the intentions of his set. It progresses without making conscious effort. All this until an obstacle, such as a slower moving car in front of him, appears. At that point, his set breaks, *objectification* enters the scene, and the driver contemplates whether to go slower behind it, or to overtake it, or to signal it to speed up. When the driver fails to adapt to the driving conditions through set, awareness and recognition of the causes that prevent this occurs and he consciously adapts his actions to the circumstances. If set is applied smoothly and proves successful, fixation occurs. If it is not suitable, it is difficult to overcome, so that it stands in the way of flexible adaptation.

Adaptation is a dynamic process that, although it always takes place in the here and now, arises from something that one has already prepared within oneself. It is tied to his **mental setting**, which is based on what is ingrained in him, what is not subject or very difficult to change. The building blocks of mental adjustment are personality dispositions, temperament and more permanent personality traits, fixed orientations, stereotypes and habits. The driver has a certain mental attitude to driving, to risks and to dealing with traffic situations. The setting reflects his or her more permanent motivational readiness to activate intentions and goal-directed action, the difficulty of the tasks he or she prefers. Individually characteristic mental settings give rise to an individually peculiar style of behaviour and life. **Driving style** is closely related to lifestyle, it is a derivative of it and may overlap with it more or less, but it is not a copy of it. Several driving styles can be distinguished in drivers, e.g. angry and aggressive, anxious, carefree, cautious.

X. PERSONALITY

Knowledge of personality theory is a pillar of a psychologist's expertise. Personality is a hypothetical construct, and one who deals with personality does so according to the theoretical conception to which he subscribes, how he understands this construct, and how he projects it in his imagination. Personality is a theoretical category that corresponds to the internal organization and functioning of the human psyche. It defines a certain general set of characteristics and functional components (which is the subject of personality psychology), but also different variants of their groupings in type and individual structures (which is the subject of psychodiagnostics).

We have many theories of personality, about twenty of which can be described as the most central, and many dozens more which have not so fundamentally influenced psychological thought. There is something in each of them that makes it at least a little attractive, but that does not necessarily mean that it is also useful. The most important theories of personality show many similarities, but their differences are even more striking.

How we understand personality structure in psychology is a kind of consensus, but not a truth. We cannot prove that it consists of temperament and character, among other things. However, it is practical to accept this and think in these categories. In the horizontal structural cross-section, personality is constituted by its *qualities* and *traits*. It is very difficult to identify the key, the most essential traits that would representatively unite larger groups of people. Even factor analysis did not provide more definitive clarification. The notion of traits has been conflated with the notion of *factor* and, after years of research, a plethora of them has been arrived at.

A person has a specific psychological program encoded in him or her, certain traits, temperament and personality type that remain characteristic of him or her throughout life. Whether empirically or by statistical analysis, groups of people can be traced who share common characteristics. By categorizing traits, theoretical types and typologies are arrived at.

10.1. Personality structure

Personality is a hypothetical construct, and its structure cannot be otherwise either. How we understand the structure of personality in psychology is a kind of consensus, but not the truth. We cannot prove that it consists of temperament and character, among other things. It is, however, practical to accept this and to think in these categories.

Structure is a set of relationships between elements of a set, or a way of organizing a system that is capable of self-organization and transformation. The structure of a personality is more related to its relatively more permanent organization, it tells about its architecture and the functional predetermination of the components that make it up. These, however, are in flux. Structure and dynamics are inseparable attributes of the system we have come to call personality.

In the horizontal structural cross-section, personality is made up of elements, its qualities and features. **Traits** are *personality characteristics that can be observed, described and verbally labeled* (liveliness, rashness, slowness, sociability, anxiety, aggressiveness). The situation is complicated by the fact that traits are also hypothetical characteristics, psychophysiological or psychosocial constructs that determine their manifest manifestations. **A disposition** is an *innate or acquired readiness to behave, act,*

or experience something in a certain way (actionability, excitability, anxiousness). The term **trait** is often considered a synonym of this term. It should not be so. Dispositions are a narrower concept, referring to specific reactions, traits are more general, referring to the style of functioning of the personality. The term trait is more appropriately reserved for *consistent patterns of behaviour, more general personality dispositions that are relatively persistent and stable, whether dispositional, innate in nature, or also acquired through upbringing and environment*. They are measurable when they are derived from quantifiable properties and dispositions. Traits are often understood as **personality dimensions** with their extreme poles. A trait is not just an abstract concept. It is real, even if no one has seen it, just like an attitude or an instinct.

It is very difficult to identify the key, the most essential features that would representatively unite larger groups of people. Even factor analysis did not provide more definitive clarification. The notion of trait has become confused with the notion of **factor**. Factor in the original meaning of the word means a quantity, a factor that influences and conditions something (educational factors, genetic factors). In psychology it is also used in this way, but also to denote more complex personality characteristics derived empirically or by factor analysis (introversion, extroversion, submissiveness, dominance, adaptive variability, surgency, etc.).

10.2. Personality typology

Personality typology is a construct that is based on empirical knowledge that people not only differ from each other, but also resemble each other in many ways, that there are groupings of people with related characteristics, and it is these that distinguish a particular grouping from other individuals and groupings. Although typology is always a certain simplification of the view of man, it is very useful. If we can correctly assign a person to a type, we have substantial knowledge about that person, and it allows us to more efficiently obtain, assign, and interpret other information about that person. If we know his type, we also know about those of his characteristics which we have not directly observed but which are immanent or very likely to be part of the personality make-up of that particular individual. The use of typologies has its pitfalls as well. First of all, we have not yet arrived at a full-fledged typology, and so any typology must be taken as approximate in relation to reality. Assigning a person to a type gives us a picture of him that is always only indicative.

Typology is the backbone of psychodiagnostics, especially where we are not looking for psychopathological symptoms, but are faced with the difficult task of expressing what kind of person it is who has to operate in certain specified conditions of life and work, which is to be reckoned with more or less probability in him. This applies fully to the psychodiagnosis of drivers. Assigning them to a certain type allows a more relevant assessment of their certain qualities and characteristics.

Although Hippocrates' view of the mixing of juices in the human body is naive from today's perspective, his typology is still a valid legacy of ancient wisdom after more than two millennia. This four-category content and semantic definition of temperaments is deeply rooted in theory and practice and has not been fundamentally challenged by anyone to this day. If something is said to be a temperament, there should be a consensus that it is related to the **Hippocratic classification**. All other categories in typological conceptions constructed to date and in the future should be called personality types, not temperaments.

An important milestone in the development of concepts of dispositional personality types was the contribution of **C. G. Jung**, pioneered the distinction between *extroversion*

and *introversion* and established four basic functions that each person possesses, and according to their representation in individual psychic life, people differ: thinking and feeling, intuition and perception. Although Jung established three dimensions of personality, he based his typology on a combination of only two, a dominant focus and one dominant function. He did not attempt to incorporate both bipolar functions into the typology to create a more plastic model of personality. This was done only by his follower **K. C. Briggs** together with her daughter *I. Briggs Myers*. They delineated four basic dimensions of personality (extroversion - introversion, sensuality - intuitiveness, rationality - emotionality, deliberateness - receptivity) and 16 personality types by combining them.

Factor analysis represented a major breakthrough in personality research. However, research often did not begin and rest on a theoretical conception of personality, but this was only derived from the results of factor analysis. **H. J. Eysenck** developed his concept of temperament from a clinical research sample, and so it does not stand on firm foundations in terms of generalizability and validity for the normal population. **R. B. Cattell**, like Eysenck, believed in the existence of enduring personality dimensions inferable by factor analysis. Cattell's 16-factor concept and the questionnaire he constructed seemed to hold promise for psychodiagnostics, but in practice fell far short of this expectation. The results of the examinations were formally quite spectacular, but the knowledge obtained about the person being assessed was shallow, psychometrically inaccurate, and often even misleading. Nor did his naming of new factors catch on.

Cattell's research, and that of his opponents, had the side effect of leading to the discovery of **five major factors** (dimensions) of personality. From a lexical base, the dimensions that make up the five-factor structure of personality were derived by factor analysis: 1. neuroticism, 2. extraversion, 3. openness to experience, 4. agreeableness, and 5. conscientiousness. The five-factor model is neither a theory of personality nor a typology. It conflates the dispositional subsystems of personality and character, which creates a difficult obstacle to overcome in order to arrive at a consistent typological model.

The development of knowledge so far suggests that the ancient typology of temperaments is a solid foundation from which new typologies of personality can be derived and on which new typologies of personality should be built. If we can say of anything in psychology that it is a recognized prototype, it is these four temperaments. For any new model may be a kind of test of its correctness. If they are in harmony with each other, if their mutually derivative relations are non-contradictory, it is very likely to be viable. If there is no consistency, the author of the new conception is either taking a new path of discovery, the correctness of which only the future will show, or it is a dubious construction which may shine for a while, but which will not enlighten our knowledge in a lasting way. Typologies that are congruent with the concept of temperaments are more likely to be useful in psychodiagnostic practice as well as in psychological research.

In psychodiagnostic practice, the psychologist needs to rely on theoretical distinctions about which traits are typologically principled, which ones contribute significantly to the determination of types, and which ones are marginal. G. W. Allport proposed a classification of traits into:

- *Cardinal dimensions* that are dominant in the personality and manifest in almost all its manifestations (extroversion - introversion).
- *The central dimensions* are less pronounced but are significantly applied in behaviour (emotional stability - lability/neuroticism, sensitivity - rationality, sensuality - intuitiveness, deliberateness - receptivity, primacy/secondary).

- *Secondary dimensions* that contribute least to a consistent typological picture of personality. These dimensions have not yet sufficiently demonstrated typological potential or verified such applicability, but they undoubtedly illustrate the picture of types (task-relationship orientation, performance-safety orientation, thrill-seeking-non-thrill-seeking).

Dimensions that are applied autonomously in psychodiagnostics or are adjuvant in typologies are categorized as secondary. The dimensions on the basis of which the most well-known typologies are derived can be considered central. We can consider as cardinal those from which temperaments are derived and we also find them as key in personality typologies.

XI. KEY PERSONALITY FACTORS AND PSYCHOLOGICAL STATES ASSOCIATED WITH RISKY DRIVING AND ACCIDENTS

Since the early days of motoring, it has been observed that drivers did not make the same mistakes in the same conditions, nor did they make the same mistakes as often, that traffic situations were more likely to provoke risky behaviour in drivers with certain personality traits than in otherwise personality-matched and differently situated individuals. This was the basis from which the syndromological concept of accident proneness, the accident prone concept, arose. It drew justified criticism and did not take hold, but it did prompt psychological research into the personality of drivers, which showed that risky driving, offending and accidents were likely to be associated with certain personality traits. However, there is no consensus as to which of these traits are critical or what level of psychometric value of these traits is a contraindication to being granted a driving licence or practising as a driver. The influence of personality on risky driving remains unresolved and we cannot expect to arrive at an exact determination. Personality traits are interlinked with each other and with ontogenetic circumstances, education, life experience, lifestyle, in short, we are dealing with the individual uniqueness of the driver. The same adverse characteristic in two drivers is not the same and may not pose the same support or threat to the effectiveness and safety of their driving.

Three groups of factors determine risky driving and accident rates:

1. Permanent characteristics - permanent personality equipment, personality dispositions and constitutional type.
2. Transient conditions - temporary, shorter-term conditions such as fatigue and exhaustion, alcohol and other drug impairment, illness.
3. Developmental factors - age-related psychological and physiological processes.

11.1. Susceptibility to accidents

In 1926, Farmer and Chambers concluded, based on previous statistical evidence and their own research, that there was a relationship between accidents and "poor aesthetokinetic coordination and neural instability" and introduced the term "accident proneness". Dunbar (1943) specified accident proneness as a syndrome. However, the implementation of such a medical category required the identification of the pathological personality configuration of accident proneness as an aberrant syndrome. This was not accomplished, and there was a move away from the personality-disposition conception of accident proneness.

To use the term accident prone in the sense of a person genetically predisposed to accidents is unacceptable. However, it is justified if we use it to describe a driver who has had accidents repeatedly. Such a label characterises him but does not diagnose him, nor does it mean that he must be permanently so. It is not correct to regard the propensity to have accidents as a form of driver incapacity to function under road traffic conditions, as a stable personality disposition, and to set up a general interpretive principle of his regulatory reliability in this way. However, to accept and apply the expert opinion on accident propensity as a premise is justified and it is also methodologically viable.

That certain personality traits, characteristics and factors play a significant role in risk behaviours and accident rates has been confirmed by many research studies and is true

across different cultures. The association of unsafe driving with impulsivity, emotional imbalance and asociality has been demonstrated fairly consistently.

11.2. Skills and Abilities

Driving requires certain skills and abilities. They are two distinct mental categories. We cannot evaluate a driver's abilities by his knowledge and skills. Skills and knowledge are acquired through learning and practice, they are subject to faster change than abilities, which are the result of the overall ontogenetic development of the individual, they are more general and more enduring.

Skill models of driver behaviour derived driving safety from the level of skill and ability in relation to the difficulty of the tasks performed. Accordingly, accidents are the result of drivers' inadequate cognitive, especially perceptual-motor, performance and occur when task demands exceed the capacity of their abilities. It was concluded that traffic safety can be improved by improving the skills and abilities of drivers and reducing the demands on their performance, by making their tasks less demanding. However, scores on tests of sensorimotor and cognitive performance have not been sufficiently demonstrated as relevant predictors of safe driving, and research has not confirmed the association of accident rates with reaction time, with levels of sensorimotor coordination, or with levels of intelligence. Nor did driver training aimed at increasing drivers' driving skill levels translate into the expected reduction in their accident rates.

An adequate level of skills and abilities is a prerequisite for driving, but more relevant to safe driving are **executive functions**, *a set of higher cognitive abilities that are important for effectively performing complex and novel everyday tasks*. They involve volition, planning, problem solving, multitasking, attitudes and behavioural self-control. Weaker levels of executive functions are manifested by difficulties in making decisions and finding solutions in complex traffic situations (e.g. when starting to overtake a vehicle or when merging into a lane), reduced efficiency in processing information from internal and external sources, and impaired ability to recognise one's own driving errors and failures.

11.3. Attitudes

Everything that the driver knows about and has some meaning for him, he has an attitude towards. He has attitudes to driving, to driving on the motorway, to a certain route, to other drivers, to women behind the wheel, to the traffic police, to alcohol, etc. Attitudes play a role in driving depending on their valence, their positive or negative direction and their intensity. Inappropriate driver attitudes, especially those towards risk and road safety, have been and will continue to be enemy number 1. We are unlikely to change the dispositional characteristics of drivers that condition their risk-taking behaviour, but their inappropriate attitudes can be changed, albeit not easily. Shaping the desirable and rebuilding the inappropriate attitudes of road users is one of the most essential tasks in maintaining a functional and safe road transport system.

Attitude has three components, *cognitive, emotional and conative*. A driver's attitudes towards seat belt fastening, alcohol or automatic restraint systems depend on what he knows about them and what his emotional relationship to them is. Unless he knows that even a small amount of alcohol adversely impairs his responsiveness behind the wheel and is happy to drink, he will act as such and is more likely to get behind the wheel. Emotions are often inconsistent with rationality. People also have irrational attitudes and hold onto them for their positive emotional valence. The driver knows that fast driving is

dangerous, but it gives him pleasure and he has a positive attitude toward it, even when reason tells him he shouldn't. Even if the rational component of the attitude changes, it doesn't mean that the emotional component changes synchronously. Some attitudes are formed by the driver's education in driving school, some are formed dominantly on the basis of emotional experiences while driving, and some seem to have arisen without the participation of reason and emotion, simply through assimilation to other people's behaviour, through the adoption of social habits and patterns of behaviour. Attitudes are differentiated into *explicit and implicit*, according to whether one is aware of them or whether they rest on automatic evaluations of objects in situations where one is not in conscious control of one's behaviour. Many a driver thinks he has democratic attitudes towards other participants, but when his interests and rights are at stake he behaves in an intolerant or overbearing manner.

Attitudes are linked to, but not identical with, motivation. Motives activate driver behaviour (e.g. driving fast to meet a deadline) and attitudes are manifested in the driver's evaluation and preferences (whether he or she is attracted to and appreciates fast driving, or is more likely to find it annoying). The cognitive and emotional components of attitude influence the **intention** to perform a certain behaviour as well as the behaviour itself. Intention does not yet constitute action; it is merely a readiness to act. It depends on the complexity and difficulty of the task and the remoteness of the goal to what extent intention is separated from the decision to act. Intention is determined by attitude as an inner readiness for a delayed and not easy action. The realization of intention requires a series of actions and the planning of ways and means to achieve the goal. Intentional action is planned and is an essential part of volitional action.

According to *the Theory of Reasoned Action* (TRA), the most significant predictor of behaviour is not attitude but intention. Thus, what is important in driver behaviour is not the driver's attitude towards the object of the attitude, e.g. seat belts, but his attitude towards the behaviour towards this object. Therefore, the driver is not asked about his attitude towards seat belts, but whether he considers it good or bad that he buckles or will buckle his seat belt (evaluative beliefs) and whether he believes that if he were to buckle his seat belt, it would be beneficial, safer for him (instrumental beliefs). The subjective norm expresses what he thinks people important to him will think about it. If he thinks they think he should cling and is motivated to please them, he tends to behave according to the norm. The comparison between internal and external pressures leads to the intention to implement or not implement the behavior. The driver's motivation is exerted in the direction of self-directed behaviour (e.g., I will drive slowly) and submission to social pressure (others will appreciate it), but this can also induce conflict (I will be judged for slowing down in traffic).

Ajzen's *Theory of Planned Behavior* (TPB) is an enriched conception of intentional behavior (Ajzen 1985, 2000). Intention does not yet constitute action; it is merely a readiness to act. Intentional action is planned and is an essential part of volitional action. TPB (Figure 11.1) is extended from TRA by a new element, the factor of *perceived behavioral control*. How a person perceives the possibility of behaving in a certain way is determined by his or her beliefs about his or her own behavioral control and the ease or difficulty of performing the behavior. A person's intentions and behavior are determined by his or her awareness of his or her own competence (self-efficacy), which implies his or her belief that he or she is in control, in control of his or her own behavior and performance, and is not in the grip of external, uncontrolled influences. Intentions occupy a central position in TPB, and attitudes are only one of three factors that determine intentions. Attitudes arise spontaneously and consistently from beliefs that are available in memory and subsequently guide behavior. Since the most important factor in the

execution of a behavior is intention, it is unlikely that a driver will execute a behavior without motivation. Even if he is motivated and a certain behaviour is important to him and he has the intention to perform it, he also needs to have the knowledge and skills and there should not be serious social and environmental constraints to perform it. The experience of performing the behaviour may induce habituation and then the intention will not be as important for performing the behaviour in question.

TPB is attractive because of its unpretentious application in research projects. Its psychometric instruments are constructed uncomplicatedly in the form of bipolar 5- to 7-item scales, and even the creation of a custom questionnaire does not pose a major problem for researchers. Most research from the TPB position on the relationship between attitudes and unsafe driver behavior has focused on attitudes toward speed, which has shown that attitude, subjective norm, and perceived control are significantly related to the intention to drive fast, exceeding posted speed limits.

Perceived behavioural control is the most significant predictor of road users' intentions and behaviour. If drivers exercised volition, if they wanted to, they could drive at safe and desired speeds, but many do not because they believe they have control over driving fast. Likewise, perceived behavioral control is the best direct predictor of impaired driving. Subjective norms and intentions have a weaker link to such behavior.

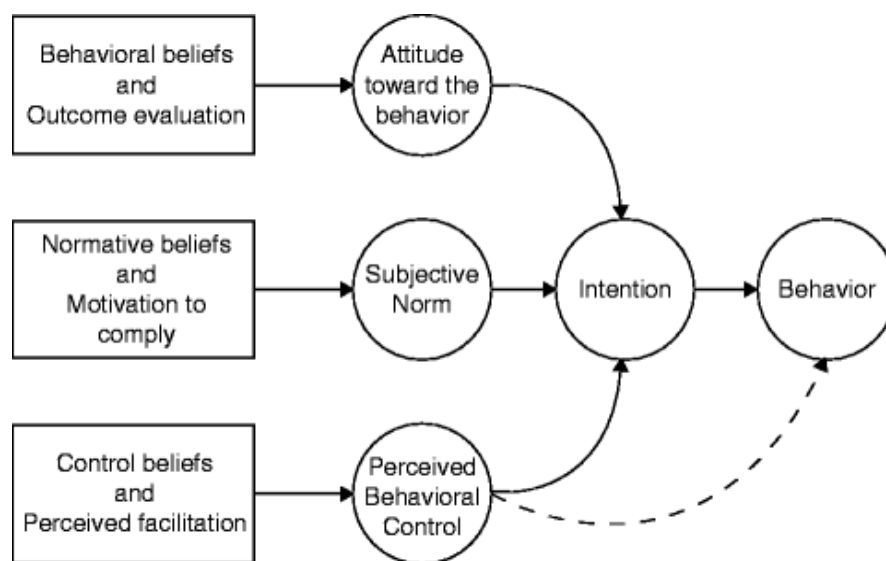


Figure 11.1 Model of planned behaviour (adapted from: Ajzen, 1985)

Changing attitudes

The demonstrated links between attitudes and behaviour are reflected in efforts to induce positive attitude modification and thus safer behaviour among road users. The reasons why this has not been achieved to the desired extent are the resistance of attitudes to change, the difficulty of developing the most effective intervention methods and programmes, the low willingness to cooperate of those affected by attitude change, as well as the persistent ambiguity in attitude theory. TPB is broadly effective in explaining people's behaviour, but considerably less so in modifying it.

Perhaps the biggest barrier to achieving positive attitudinal change in road transport is emotion. Attitudes correspond to the best feeling and drivers find it difficult to give up attitudes that make them feel good emotionally. If talking on the phone behind the wheel or driving fast gives the driver pleasure, this contributes to maintaining a positive attitude towards such a dangerous activity. If the desired change in behaviour and associated attitudes is contrary to the best feeling, it will be very difficult to achieve. Another serious barrier is customs and traditions. It is difficult to change inappropriate behaviour that is habitual, that corresponds with the majority attitudes in society.

Different attitudes have different severity in terms of driving. Some belong to the category of central, concerning important objects (safety, children, health, employment), others are peripheral, their importance is small to insignificant. Central and extreme attitudes are more resistant to change. It is easier to change a driver's attitude to a particular petrol station than to driving fast; it is easier to change the attitude to drinking alcohol before driving of a casual drinker than of a drinker who has drinking embedded in his or her lifestyle. Attitudes can be simple, based on a single cognition or experience, or multiplex, such as a driver's attitude to safety, which rests on a broad plethora of them. People evaluate different aspects of safety differently, and this multiplexity complicates efforts to change it. With rare exceptions, it is impossible to influence everything underlying certain undesirable attitudes. A viable route is to identify the most essential formative elements and the focal function of the attitude and focus on these as a priority, while applying a roundabout manoeuvre to attack the function to which it is most closely related.

11.4. Values

When a person is aware of his values, he reflects on what is important, valuable for him in life. Values relate to desirable goals, motivate and are a criterion for judging one's own actions and the actions of other people. Values are something like a censor for different motives; they open the gate for some and close it for others. Each person forms his or her own value system, which does not change in content, but the order of values may change. When he falls ill, health is very likely to become a central value for him. Similarly, when a driver experiences a serious traffic accident, driving safety comes to the forefront of his value ranking.

Values lie deep in the intimate sphere of the personality, are only to a very limited extent observable and little open to recognition. A study of values that relied on their deduction from human actions would be very difficult, cumbersome, and indeterminate. The only viable route is the questionnaire method. But the results thus obtained are burdened with bias. Respondents are very likely to testify to desired values and not to those they actually profess. They know which values are generally valued and appropriate them, even if they do not follow them. Values can be arrived at by examining attitudes. Values do not refer to specific objects and persons; they are more abstract than attitudes, but they are reflected in them. Attitudes can be positive or negative; values are always only positive. Values are more enduring than attitudes and more difficult to change.

It is in the interest of road safety that *the value of safety* should be central to the values of road users. Practice does not suggest this and research has not found such a value preference. Road transport circumstances are not extremely threatening and therefore do not make the value of safety very salient. Efforts to reinforce the position of certain values are successful if they are consistent with the existing culture, and therefore the focus should be on shaping a desirable road transport culture. However, this is a long-term and complex process.

11.5. Exhaustion

The depletion of energy in the body manifests itself in fatigue and drowsiness, which adversely affects the performance and efficiency of drivers and endangers road safety.

Sleepiness

Fatigue and *drowsiness* are not the same thing. We can better express what drowsiness is than what fatigue is. We are sleepy when we feel like sleeping. However, we can be tired even though we have had enough sleep and not feel sleepy. We are better at predicting that a person will be sleepy if he does not get enough sleep, but we are worse at predicting his tiredness. In car accidents, it is difficult to prove whether fatigue or drowsiness was the cause.

Each person has a certain rhythm of waking and sleeping that contributes significantly to his or her alertness. Physiological processes exhibit roughly 24-hour circadian rhythms that overlap with the rhythm of body temperature change during the day. In humans, vigilance of attention varies in accordance with this rhythm, and there is a decline in performance in the afternoon and especially at night. Less than 9 to 12 hours of sleep in the last 48 hours and less than 5 hours of sleep in the last 24 hours represent a critical range of increased crash risk for drivers. Sleep deprivation impairs drivers' performance, especially impairs attention, increases reaction time and reduces reaction accuracy, especially in more complex tasks.

A drowsy driver drives more through automated tasks and habitual patterns and finds it harder to think and solve problems. When drivers are drowsy, they retain the ability to perform routine activities to an acceptable degree, they are generally good at keeping the vehicle in its lane and at keeping a safe distance from the vehicle in front, but their performance will be significantly impaired in responding to unexpected events.

Drowsiness can be induced by microsleep, which is a 0.5 to 3-second state at the borderline between sleep and wakefulness in which the driver does not perceive stimuli or perceives but does not react to them. Microsleep does not occur out of the blue; it is preceded by a number of warning signs in addition to a feeling of drowsiness, such as eyelid strain, yawning, blurring of vision, straining to maintain attention, and general flaccidity. Underestimating, ignoring or suppressing them will not avert the threat of microsleep. Drowsiness is highly resistant to the driver's motivation to suppress it, to push through and be alert again. Intense drowsiness and fatigue induce unpleasant sensations that can take on a state of agony. A driver who is seized by intense drowsiness and does not deal with it by resting is embarrassed and dangerous when driving.

Fatigue

Fatigue comes in several forms, such as physical, cognitive and emotional. It has multiple components and manifestations, physiological, performance, behavioural and experiential. These components are related, but correlations between them are low. A driver may experience fatigue without concomitant physiological changes, or conversely, these may be present but he does not experience fatigue. A major problem in fatigue research lies in the lack of a generally accepted metric of drowsiness and fatigue.

Fatigue is most often thought of as a physiological state that is the body's response to the depletion of energy stores in muscle and nerve cells. It is a protective lull in activity that allows energy stores to recover. The general manifestation of fatigue is a decline in physical and mental performance. On the physical side, it is mainly a loss of muscle strength. In the mental sphere, the manifestations of fatigue are more numerous. The driver is less attentive due to fatigue, reacts more slowly and superficially, his

sensorimotor coordination deteriorates. The threshold of sensitivity to visual stimuli increases, visual acuity, colour discrimination and distance estimation decrease. As fatigue increases, perception and maintaining safe distances from the vehicle in front deteriorate. Fatigue impairs peripheral vision, reduces the driver's useful field of vision, and produces a tunnel effect. The effects of fatigue are more pronounced when cornering than on straight sections. On smaller radius curves, tired drivers find it more difficult to control the steering wheel and are more likely to drift out of their lane. As a result of fatigue, the ability to anticipate the nature of the road and events becomes more reactive and behaviour less anticipatory.

A drop in performance is more likely to occur with monotonous rather than standard or even slightly more demanding driving. It can be termed *passive fatigue*, which arises from a lack of stimuli and low demands on the driver, as opposed to *active fatigue*, arises from the workload and especially the overload of stimuli and demands on the driver. The intensity of the feeling of fatigue may not correspond to the actual state of exhaustion, loss of energy.

Monotony

Driving monotony occurs when driving is tedious, when stimuli are few or repetitive and predictable. Such conditions are induced by driving on the motorway ('motorway hypnosis'), but also by driving on a road with few curves, along a familiar and repetitive route. Monotony induces fatigue, but drivers may not feel fatigued when driving in monotony, and hypovigilance from monotony occurs even in well-rested drivers. When driving under conditions of monotony, changes in neurophysiological processes occur, which are also manifested in the EEG record. This condition is accompanied by a decline in performance that occurs after less than 20 minutes of monotonous driving.

Monotony affects the perception of time. During monotonous driving, the driver performs automated tasks, his mind is not occupied with the tasks of driving. He indulges in feelings and thoughts that flow freely in his inner world, so that even then time passes slowly. Under conditions of cognitive load, the driver performs a number of demanding mental operations which, although objectively more time-consuming, the amount of mental content is less, and so time seems to pass quickly. Under monotonous conditions, a condition known as driving without *awareness* may occur. It is characterized by a loss of attention without being induced by fatigue. Unlike microsleep, it takes place without closing the eyes. The driver is mentally absent and when he or she awakens from this state, he or she cannot remember what happened during this time of driving.

Resistance to fatigue

It is known from experience and confirmed by research that people differ in their resistance to fatigue. Some can continue working for long periods of time without experiencing fatigue, while others start to show signs of fatigue very early on, with fatigue signing on their performance more for some and less for others. Many drivers are able to maintain good performance even after several hours of driving. Obviously, a lot depends on how they acknowledge fatigue and drowsiness, how they approach it, what their experience of it is.

The driver is able to maintain good performance despite limited sleep time. The extent to which he can do this depends on his individual tolerance to sleep deprivation, his fitness and, last but not least, his attitude to fatigue and his performance motivation. The driver actively responds to feelings of fatigue and thereby influences it. Fatigue is not a separate phenomenon and process, but is the resultant of the interaction of the processes of deactivation and compensation.

Fatigue is an unpleasant condition and produces aversion, both to it and to the activity with which it is associated. It can also cause a weakening of the motivation to compensate for its adverse manifestations and consequences by increased effort. On the other hand, its appetitive side may be present if the driver has not lost the 'will' to perform despite fatigue, if he or she cares about achieving his or her goals. If his goals are important to him, he may decide to exert effort to overcome the fatigue-induced decline in his performance. Increased effort, however, may contradict his well-being, so he may exercise the second alternative, to reduce the difficulty of the goals or to withdraw from the activity. It is up to him how he regulates his actions. Fatigue is, to some extent, the result of mismanaging one's goals and activities.

Although people differ in their need for sleep, some need more and some less, in general a person needs at least six hours of sleep to maintain performance. However, it always depends on other circumstances as well, especially the demands of the work being done, the duration of wakefulness and sleep in the previous days, and also sleep habits. A driver cannot rely on the fact that he or she enjoys driving and is able to relax while driving. It will always be the work and the task that require his alertness. To keep it at the required level, he can use secondary activities to enliven the monotonous driving, such as listening to music or talking to a passenger. Drivers help to ward off fatigue by consuming *energy drinks and coffee*. However, the best way to combat fatigue is to rest. Professional drivers take driving breaks more systematically and make it a habit to plan them before driving. Non-professional drivers usually react to fatigue only when it overtakes them.

Increasingly sophisticated fatigue detection devices are being developed, but their application is accompanied by the problem of drivers acting on these warnings. Unless they force the driver to stop driving, they will only confirm what they themselves very often know, that they are getting tired and should stop driving.

11.6. Load and stress

Driving, like any other occupational activity, involves certain forms of strain that have a differential impact on driving performance and safety. A *reasonable workload* is defined as one where the driver's performance is in balance with the conditions and demands of driving. *Optimal workload* does not require a greater mobilisation of forces and does not have negative consequences for the driver; on the contrary, it keeps him fit, gives him satisfaction and is a source of self-development. The category of optimal load includes **eustress**, which is a positive load that is positively experienced and experienced positively. If the demands on the driver rise above the level of the optimal load, his equilibrium state is severely disturbed, he is aware of this and experiences unpleasant emotional strain. This is *borderline stress*. It is within a person's power to cope with and, despite its negative concomitants, may not harm him or her, or at best may strengthen him or her. A driver needs to train himself to be a full-fledged driver even in this way. *Excessive load* is referred to as **stress**. If prolonged, it can cause psychological and somatic harm. A special form of stress is **distress**. Unlike stress, it is always conscious and is subjectively perceived as an inability to cope with the demands placed upon one, as a loss of control over the situation and oneself. It causes anxiety and depression. Obviously harmful is *extreme stress* to which one cannot adapt, leading to maladaptive behaviour or even psychological failure.

Stress results in impaired concentration, reaction and cognitive abilities of the driver, leading to a deterioration in his overall work performance. Increased information load causes losses in the input of information to a greater extent than in the processing phase.

Under stress, the driver is more likely to overlook important signals than to misjudge the signals. Information overload is also experienced voluntarily when the driver is engaged in secondary activities in addition to driving. The cognitive load is caused by circumstances that he cannot deal with by automated procedures and has to deal with them in a time crunch.

If the driver is subjected to a reasonable load, after two to three hours of driving, he or she may or may not experience slight exhaustion. A short break would be sufficient for him to recover. With longer rides or heavier loads, the exhaustion increases and negatively affects his performance. He is more likely to make mistakes and has to push himself harder to be attentive. Even with such a load, his performance normalizes after a more substantial break in riding. When the demands of driving increase and induce stress, the driver's performance deteriorates more noticeably and the driving break does not sufficiently recover his strength. With recurrent stress, the driver ceases to enjoy driving and his interest in driving gradually becomes more and more waning, and he performs it inertia and with effort. If he does not allow himself the conditions and more time to recover, this condition may gradually become chronic. The well-being of the affected driver is devastated and the burnout syndrome comes to the fore.

Coping is an important determinant of driver performance. Essential in coping with load is how they evaluate the stressful situation. Acceptance and avoidance are the two most essential responses to stressful events. The choice of coping strategy influences the controllability of situations. Those that appear controllable are more likely to prompt a coping strategy, and those that appear uncontrollable are more likely to elicit emotional and avoidant responses.

The manifestation of constructive coping is *proactive coping*, which is an individual effort to prevent or change a difficult situation before it happens. It consists of recognizing and anticipating potential stressors so that they can be eliminated in the future. Proactive coping is a thoughtful form of coping, it is oriented towards problem solving, skill improvement and action planning. In contrast, reactive coping is an orientation to emotion and mitigating the emotional impact of stress on survival.

The driver may vary his coping strategies, not reacting uniformly in different stressful situations. However, there is much to suggest that drivers prefer a particular style of coping that they have developed based on their dispositional characteristics and how they have learned to cope with stress in their previous practice.

Multitasking and secondary workload

Humans can and often need to perform multiple tasks simultaneously, which is referred to as *multitasking*. In some cases this is easy, such as walking while talking, in others it is very difficult, such as listening to what someone is saying and reading at the same time. The harder the primary task is to perform, the more performance decreases in the secondary task, and the reverse is also true. The more difficult the driving conditions in rush hour or at high speed, the less well the driver obtains and processes information from the IVIS, or the more difficult the IVIS is to work with, the more it interferes with the monitoring of the road. In addition to the primary tasks of visual lane monitoring, kerbing and dashboard information system monitoring, drivers also add secondary tasks that have nothing to do with driving, manipulating the radio, talking on the phone or even texting, talking to the passenger, solving various problems in their minds, eating, drinking, grooming their appearance.

The driver has multiple information processing resources (visual, auditory, olfactory, tactile) and can use them simultaneously if the task requires it, but if two tasks require the same resource, it can only be applied sequentially. The driver's perceptual and motor

responses can run parallel to thinking, but he cannot have multiple issues in his mind at the same time, he can only think about one at a time, and then the other. With a secondary task, the cognitive activity associated with it occupies the resource space for cognitive engagement with the primary task. Tasks that require the same resource at the same time cause problems for the driver, he performs them more slowly and is more likely to perform them incorrectly. Multiple tasks can be performed in synergy, but they interfere with each other, and an increase in the difficulty of one task will result in a loss in the performance of the other task. Interference is greater when performing similar tasks than when performing dissimilar tasks. Since the primary task of the driver is to monitor the roadway, the associated task of also monitoring the visual instructions on the display will interfere with performance in the primary task because both tasks are competing for the same resource. However, if auditory instructions are received, a different resource is used and the distracting effects on performance in the primary task will be minimal. Focal and ambient visual information processing can occur simultaneously because they use two separate resources that are linked to distinct cerebral structures. The driver can maintain the vehicle in the lane with ambient vision and perceive the road sign with foveal vision at the same time, without performance suffering as a result.

Talking on the phone behind the wheel is an associated, unnecessary and distracting secondary activity, but one that is very common when driving. Basic phone handling is mostly a well-automated activity, but it still interferes with the sensorimotor tasks of driving. Telephoning engages not only the driver's hands and eyesight, but also their imagination, memory and thinking. His attention and mind turn inward at the expense of his perception and rational evaluation of the outside world. The more complicated the road conditions, the more distracting the phone calls become. Drivers react more slowly, make more mistakes, are less sensitive to risks, have reduced situational awareness, and their vision is tunnel vision. Phone handling is undoubtedly distracting, but eliminating it with hands-free technology does not solve the problem of interference, because the mental burden and distraction caused by communication is essential. Texting exceeds all other secondary activities in distraction. It occupies visual, manual and cognitive resources and interferes with the task of controlling the movement of the vehicle.

A disturbing mental activity is also a **wandering mind**. Wandering thoughts come to mind effortlessly, without more obvious external precedent stimuli, and in order to run their course, they need one not to be currently subjected to mental effort and trying to direct them. A wandering mind is triggered when the brain and consciousness are not occupied with processing information from the external environment and dealing with urgent situations. Such conditions are mainly created by quiet and monotonous driving.

The mind is rarely aware that it is engaged in wandering thoughts, as if it is unwilling to take note of itself. If a wandering mind is in progress, external information is less likely to be processed, although reflexive and automatic responses remain preserved. A driver wandering in thought does not deliberately shift his gaze in the field of vision but "does not see what he sees", he slows down or increases speed, switches lights, but lacks the conscious intention to attend to a particular stimulus and deliberately perform a particular action. Often he or she will not awaken from the wandering mind until the last moment or even too late to brake or make an appropriate manoeuvre in time.

11.7. Sensation seeking

Zuckerman, the author of the concept of sensation seeking, considers it a personality trait, which he defines as "the need for varied, novel, and complex excitement and experiences, and the willingness to take physical and social risks for the sake of such

experiences" (Zuckerman, 2007, p. 49). Thrill-seeking is associated with extreme sports, motorcycling, and for some, risky sexual activities and criminality. Thrill seeking is not a psychological disorder.

In order to survive, a person must show some affinity and tolerance for new stimuli and exciting experiences, but those who are conditioned to seek them out more readily may be more likely to cause problems for themselves and others. Those with higher levels of thrill-seeking do not seek risk per se, but sensations that can be achieved through risky activities. They cannot get rid of this personality disposition and will always be inclined towards adventurous and dangerous activities. In all research, involving both men and women, across different national cultures, it has been shown that men tend to seek thrills to a significantly greater extent.

Thrill-seeking drivers perceive driving as less dangerous. They are efficient, control the vehicle well, react promptly and do not make driving mistakes more than others, but are more likely to deliberately break rules and discipline. They are more likely to overestimate their abilities and underestimate traffic risks. They take more risks and may therefore have more accidents. Thrill-seeking is associated with drivers' dominant focus on perceptual-motor skills, not driving safety. They are more averse to boredom and are more likely to diversify their driving with fast driving, risky manoeuvring and exciting secondary activities. It has been shown that drivers who scored higher on thrill-seeking also showed a stronger tendency to drive under the influence of alcohol. Thrill-seeking does not deprive drivers of self-control and they must guard against thrill-seeking in road traffic conditions.

11.8. Aggression

Aggression is a genotypic and phenotypic human nature, a biologically, socially and culturally conditioned psychological phenomenon. It is encountered wherever people live. The more aggression is a concomitant of road traffic somewhere, the more it is also a central problem of road safety.

Instinctive aggression in animals hurts other animals, but it is necessary for the survival of every animal. Related to instinctive aggression is **affective aggression**. Its source resides in the developmentally oldest brain centers (limbic system, corpus amygdaloidum). It is also commonly referred to as impulsive aggression because it easily flares up. It is accompanied by strong negative emotions, anger or fear. It is intense but unconscious and unplanned. It is not a means to an end, but an end in itself. The dominance of such aggression forms the image of *an affective type of violent person who is easily provoked, irritable, emotionally unstable and impatient*. This type of violent person is a permanent threat to discipline and safety in road transport.

Aggression that is not reactive in nature, but is also a means of achieving certain benefits and goals, is referred to as **instrumental aggression**. In order to achieve their goal, drivers use instrumental means to annoy or even threaten others, flashing their lights, using red warning lights, accelerating and braking hard, manoeuvring the vehicle in a threatening manner. Thinking and acting in a planned and goal-oriented way is called agonal, and **agonal aggression** is distinguished in this sense. It is mainly expressed in the ability to *compete with* others and to assert oneself against them. When agonal aggression is excessive, we are dealing with *a type of agonal aggressor* characterised by the use of aggression as a means of satisfying his or her goal orientation and ambitions with less or no regard for the interests of the other participants. He maintains self-control, is not given to impulses, but is all the more attracted in his fantasies to the goal state and motivated by the need for success. He does not need situational stimuli to arouse aggression; he

deliberately provokes it himself, chooses his own objects of self-assertion, acts unemotionally, often cold-bloodedly and harshly, and does not concern himself with compassion for others.

The most normal and least harmful form of aggression is *playful violence*. Violence is practised in the pursuit of admirable perfection, but not in the pursuit of destruction. Examples are the various fighting games in which the aim is not to maim or kill the opponent (although even that can happen if he has been unlucky). The main goal is not destruction, but skill and displaying it for admiration. Such motivation slumbers and or even manifests itself in more than one driver. Young drivers are especially prone to this form of aggression, and only exceptionally old drivers.

Provocation and inhibition of driver aggression

Aggression does not arise of itself and for itself. It is part of a complex system. In every society, there are certain behaviours that are acceptable and at the same time behaviours that are not tolerated. Cognitive and emotional components are intertwined in the provocation and inhibition of aggression. Not only the emotions that the driver is currently experiencing, but also those that he or she expects to experience, play an important role. They relate to the future, with imagination of possible situational alternatives and cognitive-emotional appraisal of their consequences.

If a driver is being restrained or harassed or attacked, if he or she does not accept this, the driver may react by escaping, defending or counter-attacking. How he reacts depends on many circumstances, on his personality, experience, attitudes, whether or not he is afraid, agitated, angry or cool.

Anger often accompanies aggression, but a person can be aggressive without being angry, and an angry person does not have to be aggressive. Drivers who have themselves been the victim of aggression or have been in an accident are more easily angered. No significant relationship was found between driver anger and general aggressiveness and aggressive driving behavior. Drivers become irritated when their rights are denied and their driving comfort is impaired. Female drivers are more prone to irritation than male drivers, who in turn are more prone to aggression

The bottom line is that aggression develops and unfolds within personal interaction and social context. Aggression looks different from the point of view of the aggressor, the victim and the observer. The aggressive driver perceives others as more likely than themselves to be aggressive or as potential aggressors. Aggressive behavior is determined by the driver's perception of the initiator's intent and not whether the other person actually has such intent. The perception of aggression-provoking stimuli is incomplete and varies individually. Correct inference of intent depends on the driver's ability and willingness to correctly decode and interpret the information.

The central inhibitors of aggression are *punishment, guilt and shame*. Aggressive expressions are dampened by fear of its consequences. It may not prevent it altogether, but it may encourage its transformation into less obvious forms, such as ridicule, irony. A specific catalyst of aggression is *fatigue*. A driver who has had an exhausting drive is unlikely to experience intense anger and display outright aggression.

Aggressive behaviour in the context of personality, gender and age

Aggression is more likely to occur in people who are predisposed, set up for aggressive behaviour. Research has shown that aggression is linked to temperament, emotional lability, irritability, impulsivity, anger, and narcissism, but these characteristics and dispositions do not in themselves provoke or explain aggressive behaviour, but they are suitable conditions for its emergence and application.

Men are more aggressive than women. The male sex hormone, testosterone, affects neurobehavioral function, both emotional and cognitive. Women are less aggressive, but after menopause their aggressiveness increases due to a decrease in estrogen production and greater production of male sex hormones. In most cultures, men have more aggressive behaviour patterns than women, but the emancipation movement is blurring this traditional gender picture. Aggressive behaviour is related to power. That women do not seek power and prefer to stay in the background and try to control those who perform aggressive acts is less true than in the past.

Younger drivers are the most likely to commit aggressive acts on the road and are also the most frequent victims, and the opposite is true for drivers aged 55 and over. However, the typical aggressive driver is not a young person, but a middle-aged man driving a powerful and expensive car, speeding and recklessly overtaking,

Social and cultural determinants of aggression

The use and expression of aggression depends on the positions of the parties involved in the conflict. The greatest aggression is provoked by an attacker who is a subordinate, an equal and even a friend. The least aggressive response is when authority figures are attacked. The intensity and frequency of aggression are related to the status of both the attacker and the status of the one being targeted. The anonymity that drivers experience in the bowels of their cars frees them from social control and may encourage aggressive behavior. They feel more anonymous on the highway than on a city road, more at night than during the day, more on an uncongested road than in a traffic jam.

There are significant differences in aggression and violent behaviour in different countries around the world. In societies where aggressive behaviour is considered normal and useful, people naturally learn such behaviour, adopt aggressive patterns and scripts, and react aggressively without being aware of their behaviour as aggressive or feeling the need to re-evaluate it. Aggression is influenced by *conformity*. The positive effect of conformity is greater the more pronounced and united a society is in condemning recklessness in road traffic and, conversely, the negative effect of conformity is more pronounced in a society in which masculine, competitive or downright aggressive behaviour is tolerated

Psychological assessment of aggression and aggressiveness

Psychodiagnosis of aggression and aggressiveness is problematic. Even when valid psychodiagnostic methods are applied, we are not sufficiently confident that we will obtain truly reliable results. On the one hand, drivers are unaware and, to an even greater extent, unwilling to admit aggressive behaviour, rationalising and camouflaging it. Projective methods such as the Hand test have not proved to be the way to go either.

One of the most widely used methods to date has been the Buss and Durkee Hostility Inventory (BDHI), despite well-founded doubts about its validity. Increasingly, the Deffenbacher Driver Anger Scale (DAS) and the Driving Anger Expression Scale (DAX) have been applied. However, as anger questionnaires, they do not measure aggression. One of the most sophisticated psychodiagnostic tools for sensing aggression is a set of questionnaires developed by Caprara and colleagues (1987) based on their conceptualization of aggression. This questionnaire complex has 170 items, which is very time consuming to administer and is a barrier to its use in psychodiagnostic practice and research. A suitable psychodiagnostic instrument appears to be the POAG-SM (Kucek, Kucekova, 2024), the Preparedness for Aggression and Hostility Questionnaire (POAG-SM).

11.9. Locus of control

Locus of control (LOC) is the way an individual perceives phenomena and situations in relation to his or her behaviour. At one pole of this dimension is the **internal locus of control** as a person's beliefs about his or her own controllability of the consequences of his or her behavior. Such persons perceive the conditions that are important for controlling outcomes as located within themselves, as dependent on them, and as predictable by them. They have an awareness that they have their destiny in their own hands, take responsibility for their actions, and apply problem-focused coping behaviors. At the other pole is the **external locus of control**, which is characterized by the person's beliefs and generalized expectations about the decisive influence of factors external and independent of him or her. Reality appears to the person as uncontrollable and unpredictable, and external influences are seen as controlled by higher authorities, fate, and chance. Her awareness of her own competence is low and she is more easily threatened.

The application of the LOC concept in practice has shown that the prediction of behaviour by this personality trait is dependent on the context in which it is applied. The contextual approach was reflected in the conceptualization of LOC as a specific construct within certain domains. In the domain of drivers, LOC questionnaires were developed with separate scales of driving internality (DI) and driving externality (DE).

The results of research have shown a more adverse effect of extrinsic than intrinsic LOC on safe driving behaviour, but overall the results of studies that have looked at the relationship of LOC with accident rates are equivocal. Undoubtedly, LOC enters into the driver's process of assessing reality, influences his reactions and behaviour, and is an important component of his driving style, but it cannot be relied upon to reliably predict his success, riskiness and safety. A driver's LOC, combined with his abilities, skills, personality traits, experience and personal driving history, contributes to a psychodiagnostic picture of him and to a conclusion about his psychological fitness to drive.

11.10. A type of behaviour

In 1959, cardiologists Meyer Friedman and Ray Rosenman introduced their concept of the Type A Behavior Pattern (TABP), which is characterized by heightened ambition, time urgency, escalated competitiveness, easily evoked hostility, explosive vocal stylization, and rapid motor mannerisms. This complex of personality dispositions was considered a serious risk for the development of coronary heart disease. Opposite to this type is the B type of person, who needs to live in non-stressful conditions, is not in a hurry, is patient, makes prudent and hesitant decisions, does not need to win, is rather concessive...

The TABP belongs to the masculine sex role and clearly functions more successfully in environments and occupations where such an orientation is advantageous. Occupations such as watchmaker, accountant, diplomat or priest are not suitable for him. He needs the more competitive and combative conditions of work and life offered by, for example, the profession of soldier or businessman. Type B is inherently low in masculinity and will therefore do better in more cooperative, peaceful and considerate working conditions. However, he is more likely to face adaptation problems due to higher social anxiety, lower social self-esteem and a tendency to depressive mood swings, traits more inherent in women than men. Driving is a job in a competitive and rather stressful environment, which obviously fits Type A better, although from a road safety point of view we would

like to see participants tending more towards Type B. The reality is that both types operate and have to function adaptively.

TABP has been shown to be associated with riskier and more dangerous driving. And the type of driver always needs to affirm his or her worth, focuses on his or her own ego, status, goals, gains and pleasures, and tends to see others as inhospitable rivals. He is largely oblivious to his behavioural excesses and even if he registers them, he is still not motivated to change his behaviour.

11.11. Sex and gender

In its most basic sense, sex is the biological characteristic of human beings as male and female, which rests on the sex organs, chromosomal and hormonal makeup, and secondary sex characteristics. A person's gender carries with it multiple psychological and social aspects, and so a focus on biological polarity is both too narrow and simplistic. More appropriate is the *gender schema*, which is a person's generalized predisposition to process information about the psychological and social world through the prism of masculine and feminine gender. Gender stereotypes are formed and maintained through social structures (family, upbringing and education) and through culture, in which they are embedded as shared ideas, customs and traditions. A person is not born with a gender identity like a sex, but acquires it in the process of living in society.

Men are physically stronger, see themselves as more independent, ambitious, competitive and career-oriented. Women are more activated and deactivated by emotions, describe themselves as moral, sociable, more relationship-oriented and less assertive. In terms of driving safety, it is significant that women show significantly lower levels of perceived safety across all dimensions, cognitive, emotional and behavioural.

The emancipation movement and the democratization of societies have changed the conditions of women's lives as well as their gender schemas and the role they play in modern society. However, men and women continue to have different global selves and their ways of life are shaped in a world that was and is organised according to masculine principles. Women's lived experiences are different from men's, and therefore women leaders need to be examined by their own standards and not by men's.

The opinion that driving is more suited to men was justified especially in the past. In the early stages of motoring, controlling a car required considerable physical strength and technical prowess. Thanks to technical progress, the demands of driving have changed considerably in this respect. Not only the automobile has changed, but also the way of life of women, which in many respects resembles that of men. They increasingly need and use the car. However, they still drive and cycle less frequently than men. In bus and freight transport, women are only sporadically seen as drivers, but they can keep up with men if they are up to it. Men's prerogative remains riding higher cubic capacity motorcycles.

Gender differences in risky traffic behaviour and accident rates

In all available studies from different parts of the world, in both developed and developing countries, male drivers have been shown to have higher accident rates than women. Female drivers have more accidents when driving at normal operating speeds and when manoeuvring the vehicle. They have more accidents due to perceptual errors, rear-end collisions, parking and reversing, in urban areas, at intersections and on wet roads. Men, on the other hand, have more accidents related to higher hierarchical levels of driving, mainly due to higher speeds and drink-driving. They have more head-on collisions, accidents on rural roads, also on dry roads, when overtaking, on bends, at night, due to high speed and more often crash under the influence of alcohol. Women tend

to have less serious accidents and are less often injured in accidents than men. They are much more likely to die in accidents than women, roughly three times as often.

Men have more traffic offences and commit their first serious offence earlier than women. The frequency of offences for women decreases faster than for men as the length of driving experience increases.

Men perceive themselves as faster and better drivers. Their greater propensity for risky driving is related to a greater prevalence of the thrill-seeking trait. They perceive risk as less likely and are less concerned with the risk of a traffic accident. Women are more concerned about risk and its consequences.

Men are generally more aggressive drivers than women, and significantly more likely to drink and drive than women. Anger takes hold behind the wheel for both men and women. Men are generally more performance-oriented, and are more likely to be angered by inhibitions in getting ahead. Women are more angry when they feel threatened by the behaviour of other drivers. Angry male drivers more readily resort to verbal and nonverbal attacks and move from abusive words and gestures to physical attacks, increasing speed, "sticking" to other vehicles, restricting others from driving. Women drivers do not vent their anger outwardly in this way, they project it more inwardly and show their indignation in a more conciliatory way.

In a masculine culture, a man is expected to be pugnacious, tough, and focused on material success, and a woman is expected to be mild, gentle, and focused on quality of life. In this connection, the concept of *toxic masculinity has emerged*. It is a socio-cultural construct, it represents learned patterns of behaviour in which a proper man is not allowed to show his feelings except for anger, he does not let it be known that he is close to someone, he must be strong and energetic, and he is expected to be dominant, aggressive and violent. A man is not born with this pattern of behaviour, he becomes like this. We also find toxic masculinity in drivers. Its typical manifestations are gambling, rivalry, focus on success, aggressiveness, dominance, oppression of the weak, recklessness, belittling of women.

11.12. Age

Young and old drivers are victims of road accidents to a greater extent than people in other age categories. Puberty and adolescence are the most turbulent ontogenetic phases, which is also reflected in driving. As one transitions into adulthood, the youthful chaos subsides, and one harmonizes and matures personally. Middle-aged men aged 25-59 drive more than younger drivers and about once as much as their female peers. A driver at this age is efficient and experienced, so he or she is well placed to perform even very demanding driving tasks. In the next ontogenetic stage, somatic and psychological involutionary changes become increasingly evident with advancing years, to the point that the old man has to give up driving.

Young drivers

The adolescent forms an idea of himself and his future life, the self-concept of the child is being rebuilt into the self-concept of the adult. It is a time of psychosocial moratorium that society provides for him to experiment with the role of an adult, tolerating his groping as well as certain mistakes and excesses, with the task of making a viable identity for himself. Adolescence is prolonged as a result of civilizational changes. The secular acceleration of physical growth and sexual maturity have come into striking conflict with psychological and especially social maturity in modern times. The young person is in danger of becoming preoccupied with shallow models, of assuming values

and identity commitments without active self-examination, without knowledgeable preparation and purposeful commitment. The rising generation has always struck the older one as less moral, less responsible, less rebellious.

Risky driving and road accidents among young drivers

Being a young driver means an increased risk of a road accident, especially a serious and fatal one. In economically developed countries, road accidents are the leading cause of death among young people. Accidents involving adolescents are largely the result of their inexperience. Newcomers have a smaller range of useful field of vision, monitor events on the road in a narrower field of view, have a weaker peripheral perceptual information intake, and are more likely to fail to detect non-moving objects. They do not realise that the presentation time of stimuli is reduced when moving fast and therefore also underestimate the dangers of fast driving. They tend to fix their gaze straight ahead, fix it closer to the front of the vehicle, more to the right of the direction of travel and less often look in the rear-view mirrors. They are less likely to judge the behaviour of other drivers and are more distracted by side activities. Driving errors dominate the causes of crashes, especially among young women, who are less adept at making left turns off the road and negotiating intersections.

Young people have plenty of energy, but they run out of it more quickly and manage it less well than adults. They match or exceed them in short-term performance, but lag behind in longer-term performance. Due to *their lack of practice and experience*, their mode of processing information is more protracted and less efficient. Also, common traffic situations pose an excessive information load for beginners. They do not yet have the appropriate schemas in place to reliably integrate perceived elements and assess whether or not they pose a threat. They have little idea of what to expect and can therefore hardly focus their attention and make optimal decisions.

Young drivers' driving skills improve rapidly in their first few months of driving experience, they make fewer mistakes and their motivation and associated accidents come to the fore, mainly due to underestimation of risks, thrill-seeking and driving excessively fast. A comparison of the riskiness of young male and female drivers consistently comes out against men. Young men are more likely than adults to drive under the influence of alcohol and other drugs.

Peer influence on adolescent driving

Young people care about belonging to other young people, especially those with whom they share similar interests and social status as well as age. He trusts such people, feels a kinship with them and thus they have a strong influence on him. The influence of peers on a young driver does not have to be explicit, i.e. that they directly urge him to drive in a certain way. Usually, their influence is implicit when he drives in a way that conforms to the norms and attitudes of members of his reference group.

Young drivers under the influence of their peers are more likely to drive fast, fatigued, intoxicated, show off, take risks and are less sensitive to the potential consequences of risky driving. Teenage passengers distract the driver, disturbing him or her with loud and intrusive conversation, 'banter' and exuberant partying. Such disruptive behaviour is more common when there are more of them in the car and especially when they are under the influence of alcohol. The influence of peers is particularly dangerous when driving at night after discos and similar events.

As passengers, young men and young women differ in how and whether they will react to the driver's driving style. Male co-drivers are more likely to find it acceptable to ride with a dangerous driver and not address his driving style. They are more concerned that

they might be seen as wimps when expressing their fears about risky driving. Women, when they do not feel safe, are more likely to express their feelings to the driver.

It is evident that the combination of gender, young age, immaturity and lack of experience has a detrimental impact on young people's driving safety. Although unsafe driving behaviour in young drivers is not a disorder, the designation as *Transitional Developmental Syndrome of Unsafe Driving* is justified.

Senior drivers

The demographic structure of developed countries has changed; these societies are ageing. In the next two to three decades, the population over 65 is expected to increase by 40 per cent and the proportion of people over 80 is expected to double. People over 65 are now healthier, wealthier and more mobile, increasing their demand for social and leisure activities. This translates into a significant increase in the number of senior drivers. Retirement will fundamentally change people's lifestyles and this is reflected in changes in driving habits. They stop travelling by car to work and use it more for social contacts, hobbies, leisure and, most importantly, for better access to services. The likelihood of various diseases increases with age. These tend to restrict driving or even lead to the withdrawal of driving licences. However, even elderly drivers with impaired health do not give up using the car in many cases, they just adapt to their health problems, drive shorter distances and avoid driving at night.

Although women live on average longer than men, they drive less often in old age compared to men. Women quit driving earlier and more definitively, even when their health still serves them. Men drive until later in life and only stop when health problems prevent them from doing so. Older men drive roughly twice as many miles as older women, and their accident rates are also twice as high, but women are more likely to be injured and killed in accidents because they are more likely to make mistakes and commit offences that lead to more serious accidents.

Risky driving and accident rates among seniors

Older drivers see less sharply, are less able to focus their vision in front of the vehicle, and can thus reliably register traffic signs and pedestrians. They are less able to detect stationary and especially moving objects on the road, less able to judge distances between vehicles, less able to judge the movement of other vehicles and underestimate the movement of fast-moving vehicles.

Slowing of motor and mental activity is a characteristic concomitant of old age. Hazard recognition and response in old age require more time and are less reliable. Their ability to divide attention decreases and selective reaction time increases. They are demonstrably worse at processing information and solving spatial relationships, short-term memory, and navigational skills. Older drivers can drive fairly safely on straight stretches and in curves, but are more dangerous when negotiating junctions and in situations where information needs to be processed and reacted to quickly. They have increasingly obvious problems with left turns, as they have to monitor and assess the movement of vehicles on both sides in order to judge the appropriate moment to turn. Their situational awareness is diminishing, in particular they are less aware of what is happening behind their vehicle.

Old people need to have peace of mind and protect themselves from complicating their lives. Thrill-seeking is increasingly alien to them. They become more easily confused, lose their clarity in more complicated situations, linger or misjudge ambiguous or contradictory information, make mistakes when yielding the right of way, when turning and overtaking. They are resistant to the extinction of conditioned reflexes, but the

conditioning of new reflexes is more difficult, and their behaviour is therefore more rigid. They find it more difficult to adapt to novelty in the car and on the road.

Seniors drive slower, are not in a hurry, are more patient, do not compete and overtake less. They drive less frequently and shorter distances on familiar routes, which reduces the likelihood of an accident. Despite this, accident rates after seventy are the highest of any other age group. They have more accidents compared to other drivers, not only in difficult driving conditions, but also outside junctions, when driving at low speeds and in daylight. Worst of all, drivers over 65 are the second largest category of drivers who have fatal crashes, after teenagers. They have more vulnerable bodies that are less able to withstand impacts. Of all drivers, seniors are the least likely to be aware of violations, are not inconsiderate of other road users, are very rarely ticketed for speeding, and are not caught driving under the influence of alcohol. They are more risk averse.

Perhaps too high expectations were placed on improving the safety of older drivers through the use of information technology. Automated devices that take over some of the driving task, such as maintaining a constant speed or automatic parking, have been shown to be more effective than technologies that only provide the senior with feedback about his driving (outside temperature gauge, deviations from the driving path). They take longer for him to notice and can also be distracting. Adapting to ADAS is often problematic for drivers who have been driving all their lives without such support systems, they don't trust them. Such drivers are more willing to accept technologies that give them feedback than technologies that reduce their workload.

Self-assessment and self-management of older drivers

Research has shown that objective data and older drivers' subjective accounts of their own performance and self-management are not in reasonable agreement. Many seniors fail to form a correct opinion of their driving abilities. *Self-regulation* is an essential factor in road safety for seniors, by which we mean *modifying one's own driving behaviour to adequately match the changing cognitive, sensory and motor capacities of the ageing driver*. Experts agree that most seniors are able to adequately regulate their driving and compensate appropriately for declines in performance. Older drivers tend to spontaneously limit their car journeys to shorter distances, drive more slowly, avoid driving in more demanding conditions, in a hurry and with secondary loads, and avoid driving at night and in bad weather. The more seniors perceive and are aware of a decline in their performance, the more likely they are to drive more carefully.

Older drivers feel that their physical and mental abilities are deteriorating, but they don't like to admit it when it comes to their fitness to drive. They do not want to give up the car. Seniors cannot be relied upon to figure out the right time to stop driving on their own. A medical assessment of an elderly driver's fitness to drive is the most viable basis yet for determining whether to retain or revoke their driving privileges. There is a gradual trend towards *assessing the mental fitness of older drivers*. Such an assessment is carried out by a combination of nomothetic and casuistic forms of psychological examination.

Society should be interested in people living out their old age in a meaningful and as enjoyable way as possible. Measures to promote healthy lifestyles and optimise healthcare are designed to do this. A specific measure is the *rehabilitation programmes for old drivers*.

XII. DRIVING UNDER THE INFLUENCE OF ALCOHOL AND OTHER PSYCHOTROPIC SUBSTANCES

Countries differ in the prevalence of drugs in society and in road transport, in information and education campaigns and programmes, in measures against driving under the influence, in penalties for related offences, and in screening methods, forms, extent and quality of detection. Most countries have implemented legislation to prevent the use of illicit drugs and to regulate the use of licit drugs. Detection of drug use while driving and in accidents has become a routine part of the work of traffic police.

Both drink-driving and alcohol-related fatalities have declined in economically developed countries, while drink-driving and fatalities have increased in economically developing countries, and, conversely, driving under the influence of non-alcohol drugs has increased. Among illicit drugs, synthetic cannabinoids, opiates and cocaine are the most abused by drivers in Europe, amphetamine, benzodiazepines and cannabinoids in the USA and ketamine, morphine, methamphetamine and khat in Asia. Road safety is complicated by drivers driving under the influence not only of drugs but also of psychotropic drugs.

We understand the effects of alcohol on human performance and behaviour, including driving, much better than we understand the effects of other drugs. Although the effects of different drugs vary, the vast majority of them have the same overall effect, which is to reduce the quality of mental and physical functioning, leading to reduced performance and increased risk of being involved in an accident. Different drugs take effect on the driver at unequal intervals after ingestion and their effects persist for unequal lengths of time. The degree of impairment depends on the size of the dose and the frequency of drug use. Exceptional or occasional use of a drug produces greater effects. Those who use more frequently or even systematically develop a tolerance to the drug. As they tolerate its effects, they generally need to increase their doses. *Tolerance to a drug is defined as a reduction in the pharmacological effect of a drug as a result of previous administrations of that drug into the body.*

It is an indisputable fact that the use of alcohol and other drugs has a negative impact on individual lives and the lives of societies, not least on road safety. We have learnt from the past that a radical cut such as alcohol prohibition is neither a good nor a viable solution to drinking problems. However, an absolute ban on its use in certain high-risk workplaces and, therefore, by drivers can be implemented. It is not enough to fight against ills, we must also fight for a healthy and valuable lifestyle. Educating and positively shaping the culture of road transport is a never-ending task.

12.1. Alcohol

Alcohol, like other drugs, is consumed for its intoxicating effects, but unlike drug use, it can be consumed without the intention of inducing intoxication. In accordance with cultural practices, it can be consumed as a delicacy. Countries have different alcohol consumption patterns. The higher the average alcohol consumption in a country, the more frequent episodic heavy drinking.

The neuropsychotropic effects of alcohol are directly related to its blood alcohol concentration (BAC). The BAC is given in % or ‰. One per mille means that there is 1 gram of 100% alcohol in one litre of blood. Breath alcohol content (BrAC) is given in mg

of alcohol in one litre of air, where 0.1 mg/l is approximately equivalent to 0.2 ‰ of alcohol in the blood.

BAC 0.2 to 0.5 ‰, mild drunkenness. A healthy adult in this state retains self-control and can perform routine activities reliably.

BAC 0.5 to 0.8 ‰, drunkenness. A person so intoxicated is not yet conspicuous by his behaviour, although his mood is already influenced by alcohol. His inhibitions are weakening, but on the whole he retains self-control. There is a regrettable decline in performance. Peripheral vision and spatial perception, estimation of distance and accuracy of reactions deteriorate, complex reaction time is prolonged, attention span decreases. The likelihood of an accident increases by a factor of 5 to 8, and by a factor of 10 or more for young drivers

BAC 0.8 to 1.5 ‰, light drunkenness. Visual perception weakens, vision begins to blur, visual field narrows. Decline in performance deepens, lapses in automated tasks occur. The ability to drive safely is definitely impaired. The likelihood of a traffic accident increases 30-fold or more.

BAC 1.5 to 2.0 ‰, medium degree of drunkenness. Gait is more uncertain, reaction time prolonged, spatial orientation impaired, vision blurred and gaze transmission more prolonged, peripheral vision ceases to function. Reaction is impulsive, self-control unreliable. The likelihood of a traffic accident increases more than a hundredfold.

BAC 2.0 to 3.0 ‰, severe drunkenness. Sensorimotor function is severely impaired, responsiveness is slow and very inaccurate, vision is blurred, memory lapses, palimpsests are common. Speech is slurred. The drunk is confused and confused. The risk of accident is very great.

BAC 3.0‰ and above, alcohol intoxication status. Quantitative and qualitative disturbances of consciousness occur, ranging from somnolence to coma.

By 2013, 89 countries (representing 67% of the world's population) had a BAC limit of 0.05‰ or less. The trend is towards universal enactment of zero tolerance.

BAC depends primarily on the amount of alcohol consumed, but also on body weight, the ratio of muscle to fat tissue in the body and gender. A simple approximate conversion of the alcoholic beverage consumed to its induced BAC is that one alcoholic beverage (i.e. half a litre of 12° beer, or 5 cl. of 40 % vol. spirit, or 2 dcl. quality wine) will induce a BAC of 0.4‰ in a 75 kg non-obese man and a BAC of 0.6‰ in a 60 kg woman.

The body has to process the alcohol. Alcohol metabolism has its own laws. The absorption of alcohol (approximately 20% of the alcohol consumed) starts in the stomach. When the stomach is full, absorption is slower. Almost immediately after drinking alcohol, biotransformation begins, the aim of which is to remove the alcohol from the body. The liver plays a decisive role in this process, using the enzyme alcohol dehydrogenase to oxidise 90-95 % of the alcohol, with toxic acetaldehyde as an intermediate product, which causes nausea. This is broken down by aldehyde dehydrogenase into acetic acid, which is a source of energy, and carbon dioxide and water. Women and Asians have naturally low levels of alcohol dehydrogenase in their livers and so metabolise alcohol more slowly and less well, so they tolerate less alcohol. Conversely, in people used to drinking, it is faster. MEOS (microsomal ethanol oxidising system), which is activated when higher doses of alcohol are drunk for longer periods of time, is significantly involved in their higher tolerance and processing of alcohol.

The concentration of alcohol in the blood and thus its effects are not the same over time. The so-called *Mellanby effect* applies: in the resorption phase, alcohol affects the CNS almost twice as intensely as at the same concentration in the elimination phase.

Moderate doses of alcohol up to a BAC of 0.6 to 0.8‰ are more likely to induce pleasant sensations than higher concentrations. Small doses of alcohol are more likely to

have subjective activating effects; the person may feel more alert. The more alcohol a person consumes, the more its sedative and disintegrative effect is felt.

Alcohol and driver performance

Each person experiences and evaluates their condition in their own way, and it is natural that they may not feel the effects of a small dose or be aware that they could affect their performance. However, the reality is that alcohol, even at small doses, affects driving performance at all hierarchical levels of the driver's tasks.

Divided attention has been shown to be the most sensitive to the effects of alcohol, which is impaired from a BAC as low as 0.2‰. In the BAC range of 0.3 ‰ - 0.4 ‰, lane-following and simple reaction time are only insignificantly affected, so that the driver is able to kerb, to keep the vehicle in the lane, quite reliably. However, it is dangerous because there is significant impairment in attention, fine sensorimotor skills, visual acuity, contrast sensitivity, depth perception, visual search, eye movement control, and also impairment in emotional and more complex cognitive forms of behaviour.

A BAC above 0.5‰ has been shown to impair driving. It adversely affects the speed and accuracy of eye movements, the amplitude, number, duration and speed of saccades, motion parallax, impairs scanning of visual images, the supply of visual information and depth perception, the focus of visual perception shifts to central vision and peripheral vision becomes increasingly impaired. Relatively least affected, or affected only at higher blood alcohol concentrations, are reaction time, vigilance of attention, visual acuity, blending of intermittent light, adaptation of vision after glare, and sensorimotor coordination during keration.

Alcohol impairs inhibitory control, so that an alcohol-affected driver is more easily influenced by various incentive impulses, reacts impulsively and is more willing to put himself at risk. He accelerates hard and stamps hard on the brake pedal, cornering faster. The risk of lane departure increases significantly as the blood alcohol level rises

Research has consistently confirmed that **the risk of traffic accidents** rises exponentially with blood alcohol level from 0.08‰ onwards. Up to a BAC of 0.04 ‰, the increase in accident rates is not significant. Each 0.2‰ increase in BAC represents a twofold relative increase in the risk of a fatal accident. Crashes caused by drink-driving are more frequent at night and on weekend days, after entertainment events and near hospitality establishments. They are more frequent at junctions than on the straight road

Accidents caused by drink-driving are most common among young drivers, and of these, roughly more than 20% are fatal. Young people are inexperienced as drivers and have no experience of drinking. They have less control over their alcohol intake. They do not realise what each additional dose of alcohol will do to them, how the effects will accumulate and they will easily drink more in one sitting, so when they drive under the influence they often have a higher BAC and are more impaired compared to adult drivers.

Driver attitudes to drink driving

We can calculate that those who are personally risky even without alcohol become even riskier under its influence, and this applies especially to impulsive and thrill-seeking persons, whose alcohol-induced impairment of inhibitory control exacerbates these dispositions.

A more significant fact of drunk driving is recidivism. The very first arrest due to alcohol increases the likelihood of recidivism, and each subsequent arrest increases the likelihood even more. Recidivism always indicates that the driver in question is more of a problem driver, either because of his or her more serious drinking or because of his or her less adaptability, even dissociativeness.

Drivers' attitudes to drinking and driving are shaped by education and training, but also by their society and wider culture. These attitudes are fundamentally determined by their knowledge of the impact of alcohol on driving. It is not enough if they are informed about the legal BAC limits. Unless they know, understand and believe how even small doses of alcohol affect drivers, they will not avoid JVs. It is not enough if their attitudes are influenced only by fear of being detected by a police check, fear of being fined and having their licence revoked. They will not be sufficiently motivated to avoid drinking and driving, rather they will avoid places where they could be checked

A survey of drivers' attitudes to road risk conducted in 19 EU countries, SARTRE 2, showed that drivers in all countries surveyed accepted the validity of the BAC limit and were aware of the risk of alcohol to road safety. The research indicated the importance of a zero BAC limit, as in countries where it applies, drivers take it for granted that they should not consume alcohol while driving.

Measures against drink driving

There is no doubt about the positive benefits of legislative measures such as the setting of a higher drinking age, the regulation of the points of sale of alcoholic beverages, as well as higher excise duties and prices for alcoholic beverages. Together with the legal BAC limit of 0.3 to 0.5 ‰ and zero BAC for professional, young and novice drivers, they have a positive impact on road safety. Each of these measures reduces the number of road deaths by around 5-6%

Breathalyser checks for alcohol consumption have become an important part of the fight against drink-driving. They are mostly carried out randomly. They have a greater effect if they are carried out non-selectively on all drivers at different places and times, if they are carried out frequently and systematically, and if they are well publicised so that the public is properly aware of them.

The most traditional measure against drink-driving is *fines*. They are counted on to have a deterrent effect. When fines are combined with other measures such as *licence suspension and imprisonment*, their deterrent effect is somewhat greater.

Alcolock appears to be a promising measure. It is an ingenious and effective device that prevents the car's ignition from being activated if alcohol is present on the driver's breath. The installation of an *alcohol interlock* also appears to be an effective measure. While driving, the driver is obliged to stop at the signal given and take a breathalyser test for alcohol within 6 minutes. In general, the use of such a device appears to contribute to a 45% to 95% reduction in repeat drink-driving offences, especially when combined with the obligation for these offenders to complete a behavioural rehabilitation programme.

Everything we know so far about the effects of alcohol on drivers encourages us to eliminate it from road transport altogether. Measures to achieve this must be proactive. Prevention and education are central to them.

12.2. Cannabinoid substances

Marijuana is made from the dried leaves and inflorescences of cannabis (*Cannabis sativa*) and hashish is made from the resin of the male plants, which is roughly six times more potent. The three main constituents of cannabis are cannabinol, cannabidiol and the most important psychoactive substance delta (9)-tetrahydrocannabinol (THC). THC enters the body in three ways, by smoking, vaporisation and inhalation (vaporisation) and eating. Smoking produces the fastest effect (within 2-3 minutes). Once THC enters the bloodstream, it is metabolised into a chemical compound which binds to adipose tissue and only after about half an hour is it released back into the bloodstream, enters the CNS

and, depending on the dose ingested, produces a roughly three-hour high. After inhalation, the THC level in the blood rises rapidly at first, the intensity of the effect reaches a maximum after 15 minutes and lasts for 60 minutes, after which it drops noticeably and the intoxication subsides within about three hours. Detection of cannabis is most reliable from blood, followed by urine and much less so from saliva and sweat.

In most countries, alcohol is legal and cannabis is illegal, which contributes to the fact that the prevalence of cannabis in road transport is not as high as that of alcohol. Of the total number of drugs intercepted in Europe, cannabis is the most frequently intercepted.

Early onset of cannabis use can be considered a significant predictor of driving under the influence of this drug. The greater the frequency of cannabis use, the more likely a driver is to drive after ingesting cannabis. Acute cannabis intoxication has been shown to be significantly associated with increased crash risk. According to the results of epidemiological studies from developed countries, it is estimated that drivers who have been in an accident were roughly twice as likely to have THC in their blood than those who had not been in an accident. At higher ingested doses of cannabis, this likelihood is 3 to 7 times higher. Significantly more accidents are experienced by those who have ingested cannabis in combination with alcohol.

Effect of cannabis on driving

Cannabis intoxication is generally manifested by relaxation, calmness and ease, cheerfulness, smiling, but also by increased suggestibility, a tendency to impulsivity, perceptual disturbances, subjectively slowed perception of time, sharpened perception of colours and tastes, synaesthesia (hearing colours). The judgement is not affected, but with increasing dosage, movements and actions become increasingly out of volitional control. The greatest impairment of performance occurs in the first 2 hours after taking cannabis and its effects wear off after 3-4 hours. After the intoxicating effects wear off, feelings of fatigue, slowed psychomotor performance, and mental and physical passivity set in. In acute intoxication, there may also be a 'bad trip', psychological complications such as confusion, panic, anxiety, aggression, delusions and hallucinations. If cannabinoid ingestion is not combined with alcohol and other drug ingestion, they do not induce aggressive behaviour; on the contrary, they are more likely to reduce it, promoting affiliation and tenderness.

Doses of cannabis between 40-300 micrograms/kg have a significant negative effect on driving, causing prolonged reaction time, impairing attention, short-term memory and decision-making in rapidly changing situations, and only slightly impairing sensorimotor coordination and perception of time in the short term. A THC blood concentration level of 7 to 10 ng/ml is usually considered to be the threshold at which impaired driving is evident. In 75-90 % of cases, there is not only a significant impairment in sensorimotor performance but also in executive function. Hierarchically higher levels of driver performance, the ability to plan, organise, solve problems, make decisions, exert volitional effort, control emotions and behaviour are impaired. The degree of performance impairment by cannabis is related to tolerance to the drug. Heavy users are more resistant to its effects than occasional users. Tolerance to cannabis is lower in women than in men.

The vast majority of cannabis users, and especially those who use cannabis more frequently, underestimate the effects of cannabis on driving safety. The effect of cannabis on driving has been shown to be less destructive than that of alcohol and hard drugs, but it does have adverse effects. These clearly increase with larger doses and with increasing difficulty of driving tasks, even in frequent users who have a higher tolerance to the drug. The DRUID study reported that at blood THC concentrations of 3.3 to 4.1 ng/ml, the

impairment in performance is similar to that at a BAC of 0.5‰. The Norwegian classification (Vindenes et al., 2012) established THC blood levels of 1.3; 3.0 and 9.0 ng/ml as equivalent to BACs of 0.2, 0.5 and 1.2 g/l, respectively. The concurrent ingestion of cannabis and alcohol has a significant additive negative effect on driving performance, lane-keeping, lane departure duration and reaction time.

12.3. Opiates

The term *opiate* refers to the alkaloid contained in opium and polysynthetic derivatives of opium alkaloids, and the term *opioid* refers to substances with effects similar to those of opiates. Both natural and synthetic opioids are often abused for their euphoric effects, inducing a calm mood, slowed reactivity, indifference, richness of thought and increased self-esteem. Opiates are hard drugs, mostly illicit, which produce strong physical and psychological dependence. The main opiates are **morphine** and **codeine**. They have analgesic effects and are standardly used in pain management.

Even low doses of opioids have the potential to impair performance, but in general the negative effects of therapeutically administered opioids on performance have not been shown to be so severe that these patients would be considered unfit to drive. The threshold below which there is a minimal risk of causing an accident is a blood morphine concentration of 14,3 ng/ml. According to the Norwegian classification, blood morphine levels of 9, 24 and 61 µg/l can be considered equivalent to BAC levels of 0,2, 0,5 and 1,2 ‰, respectively.

At the turn of the 19th and 20th centuries, a newly discovered semi-synthetic opioid, a derivative of the morphine alkaloid, **heroin** (diacetylmorphine), was used in the substitution treatment of morphine dependence. However, it soon became apparent that one of the most dangerous addictive substances had been invented. Prolonged heroin use impairs reaction time and time perception, left-right discrimination, spatial orientation, and spatial working memory. It poses a serious safety risk when driving.

Methadone and **buprenorphine** have been advocated as safer opioid substitution drugs in the treatment of morphine dependence. Methadone does not have as strong a hypnotic effect as morphine, but its serious negative effects on performance, which could compromise driving safety, cannot be ruled out. Repeated use of buprenorphine causes minimal impairment of performance, except for impairment of episodic memory after a high dose.

12.4. Non-medical stimulant drugs

Cocaine

Cocaine is a hard, illegal drug with a high risk of addiction, but it does not have the addictive potential of heroin. It is a stimulant drug that induces a relaxed mood, heightened feelings of energy and liveliness. The effect of an ingested dose of cocaine is short-lived, lasting between 20 and 30 minutes, which makes it more likely to be used frequently. The effect of single doses does not diminish, but reinforces the need for more frequent doses, which is one of the mechanisms of the development of addiction. 1 gram of cocaine is the usual dose, and five times that amount can be lethal.

Acute and occasional cocaine use may have a partial supportive effect on driving performance due to its stimulant effects. Drivers under its influence are more responsive and quick, but also more reckless and impulsive, the inhibitory component of their responsiveness is impaired, they are more confident and overconfident, more likely to take risks and drive fast. In chronic cocaine use, sensorimotor and cognitive performance

is impaired, spatial perception and attentional impairments are common, learning, working memory, reaction time and cognitive flexibility are impaired.

The fatally injured drivers were found to have cocaine both alone and in combination with cannabis and alcohol. Such combined use of cocaine increases its negative effects and the likelihood of a fatal crash.

Nowadays it is widespread among exposed businessmen, managers, lawyers or doctors, who keep themselves in high gear with its help and drive while so doped up. Cocaine has a stable place in the criminal underworld.

Methamphetamine drugs

Methamphetamine, after its discovery, initially appeared as a promising cure for sleeping sickness, asthma and obesity, but it quickly degenerated into a street drug known as **methamphetamine**. It is sought after for its stimulant effects, inducing confidence and euphoria. Pervitin is a cheaper alternative to cocaine.

Low and medium doses of methamphetamine promote wakefulness, heighten alertness, but also induce blurred vision, memory impairment, sleep disturbances, and paranoid symptoms. Frequent use of methamphetamine increases tolerance, addiction and craving, which are accompanied by emotional lability and depressive disinhibition.

Ecstasy (MDMA, 3,4-methylenedioxy-N-methamphetamine) is chemically related to amphetamines and has the same energising effects as amphetamines, but in addition it produces euphoria and intensifies the experience of contact with other people. It has become a popular party drug.

Ecstasy in weaker doses is stimulant, increases heart rate and blood pressure, suppresses the need for sleep and feelings of hunger, and increases verbal, mental and physical activity. After ingesting it, the subject enters a state of well-being for about two hours, his sensory perception intensifies, sensory stimuli are stronger and have greater experiential depth, and the surrounding world seems sympathetic and friendly to him. He is overflowing with energy in social interaction, is talkative, has intense feelings of belonging, and is more empathic than usual. MDMA induces positive emotional appraisal of social situations and reduces negative perceptions of unpleasant ones. Other stimulants do not have this effect. Ecstasy in higher doses markedly affects perception and consciousness, the world around us appears almost unreal, illusions and pseudo-hallucinations occur. According to current knowledge, moderate and irregular consumption of MDMA does not lead to dependence.

Ecstasy is most commonly used at social entertainment events, even in combination with other drugs, especially alcohol. A person feels more powerful after consuming the combination of alcohol with MDMA than after consuming alcohol alone, which can lower his or her inhibitions to drive intoxicated.

It is unlikely that drivers deliberately use methamphetamine and ecstasy while driving because of their stimulant effects. Rather, they are more likely to be found on the roads by users who get irresponsibly behind the wheel while high. In countries and regions where the prevalence of ecstasy is higher, its abuse among drivers is also more frequent.

An MDMA-affected driver is insensitive to fatigue and has a subjective feeling of freshness and focus, which, while it boosts his performance and increases his self-esteem, also puts him at risk. Ingestion of a 75 mg dose translates into improved performance in the parameters of driving speed, lane-keeping and divided attention. The downside of MDMA use is that it interferes with vision, the pupil is dilated and slower to react to light, causes problems encoding information, impairs motion perception, impairs attention, working memory and cognitive flexibility.

12.5. Psychedelics

Psychedelics are substances that induce altered states of consciousness. Symptomatic are accelerated thinking, a rich and vivid imagination, altered perception of space and colour, feelings of detachment, illusions and pseudohallucinations. In pseudohallucinations, unlike hallucinations, the intoxicated individual is able to realize that the perceived contents are not real, only illusory. The best known psychedelics are LSD (lysergic acid diethylamide), psilocybin, mescaline, and ketamine. Psychedelics are classed as hard drugs, although their potential to induce addiction is negligible. Their use is not associated with aggressive behaviour. They suppress self-assertion and dominance, encouraging rather defensive reactions. Driving under their influence is dangerous. They cause misinterpretation of visual and auditory stimuli, impair attention, sensorimotor and cognitive performance.

The dangers of taking psychedelics are related to the greater impairment of performance after ingestion of a higher dose and, in particular, the fact that their effect is influenced by the course of intoxication, depends on the mental state of the person at the time of taking the psychedelic and on the physical and social conditions in which they take them. The accompanying pseudohallucinations not only jeopardise driving safety but even make driving impossible. A person who ingests psychedelics is at risk when driving even if he or she has not ingested them before driving. There may be a 'flash back', which is a state like after taking a drug, even if the drug has not been ingested at the time.

12.6. Medical drugs

The invention of new drugs, production and demand for pharmaceutical products are constantly increasing. On the one hand, this makes an important contribution to restoring and maintaining a favourable state of human health; on the other hand, it causes problems with toxicity and undesirable side-effects of medicines, with their over-prescription and pharmacopharmacophagy. This applies in principle to the category of medicines with psychotropic effects. A large proportion of people treated with them work and engage in various activities, including dangerous ones such as driving.

The ICADTS (International Council on Alcohol, Drugs and Traffic Safety) recommendation categorisation of drugs is helpful for doctors when prescribing psychoactive drugs to patients who intend to drive. It is a classification of psychoactive drugs according to the extent to which they are dangerous when driving. In the first category are drugs with mild adverse and infrequent CNS effects, which would roughly correspond to the effects of alcohol at BAC levels below 0.5‰, so that it is not dangerous to drive after taking them. In the second category are drugs potentially more severely affecting driving performance, as with a BAC equivalent of up to 0.8‰. In the third category are drugs that cause massive impairment of driving performance, equivalent to a BAC greater than 0.8‰.

Tolerance develops to most psychoactive substances, which is less likely with sporadic use. The effects of these drugs depend on the dose taken, the time since ingestion and their elimination half-life, the development of tolerance, the age, sex and health status of the user. Psychoactive drugs mainly impair attention, visual perception and psychomotor responsiveness. Drivers driving under their influence swerve dangerously off the road, are less able to maintain a constant speed and safe distance from other vehicles, and respond less reliably to important signals.

Certain groups of drugs are riskier, and more attention has been paid to these (analgesics antiepileptics, antihistamines). **Psychopharmaceuticals** pose the most

serious risks to drivers among medicines. A number of them are addictive and dependence on them develops. Women and older people tolerate the effects of psychopharmaceuticals less well than men and younger people. Psychopharmaceuticals are traditionally classified according to their intended use as drugs affecting alertness, mood and integrity. Psychostimulants, hypnotics and anaesthetics affect wakefulness. Affectivity is affected by antidepressants, anxiolytics and antimanics. Integrity is affected by antipsychotics or neuroleptics, psychedelics and nootropics. Behind each of these categories lies a large number of specific original pharmaceutical preparations and generics.

We are faced with the dilemma of whether to allow the use of psychoactive drugs in therapy, even when driving, as they are clearly effective, normalizing patients' functioning and thus improving their performance, or not to allow their use when driving, as they also adversely affect driving performance and thus compromise driving safety. The golden mean remains to allow patients taking psychoactive drugs to drive, but only in indicated and carefully assessed cases and with unquestioning respect for the prescribed safe doses.

Amphetamines

Amphetamines (alpha-methyl-phenethyl-amine) are psychostimulants, substances that have a strong excitatory effect on the CNS, reducing drowsiness and the need for sleep, increasing sensorimotor activity, inducing feelings of energy, alertness and confidence, improving mood, but also inducing emotional lability, restlessness and anxiety. Their therapeutic application is risky because they are highly tolerant, addictive and addictive. The use of stimulants by drivers seems understandable: they want to suppress drowsiness, they want to be alert, to drive safely. However, despite the subjective feeling of refreshment, amphetamines affect mental performance and compromise the safety of their driving, inducing a high probability of an accident.

Nicotine also has stimulant effects on the CNS. Its stimulatory effect on driver performance is largely devalued by the secondary burden that smoking can impose. In addition, smoking in the enclosed cabin of a car deprives it of necessary oxygen.

Tranquilizers and hypnotics

Tranquillisers are drugs that counteract anxiety (anxiolytics) and mental tension (sedatives). Tolerance to anxiolytics develops slowly and their adverse effects on performance are not reduced by alleviating anxiety. Hypnotics are drugs that induce and deepen sleep (barbiturates, benzodiazepines, z-pharmaceuticals). Depending on the dose ingested, their elimination half-life and the time between ingestion and driving, hypnotics can be considered to have an effect on driving performance. Hypnotics with a longer half-life have negative effects on performance as late as the next afternoon. The use of diazepam and related drugs significantly impairs driving, especially in the first 2-4 weeks of treatment. As tolerance builds up, their negative effects are attenuated. The simultaneous use of benzodiazepines with alcohol increases the risk of an accident by 7.7 times.

Antidepressants

Depression interferes with the performance of the person affected by it. If the depression subsides after taking an antidepressant, the person's performance will improve. Antidepressants do not induce euphoria or dependence. It is very difficult to detect and evaluate any negative effects of this medication on performance in such a case. Moreover, antidepressants do not act immediately. The sedative effect of antidepressants wears off after repeated ingestions and both psychomotor and cognitive parameters of driving performance of drivers become normalised. On the whole, their adverse effects on driving performance appear to be milder than those of hypnotics.

XIII. THE MOST VULNERABLE ROAD TRANSPORT USERS

The most vulnerable road users are pedestrians and drivers of single-track vehicles. Single-track vehicles are less stable and lack passive protection elements, bonnets, seat belts or airbags. Their driver is more directly connected to the vehicle than the driver of a car, controlling the direction of movement of the vehicle also by leaning the body, as he would when walking, but moving at a higher speed and with greater lateral deflections.

13.1. Pedestrians

Walking is such an obvious and essential part of human functioning that it is often not thought of as a mode of transport. Walking is healthy, inexpensive, environmentally friendly and the most natural and least threatening to other people among other modes of transport. Walkers can move more nimbly in a small space than vehicles, but they are not physically protected from them. Pedestrians account for around 21% of road deaths in the EU.

Pedestrian accident rates are related to physical walking conditions, weather and lighting, motorists' compliance with speed limits and vehicle speed when colliding with a pedestrian, age and gender, and alcohol and other drug use.

The most common cause of pedestrian fatalities (68%) is a collision with a car. If a pedestrian is struck head-on by a vehicle travelling at speeds of up to 20 km/h, the risk of killing the pedestrian is relatively low. At speeds of 30-40 km/h, it is twice as high, at 50 km/h up to six times as high, at 60 km/h eighteen times as high and at 80 km/h the pedestrian is almost certain to be killed. The risk of being killed at any speed is much greater when pedestrians over 75 years of age are struck.

Drivers in cars and pedestrians perceive moving cars on the road differently. Pedestrians, who do not drive themselves, perceive and evaluate the movement of cars more problematically, so they have not directly experienced the limits of the braking distance, centrifugal force and manoeuvring capabilities of a car. And, of course, especially children who do not yet understand elementary mechanical laws. Children of younger school age still visually and auditorily underestimate the distance and speed of approaching vehicles. It is natural for them to engage in other activities while walking and it is more difficult for them to concentrate on walking. Children are more likely than adult pedestrians to focus their gaze around themselves rather than on the surface they are walking on. Pedestrians in their adolescence can perceive traffic situations correctly and also have sufficient knowledge to move safely in the traffic environment. Their greater vulnerability and vulnerability stems from their personal immaturity and less willingness to submit to traffic discipline.

From the pedestrian's point of view, it is important to estimate the speed of the approaching vehicle and its braking distance as accurately as possible in order to cross the road safely. The pedestrian does not make any complex calculations, but his perception and experience inform him quite accurately about this parameter. Pedestrians usually cross the road without thinking only if the car is within 10 seconds of them. If an automobile is within one second's travel distance, no normal pedestrian will enter its path. When the car is within 3 seconds of travel, roughly 15% of pedestrians decide to cross the road, and at five seconds more than 50%.

The willingness of drivers to give way to pedestrians is generally low. Empirical evidence suggests that when a pedestrian is merely standing at the edge of a pedestrian crossing, most drivers continue driving unchanged or slow down slightly, and only one in two or three drivers brake visibly and some even stop to let the pedestrian pass. The likelihood that drivers will allow a pedestrian to cross increases when the pedestrian looks at the driver, even more so if the pedestrian places his or her foot on the roadway, and even more so if the pedestrian indicates with his or her hand that he or she wants to cross. Drivers decide their strategy at a distance of 40 to 50 metres in front of the pedestrian crossing. If they do not reduce their speed at this distance, they are sending a signal to the pedestrian that they do not intend to give way. The lower the vehicle speed (roughly 30 km/h), the more likely the driver is to slow down or stop even more and the less likely it is that a collision will occur.

Traffic lights at crossings are set up to allow pedestrians to cross safely. The crossing interval was derived from a walking speed of 1.2 m/s, which may however exceed the abilities of elderly pedestrians, women walking with a child or carrying a larger purchase, and especially people with limited mobility. The average walking speed of elderly people is 0.9 m/s for men and 0.8 m/s for women, so they are not always able to walk safely across a pedestrian crossing. A reduction in walking speed of 0.1 m/s is associated with a 7% increase in accident risk. Men are more likely to cross the road at a red signal than women. Women appear to be more patient in waiting for the green signal. Men's waiting was approximately half that of women.

As pedestrians, men commit more offences than women, have more accidents and are more likely to be injured as a result. Male pedestrians are twice as likely to be fatally injured as women. The distribution of accident rates in relation to age is a U-shaped curve, with young and old pedestrians having the highest rates. Older pedestrians tend not to knowingly break the rules. Walking safety, walking range and pleasantness decrease in the elderly in parallel with the deterioration of their sensory perception, mobility, reaction time and information processing. They are threatened and deterred by uneven and slippery pavements and road surfaces, higher pedestrian and vehicle density, intersections and crossing the road. They walk shorter distances than older people walked in the past. Research has shown that the extent to which older people walk is closely related to the characteristics of their neighborhood environment, the availability of services, lighting, the volume of motorized traffic, barriers along the route, and benches for resting. When choosing a route, young pedestrians prefer one that is direct and fast, albeit more dangerous, while older pedestrians prefer the safest and most comfortable route.

The decision to walk is influenced by perceived safety in the sense of not being at risk of harassment and violence from others (security) and perceived safety in the sense of not being at risk of harm or injury in an accident (safety). In city centres, restrictions on pedestrian mobility are driven by fear of harassment, assault and harm, while in rural areas, fear of traffic accidents is more effective. Pedestrians are more concerned about their safety at night than during the day, but perceive the risk of an accident as greater during the day.

People experience negative rather than positive emotions while walking through the city. However, walking in an urban environment can also be a source of pleasure. A pedestrian does not need perfectly paved paths that take the shortest route to their destination, because those are boring. He does not mind obstacles when he is in a safe, well-lit, interesting and pleasant environment. Social, safety and aesthetic factors, not least greenery, attract people to walk.

13.2. Cyclists

People are now more interested in doing something for their fitness and health, which is reflected in the increase in the number of inexperienced cyclists and their accident rate. Cyclists have a lower accident fatality rate than pedestrians (6% vs. 17%), but there are fewer cyclists. Young and old cyclists are at increased risk of accidents, similar to walking.

A cyclist has a harder time compensating for impaired balance than a pedestrian. He cannot compensate for the misalignment by stepping sideways. It is more difficult to regulate a fall because he is wedged in the bicycle and usually falls even at higher speeds. The ability to maintain stability is more important at low riding speeds, and this is when the poorer performance of older cyclists becomes apparent.

Less experienced cyclists are less able to divide and transfer visual attention closer and further apart. They are more aware of the road they are on and less aware of the situation on the road. All cyclists experience a shift of attention from more distant environmental areas to the surface features of the track when riding on poor quality track. Riding on a cycle track with a poor quality surface alters perceptual strategy and weakens the cyclist's alertness to environmental hazards. Cyclists who ride frequently are both more sensitive to risks and better able to anticipate them. On the other hand, being more frequently exposed to risk and having gained experience in dealing with it may desensitise them and make them more likely to underestimate it.

A widespread habit of pedestrians and cyclists is listening to music through headphones while driving. Therefore, they do not hear, or hear only insufficiently, sounds important for their safety, especially the sound of cars and warning signals. As with motor vehicle drivers, mobile phone use is a serious safety issue for cyclists. Cyclists who use a mobile phone while driving, although they are travelling at lower speeds, will increase their sideways swerving, ride more in the centre of the lane and have poorer visual detection.

Accidents and injuries to cyclists are very often caused by motorists. When a car driver passes a solid obstacle or a slower moving car at a distance of less than one metre, it may not be downright dangerous, but if he or she passes a cyclist at that distance, he or she is endangering the cyclist. Cyclists find it more difficult to keep a straight line, are more easily deflected from a straight line, and can come into direct physical contact with a closely following car. The car driver detects cyclists and motor vehicles differently. When crossing intersections, car drivers tend to fix their gaze on the cyclist's face, especially when the cyclist makes eye contact with them. At that point, they do not notice his body, including the shoulder with which he is signalling the direction of his turning movement. This slows down their decision-making and reactions. Social interaction takes priority, at the expense of monitoring safety signals. Drivers who have their own experience of cycling are more cautious when overtaking cyclists, do not "stick" to them and spontaneously circle them at a greater distance.

Cyclists condemn motorists more than pedestrians. They won't blame pedestrians for incidents they have had with them on sidewalks and at pedestrian crossings. Older cyclists are more lenient with pedestrians than younger cyclists.

There is no doubt that the helmet has protected thousands of cyclists from injury and death. Yet many cyclists refuse to use it because of discomfort and underestimation of its importance. As with motor vehicle drivers, driver optimism plays a role in this. For adults, the most common reason for not wearing a helmet is that they only ride short distances close to home and that wearing a helmet makes them look ridiculous. Conversely, feeling safe and getting into the habit of wearing a helmet are the most

important influences on helmet wearing for both children and adults. Helmets are predominantly used by cyclists who ride more aggressively and helmets are part of their cycling identity as part of their safety gear. However, this protection encourages risk compensation in them, provoking a faster and more dangerous way of riding.

Several studies have shown that cyclists are more satisfied with this mode of transport than users of other modes. Experiencing accidents has an impact on their attitudes towards cycling. The more serious the injury, the more it reduces their riding comfort and their desire to cycle.

13.3. Motorcyclists

Like the rider when riding, the motorcyclist must blend in with the bike as much as possible, not sitting on it passively, but reacting with his body to sharper changes of direction, leaning sideways, countering by leaning forward or leaning back to sudden deceleration and acceleration of movement, sitting flexibly, crouching down if necessary, and putting up less air resistance or balancing. The motorcyclist is more intimately connected with the motorcycle and the outside environment than the car driver, his perception of movement, speed, and also of the road and landscape is more immediate sensorially, and the application of his own skills is also more hands-on. The sensations from the interoreceptors are more intense, the perception of air resistance and the passing environment in the field of vision are more urgent than for the car driver. He experiences the energy of the machine, he sees and feels it plunging into space, slicing through the invisible air mass in front of him as everything passes behind his face, he hears the engine sputtering or, if he, its master, wills, roaring, he feels the ride with all his senses and with his body. It can bring him pleasure, relief and satisfaction, ridding him of troublesome thoughts, for now his mind is filled with what is currently overwhelming his senses. It may both uplift and provoke him to intensify the experience.

Understandably, not everyone rides a motorcycle primarily for such pleasures. There are riders who just need to be transported, preferably as comfortably and safely as possible. The different motivations for riding a motorcycle and the differences in its use have led to a distinction between two categories: **motorcyclists and motorcyclists**. *Motorcyclists* are those who use a motorcycle for routine local transport over shorter distances, usually for commuting to work. *Motorcyclists* (bikers), in addition to their utilitarian value, find in the motorcycle mainly a means of evoking experiences in the context of their specific lifestyle and it is a symbol of their personal identity.

The subculture of motorcyclists has changed in recent decades. In poorer countries, motorcycles have retained their dominant transport function and are also used to transport materials. In motorcycling developed countries, there has been a massive increase in the number of those who use motorcycles for leisure and those who, according to their hobbies, form clubs, some of them outlaw motorcycle clubs. The public is not currently hostile to motorcyclists, but, given their high accident rate, they are viewed with disapproval, being called 'voluntary organ donors'.

In recent decades, in most countries, traffic fatalities for cars have been declining and those for motorcycles, on the contrary, have been rising. Compared to car drivers, motorcyclists have 30 times the fatality rate per kilometre of travel and 3 times that of cyclists. Most motorcyclist fatalities are in good daytime visibility and on dry roads. Most of their accidents (46%) happen when they collide with a passenger car. Driving at higher speeds is the cause of 90% of serious and fatal accidents. Stunts are not as common, but very dangerous.

Motorcycle riding is generally characterized by higher speeds and more rapid acceleration and deceleration, which translates into smaller safety distances between motorcycles and other vehicles. Riding a motorcycle is less comfortable and more physically demanding than driving a car. A 60-minute motorcycle ride causes riders to feel uncomfortable sitting because the pressure on the seat is unevenly distributed and sitting causes muscle fatigue.

The causes of motorcyclists' accidents are in many ways the same as those of car drivers, but they also have their own specificities, which are conditioned by the different design of motorcycles and the related driving behaviour. The higher power-to-weight ratio of a motorcycle than that of a car determines the differences in their dynamics, which are mainly manifested in braking, cornering and stability disturbances. They are more vulnerable to the motorcycle's lesser adhesion to the road surface. Motorcyclists' *phone calls while driving* are a major contributor to the accident rate. One-handed steering is undoubtedly more difficult and dangerous on a motorcycle than in a car.

Motorcyclists' propensity for risky driving is more likely to be related to certain personality traits, especially a tendency to thrill-seeking and impulsivity. Some personality traits play a greater role in motorcyclists' risk-taking behaviour, others a lesser role, but their influence may not be significant, as it is mainly attitudes that influence risk-taking behaviour, and only through these do personality traits act

Car drivers are generally less aware of the presence of motorcyclists on the road than they are of the presence of cars. They suffer from inattention blindness. They are focused on spotting cars or overlooking a motorcycle because they are not looking in the right place at the right time, and a motorcyclist makes a surprise appearance where they weren't expecting one. Additionally, cars are larger and attract their attention more than smaller motorcycles. The contrast of the motorcyclist with his surroundings is essential for the visibility of the motorcyclist; he should attract the attention of car drivers as much as possible with his outfit. Inexperienced drivers are more likely to have unreasonable expectations of motorcyclists, overestimating their manoeuvring capabilities and their ability to avoid a collision more easily. More adequate mental models are held by car drivers who have also ridden a motorcycle

XIV. DRIVING MODELS

The first model of car driving, by Gibson and Crooks (1938), conceived of car driving as fundamentally the same type of locomotion task as walking, except that driving is faster, the braking distance is longer, and the visual stimuli are not the same as in walking. The area of the road in which the driver has a good view and can safely drive the vehicle is referred to by the authors as the safe travelling area. Its extent depends on what the driver can and cannot afford, on the perceived valences of different areas of the visual environment. Those with negative valence are the limits of the eliciting responses to keep the vehicle within the safe driving field (braking, acceleration, steering wheel turning).

A significant advance in performance modelling was induced by Norbert Wiener (1948) with his management theory. Since then, it has become commonplace that driver performance modeling is built on inputs, outputs, and feedback. These models rest fundamentally on four components: arousal, perception, decision making and action.

Huguenin (1988) considers acts to be more important than behaviour. In his view, action is a function of situation, predisposition, and the process of assimilation (Figure 14.1). A situation may be routine, which the driver handles automatically by applying habitual patterns of responding, or complex, which requires his or her decision-making in unforeseen, emergency, and conflict situations. Situation recognition depends primarily on the driver's predispositions, which consist of his/her driving qualifications, his/her suitability in terms of physical and psychological prerequisites for driving and his/her driving competence, meaning his/her current state, his/her current ability to drive. On the basis of the situation and predispositions, assimilation processes take place. Adaptive driving takes place with the participation of the driver's attitudes, information processing and motor skills.

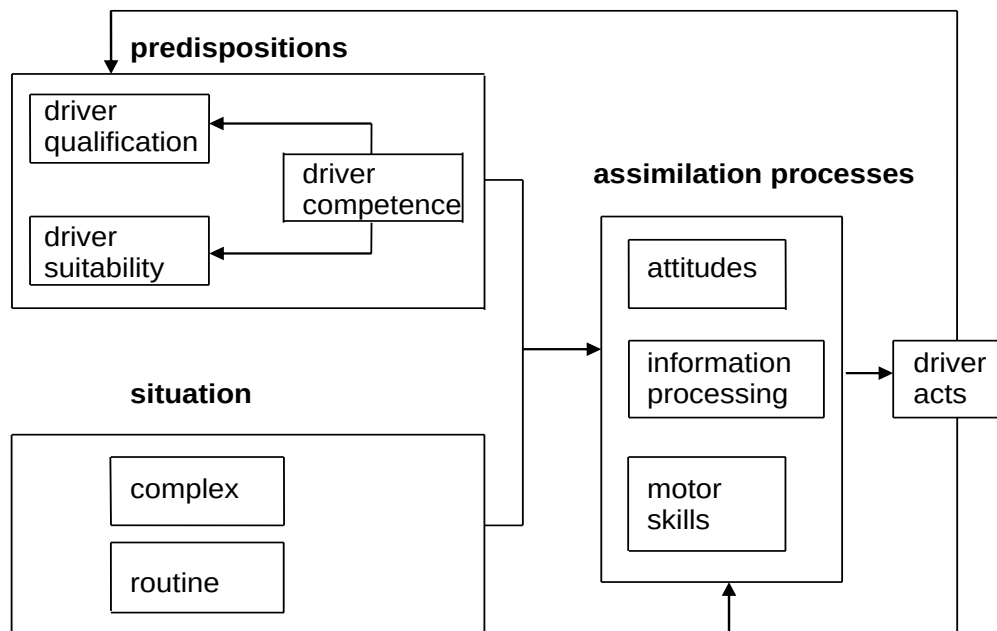


Figure 14.1 Huguenin's model of driving (after: Huguenin, 1988)

Fuller (2002) is the author of a descriptive-functional model of driver performance, which he derives from meeting the demands of his tasks. Task performance demands are conditioned by the environment (road and physical conditions such as visibility, vehicle adhesion to the road surface), other road users and the information, control and operational characteristics of the vehicle. In addition, there are two elements that are determined by the driver: road position and speed (Figure 14.2, Part B).

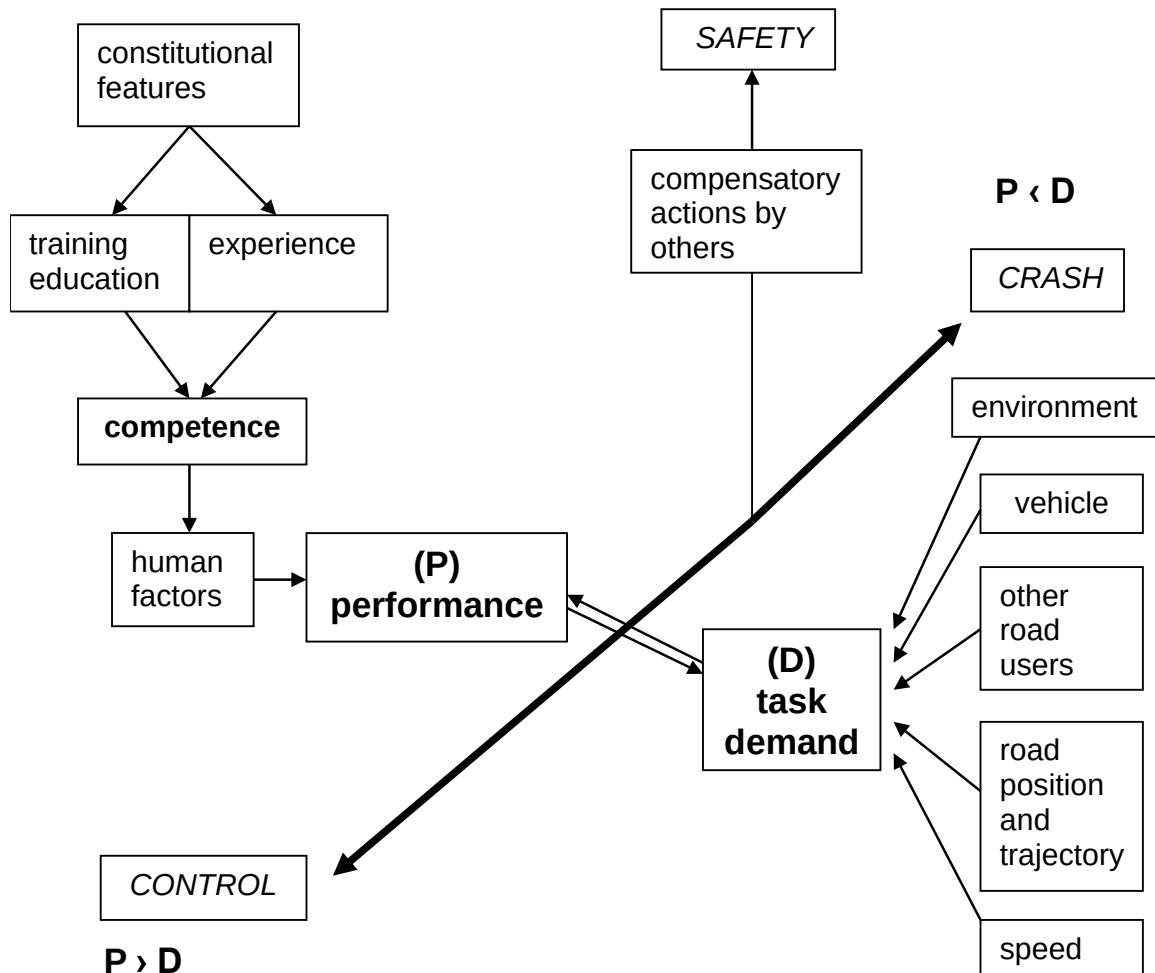


Figure 14.2 The task-performance interfacial model (adapted from: Fuller, 2002)

Driver performance is determined by the driver's competence, which Fuller derived from the driver's biologically determined psychological makeup and the qualities acquired through education, training, and experience. Emotions, fatigue, inattention, stress, motives, alcohol and drugs, or any other human factor can reduce competence and thus driver performance (Figure 14.2, A).

Putting together the model of task demands and performance results in a model with their interface (shown by the thick line in the figure). If performance exceeds the task demands, the driver is able to proceed safely; if it does not, there is a risk of losing control, but not if other road users make certain defensive or evasive manoeuvres that effectively change the task demands at the critical moment. The more the two levels balance each other, the harder the task becomes for the driver, and the less performance margin is left to cope with the demands of a sudden increase in performance. The driver's

dynamic interaction with the environment and the traffic situation determines the difficulty of the task, and how he perceives it compares with his goal. Fuller calls this process task-difficulty homeostasis.

The driver is motivated to maintain his preferred difficulty. If he goes at a higher speed and performs difficult manoeuvres, so that he reaches the limits of his standard performance, he will reduce the difficulty of the task, slow down and apply more undemanding manoeuvres. If the demands of the task are below his performance band, he will increase the difficulty of the task, increase his speed, overtake more, or engage in secondary activities.

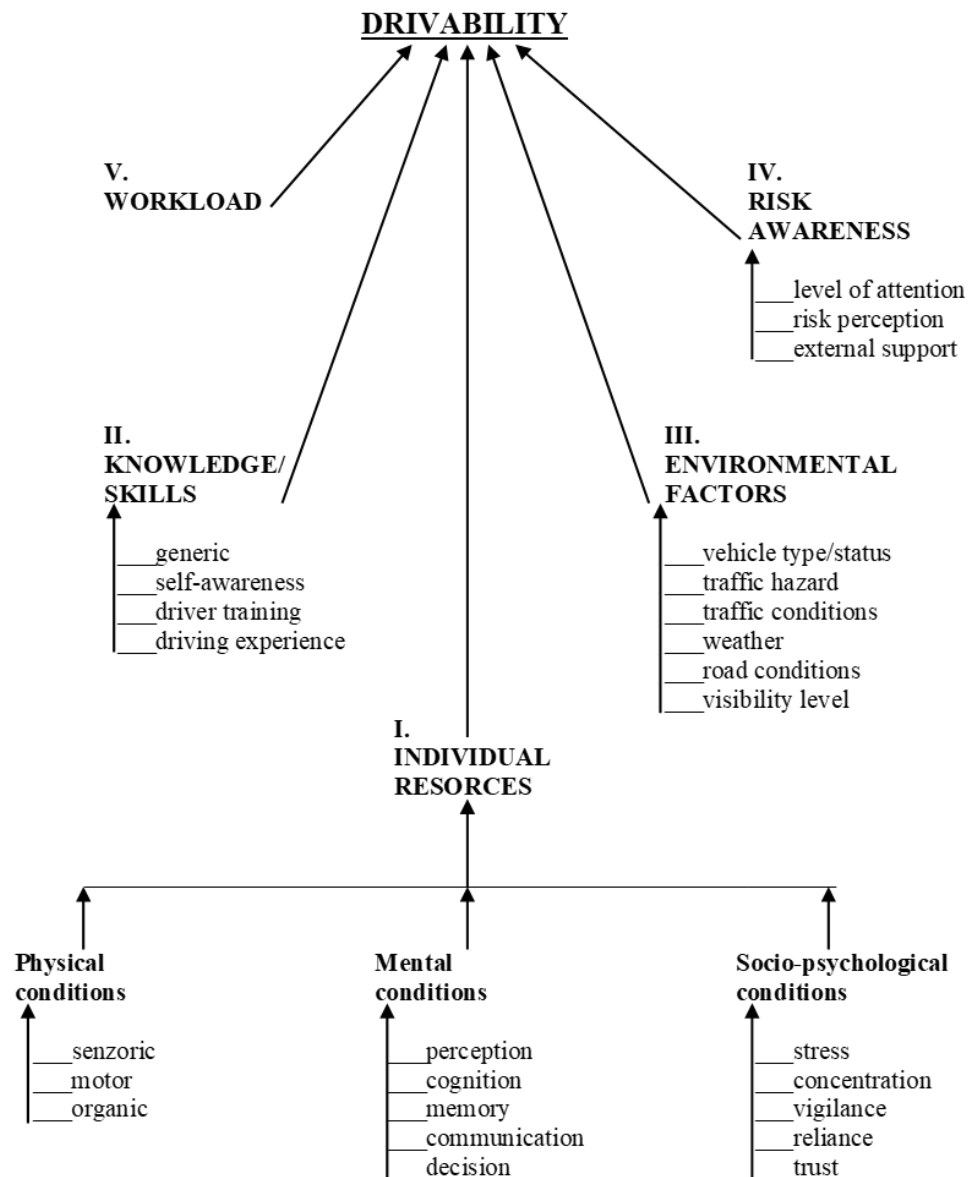


Figure 14. 3 Composition of the DRIVABILITY model (adapted from: Bekiaris, Amditis, Panou, 2003)

A more richly structured model of driver performance, **DRIVABILITY**, was developed by **Bekiaris, Amditis, and Panou** (2003). They identified the following five factors as essential to driver performance (Figure 14.3):

- I. Individual resources
 - a) physical conditions, i.e. motor, sensory and organic functions of the driver;
 - b) the mental state of the driver, which depends on his perception, cognition, memory, communication and decision-making, stress, level of alertness and concentration on the task;
 - c) the socio-psychological conditions created by stress, trust and faith.
- II. Level of knowledge and skills. These relate not only to what the driver has learned in driving school and his experience, but also to his general knowledge and education, as these influence his motivation and behaviour.
- III. Environmental factors creating traffic risks. These include road and traffic conditions, weather, visibility, vehicle condition and indeterminate traffic hazard.
- IV. Risk awareness, which depends on
 - (a) risk perception, recognition and understanding,
 - (b) levels of alertness, attention and awareness,
 - (c) external support to ensure that the driver recognises the risk in time (DAS).
- V. A workload that evolves over time and according to driving circumstances.

Allen, Lunefeld and Alexander (1971), defined three levels of driver roles: strategic, manoeuvring and control. In the literature, this division of tasks is attributed to Michon (1985) and has traditionally been referred to as **Michon's hierarchical task classification** (Figure 14.4). Michon delineated the levels as follows:

The lowest control level relates to driving on the road (on-line control). It does not require conscious work, it mainly refers to operative, prompt and skilful execution of tasks. The driver must perceive and react flexibly to changes in the environment, receive and give signals, keep the vehicle on the road appropriately, shift speeds, brake, give way, overtake, etc. The sequence of actions to maintain trajectory and most normal driving actions are carried out automatically.

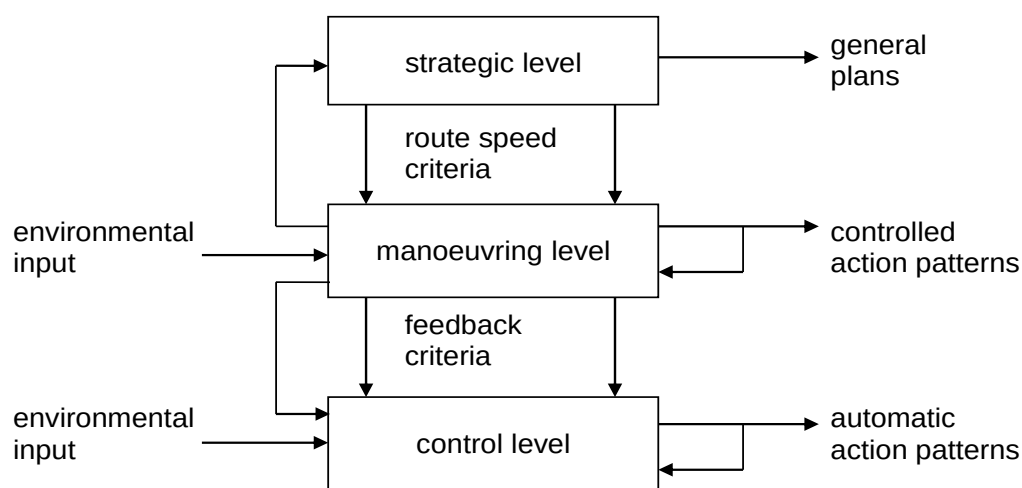


Figure 14.4. Hierarchical structure of driver tasks (after Michon, 1985)

The second, manoeuvring level, involves controlled detection and processing of information, conscious situational decisions that are conditioned by the driving circumstances, and a driving style that is consciously adapted to the external conditions and the induced physical and mental stresses. It is a level of ongoing behavioural adaptation.

The highest, strategic level includes setting the destination, route selection, a plan of action, and an assessment of costs and risks. At this level, decisions about the mode of travel are made that influence the driver's perception of risk. Depending on the severity of the intended journey, planning may be outline or more detailed.

Rasmussen's (1985, 1987) **concept** distinguishes three ways of processing information and performing tasks: skill-based, rule-based, and knowledge-based. These three categories of driver behaviour (SRK) are hierarchically arranged (Figure 14.5). The ascending levels of activity are feedback loops, with both bottom-up and top-down processes. Each of the levels is applied in driving according to what the situations allow and require. Even if, by acquiring driving experience, driving becomes a largely automated and routine activity, all three levels are still involved, none of them losing its importance.

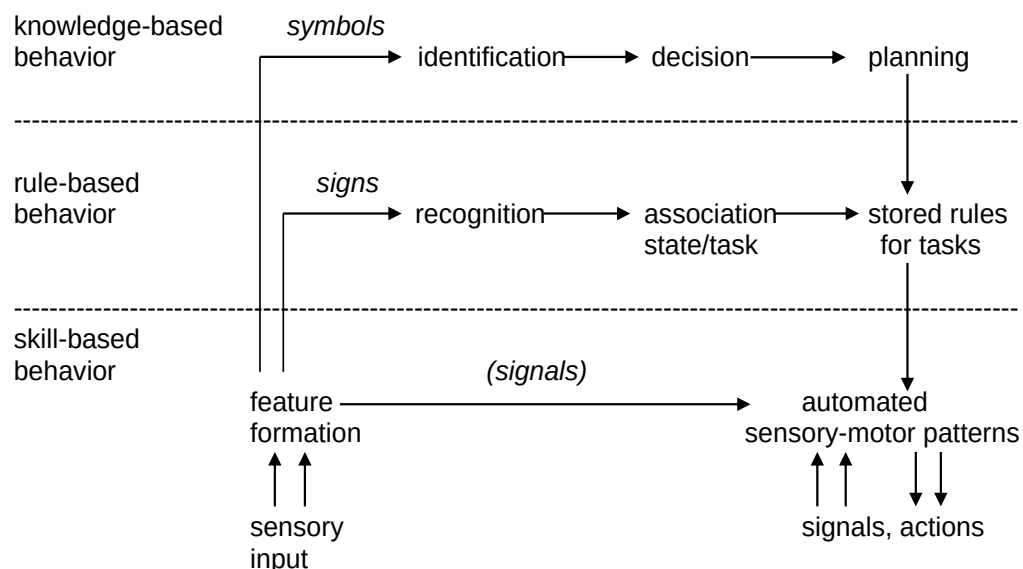


Figure 14.5 Hierarchical model of SRK (adapted from: Rasmussen, 1983, p. 258)

Performance at the lowest level relies on perceptual-motor skills, is fluid and without conscious control, is largely automated and uses *signals*, which are sensory cues, mainly optical and acoustic when driving, to attract attention, to convey information to the driver.

The second level is a sequence of actions according to a memorized procedure or rule. When a specific situation is induced, the rule emerges from memory and the driver performs the action according to a set pattern or based on previous successful experiences. Information at this level is usually perceived through *signs*, instructions, and markers. Signs, unlike signals, do not rely so much on the prescriptive principle, but are more concerned with internal conceptual representations, have a stronger cognitive charge, and use mental models. The driver does not need to look for a solution to the problem, but only to perform the action as it is set out, because that is the correct solution.

Rasmussen described the highest level as *knowledge-based*, based on knowledge and expertise. Such information processing requires an explicitly articulated goal from which a plan is derived. Decision-making rests on the evaluation and choice of goal and task. Knowledge-based performance and behaviour are applied in new, unfamiliar situations where the driver does not have a ready and proven procedure or rule. This level of cognitive control relies *on symbols*, *what* is symbolically represented in mental models.

The authors associated with the **GADGET** (Guarding Automobile Drivers through Guidance Education and Technology) project undertook to develop a conceptual model for driver training and education (Hatakka et al., 1999, 2002). They developed a four-level hierarchical model of driver behaviour, which corresponds in the first three levels to Michon's hierarchy of driving tasks. They called the fourth and highest level "*goals for life and skills for living*." It refers to the driver's personal goals, motives and attitudes in a broader sense, which determine his/her ways and skills of coping not only with traffic situations but also with life situations in general. They are closely linked to the social environment and culture. Family, friends and personal role models are important sources of internal model formation at this level.

The third level is called "*driving goals and context*" by the authors and covers, as in Michon's model, driving planning, goals, purpose and context. This level is determined by the higher level, lifestyle.

The second level, "*mastery of traffic situations*", is based on the driver's knowledge, adaptation and foresight. Here the driver applies both his practical driving experience and more general knowledge, e.g. of overtaking, junction crossing, driving on slippery surfaces, braking distance, centrifugal force, etc.

The first, lowest level, '*vehicle manoeuvring*', represents the executive functions of driving, based on the skills of controlling the movement of the vehicle and on the knowledge that is immediately applicable to its control, e.g. switching lights, adjusting and using rear-view mirrors, applying traffic sign commands.

Hollnagel, N  bo, and Lau (2003) attempted to develop a comprehensive *model of driver adaptive control* (DiC) based on the principles of cyclical and contextual control. The DiC model (Figure 14.6) depicts the dynamic nature of driving in the form of multiple levels of feedback loops that are simultaneous, both closed and open, and correspond to reactive and proactive actions. The driver simultaneously maintains the direction and speed of the journey and monitors what is happening on the road, checks the data on the dashboard, and can plan the next driving route or changes to it. If certain automatic subsystems are in operation, he must and can control their functions.

The control model is described as a cycle that links goals, actions and results. The cycle operates at each of these levels but has different characteristics. The feedback loops at the lowest task level correspond to the activities of maintaining the vehicle's speed, fore-aft and lateral position. Hollnagel refers to these as closed-loop control, which the driver can perform with little investment of attention and effort. Anticipatory control is rarely applied at the first level. Compensatory control predominates. If deviations from the desired performance occur in such an undemanding and automated activity, the driver must correct them immediately. The second level loop provides the criteria and objectives for the control of the driving path. These actions are also performed largely automatically by the driver, but anticipatory control is also applied. The loops at the monitoring level are both open and closed and relate to the state of the common driver-vehicle system in relation to the external environment. The driver monitors the situation on the road and in the vehicle, conditions, obstacles and progress problems. Accordingly, he/she creates goals and plans for further progress. This control is predominantly anticipatory. The highest goal level provides for the generation of driving criteria and goals and, according

to Hollnagel, has a clearly closed-loop nature; the driver does not assess changes in the driving goal routinely but in a loose, guessing manner (loose assessment) and takes more time to do so, not reacting as immediately and quickly as at the lower levels. Goals act in a feedback loop to lower levels, which in turn act back on this highest level. If effective control of this system is to be ensured, it must take place at all levels simultaneously.

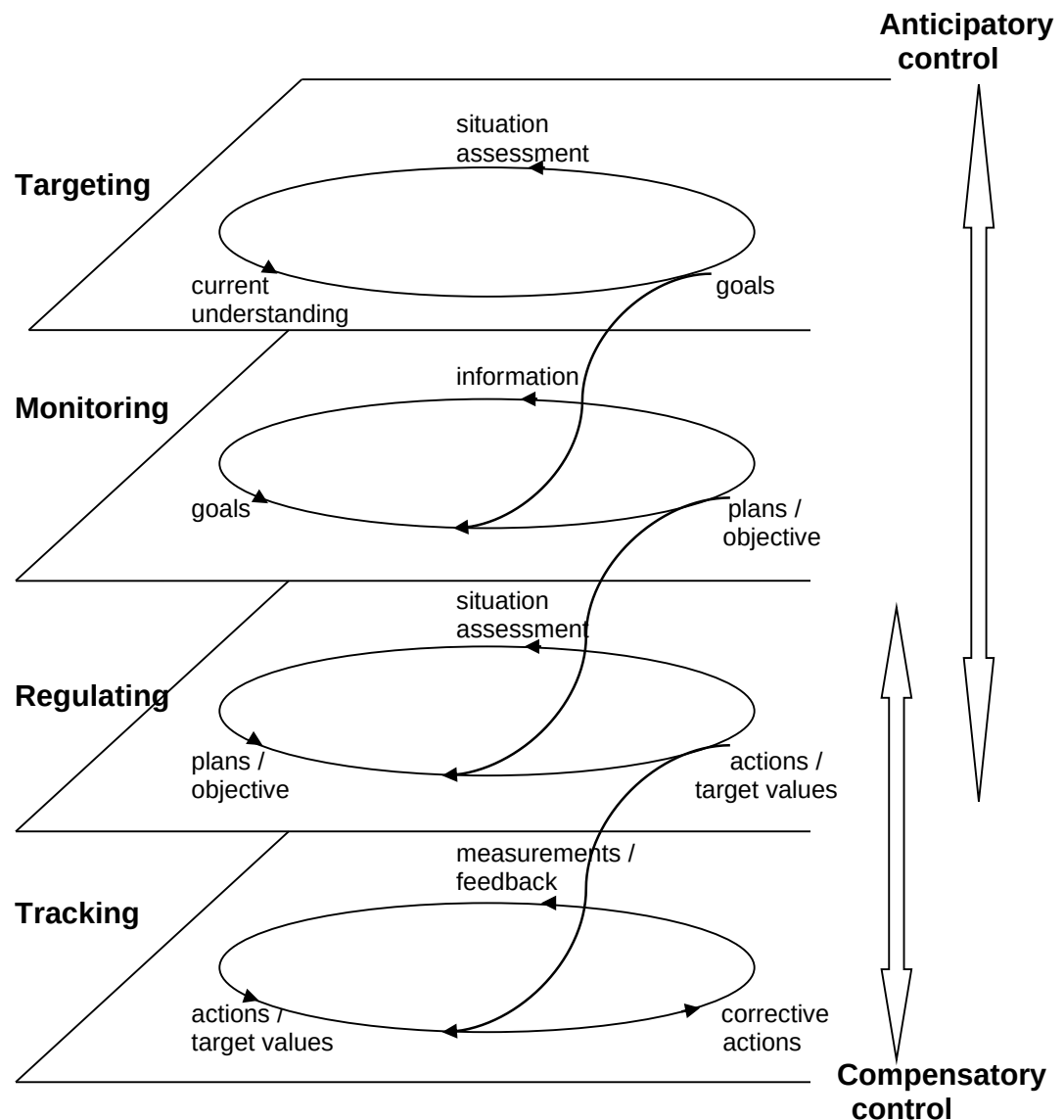


Figure 14.6 DiC model (loosely redrawn after Hollnagel, N  bo, Lau, 2003)

The ITERATE project set out to investigate the effectiveness of both existing and newly developed advanced driver assistance systems, ADAS. This model is based on the concept of parameters that allow the assessment of the dynamic behaviour of the driver and the simulation of the error making process (Figure 14.7). The researchers associated on this project (Oppenheim, 2010) have established error, reaction time and situational awareness as the dependent variables in the projection of the current situation onto risky behaviour. They identified five factors from the driver's side that influence risks and traffic safety and derived static parameters for them that act on the model input:

1. Attitudes and personality. They are represented by the arousal-seeking parameter, which is measured by the Sensation Seeking Scale.
2. Experience, as measured by the Hazard Perception Test.
3. A driver condition measured by time-on-task based fatigue.
4. Task demands that are derived from variations in traffic and roadway geometry.
5. A culture that is measured by international differences in similar parameters to those used in the SARTRE project.

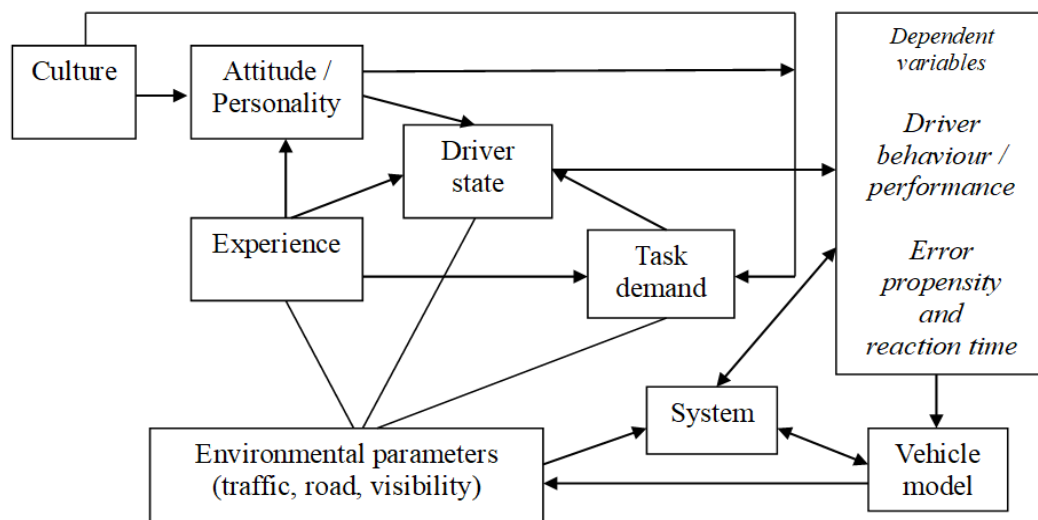


Figure 14.7 ITERATE model (after Shinar and Oppenheim, 2011)

How a driver perceives and evaluates himself is crucial to how he drives, how he thinks and acts, and what risks he takes. If his subjective self-image differs from objective reality, this can have negative consequences for him. These disparities relate to the **calibration of driving**. *Calibration is an expression of the degree to which people are able to judge the correctness of their observations or decisions.* Calibration analysis quantifies the relationship between the accuracy of self-judgments and confidence in their accuracy. The measure of calibration is the bias score. If it is highly positive, it indicates overconfidence, and conversely, if it is low, it indicates self-deprecation.

The factors embedded in the performance and driving models do not capture their effect on drivers' judgements of situations and self-assessment. Therefore, the design of the calibration model should include a useful mechanism for selecting information signals for subsequent interpretation and decision making. Horrey and colleagues (2015) proposed a model that is applicable to the examination of calibration and its role in road safety. They used a concave lens model in its construction (Figure 14.8).

The lens model is meant to represent how people use different information keys to make judgments about the state of reality, of the world. The observer (S) considers different information keys W in relation to an environmental criterion (E). From this, the degree of agreement between the judgment and the environmental criterion can be inferred. On the right side of the lens is the subjective judgment (Y_s). The observer observes the utility of the key for himself and makes a judgment or evaluation of reality. He uses heuristics, thus limiting his information processing, but it is useful to him because he cannot absorb all the information fully.

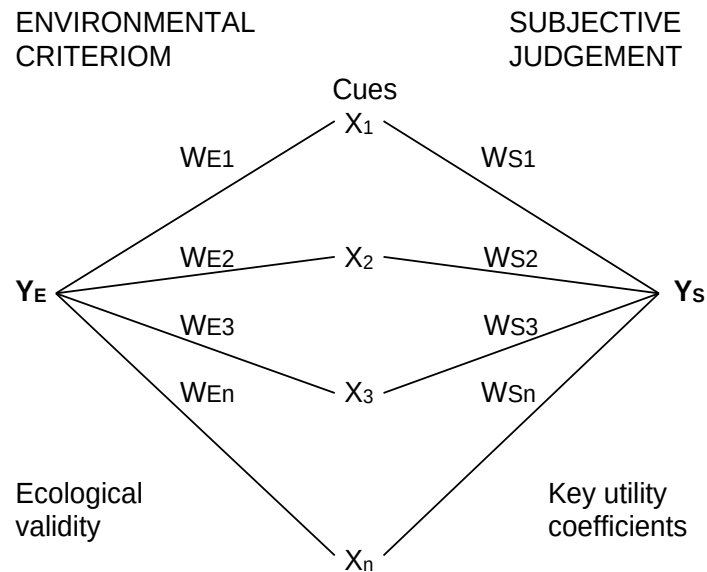


Figure 14.8 Lens model (after Goldstein, 2006; Horrey et al., 2015)

New driving models can be expected to be increasingly more compatible with reality and more predictive. Driving modelling will build on existing knowledge. Michon's hierarchical concept of levels of driving tasks and Rasmussen's hierarchical concept of how information is processed and tasks are performed appear to be proven pillars of further modelling so far. This complex of driver tasks and activities is represented by the quadratic model of driving (Figure 14.9). Each of its cells has its own specific content. This is illustrated by the matrix of levels and types of driving tasks (Table 14.1), which is extended from the quadratic model to include lifestyle as the highest hierarchical level.

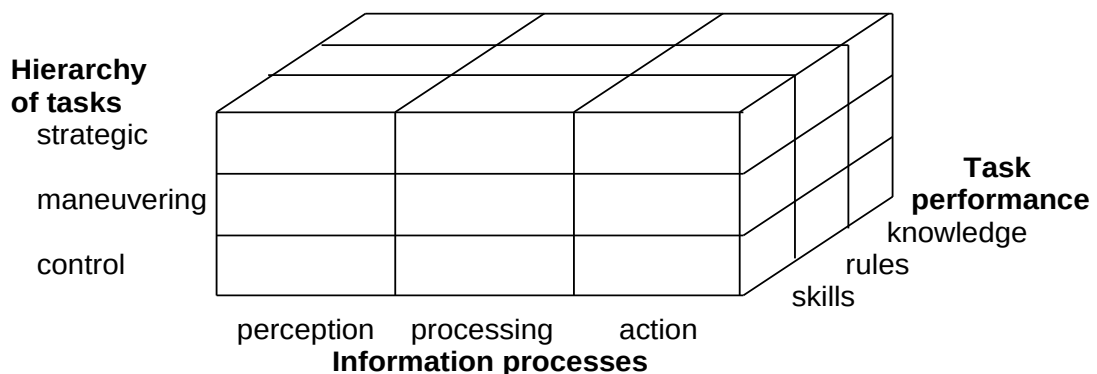


Figure 14.9 Quadratic model of driving (Theeuwes, 2001)

Table 14.1 Matrix of levels and types of driving tasks

Hierarchical level	Type of task performance		
	CUSTOMS, SKILLS	RULES	KNOWLEDGE, SOLUTIONS
IV. LIVE STYLE	Established lifestyle Customs and rituals Competitive vs. cooperative style <i>risks:</i> Inappropriate habits Poor condition Thrill seeking Psychological problems	Individual standards Policies <i>risks:</i> Disrespect recognised standards Lack of morality Poor self-discipline Bad peer influence and acquaintances	Cultural maturity Values Education Knowledge and expertise <i>risks:</i> Low mental level Serious changes in way of life
III. STRATEGIC LEVEL	Continuous adaptation to situations that you does not require improvisation <i>risks:</i> Revaluation of own possibilities and forces Underestimation of preparation Offences, violence Setting off on a journey in a bad state (exhaustion, alcohol)	Comparison and adapting familiar practices to new circumstances and demands <i>risks:</i> Lapsus Mistakes, misapplication of rules and experience Want to win	Planning and selection routes in an unknown area Resolving new and crisis situations <i>risks:</i> Missing or incorrect knowledge Errors Unreasonable expectations
II. MANOEUVRING LEVEL	Performance of conventional tasks, acceleration and braking Controlled detection, Monitoring <i>risks:</i> Lapsus Inattention Inflexibility	Routine handling of common situations and problems - giving way, overtaking, lane choice ... <i>risks:</i> Errors Correct procedure, but in an inappropriate situation Lapsus	Coping with challenging situations - in heavy traffic, unfamiliar terrain, bad weather ... Problem solving Controlled processing of information. <i>risks:</i> Uncertainty, ignorance Errors Bad passenger advice
I. AUTOMATED LEVEL	Automatic maintenance direction and speed Automatic detection and information processing Ride along a known route <i>risks:</i> Monotony Impulsive reactions Inattention, lapsus	Routine implementation tasks by well learned rules and procedures <i>risks:</i> Routine, driving in the grip of a stereotype Lapsus	Knowledge associations with the circumstances <i>risks:</i> Fixed set Not thinking, even if to think had Lapsus

We cannot create a model that encompasses and addresses all driver behaviour and actions, but only a bearable part of this complexity. In a dynamic system of driving behavior, some relationships between variables are typical, some manifest as frequently occurring scenarios, others rarely, and some are unique. The model must be a tolerable reduction of the complexity of driving, but it must incorporate that driving does not just take the beaten path, but also has detours from it. Reducing the complexity of driving has been addressed in much driving research by selecting parameters that should represent some area of the driver's psychological makeup or dynamics. Parameter selection will always be a problem. The fewer parameters and their measurable variables we choose, the less representative the research will be, and the less the possibility of generalizing the results and findings obtained. If, on the contrary, the number of parameters is large, it is questionable whether we will be able to follow the line of specific effects of each of them in complicated interactions with the effects of other factors. The solution is to construct models that capture the universally valid structure and dynamics of driving, into which parameters can be fitted in accordance with the logic of the model construction, and to investigate the chosen driving processes on the basis of the system dynamics captured by the model, and to understand the dynamics of the cycles, the cycles of cause and effect of the observed phenomena in accordance with this. Similarly to the definition, the model should be an expression of the theory in a nutshell. This is illustrated by the following *derived model of driving* (Figure 14.10).

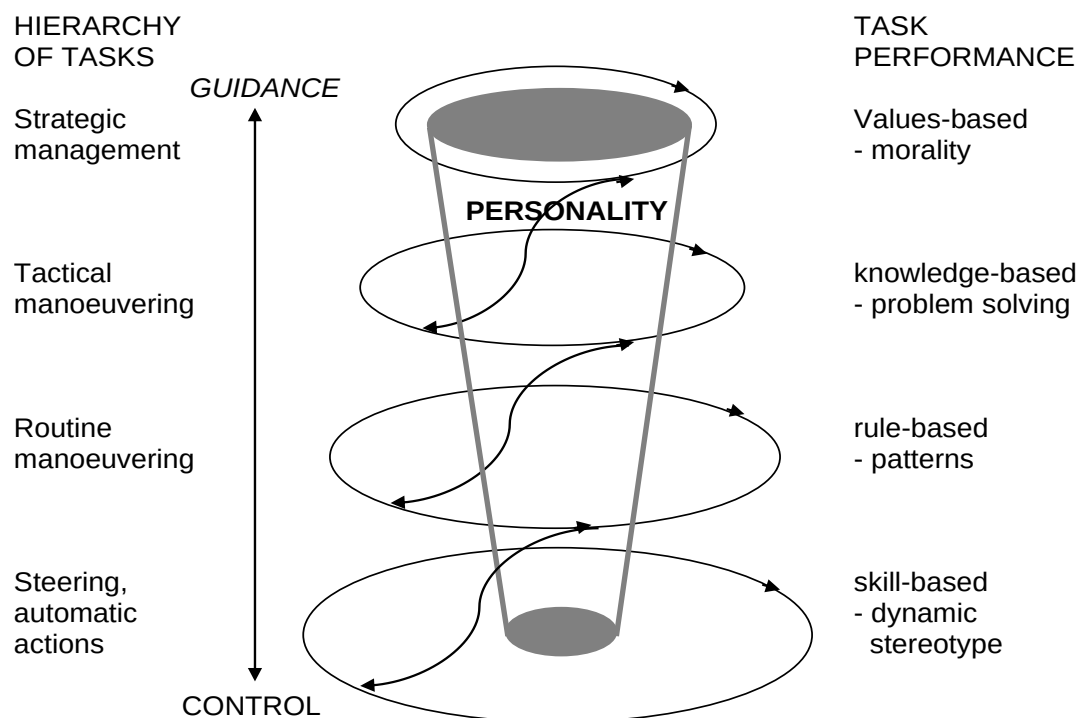


Figure 14.10 Derived driving model

At the core of the model is personality, which is mainly asserted by focus at the lowest automated driving level (in the region of the lower dark ellipse). Upwards (towards the

upper dark ellipse), the effect of focus gradually fades and is replaced by the effect of personality adjustment. Adjustment is a more complex and complicated factor than focus, as illustrated by the widening cone shape of the core.

The feedback loops of control and management in this model (ellipses) are not equal in size, they get smaller towards the top of the task hierarchy. This corresponds to the fact that the focus of driving tasks and performances lies mainly at their lower levels, on permanent and automated activities, on maintaining the position and speed of the vehicle and, to a slightly lesser extent, on manoeuvring it. Tasks of a tactical and strategic nature are performed less frequently by the driver. The lowermost ellipse is the largest, because the driver tends to drive in an uncomplicated, effortless, as comfortable as possible manner. It is natural for a driver to prefer driving activities that are easy to perform, whether by applying automatisms, his or her skills, or by uncomplicated handling of situations according to experienced, learned, established patterns and rules. In the process, as the beginner gradually becomes a more advanced driver, the less experienced a more seasoned one, he transforms complicated operations into simpler ones that he can perform routinely. The driver begins his career by acquiring declarative knowledge and compiling declarative mental models. Expressed in the terms of Rasmussen's SRK classification, this is the stage of rule-based performance. In subsequent phases, procedural knowledge, which are learned skills that are no longer compilational in nature, but emerge on an empirical and heuristic basis, is increasingly applied. The application of theoretical knowledge is increasingly replaced by the practical manipulation of symbolic representations. On the basis of practical know-how and experience, the driver builds up an arsenal of hidden knowledge.

XV. PROFESSIOGRAPHIC ANALYSIS OF THE DRIVER'S ACTIVITY

15.1. The professiographic method

The activities carried out behind the wheel of a car, whether the driver does them as a job or just for fun, are *skilled work*. Work is a form of purposeful action that is preceded by an idea of a certain state of affairs and the conduct and activities are organized with a view to achieving it. The driver's actions, which are subordinate to the goal, are predominantly goal-conscious. It is the exercise of thought, decision-making and will.

An indispensable prerequisite and basis for psychological assessment and selection of workers for the performance of a certain job, a certain profession or a certain job function is a thorough analysis of this work and the resulting knowledge of the requirements for the psychological abilities and characteristics of workers. *The occupational method is a description of a particular job, the activities contained in it and the determination of the requirements for their performance according to defined criteria.* It is generally implemented in four stages:

1. A list of tasks and activities that are the content of the work.
2. A description of the circumstances under which the work is performed that affect its performance.
3. Determination of somatic and psychological requirements for its successful performance.
4. Elaboration of the general characteristics of the work with emphasis on its main components,
that are most essential to its successful performance. It is referred to as a *job description*.

The output of the professiography is the *professiograms*. Each profession should have its own one, which allows comparing the specific demands of professions on a person. Only on the basis of knowledge of all the tasks that a person performs in a given job can one deduce the degree to which certain skills and qualities are required of a worker. In contrast to the *elemental (task) analysis of work*, in many occupations the focus is on the *functional (task) analysis of work*. The occupationally derived demands on the worker must be objectively assessable and the associated characteristics measured (visual acuity, muscle strength, reaction speed, etc.).

15.2. Job analysis

In English terminology, two terms are used, *work analysis* and *job analysis*, for which we do not have suitable equivalent expressions in Slovak, and therefore they are not differentiated. In the English literature, job analysis overlaps with occupational analysis. Job analysis reveals and lists individual *tasks*, the smallest sections of an activity, which can be performed independently, but the performance of such an individual task does not yet lead to the achievement of the goal of the activity, but without its performance, the activity would be meaningless. Actions are linked into chains that form *work operations*, the execution of which fulfils certain *activity goals, tasks*. Actions consist of the smallest functional elements (the act of switching on a device involves receiving and interpreting information, deciding whether or not to perform the action, pressing a button, checking whether the device is switched on) that are relevant for assessing the psychological

demands of the actions (e.g. speed and accuracy of decoding information, perceptual insight, selecting the correct button, etc.).

15.3. Psychological occupational profile of drivers

Professionalization is a complex method in which the psychologist cooperates with other professionals and with people from practice who have experience in the given work and profession. As a result of rapid technological change and accelerating market dynamics, occupationalographies of many occupations and jobs have a shorter shelf life. Every change in technical systems and in the technology of work is reflected in changes in the demands that work places on people. There are also such changes in the work of a driver. The elements of work that have changed with increasing motorisation and the penetration of computer technology are precisely those that place increased demands on the psychological side of driving.

Psychological occupational psychographics in road transport makes it possible to answer these questions:

1. What specific demands does the driver's job place on his/her psyche? What skills, abilities, personality traits and aptitudes does it require?
2. What positive and negative effects does this work have on the driver's psyche? Which of its components are most stressed?
3. How can this work and the working environment with the physical and technical characteristics of the car interfere with the orderly course of mental processes? To what extent are they consistent with the requirements for effective work performance and what are their psychological and hygienic implications?

A driver's CV should not be missing anything essential, but at the same time it should be relatively as simple as possible, well arranged. The driver's occupational profile consists of:

1. *Function analysis.* It deals with different work functions and the relationships between them. Functions arise from the identified requirements, the breakdown of the purpose of the job into tasks, the description of the functions, the assignment of the functions to the driver and the car, the criteria for the performance of the functions.

2. *Analysis of activities.* Captures a set of driver work activities. It assesses their relative importance and the demands they place on him.

3. *Workflow analysis.* It focuses on the flow of events in the system of work, their distribution, their mutual functional and temporal dependence.

4. *Decision analysis.* Specifies the requirements for decision making as a variable between information inputs and outputs.

5. *Job description.* Specifies the duties of the driver and the requirements for his qualifications, skills and experience.

6. *A description of the type of car and working conditions* and the resulting demands on the driver.

15.4. Competence-based approach in professionography

When we ask about a person's competence, we are asking about those characteristics, qualities and gifts that determine whether or not he is the master of a situation, whether or not he has control over it, whether or not he can succeed in it. A person's competence is not general, but is always linked to certain situations and conditions.

1. Competence is always *environmental* in nature. The demands of being a doctor or a driver are different in a developing African country and in Western Europe.

2. Competence is *instrumental*, that is, a competent person must know what to know, master the tools and procedures, the relevant technique and technology.
3. Competence has a *moral* component. A competent person is one who respects socially accepted norms and values, acts responsibly and morally.

Competence, like any system, is optimal when it is in an equilibrium state. Its equilibrium depends on two forces: what one *can do* and what one *wants to do*. If a person is motivated, wants to, but does not have the potential to do so, he will not be successful. If he has the potential but lacks the motivation, he will also not succeed. There are often cases of drivers who are smart, who can control the car perfectly and yet are dangerous on the roads. They lack the desire to drive safely, to submit to discipline, to be considerate of others. The road to road safety lies in building the competence of road users, especially by strengthening their positive motivation.

XVI. ASSESSING OF MENTAL CAPABILITY OF DRIVERS

We do not know an exhaustive and definitive definition of a driver's mental capacity, nor will we in the future. This is true not only for drivers, but also for other professions. We can only ever consider the optimum suitability of a person for a particular job in relation to the specific demands and conditions of that job. In determining the optimal psychological profile of a driver, we cannot take into account everything that determines his success in performing this job function in such diverse and dynamic conditions as road transport. We focus preferably on what has proved to be important in practice so far.

When conducting a psychological examination of drivers, the psychologist inevitably draws on a certain theoretical concept of psychodiagnostics of drivers, on a generally professionally accepted model of the required performance prerequisites and personality traits of the driver, takes into account the driver's personal and driving history, especially his/her traffic offences and any previous or ongoing psychological problems and disorders. Without a relevant, theoretically grounded and practically tested concept of assessing psychological fitness, the examination of drivers is a superficial test with a dubious output value. It would be ideal if uniform criteria for assessing the mental fitness of drivers and methods for measuring them were set up.

Psychological assessments of drivers are rather rarely carried out in some countries, in others they are systematised, in some places a nomothetic approach is set up, in others they are more of a casuistic nature, clinically or forensic-psychologically oriented.

16.1. Psychodiagnostics

Diagnosis is the recognition of a disease and its naming. In this understanding, the term psychodiagnostics should be used to refer to the identification of psychological disorders and illnesses and to refer to psychological investigative procedures that affect both the presence of symptoms and syndromes and the prognostic aspects associated with them. The recognition of disorders and illnesses is the mission of clinical psychodiagnostics. In traffic psychology it is only an associated goal. The object of its cognition is not a potentially or realistically ill person, but a person performing a specific job. The investigative approach to her as a patient is inappropriate and unethical. The use of the term psychodiagnosis, which clearly has clinical connotations, is not correct in such a case. Nevertheless, it is used. Practical reasons and custom lead to this. If we are psychologically testing a person for a purpose other than diagnosis, it would be more correct to speak of a psychological examination or assessment of personality or an assessment of his or her psychological capacity. This is more wordy, the use of such a label is lengthy, it lacks simple terminological precocity, and so the term psychodiagnostics has come to be used outside the clinical sphere as well.

Psychodiagnostics is broadly defined as any procedure designed to reveal the factors that are the basis for explaining behaviour or disordered behaviour and more specifically as "a set of methods and procedures affecting the level of development of a person, the characteristics of his personality, his current state, the presence of symptoms and syndromes, the potential possibilities of his development". In this view, diagnosis in psychology has less definite content than in medicine, where it is determined nosographically. A psychological diagnosis may also be such (mental retardation, debility, submissive or directive type, a certain temperament), but especially in the non-

clinical sphere it is an expression of certain knowledge about the person under examination, often having more the literary than the strict character of a medical diagnosis and nomenclature. The traffic psychologist diagnoses a person less and assesses more.

The number of alternative personality classifications is increasing. On the one hand, this expands the possibilities of psychodiagnostic identification and description, but on the other hand it complicates and especially obscures psychodiagnostics. The same person will be sanguine-melancholic according to a classical typology, epithemic according to another, intuitive-cynical according to yet another. When we put it all together, sometimes it fits well, but it can also be a mess.

In psychology, examinations whose outcome cannot be summarized in a diagnosis predominate, and psychologists must resort to descriptive inference, describing the findings in traits, contexts, and personality in a style that is often even fictionalizing, in order to convey what they mean and to be properly understood by others. A concise and plausible description of the person being assessed is valuable, and the fact that psychodiagnostics can arrive at it is its asset.

Personality is an open system in which its individual subsystems, individual psychological functions and characteristics are organized, interrelated and interdependent, and the whole system is in interaction with other systems. The assessment of personality must respect this fact, considering the person as a psychic system, a whole. In general, there has been a shift from psychometrics to psychodiagnostics, from observing isolated traits to assessing them in the context of the personality as a whole. If we detect aggression in a person, it will make a difference if we assess it in isolation or in connection with other personality characteristics, with his or her level of reason, emotionality, sophistication, integrity. Since the whole cannot be understood by mechanically combining elements, those psychodiagnostic procedures that can capture personality in a more complex horizontal and vertical cross-section are more effective.

Clinical psychodiagnostics usually proceeds from the individual to the whole, from the identification of symptoms (e.g., depressed mood, nervousness, submissiveness) to the determination of personality. The specificity of the clinical assessment of personality is that a mental disorder or illness pathognomically marks it. Psychodiagnosis of healthy people should start from the higher functions and levels of personality (self-concept, life style, personal ideology and attitudes) through structurally lower situated factors (intelligence, cognitive style, abilities, motivation, habits and routines, etc.) to its basal elements (reactance and interfering variables). In traffic psychological diagnosis, a holistic principle is applied, a progression from the whole to the particular, from the identification of a personality type to the assessment of certain characteristics that are relevant to the successful performance of the driving function, as reflected in its behaviour refracted through a specific personality constellation (e.g. emotionality, coping, conscientiousness or persistence in the context of temperaments and personality types).

Psychodiagnosis of normal people is not symptomatological, their characteristics should not be inferred from psychopathology, nor can it be limited to the resulting factorial scores of multidimensional questionnaires. It is the creation of psychological portraits, which questionnaires make possible, depending on their construct quality and on the psychologist's ability to handle them and extract their psychodiagnostic potential. In personnel selections, we should never be satisfied with knowledge of a few specific characteristics of candidates, nor with their averaged personality traits, but think of the person in context and seek to know the individual peculiarity of his personality in order to be able to make responsible judgments about whether he will succeed in interacting with the conditions and environment within the defined job competencies.

16.2. Psychodiagnostic approach

Depending on the goals of the psychological examination, the psychodiagnostic may choose one of four methodological approaches: idiographic, nomothetic, a combination of them, and competence-situational.

The idiographic approach is chosen if the goal is to observe, to know what characterizes the personality of an individual, in what way it is unique, what is characteristic for it, who this individual is and to understand why it manifests itself in such a way and not in another way. It is a causal approach that is inherent in clinical, forensic and counselling examinations, the aim of which is to establish a diagnosis and prognosis, to determine appropriate therapy and preventive measures, to assess prediction. By applying this approach, we do not evaluate an individual according to the criteria for the performance of a particular job and the mastery of specific competences.

The nomothetic approach focuses on revealing how an individual differs from other, comparable persons on set performance and behavioral parameters. In the nomothetic approach, it must be determined which traits and characteristics are predictors of successful and unsuccessful performance in a job function, and we must have norms that are established from examinations of a representative sample of people who perform a particular occupation. However, it is not enough to measure a driver's performance or certain characteristics with a test and to report the results he or she has achieved, but also to interpret them in the context of the theoretical concept of psychological competence and the occupational definition applied.

Combined approach. The combination of idiographic and nomothetic approaches is finding increasing application in work and organizational psychology. In traffic psychology, when examining drivers who have committed more serious traffic offences (aggressive driving, driving under the influence of alcohol or other drugs, repeated serious traffic offences), the traffic psychologist needs to assess not only the more global psychological competence of the driver, but must assess the relevant characteristics and manifestations in the context of the uniqueness of his/her personality in relation to the situational circumstances, in order to understand why he/she behaved as he/she did, and to make a prediction as to how and under what conditions he/she will adequately perform the function of a driver under the given conditions, or, more precisely, how he/she will perform the function of a driver in the given circumstances. why he should not perform it.

The competency approach is a newer approach, better known as *assessment centre* (this term is not translated in most countries). Each job, job classification, job function, places its specific demands on a person, some of which represent the most essential, core competencies. Competences are linked to specific situations and tasks. Subjects perform a variety of tasks that simulate key aspects of the job (managing people, making decisions, dealing with conflict and crisis situations, dealing with stress and risk, etc.) and are evaluated by a number of observers, mostly practitioners. Although under artificial conditions and over a relatively short period of time, AC usually provides a more reliable picture of a person's abilities and job performance than information from tests and questionnaires alone. AC is mainly applied in the selection of managers, the identification of their development potential and in their training. In assessing the mental fitness of production operators or drivers, AC is not applicable in a standard structure and scope.

16.3. Basic determinants of psychodiagnostic

The assessment of drivers' mental fitness is fraught with inaccuracy and error. These are mistakes that can be made in the professional work of a psychologist, mistakes related

to the level of psychodiagnostic methods and psychodiagnostics as a professional discipline, mistakes caused by the lack of clarity of the mission of psychodiagnostics of drivers and shortcomings in the concept of its implementation, including insufficient professional training of psychologists. Three components are always involved in the level, quality, credibility of the results of psychodiagnostics: the diagnosed person, the diagnosing person and the diagnostic methods.

Diagnosed person

The final effect of psychodiagnosis always depends on the cooperation of the diagnosed person. We can get him to cooperate and not force him. We can support the credibility of the proband's account of himself by our approach to him and by administering methodologies that are appropriate to his mental capacity. The psychodiagnostic examination is in some ways threatening to the driver. He or she is concerned about a good result, wants to retain a favorable awareness of his or her worth and, in the case of professional drivers, a job. Worry, tension and fear can distract his attention, impair his performance and participate in distorting his self-reporting. We cannot expect people to know themselves perfectly, and a degree of inaccuracy in self-description will always be present.

Psychodiagnostic

When examining personality, the psychodiagnostician inevitably starts from a certain theoretical conception of personality. Based on this, he chooses test methods and approaches the interpretation of the results. The theoretical conception of personality provides the psychodiagnostic practitioner with a platform for determining the relevance of the complex results to the functioning and well-being of the person being assessed. The psychodiagnostic is necessarily in the position of a prognosticator, i.e., he or she is to understand something that is in the present and use it to predict the future. He or she ascertains the present condition and trends of the person being assessed and predicts the development, how that particular person will perform in certain conditions of work and life, while both he or she and the environment will evolve.

Personality is a system in which everything is related to everything. The psychodiagnostic cannot examine everything; he must preferentially focus on what he is able to examine and by knowing what he is able to gain key insights into the personality under consideration, while also gaining insights into what he has not purposefully examined. Interpretation of the results does not rely solely on the analysis of the data taken. Interpretation also engages the imagination. This enables him to uncover and understand hidden connections and gives the revealed knowledge a fuller meaning, sometimes different from that offered by normative interpretation. Analytical procedures can be learnt and taught; imaginative ones are a faculty with which the psychodiagnostic is endowed to a greater or lesser extent and which he develops through practice. Creative imagination, backed by professional knowledge and experience, is the driving force behind the psychodiagnostic art.

The practice of psychodiagnostics is recognised as a professional activity requiring appropriate training and specialisation. However, even the acquisition of psychological training does not guarantee the full exercise of psychodiagnostics. As the psychologist gains experience and develops his or her knowledge, his or her diagnostic mastery increases, and he or she usually also gradually becomes more and more aware that psychodiagnosis is not some technocratic skill, but that *psychodiagnosis is an art, not*, of course, as an artistic activity, but in the sense of mastery, of being able to do something, to know something.

The outcome of a psychological examination of a driver by indicating that he or she is "fit" or "unfit" says nothing about how or why the psychologist reached that conclusion. It looks, then, as if all drivers with a 'fit' conclusion are equally good and safe on the road. This is, of course, nonsense. Everyone is potentially risky. Every driver inevitably has certain strengths and weaknesses which may be specifically reflected in road traffic conditions. In a psychological assessment of a driver, the final report should briefly and clearly state the characteristics of the driver that might compromise driving safety and the psychological circumstances that are an acceptable guarantee that he can control them and is mentally competent as a driver.

It is a mistake if the psychologist does not have or ignores the duty to inform the driver in an informed manner about the results of the examination, about his/her strengths and weaknesses, why he/she is or is not or may be a risk on the roads, or in which conditions and situations he/she may be more likely to be a risk. He should competently instruct the driver on how to deal with his actual or potential weaknesses.

Psychodiagnostic methods

There are a lot of psychological tests and questionnaires, but still very few really good ones. Also, depending on the cases under consideration, a psychodiagnostic may use only a few of them. There are functions, qualities and personality traits that are easier to assess (accuracy and speed of sensorimotor reactivity, emotional stability - lability, masculinity - femininity, etc.) and more that are very difficult to measure in a relevant way (aggression, responsibility, values), and it is in this area that the lack of valid psychodiagnostic tools is noticeable. Moreover, only methods standardised specifically for drivers should be used in driver psychodiagnostics, which also take transcultural differences into account.

In contrast to narrow methodologies that focus on determining the presence and degree of a certain trait or condition (e.g., anxiety - MAS, STAI) and empirical questionnaires (e.g., MMPI), multifactorial personality questionnaires (e.g., Eysenck's questionnaires, Cattell's 16 PF and, in this millennium, especially the NEO questionnaires, built on the concept of the five big factors) have become more popular over time. However, no single methodology can cover personality in all its complexity. Depending on the theoretical underpinnings, it focuses on a narrower set of dominant characteristics that most closely capture the theoretically defined personality structure.

Projective methods, ROR, FDT, TAT, Unfinished Sentences and others have a specific position in psychodiagnostics. Their application in the nomothetic approach to the assessment of psychological fitness for various professions is problematic. They cannot be standardized for a population of drivers as can performance tests and questionnaires. They are important for detecting psychological disorders as well as the simulation, dissimulation and aggravation tendencies of the driver under investigation.

An important psychodiagnostic tool that should be part of every psychological examination is the *interview*. Many traffic psychologists tend to underestimate its importance. On the contrary, where there is a lack of confidence in the validity of questionnaires, it has a dominant position. In the field of work and organizational psychology, **behavioral interviewing** is most useful. Its essence is that the person being assessed is asked about his or her traits and other characteristics, always giving specific examples of how they have manifested themselves in the past. The questions must not be theoretical, or even unaddressed and hypothetical ('What do you think a good driver should be like?'), but behavioural ('Give me examples of situations in which you have shown yourself to be a good driver'). If the person being judged ascribes to himself a characteristic that he does not actually possess, he usually cannot even give convincing examples from his own life.

Drivers usually consciously downplay their part in accidents, and even unconsciously apply attributional biases in their portrayal, attributing their shortcomings to circumstances or the influence of other people. They more readily and vividly describe situations where the accident did not happen to them, but almost did. The important thing is to ask about *near-misses* in a non-threatening, non-critical way, so that the driver feels that he or she can document how he or she was able to handle a difficult situation. Early accidents are very valuable for learning about drivers' personalities and take on symptomatic and prognostic significance when they happen more frequently.

Computer-assisted psychodiagnosis is becoming more and more established and, unfortunately, the extreme of being totally implemented by it. A whole range of performance tests and questionnaires have been transformed into such a version and new tests have been created whose administration and scoring are dependent on the computer. The electronic form of the tests relieves the psychologist from routine administrative work, which is a source of frequent errors. PC-based psychodiagnostics has gradually evolved from this basic level to a more complex systemic form, where semi-automated interfaces abundantly support the processing of results also at a comparative level, work with databases from sources other than the information from the current examination, and allow for a more expert evaluation and interpretation of the results. The aim of developing this form of psychodiagnostics is not to replace the psychologist with a computer, but to improve the quality of this professional activity by fast and error-free processing of input data and rapid access to relevant information for diagnostic reasoning.

PC-assisted diagnostics have brought great time savings and greater convenience to examinations, prompting *Computerized Adaptive Testing* (CAT). Standard performance tests are constructed so that the tasks contained in them identify persons from poor to excellent in a given parameter. Thus, most tasks are too difficult for the weak and too easy for the excellent. An adaptive testing system consists of the computer system selecting additional tasks for the test taker based on the test taker's previous solution that are only suitable for him. Testing is adapted to the ability level of the test taker during the examination, the set and order of tasks are not fixed, the set suitable for the test taker is continuously shaped.

The results of some tests and questionnaires are easier to interpret, others more difficult, some allow only very brief statements (e.g. that a person is or is not anxious, what IQ value he or she has reached), others allow a more plastic description of a person (multidimensional tests of intelligence and personality). In some cases, it is sufficient to confirm or exclude the presence of a particular characteristic or to establish a more global level of intelligence. In others, we need to express how the individual thinks, how he solves problems, in which tasks and why he thinks better and worse, what his character is, what his aptitude for a certain job is, we give a prognosis of his employment, self-realisation or re-education.

Psychodiagnostic methods are derived from artificial, hypothetical models of the mental system, so there will always be a disparity between the real and the test image of a person. To grasp the individual composition and level of traits and the variability of the dynamic relationships of the elements of the individual personality make-up of a particular personality is the most challenging task of the psychodiagnostic.

16.4. Mental capability of the driver

We cannot judge the mental fitness of a driver without being able to answer the question *what kind of driver should he be?* The answer that he should be *reasonably efficient and should exhibit personality characteristics that do not make him a risk on the*

road is correct, but it is vague. It requires a psychometric specification of which performance characteristics and personality traits and at what level of their test scores. We cannot track a large number of parameters, we have to select and focus on the most important ones. The basic structure of psychological competence consists of three categories of psychological aptitudes: 1. skills and abilities, 2. knowledge and experience, 3. personality dispositions and traits. Seemingly absent here is the category of psychopathology. However, it is contained within the above categories. In each of them we may come across drivers with specific psychological disorders.

The assessment of drivers' mental fitness in the sphere of their skills and abilities focuses on the assessment of the level of sensory perception, reaction time, attentive scanning, sensorimotor coordination and reasoning abilities. They should be at a level that ensures reliable and safe driving even under the effects of transient conditions. These abilities are tested to different extents and by different methods, which makes it difficult not only to compare research results but also to set more precisely the generally accepted level that compromises safe driving and the boundaries that mark driver incapacitation.

The manner, extent and depth of intelligence testing in assessing the mental fitness of drivers depends on the tasks they will be performing, their job description. In most countries, a driver's intellect is required to be non-deficient or subnormal in order to be granted a driving licence. Formally, this is easy to set up if we accept the psychometric standard of IQ and condition the mental competence of the driver with a lower limit of 80-85 IQ. However, intelligence is considerably more than IQ and the problem of establishing the required level of intelligence for safe driving is all the greater. No intelligence test or intelligence test battery measures intelligence perfectly.

Analyses of accidents and unsafe driver behaviour have conclusively shown that good sensorimotor skills, intelligence and knowledge are not sufficient to guarantee safe driving. Success and safety behind the wheel of a car depends not only on whether the driver is intelligent and skilful, but also on his motivation, attitudes, the difficulty of the task he sets himself, his temperament and character. Although several studies have confirmed the relationship of accident rates with personality traits, these results are not clear-cut. There are qualities and personality traits of the driver, such as inaccessibility to corrective experience, primitive aggressiveness, or asociality, that clearly disqualify him or her. Some other characteristics, such as irritability, impulsivity, neuroticism, agonial aggression, excessive thrill-seeking, are only more likely to make a driver a risk. In a number of countries, the five big factors questionnaires are used to assess driving competence. However, no consensus has yet been reached on which of these validly predict risky driving. Research has most often found significant predictive value of safe driving for the factors of emotional composure and conscientiousness. However, even if we know a characteristic is a highly likely predictor of risky driving, it still does not mean that a driver with that characteristic is unfit. A person's behaviour and personality are whole entities and we cannot base an assessment of fitness on one isolated characteristic. We must, as far as possible, try to assess personality holistically.

The portfolio of required abilities and qualities of a driver, and even those that are unacceptable, is not precisely defined in each country, nor is the scope and depth of professional psychological assessments, nor which psychodiagnostic methods must be used. In the EU, the application of psychological assessments of drivers is left to the initiative of individual countries, so that in some places they are not carried out at all, in others an interview with a psychologist is sufficient, in others they are carried out only for medical complications, after criminal offences or for drivers of advanced age, and only in a few countries are they professionally defined and enshrined in legislation, and even then mostly only for professional drivers.

XVII. EDUCATION AND RE-EDUCATION OF DRIVERS

Education is an activity directed towards the acquisition and improvement of a person's abilities and qualities. Education does not create or change personality dispositions and temperament. It shapes a person's *character*. From a normative point of view, character is understood as behaviour conforming to the expectations of society. Driver *education* and driver *training* are two distinct, albeit interrelated, concepts and measures. Driver education is the conscious acquisition of professional knowledge and experience and the formation of appropriate attitudes and moral qualities. Training refers to the acquisition of procedural skills of drivers, both sensorimotor and cognitive, forming and strengthening the habits necessary to control and operate a vehicle.

The classical method of teaching is the *frontal method*, in which the teacher explains the material in front of the pupils. It is a *transmissive method of teaching*, which sees the pupil as a passive recipient of knowledge and the teacher as an authority who possesses knowledge and transmits it to the pupil by lecturing. In contrast, *constructivist education* is based on the assumption that knowledge is formed and acquired through the manipulation of information, that the pupil constructs knowledge himself, actively discovers knowledge, and is thus motivated to acquire new knowledge. The teacher acts as a facilitator who does not give ready-made solutions and knowledge. The student is to arrive at these by the social-discursive method. The constructivist method is not appropriate for learning that is fact-based or in which the learner is unlikely to arrive at knowledge on his/her own.

Traditionally, driver training has focused on the lower levels in the hierarchy of driving tasks, but little on driving strategy, metacognitive skills, risk avoidance, and self-assessment. The progressive GADGET model (Hatakka et al., 2002) of driver education is based on a hierarchical conception of driver behaviour from which differentiated, interrelated goals for driver education are derived. The higher level, by applying feedback, directs and controls the lower level.

1. At the lowest level of this hierarchy, the aim is to acquire the knowledge of how to control the vehicle so that the driver can move and manoeuvre it.
2. At the second level, he learns to adapt his speed to the circumstances, maintain distances, control the traffic lights, and learn the rules and regulations.
3. Learning objectives at the strategic level relate to the purpose of the journey and its context with the material and social environment.
4. At the highest level, these are goals for life and skills for living. The driver needs to develop social skills, appropriate attitudes and the ability to exercise self-control so that driving contributes to his or her well-being, life satisfaction and self-development.

Defensive driving courses have gained a stable place in driver training. Defensive driving has five basic rules:

1. *Anticipate*. The rule encourages the driver to not only concentrate on what's happening around him or her right now, but to also be concerned with what's going to happen in the next 15 seconds.
2. *Use peripheral vision*. The driver must register pedestrians and vehicles on his side in time.
3. *Keep your eyes moving*. The driver should not fix his/her gaze only in front of him/her, but cover as wide a field of vision as possible.
4. *Monitor what is happening behind you*. The driver should use the rear-view mirrors.

5. *Be seen*. This means not only using headlights, taillights and indicators, but also making eye contact with other road users.

Defensive driving is not slow or submissive or worried. Perhaps it would be more appropriately referred to as *proactive driving*.

Awareness-raising campaigns are used to educate drivers and other road users, most often focusing on compliance with speed limits, seat belt use, child seat use, fatigued driving, alcohol and other drugs. Mass media campaigns have only a moderate and in some cases no effect. More effective are those that are combined with legislative and educational measures. An example of a relatively effective campaign was the Norwegian campaign "Speak out!" ("Speak out!", Norwegian for "Si i fra!"), which targeted adolescents to encourage them to make verbal efforts to avoid dangerous driving as passengers, making it clear to the driver when they do not feel safe.

17.1. Driver behaviour change programmes

More demanding than education is *re-education*, which is aimed at bringing about a change in the views, ways of thinking and behaviour that have been formed by previous education and which are not in line with the interests of society. So not only are we educating a person towards something, but at the same time we have to disrupt and change what has already been achieved and create a new state instead. However, the original state resists change, which makes re-education difficult.

Sanctioning measures, although they have a discomfiting and deterrent effect on drivers, do not lead to a correct perception of dangerous behaviour and do not curb it in the longer term. This has prompted efforts to apply interventions that would more effectively change inappropriate driver behaviour. Initially, these were refresher training programmes aimed at teaching drivers to drive better and instilling more thoroughly the rules of the road. They have not had the expected effect because the problem of undisciplined drivers is not their lack of skills but their inappropriate attitudes and maladaptive behaviour.

From the early 1970s onwards, behaviour improvement courses ("behaviour improvement", in German "Nachschulung") started to emerge in the USA and Europe. Most commonly, such courses are referred to as *rehabilitation* programmes. Rehabilitation is a set of measures to restore the somatic and psychological functions of a sick person and its mission is to return the sick person to a normal life. Rehabilitation is a medical field and it is not correct to label interventions for drivers who are not ill in this way. In some countries, courses are named as *vocational counselling* for drivers. Counselling is consultative help on what the client has a problem with or what is their specific concern. Many drivers do not see their inappropriate behaviour as their problem and are not interested in doing anything about it. A more appropriate name is **behavioural modification courses (BMC)** or *driver behavioural remediation courses*. These are purposeful and specifically structured practices that aim to modify at the two highest levels of the hierarchical model of driving behaviour, changing attitudes and beliefs to minimise the likelihood of risky driving.

BMCs are not training programmes, although they do include training in the form of information inputs and clarification. Nor are they *psychotherapeutic programmes*, even though some elements of them are applied. BMCs are not training groups (t-groups), they are not aimed at developing soft skills, as is the case, for example, in trainings on effective communication, people management, etc.

There are a growing number of countries where BMC has become part of tertiary prevention. There is not yet a uniform system of behaviour modification courses for

drivers who commit serious offences in the EU. In some countries, attendance is voluntary and allows offenders to obtain reductions in their criminal sanctions, and in other countries it is enshrined in legislation as a condition for the reinstatement of a driving licence. Courses are delivered in certified centres and are conducted by psychologists with the requisite qualifications.

17.2. Types of behavioural modification courses

Drivers who have committed driving offences do not form a homogeneous group. They can be differentiated according to the phenomenon that gives rise to the road safety risk:

BMC for drivers with serious offences

Most traffic violations and accidents are caused by inappropriate attitudes, habits, indiscipline, recklessness and competitiveness. Unsafe driving behaviour is the result of certain patterns, scenarios and mental models and cannot be changed or eliminated by teaching or practicing skills. Offences and accidents are committed even by drivers with very good skills and knowledge, and they commit them even when they know they are wrong. The problems with offences and accidents are more about drivers doing things they know they shouldn't do than about not knowing what they should do and how they should do it. A specific category of problem drivers are novice and young drivers. Their problems and offences are fundamentally determined by their immaturity. They lack not only driving but also life experience. BMC is designed to help them overcome this deficit, to teach them to be more realistic about the various factors that influence driving and to have a more realistic view of their driving ability and themselves.

BMC for aggressive drivers

Aggressive drivers may benefit from BMC for drivers with serious driving offences, but their aggressive behaviour will be more effectively influenced by courses that specifically address the causes and elimination of reckless driving behaviours, the strengthening of their rational and emotional control, and the prevention and management of anger and aggression.

BMC for drivers caught driving under the influence of alcohol and other drugs

These BMCs have the greatest tradition and have earned a positive reputation. Their mission is not addiction psychotherapy, but to change inappropriate attitudes and behaviours of drivers. It is therefore desirable that any driver caught driving under the influence of alcohol/drugs should be examined by a psychiatrist to confirm or rule out alcohol or other drug dependence. Drivers with an addiction need to undergo treatment and, if they are shown to be abstinent for a specified period of time after completion of the treatment, they may be admitted to the BMC on the advice of their treating physician or psychiatrist, as appropriate.

Reconditioning programmes for older drivers

The program designed to enhance the driving performance of senior drivers is not a BMC, a re-education program, but a *reconditioning program* that predominantly focuses on the first two hierarchical levels of driving tasks. We cannot expect a reconditioning program to reverse involuntional somatopsychic changes, but seniors benefit if they practice driving in non-threatening conditions and receive credible feedback from the instructor about their driving performance and driving competence.

17.3. Theoretical approaches to behaviour change

In developing campaigns and rehabilitation programs, their authors find support in various theoretical psychological concepts such as the theory of protective motivation, the health belief model, the theory of problem behavior, the theory of planned behavior, the theory of interpersonal behavior, the theory of cognitive dissonance, the theory of persuasive communication, prospect theory, and others. It is, of course, unrealistic to create a behavior modification campaign or course for drivers that encompasses all that these theories have to offer. On the other hand, we can find no example of a campaign or course that is consistently built on a single theoretical concept. To varying degrees, the various elements of the different theories are used eclectically rather than systematically in their development.

According to **the conditioning theory**, a person is dependent on environmental influences, responds to these stimuli, and retains or loses the induced responses depending on reinforcement. However, the process of behaviour change is more complicated than this theory explains. Its limitations are overcome by **Bandura's social learning theory** (Bandura, 1977, 1982). Bandura starts from the premise that a person acquires and maintains his or her behavior in a particular social context. The external environment influences him and he in turn influences it back as well. He established the principle of reciprocal determinism, which is an interaction process between behavior, environment, and internal mental processes. Central to this interaction system is the Self, which regulates behavior by self-observation, inference, and reactions to one's own behavior. Overcoming inappropriate habitual driver behaviour requires a mindful approach and the involvement of the Self, which is closely related to cognitive processes. The key to behavior change is changing expectations of personal effectiveness. If a driver acquires a belief in the utility of adhering to a set maximum speed and believes that he or she can drive that way, his or her expectation of efficiency will be high. Efficiency expectations are an essential part of adaptive driver behaviour. They determine which activities they will choose, how much effort they will exert in coping with the demands of driving. Behavioural change will not be achieved without changes in efficacy expectations.

The medical field has long focused on changing the behaviour of patients affected by diseases in the prevention and treatment of which the behavioural component plays an important role, e.g. hypertension, obesity, insomnia, substance abuse. An interdisciplinary field, *behavioural medicine*, has emerged and within it theoretical concepts such as the *Health-Belief Model* (HBM), the *Integrative Behavioural Model* (IBM) and the *Transtheoretical Model of behavioural change* (TTM). Their application in practice has clearly demonstrated their potential for behaviour modification. They are also inspiring and applicable in the sphere of modifying undesirable driver behaviour.

The HBM concept is related to Rogers' **protection motivation theory** (PMT). According to this theory (Rogers, 1975), motivation for adaptive behavior is a function of four beliefs: 1. a person's belief that the threat is serious and will have serious consequences, 2. a belief that the threat is concerning and can happen to him or her, 3. a belief that the person can preemptively protect him or herself from the threat, and 4. a belief that the recommended protective behavior is actually effective. Two factors work against adaptive motivation: the reinforcement (reward) associated with maladaptive responses and the cost of adaptive behavior. To be successful, a behaviour modification intervention must convince drivers that the threats are serious and of immediate concern to them, while at the same time offering them an alternative to maladaptive behaviour and reinforcing their consciousness of personal efficacy. *The driver will not change his or her*

misbehaviour unless he or she is aware of the seriousness of its consequences and the benefits of the desired behaviour, and unless the change would be arduous for him or her and he or she has confidence in his or her ability to achieve it.

The integrative model of behavior incorporates constructs from the theory of reasoned action and the theory of planned behavior. The most important determinant of behaviour according to this model is *intention*. In order to induce an intention for favorable behavior change, a driver must have a favorable attitude toward safe behavior and think that other people, especially those whose opinion he cares about, think that he should do so as well. A driver's intention to change his or her behaviour is more likely to be induced and easier to implement the more he or she knows about the importance of safe driving and the more positive the emotional response the desired behaviour evokes in him or her. It is difficult to make a positive change in attitude if that change will interfere with the subjective norm. The solution is that the driver accepts a different subjective norm, thus caring about the opinion of people who profess a safe way of driving, or that we positively influence the mindset of his social environment. The first alternative is more quickly achievable, but we must not neglect the long-term process of shaping positive social norms in road safety. The more road users become convinced of the effectiveness of safe traffic behaviour, the more such behaviour will become a social norm.

The transtheoretical model of behavior change describes and explains how people change their risk behaviors and form desirable behaviors (Prochaska, Velicer, 1997). The central construct of this construct is the delineation of five stages of behavior change:

1. *A stage of precontemplation* in which the person is not yet aware that he or she has a problem and so has no intention of changing his or her behaviour and is in thrall to existing stereotypes. Unless the driver admits and realizes that his or her serious problem is his or her unsafe driving behavior, he or she will be unwilling to change his or her inappropriate behavior.

2. *The stage of contemplation* in which a person becomes aware of his problem and begins to consider how to overcome it. However, her attitude towards behaviour change is still ambivalent. She sees the benefits of changing behaviour, but also the benefits of keeping things the same. Although she recognises the need for change, she may not know what she should do and does not feel a commitment to make it happen. Most drivers know that some of their driving behaviour tends to be dangerous, but unless they are lucky and cause an incident or accident, they usually just toy with the idea that they should drive more cautiously.

3. *The preparation stage* begins when a person decides to change behaviour. He or she becomes interested in relevant information and options for action. This stage may trigger or accelerate an event that will arouse motivation to change. It does not have to be an accident directly, often an early accident is enough.

4. *The action stage* is characterized by a change in behavior. The person modifies his actions to overcome his problem. He or she tries to behave in a different, more appropriate way. This stage requires the most conscious effort.

5. *The maintenance stage* is the reinforcement of new habits, stabilization of the induced behaviour change, consolidation of its integration into the lifestyle.

These five stages are complemented by the *stages of cessation and relapse*. The cessation stage is characterised by the person no longer needing to reflect and work on behaviour change. This has already become part of their lifestyle. However, at this stage there may be a failure, a lapse, where the person briefly returns to the original inappropriate behaviour, or there may be a relapse and the person behaves in an inappropriate way again in full, the smoker starts smoking again, the obese person

overeats again, the driver drives dangerously fast, aggressively or under the influence of alcohol again.

The amount of time an individual spends in each stage varies, but what he or she has to achieve in each stage is the same for all of them. For example, in a smoking cessation programme, the pre-contemplation phase takes over 6 months, the contemplation phase another 6 months, and the maintenance phase at least as long. When modifying dangerous driving behaviour, we can expect that for simpler forms of misbehaviour, such as disregarding important road signs, the duration of the different phases tends to be short. The more complex and vital the driver's behaviour we want to change, the longer the process of changing it takes and the more demanding it is.

17.4. Methodology, organisation and professional management of the BMC

BMCs are methodologically based on the interactive principle, concentrated group learning, where information input, discussion, exemplification, practical demonstrations, thematic video-plays, problem and solution situations, own experiences and self-reflection, feedback from other participants, social facilitation are applied. The BMC leader is not a lecturer, teacher or therapist, but takes a cooperative *facilitator* role. BMC participants are not pupils, listeners or patients, but active participants who are stimulated to authentic expressions, to an engaged approach to what is happening in the group and to achieving the goals of the programme. Each client should come to the conclusion not that they have to, but that they want to change their behaviour.

The BMC is not a didactic programme, but it also contains didactic practices. It provides drivers with important information and new knowledge, but most importantly, it helps them to form the right opinions about how to drive safely. BMC involves convincing drivers that some of their beliefs are wrong and that others are useful and correct. A method of deliberate verbal and non-verbal influence, **persuasion**, is used. It is up to the free choice of the recipient whether to comply with the persuader. This distinguishes persuasion from coercion. Under coercion, a driver may board a BMC, but the change in his or her inappropriate beliefs is induced by persuasion, not coercion.

The traditional method of persuasion is fear-mongering. Fear is a positive motivator as long as the recipients believe that they are capable of defending themselves against the threat. It is helpful if they fear the consequences of smoking, unprotected sex, drug use or risky driving. If it is in their power to avert the threat, fear will not paralyse them. It is different if they experience fear when they are threatened by a terrorist or their brakes fail while driving. Then their ability to ward off the threat is negligible. If someone is unaware of the danger of infectious disease or injury while riding a bicycle or riding in a car, they will not experience fear and are less likely to protect themselves. Fear-mongering has been reduced in persuasion for ethical reasons.

It is not only the influence of the psychologist, but also the influence of the course participants on each other and the effect of the atmosphere in the group that attack the experiencing, thinking, emotions and attitudes of the participants, so that they become more open to their change and direct it in a desirable direction. Thanks to the *feedback* that the individual receives from the other participants, his or her self-reflection is strengthened and self-evaluation is corrected. Discussion is a tool for achieving change, but also a manifestation and sensitive indicator of group dynamics. The facilitator's mission is to induce, maintain and guide it.

BMC is not an awareness-raising event or a debating society. The course should have a binding *content and a programme scheme* that can be adapted to the composition of the

participants, their behavioural peculiarities and deficits (not disorders), their needs and the possibilities to influence them. BMCs that have proven to be effective apply a similar organisation and methodology to t-groups. The optimal group size is between 6 and 10 members. Smaller and larger numbers of participants do not allow to maintain their interest and induce appropriate group dynamics. The course consists of 3-4 sessions of approximately 3 hours. It is recommended that the individual sessions are spaced several days apart, as changes take time. It is very beneficial to organise an informal meeting for BMC participants half a year to a year apart, where they share their experiences and learnings, and where they also receive appreciation from people who understand what they have been through.

XVIII. CLINICAL TRAFFIC PSYCHOLOGY

– special part

The share of drivers with psychological disorders in the accident rate appears to be marginal. But the fact is that we do not know the true situation. We do not have a reliable record of whether or not drivers who have had an accident have suffered from a psychological disorder. Even if it is known in certain cases that a driver has been diagnosed with a psychological disorder, we can usually only assume that this caused his accident, because it is rarely investigated in detail. It is not uncommon for accidents to be caused by drivers who have a mental disorder of which they were unaware.

A common problem is drivers who have been diagnosed with a psychiatric disorder but continue to drive, either despite a doctor's advice to stop or because their doctor has not told them not to drive. There is inconsistency and much confusion in the diagnosis and assessment of the fitness of drivers with mental disorders. The psychologist does not just assess the disorder according to set criteria and standards; he is interested in the individual with the disorder, trying to understand him, to discover his strengths and weaknesses, to assess how he can function as a driver with the disorder.

18.1. Dementia

Dementia is a syndrome resulting from a brain disease in which cognitive function is irreversibly impaired. Dementia arises predominantly in old age. The critical age tends to be 65 years and above. People are living longer and so the number of older people with dementia is increasing. The disease is usually chronic and progressive and goes through developmental stages. Symptomatic is impairment to impairment of memory, information processing, thinking and emotional control. In mild dementia, some individuals are able to drive, but this requires an assessment of their driving ability. In moderate and severe dementia, driving is not an option. Those most at risk tend to be drivers with Lewy body dementia, in which the quality of performance is impaired by hallucinations, and drivers with frontotemporal dementia, in which the initial signs of cognitive impairment are subtle and the personality changes (egocentrism, tactlessness, disinhibition or apathy) are at the forefront, making it unsafe for them to drive.

To identify drivers with dementia, the least reliable source of information is the affected driver himself. He or she is unaware of and unaccepting of the symptoms of the disease and downplays his or her condition in order to keep his or her driving licence. His condition is often underestimated by those close to him who, in more than one case, want him to remain independent and not have to be bothered with transporting him, or who simply feel sorry for dehumanising him.

We cannot treat mental impairment as some "mitigating factor" and be more lenient when judging a driver with dementia. If that person is to be an active part of road transport and function in a way that does not undermine its safety, he or she needs to 'keep up' with others, meeting performance and safety criteria as others do.

Alzheimer's disease always manifests as a smoothly progressive dementia syndrome. Cognitive impairment develops subtly, initially with episodic memory impairment, impairment of attention and visuospatial skills, and helplessness in dealing with new and more challenging situations. With the development of the disease, the old-memory, orientation in time and place also deteriorates, the intellectual impairment and uncriticalness of one's own condition escalate. Mood disorders and psychotic symptoms,

most often paranoid delusions, are added. In the second stage of the illness, the sufferer increasingly needs the help of others and eventually becomes totally dependent on them. The more advanced the stage of Alzheimer's disease, the more severe the impairment of driving ability. Its assessment should not be based on a medical diagnosis but on a transport psychological examination.

Parkinson's disease is a chronic neurological disease with a relatively slow progression that usually appears after the age of 50. It is characterised by three main symptoms - tremors, muscle rigidity and reduced mobility. The typical symptom is difficulty starting the intended movement. In addition to the hypokinesia, depression, which often accompanies the disease, makes driving difficult, but even more so dementia, which occurs in around 40 % of cases. There is also a form of dementia manifested by Parkinson's syndrome and is characterised by the presence of Lewy bodies in the brain cells. In the early stages of Parkinson's disease, the cognitive deficits are so mild that the affected driver retains good performance and may not be dangerous. However, we cannot rely on a clinical diagnosis; it is necessary to psychodiagnostically verify his driving competence.

18.2. Vascular and traumatic stroke

Stroke usually has a dramatic course and difficult-to-predict consequences. Ischaemic stroke results from sudden occlusion of a cerebral blood vessel due to thrombus formation or embolization. The consequence of blockage of oxygen supply is immediate impairment of brain function. When oxygen deprivation lasts for several minutes, irreversible changes in the cells occur. The symptomatology of the neurological impairment caused by ictus depends on the extent and localization of the damage. In addition to motor, sensorimotor and cognitive disturbances, restlessness, confusion, panic attacks, anxiety and depression may occur. About one third of those affected achieve partial or complete recovery.

Focal, diffuse or polar brain damage can occur in head injuries, gunshot wounds, blows, falls and very often in car accidents (head striking the windscreen). A related category to vascular and traumatic strokes are brain tumours. Focal brain disorders result from compression of nerve tissue and disruption of blood flow.

Patients with moderate and severe brain damage are characterised by slowed information processing and impaired long-term memory, attention, working memory, executive function, social cognition and self-awareness. They have difficulty performing two tasks concurrently when it is not possible to do them automatically. Higher levels of driving, such as resource allocation and task switching, tend to be better maintained. Brain damage interferes with personality. Poorer self-awareness and self-efficacy beliefs are typical. Combinations of impulsivity and apathy may also occur.

A diagnosis of stroke or traumatic brain injury is not a definitive indicator of impaired driving ability. Neurological tests are not sufficiently sensitive tools to assess it. Discrete cognitive deficits are more likely to be picked up by psychodiagnostic tests of cognitive ability.

18.3. Epilepsy

Epilepsy is currently classified as an epileptic syndrome, not a nosological entity. It is characterised by transient seizure states that cause intense muscle spasms and complete or incomplete loss of consciousness. The onset of an epileptic seizure may be preceded by an aura. The most serious psychological manifestations and consequences are caused by a grand mal seizure. It begins with immediate loss of consciousness and tonic convulsions.

This phase may be followed by a deep coma or only dimmed consciousness. Seizure is usually followed by retrograde amnesia. Small epileptic seizures (petit mal) are of only a few seconds duration and during their course the patient may resume the started activity out of inertia. These seizures may escape attention and in more than one case are not anamnesticly captured. About one-third of epilepsies are pharmacoresistant; the remainder of treated epilepsies have a favourable prognosis.

Approximately one per cent of the population is affected by epilepsy, including a significant number of drivers. People with epilepsy are at increased risk of serious road accidents, with pedestrians being at the highest risk of accidents, followed by cyclists and finally car drivers. A 6- to 12-month seizure-free period and treatment with antiepileptic drugs appear to be protective against accidents.

In the period between seizures, paraclinical examination (EEG), clinical neurological and psychiatric examination may be within normal limits, but neuropsychological examination is likely to reveal deficits. These may involve sensorimotor and cognitive functions, as well as personality changes of subclinical severity.

The notion that auras are effective enough to warn drivers of a seizure and thus able to prevent a crash in time is poorly supported by research. An epileptic seizure follows an aura with too short a time interval for the driver to stop driving and safely bring the car to a stop. The aura alone interferes with the epileptic's ability to perform reliably and safely on the job. In most cases, however, it is not the seizures themselves that cause accidents, but the effects that epilepsy has on a driver's performance. The potential cognitive impairment in epilepsy depends on its severity, the location of the epileptic focus in the brain, the duration and the age at which it occurred. Repeated seizures can severely impair attention, sensorimotor and cognitive abilities, affect the emotional sphere and personality. They are also at greater risk of developing other psychiatric disorders.

The principle measure in preventing accidents involving drivers with epilepsy is to thoroughly examine them and to educate them about the driving risks posed by this disorder and the need to respect the driving prohibition within a time period determined by a doctor. A return to driving should be conditional on an assessment of their psychological fitness to drive.

18.4. ADHD

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder. It affects not only children, but also adolescents and adults and affects approximately 5% of the child population and 2.5% of adults. There are changes in symptoms with age, but the basic picture of the disorder is maintained. The sufferer is hyperactive, inattentive and reacts impulsively, has difficulty concentrating and sustaining attention on tasks, makes mistakes out of inattention and does not pay enough attention to detail, is easily distracted by external stimuli, does not follow instructions and fails to complete tasks. Avoids tasks that require concentrated effort. In adults, it is noticeable that they poorly organize activities, fail to meet deadlines, and are bound by impulse control. Comorbidity of ADHD with intellectual and learning disabilities, emotional disturbances, dissociation and delinquency is common. There is no psychological test that reliably identifies ADHD. However, psychological tests are very helpful in recognizing and assessing performance deficits.

Each of the symptoms of ADHD can seriously impair driving performance and driving safety. Because it is an attention disorder, it most severely affects the lowest hierarchical level, reliable signal detection, input processing, and sensorimotor response patterns. Drivers with ADHD are characterized by reckless driving, have poorer vehicle control

and greater frustration with other road users, engage in secondary activities, and generally exceed the speed limit. They therefore have more frequent traffic accidents. The worst offenders tend to be those who have stronger comorbid disordered behaviours, especially defiant behaviour.

18.5. Pervasive developmental disorders

Pervasive developmental disorders are specific disorders in childhood and adolescence. They are permanent, so they extend into adulthood. They affect all of a person's cognitive functions, intellect and personality. The most common pervasive disorder is *autism*. A related disorder is Asperger's syndrome, which differs from autism in that there is no overall delay or retardation of speech or cognitive development. Individuals with this disorder have normal general intelligence but exercise it clumsily.

Symptomatic of autism spectrum disorders is a triad of impairments in social interaction and communication, perception and imagination, and a repetitive repertoire of activities and interests. Perception is characterized by hypersensitivity to certain sensory stimuli, fascination with details, numbers or letters. Attention disorders have two extremes: hyperprosection, the irreducibility of attention, and hypoprosection, the inability to concentrate on a single activity. Conspicuous are difficulties in processing information from two sources simultaneously. The autistic person lacks empathic thinking. He understands only what he knows from sensory experience and has difficulty understanding abstract attributions. Excellent mechanical memory is common in autism. The intellect may be subnormal, but it may also be above average in the sense of the term "idiot savant," resting on hypermnesia, mechanical encyclopedic knowledge, or fascinating numeracy. The autistic perceives the world around him according to himself and is focused solely on himself. The symptoms of autism and the degree of disability vary widely, from severe forms that require constant assistance to milder disabilities that allow autistic individuals to function independently and to fit in with healthy people.

Autistic people have problems obtaining a driving licence. More problematic than deficits in skills and abilities is their impaired interactional behaviour and lack of empathy. The autistic learner needs to learn what others take for granted, to sit behind the wheel and focus attention on relevant stimuli, and to take into account the behaviour of other participants within his or her capabilities. It must be expected that the autistic person will find the traffic environment chaotic. He or she should be helped to find order in it. She needs to organise the world of road transport in her mind so that it is comprehensible to her. It helps her to find stereotypes and a fixed routine in driving too.

In order to acquire the necessary skills and abilities, autistic people need tailored teaching, especially a personal approach, direct communication and visual communication of the necessary knowledge. Teaching should not force them to 'act' like normal healthy drivers, it must take into account their specificities. The instructor should accept the autistic person for who they are and as a partner in the learning process when practising new skills. Autistic people are different from healthy people and also drive differently from them. These differences need to be addressed in driving lessons and rehabilitation programmes. Driving school will not turn an autistic person into a healthy driver. Its job is to teach an autistic person to drive with their diagnosis.

18.6. Anxiety disorders and mood disorders

Anxiety and fear are normal emotions. Although unpleasant to experience, they are an adaptive response to stress and help in coping with threatening situations. In the short

term, anxiety causes a driver to become deconcentrated or, conversely, over-concentrated on driving, to grip the steering wheel rigidly and be alert, and to experience muscular and psychological tension. When anxiety exceeds a certain level, it ceases to help and causes inner confusion and suffering, *panic*. In *anxiety disorder*, anxiety is abnormal, occurs in situations that people usually handle without much difficulty, is an inadequate response to a stimulus, and persists even after the eliciting stimulus has been removed. In the long term, such a state makes driving distressing, is exhausting and may induce resistance to the activity.

Phobic disorders, unlike anxiety disorders, are more specific. For example, an individual with *agoraphobia* is usually aware that his or her fear of open or enclosed space (*claustrophobia*) is irrational, but is unable to resist the anxiety; he or she can only avoid these stimuli. The claustrophobic driver becomes very tense and vegetative hyperactive when driving through a tunnel and may have a panic reaction. An unpleasant, bothersome and potentially risky condition for drivers is *generalized anxiety disorder*. Such a driver experiences anxiety when shopping in a store or sitting behind the wheel of a car. When driving, he or she is in the grip of anxiety regardless of driving conditions, fears vague, potential dangers, and is haunted by doubts about the rightness of his or her actions; he or she is more easily anxious, worried, and doesn't even know why. His performance is impaired, he tires quickly and feels exhausted.

Anxiety is a commonly occurring symptom after an accident. After surviving a car accident, drivers suffer from more anxiety about driving and fears for their safety. Women drivers to a greater extent than men. Both drivers and passengers may develop a specific phobia, a *fear of driving*. Anxiety and fear of driving do not constitute a formal diagnosis, but they are bothersome and their symptoms can range from discomfort to extreme distress such as panic. *Panic disorder*, unlike panic in a specific situation such as driving a car, is generalised in nature and it is not possible to predict when it will occur. The onset of a panic attack is sudden. It is accompanied by feelings of derealisation, fear of losing self-control, going mad or even dying, which are potentiated by accompanying feelings of suffocation and chest pain. Driving in such a state is high-risk.

Mood swings are a common phenomenon in people's psychological life. In contrast, *pathological moods* are very intense, have a long duration of months or even years, and cannot be deflected by rational reasoning and persuasion. In pathological moods, a person's competence is disturbed, he cannot mobilize himself, he fails even in ordinary, undemanding life situations. The most common mood disorder is *depression*. The syndromological picture of depression is dominated by a sad mood, accompanied by loss of zest for life, loss of interest and pleasure in activities that were previously attractive and enjoyable, depressed psychomotor skills, slowed and, in some cases, rigid thinking, reduced working memory capacity, indecisiveness and lack of concentration. Depressed drivers are more risky, but this may not be reflected in their higher accident rate. Their performance suffers mainly from difficulties in allocating and maintaining attention, slower decision-making and poorer response to changes in the traffic situation.

18.7. Post-traumatic stress disorder

Post-traumatic stress disorder (PTSD) is a delayed and protracted response to a stressful, traumatic event. Its main symptoms are repeated re-enactment of the trauma in thoughts, memories and dreams, anxiety, feelings of numbness and alienation. Feelings of guilt are common, and panic attacks or aggression may occur. The sufferer tries to avoid trauma-related stimuli. The disorder persists when the sufferer is unable to integrate the traumatic experience in a meaningful way with other everyday experiences. Spontaneous

recovery occurs in about 30% of cases, in 40%-60% of cases the symptoms persist for a longer period of time and in 10% they are permanent.

The leading cause of PTSD in the general population is motor vehicle accidents. These tend to be major traumatic events even when they result in only minor injuries. Every child and adolescent is at risk of developing PTSD after an accident. Its negative consequences on their quality of life persist for a year after the traumatic event. Parents are more likely to experience PTDS when they witness their child's accident.

The severity of the medical consequences, the financial problems caused by the accident, intrusive thoughts and difficult memories of the accident, rumination and anger influence the persistence of PTSD. PTSD is more likely to be induced by alcohol use than by self-help in recovering from the disorder.

18.8. Personality disorders

The classification and diagnosis of personality disorders is among the most difficult and controversial of all disorders. Personality disorders are classified according to certain criteria and symptoms, the most striking abnormal manifestations in behaviour. Disturbances in excitability, impulse control and perceptual patterns are typical. These are traits that also occur in normal people in a mild, adaptive form. According to ICD-10 and DSM-5, personality disorders are not considered to be extreme and maladaptive forms of the normal personality structure, but qualitatively different personality structures.

Individuals with a personality disorder are characterized by a lifestyle that is markedly different from that of normal people. They are always dominated by the now. They are ruled by their inert pathological focus. Whether they are paranoid, schizoid, hysterical, anankastic, emotionally unstable, addicted, their inadequate relationship to themselves and to their surroundings is always manifested. Their patterns of behaviour are inappropriate, yet they persist and are unchanging. They do not perceive their behavioural abnormalities as a disorder and see the faults in the environment. The central symptom is inaccessibility to corrective experience. They repeatedly experience problems because of their behavior but fail to learn from it and change it.

It is likely that drivers who repeatedly exhibit inappropriate or aggressive driving behaviour may fall into the category of personality disorders and warrant investigation. The psychodiagnosis of personality disorders is problematic, which is reflected in the perceived lack of methodologies to identify them. One of the few is the PCL-R questionnaire (Revised Psychopathy Checklist), but this requires training and experience and is a time-consuming method. A more feasible and, it seems, acceptably valid test is the Cloninger Temperament and Character Inventory, TCI. Symptomatic of personality disorders are reduced scores on the character dimensions, the ability to direct behavior toward intended goals (SD dimension) and to cooperate with others (CO dimension).

18.9. Addictions

According to the 10th revision of the WHO International Classification of Diseases, addictions are classified as mental and behavioural disorders caused by the use of psychoactive substances. An addiction syndrome is diagnosed when three or more of the following symptoms occur simultaneously in the last few months:

- craving, a strong desire or urge to take a substance;
- difficulty controlling substance use;
- withdrawal symptoms, pathophysiological manifestations accompanying withdrawal;
- increasing tolerance to the effect of the substance;

- continuing to use a substance despite its harmful effects.

Craving has emotional content and a strong motivational effect. It interferes with performance, impairs cognitive function, distracts and distorts attention, and causes confusion in thinking. It motivates addictive behaviour and impairs self-control. It is a serious barrier to quitting.

Non-alcohol drugs and abused psychoactive drugs differ in their effects, but the addiction syndrome is almost identical. They develop addiction more quickly than alcohol and the psychological and health consequences are different. With long-term use, cognitive impairment is very likely and, paradoxically, the drugs can cause the disorders for which they were originally prescribed, anxiety, depression, sleep disorders. It is very difficult for a patient to come to terms with the idea of stopping taking them. After discontinuation of the higher doses taken, there are strong and long-lasting withdrawal symptoms.

Excessive drinking and alcoholism cause cerebral dysfunction, decreased reaction speed and sensorimotor coordination, impaired short-term memory, impaired spatial and abstract thinking, its flexibility and learning ability. Alcoholism causes negative personality changes, characteropathy, emotional lability and emotional flattening, a focus on basic needs and the immediate given at the expense of higher needs and values. It is accompanied by a pseudoneurasthenic syndrome in which irritability, explosiveness and aggression alternate with pity and tearfulness.

The diagnosis of alcoholism cannot be based on the use of short screening scales (ADS, MALT, SADQ, MAC, etc.). The subjective history is usually given by the impaired driver in such a way as to portray himself in a favourable light, distorting and concealing information. Objective history is an indispensable diagnostic tool, but it tends to be more difficult to obtain. Laboratory diagnosis of markers of substance dependence is helpful.

Psychodiagnostic testing can detect performance, cognitive, and personality deficits related to binge drinking. The psychological examination must include a psychodiagnostic interview that can pick up signs of alcoholic development. This requires a good knowledge of the developmental stages of alcoholism and the ability to conduct the interview in such a way as to elicit relevant information. Although the developmental stages of alcoholism are not compact, recognition of their symptoms allows a picture to be formed of the progression and pathology of drinking and its consequences for driving psychological competence.

18.10. Schizophrenia

Schizophrenia is a severe psychotic disorder that significantly impairs the ability to perceive, think and behave in a socially appropriate manner. The symptoms of schizophrenia can be categorised as positive, which are excessive or distorted expressions of normal functions (hallucinations, delusions and disturbances in thought patterns), negative, which are impairments or loss of normal functions (impaired will and planning ability, mood disturbances, bizarre behaviour) and cognitive symptoms (impaired ability to concentrate, remember and solve problems). A serious circumstance is impairment of executive functions, which is manifested by difficulties in decision-making and solution-finding in complex traffic situations and reduced efficiency in processing information from internal and external sources. Such drivers have difficulty performing primary and secondary tasks simultaneously. Their ability to recognise their own driving errors and failures is impaired.

Although the clinical picture of schizophrenia is characterized by polymorphism of the symptoms, their varying intensity, and individually varying degrees of impaired performance, in general, persons with schizophrenia in the process of florid psychopathology should not drive. Currently, there is no standardized procedure for assessing the ability of schizophrenics to drive. Although antipsychotic treatment does not guarantee a return of driving performance to premorbid status, as long as the patient is treated with appropriate antipsychotic medications and cooperates with the physician, he or she can lead a full life, including driving. Whether the result of the psychodiagnostic examination of the driving performance of drivers with schizophrenia is favourable or unfavourable should be confirmed by a repeat examination, and the patient's condition should also be assessed by a follow-up examination with a longer time interval after treatment.

18.11. Diabetes, hepatopathy and cardiovascular disease.

Different somatic diseases affect drivers' performance and mental fitness to varying degrees. *Diabetes mellitus* compromises driving safety. Type 1 diabetes requires treatment with insulin. Type 2 diabetes can be managed with oral hypoglycaemic agents or diet. The most common acute complication of insulin treatment of diabetes is hypoglycemia - an excessive drop in blood glucose levels. It is accompanied by unpleasant symptoms, tremors, weakness, blurred vision, lack of focus and confusion. Hypoglycaemia while driving can have tragic consequences. However, it is not the only negative consequence for driving safety. Diabetes impairs attention and slows sensorimotor responsiveness and information processing. The risk of traffic accidents is slightly increased in patients with diabetes, compared to healthy drivers, but is acceptable. Drivers with cirrhosis may also be at risk. They have significantly more violations and accidents than drivers without cirrhosis. Patients with hepatic encephalopathy have the worst DBQ scores.

Cardiovascular disease has become a health threat to modern society and is the leading cause of death in men in developed countries. Professional drivers of commercial vehicles, whose work is often associated with an unhealthy lifestyle, lack of physical exercise, stress and obesity, are relatively more likely to develop *hypertension*. Hypertension and the drugs prescribed for it have an adverse effect mainly on attention, and to a lesser extent on sensorimotor responsiveness and visual-spatial perception. Drivers with hypertension are also a high-risk group because the disease is often associated with Type A behaviour and Type D personality, a 'distressed' personality characterised by a tendency to experience negative emotions and to avoid social contact.

18.12. Movement disability due to traumatic injury spinal cord and limb amputations

A mobility impairment, whether due to bone and joint damage, muscular disorders or brain and spinal cord damage, impairs muscle strength, range and coordination of movement, thereby limiting vehicle control and inducing a higher risk of road accidents.

Spinal cord injuries often occur during leisure activities and most often as a result of traffic accidents, especially motorcycle crashes. The extent of paralysis depends on the section of the spinal cord affected. With paraplegia, those affected may drive cars modified for manual throttle and brake control. If they were driving before the disease, they are more easily able to drive after it. Driving a paraplegic is not so much made more difficult by the transition from foot control to manual control as it is because of the other

consequences of immobility. Getting in and out of the car is problematic, leaving the car when needed is complicated and time consuming, and the paraplegic is largely trapped in the car. In the event of a crash, he or she is unable to leave the car quickly or at all, and even the thought of such a situation is frightening for him or her. Paraplegic drivers are acutely aware of threats from other drivers and other road hazards, drive more cautiously, avoid potentially dangerous situations and are not accident prone.

A related handicap is limb amputations. Those with a left-sided amputation are much less concerned about driving; those with a right-sided amputation often require vehicle modifications.

Mostly older drivers are affected by arthritis. Arthritic stiffness and pain in the limbs interferes with driving comfort, but almost all arthritic drivers are able to continue driving simply by modifying the vehicle and adjusting their driving technique.

18.13. Kinetosis and simulator sickness

Kinetoses are movement diseases that are induced by the movement of vehicles. The most famous is seasickness and airplane sickness, but it is also encountered when riding in cars, trains, on swings and merry-go-rounds. Kinetosis is not a disease in the true sense of the word. It is a transient nausea accompanied by nausea, which may be accompanied by other symptoms, dizziness, fatigue, apathy, disorientation. Air passenger nausea is quite common. In severe turbulence, e.g. hurricane zone overflights, it affects even experienced pilots. Children under three years of age are almost immune to kinetosis, which is explained by the fact that they have developed vestibular reflexes but not yet cerebral cortex functions. People who have experienced kinetosis repeatedly in an aeroplane are more easily influenced by the anticipation of its unpleasant symptoms and experience nausea in the aircraft, for example, as soon as the engines start, even if the aircraft is not yet moving.

Kinetoses are of specific interest due to their occurrence in simulators. The name *simulator sickness* has been adopted for this branch of kinetoses. This disease affects more than half of the population. Experienced drivers and pilots are significantly more susceptible than novices. This is because the organism of experienced drivers is more adapted and accustomed to real driving conditions, is trained to perceive them accurately, and is therefore more sensitive to the conditions of the simulator, which deliberately "deceives" their perception. Persons with less driving experience do not perceive the simulated driving conditions as controversially, and thus are more likely to do so without provoking nausea.

It is not recommended that a person drive just after functioning in a simulated environment, driving on a simulator or playing 3D games. His or her psychomotor control has been affected and is unlikely to perform optimally. If he has previously experienced simulator sickness, a sudden re-occurrence of his symptoms, a flash back, cannot be ruled out.

18.14. Visual disturbances.

Sight is the most important and most stressed analyzer when driving. Its weakened and impaired functionality seriously compromises the safety of driving and, from a certain level of impairment, makes it impossible. As drivers age, visual impairments such as *impaired visual acuity, macular degeneration, cataract, retinopathy and glaucoma* increase. Glaucoma represents permanent degeneration and death of optic nerve tissue. It is an insidious disease that manifests itself only subtly in the early stages, with minor

disturbances in the field of vision. However, these increase and the loss of peripheral vision becomes more severe, posing a serious threat to safe driving. Acute glaucoma is the riskiest - it is accompanied by intense pain and pressure in the eye, blurred vision and nausea. With glaucoma, the field of vision is impaired and it becomes increasingly difficult for the affected driver to cope with driving in poor visibility, especially at night. Glaucoma is not just an eye disease, but a more general neurodegenerative condition that is more likely to be accompanied by cognitive impairment. A serious risk factor is impaired selective attention

Driving is also made more difficult by *strabismus*. It's not just a cosmetic defect. Binocular vision is impaired, the eyes do not work as one organ and do not form a unified perception. Visual acuity and spatial perception are impaired, which can lead to impaired visual-motor coordination, distance estimation and visual perception.

18.15. Sleep and wakefulness disorders

More than a third of the population suffers from sleep disorders. Sleep disorders arise due to both internal and external causes. Internal, neurological causes are more likely to be narcolepsy, lifelong idiopathic insomnia, recurrent and post-traumatic insomnia, and central apnoea. Respiratory obstruction is also an internal cause. External causes are mainly inadequate sleep hygiene, disturbed circadian rhythms and quite often addiction and dependence on hypnotics and psychostimulants. Many lorry and bus drivers have to struggle to keep from falling asleep while driving. Not only do they suffer from fatigue from work overload, but they also have a high incidence of sleep disorders. These are generally an under-diagnosed occupational disease.

The most common sleep disorder is insomnia, which is characterised by trouble falling asleep, interrupted sleep and frequent awakenings, causing daytime fatigue. Insomnia is usually caused by worry, fear and stress. Acute insomnia is chronified by a simple stereotype where a person anticipates insomnia and its consequences, becomes preoccupied with such fears, and in the evening, when he goes to bed, he is agitated, the sleepiness is gone and he cannot fall asleep. During the day he is then tired, noticing and worrying about the consequences of sleep deprivation on his performance.

The most common cause of excessive daytime sleepiness is sleep apnoea syndrome. Its typical symptoms are abnormal breathing complications, shallow breathing, prolonged pauses or stops in breathing. Untreated sleep apnoea is considered a serious impediment to fitness to drive. A slightly rarer sleep disorder is narcolepsy. This is a chronic lifelong condition characterized by extreme daytime sleepiness and sudden onset of sleep episodes, sometimes in bizarre situations. Narcolepsy is a contraindication to obtaining and retaining driving privileges.

Chronic fatigue syndrome induces deficits in the domains of attention, speed and accuracy of visual information processing, spatial working memory, and overall cognitive performance. Excessive sleepiness and obstructive sleep apnea are validated predictors of accident rates.

18.16. Painful disorders and conditions

Pain is an unpleasant sensation or emotional experience associated with actual or potential tissue damage, or described in terms of such damage. On the basis of pathophysiology, we distinguish nociceptive, neuropathic and psychogenic pain, acute and chronic according to duration, and tumour and non-tumour pain according to aetiology. Pain is always subjective; there is no neuropsychological or chemical test to

measure it. People differ in pain threshold, there are pains more or less bearable, but there are also unbearable pains. Mild pain can be accommodated and even driven competently, intolerable pain cannot. Pain is intrusive and fills the consciousness of the sufferer. It always draws attention to itself, but this need not reach a level that seriously impairs attention to driving. Pain interrupts a person's attention and forces him or her to focus unwillingly and undesirably on his or her body. Intense pain paralyses his attention, perception and thought, dominates his experience and everything else takes a back seat. The experience of pain can be influenced by the subjective meaning of the situation. The ability to drive in pain is adversely affected by various comorbid conditions, fatigue, anxiety, depression, as well as by the use of medications, analgesics, antidepressants, antiepileptics and others. Any pain can affect a driver's performance and should be taken seriously, although often not by the drivers themselves.

The unilateral strain on the body when driving and the vibrations cause discomfort, but quite often also pain, which can become chronic. Truck drivers in particular often suffer from *back pain*. With vertebrogenic pain, sitting behind the wheel and checking by looking over the shoulder is painful. It is dangerous if the pain suddenly strikes a limb or other area of the body, to which the driver reacts with a reflexive movement that disrupts the direction of travel and other motor actions.

Stressful driving situations and stress often cause *headaches*. They are also triggered by long, exhausting drives, night driving, fatigue, poor ventilation and hunger. More serious than a transient headache is a *migraine*. It is a chronic neurological disease that manifests itself in intense, multi-hour to two- to three-day headaches. The headache is accompanied by nausea, vomiting and increased sensitivity to light and noise.

18.17. Obesity

Obesity has become a serious problem in the civilised world, not just a health problem. It affects a person's performance and working capacity and should be addressed more thoroughly, including in relation to psychological aspects and driving safety.

Fatness and obesity is the excessive storage of energy stores in the form of fat due to various causes. The cause is most often a combination of higher energy intake, lack of exercise, hereditary influences, psychological influences and inappropriate eating habits from childhood (primary obesity).

The most widely used indicator of overweight is body mass index (BMI), which is calculated as the ratio of weight in kg to the square of height in metres. For the Caucasian European population, according to WHO criteria, obesity is defined by a body mass index greater than 30; a value between 25 and 30 is referred to as overweight. In simpler terms, an individual weighing 20% or more more than their ideal weight is defined as obese. Severe or morbid obesity is exceeding the ideal weight by 100%, which directly reduces life expectancy.

Motoring is a major contributor to the obesity boom. People walk little and drive a lot. There is a demonstrable correlation between average mileage and population obesity rates. The prevalence of obesity is particularly high among lorry drivers. Even taking public transport instead of using cars is an effective means of reducing the prevalence of obesity.

An obese driver is not as clumsy when driving as when walking, but excessive body weight restricts the driver's ability to look around the sides of the vehicle and especially behind him or her, and adversely affects the range and coordination of movements. He is wedged into the confined space of the car and is subjected to greater static strain. Obese drivers tire more easily, are less able to cope with long journeys. Their capacity for

adaptation is curtailed and they find it harder to acquire personal well-being. They should not expose themselves to stressful conditions, take breaks on longer drives, take a walk and stretch their legs to relieve leg oedema. They are advised to ride in the morning when their legs are not as congested.

Among drivers, obese drivers are not more likely to have accidents, but their accidents are more likely to be fatal. Excessive body size and weight has an obvious destructive effect on the lower extremities in a crash, but it does protect the head to some extent. In head injuries, obesity applies more as a protective factor. Even if obese drivers have no demonstrable propensity for risky driving styles, they are destroying their bodies and thereby exposing themselves to both health and occupational risks.

XIX. FORENSIC TRANSPORT PSYCHOLOGY

Forensic psychology established itself in the system of psychological sciences in the previous century and now has a rich background of published work, but only a tiny number of those dealing with road traffic crime. It includes forensic, criminal, criminological, penitentiary and post-penitentiary psychology.

In the clarification of criminal cases, the mental processes of the offender before and during the commission of the crime attract attention. Drivers may exhibit behaviour that is not indicated by any signs in their previous life. Their criminal acts may be provoked by random circumstances. Recognising the motivation for criminal conduct is important in assessing its seriousness and sentencing.

A key issue in all areas of forensic psychology is the *personality of the offender*. Forensic psychology has rejected the notion of a dispositional criminal personality and has refocused its interest on offender typology. A general typology has been adopted distinguishing the type: 1. normal, socialized, 2. neurotic, 3. personality disturbed, 4. mentally deficient, and 5. psychotic. In the socialized type, the act committed is merely an episode of deviation from the previous life path and the personality of the perpetrator does not show significant signs of disturbance. It is related to so-called *punitive criminality*, by which is meant the potential readiness of normal, decent people to commit dishonest acts, provided they are not detected and prosecuted. These are frequent cases of both misdemeanours and road traffic crimes. Neurotic, emotionally disturbed, unstable types of offenders are also relatively well represented. The representation of offenders with personality disorders and psychoses is rarer, but not insignificant.

A relatively newer discipline is *victimology*. It deals with victimhood, i.e., the human victims of crime, victimhood, the predisposition to become a victim of crime, and victimization, the process by which a person becomes the object of a crime. Road transport en bloc represents a zone of vulnerability and there are times and places within it that are associated with a relatively increased risk of crime. It has been shown that, particularly in public transport, women are more likely to be victims of crime. Women are also often targeted by violent behaviour of drivers while behind the wheel of a car.

The immediate harm caused by the offender's crime (similarly, by a traffic accident) is only the first stage of victimization. The victim experiences shock. This phase is followed by secondary victimisation, which is the psychological damage caused by the way in which those in the victim's circle react to the criminal event. The victim may also be traumatised by the investigative and judicial process. Secondary victimisation is purely psychological in nature. It is accompanied by feelings of unworthiness, dishonour and injustice. The victim is haunted by the question of why this has happened to her. His or her self-confidence is shattered, events seem unpredictable and incomprehensible, he or she loses his or her previous certainties, becomes disillusioned and feels powerless. Finally, tertiary victimisation occurs as a result of a change in the victim's career and lifestyle. It takes individually varying lengths of time for the victim to process the trauma and return to a full life (if at all). Psychologists may be required to provide expert testimony as to whether and to what extent the car accident caused the victim to suffer a psychological disorder.

Expert traffic psychological examination

Forensic psychological assessment is viewed as an evidentiary tool, although its credentials and recommendations are usually of probabilistic value. The psychological

expert's findings are based on the contents of the criminal file, anamnestic data, interview, psychodiagnostic examination and observation. In the realm of traffic crimes, the role of the expert is to answer questions related to the crime of the accused driver:

- Does the accused suffer from a mental disorder that may affect his actions as a driver when operating a motor vehicle?
- From a psychological point of view, is the accused fit to drive?
- From a psychological point of view, what is the most likely cause of the defendant's actions or failure to act while operating a motor vehicle?

An expert psychologist helps with his or her knowledge to seek the objective truth. Also for this reason, he must use generally accepted valid psychodiagnostic methods. In the sphere of forensic psychodiagnostics it is not exhaustively determined which ones are to be used. The specific procedure of the expert examination and the choice of psychodiagnostic methods are determined by the education, theoretical and practical orientation of the expert, his experience and the situational issues of the investigator or the court.

It would be a great mistake to reduce expert examination in the field of forensic traffic psychology to the discovery of psychopathology. Although the recognition of a possible mental disorder is very important, it is not sufficient to understand the criminal conduct of the person under investigation in road traffic conditions. Moreover, in more than one case, psychopathologically intact, healthy, normal persons commit crimes. In their psychodiagnosis, we do not make do with an arsenal of clinical methods and must apply a methodological procedure for assessing the psychological competence of drivers.

The expert psychological examination overlaps to a large extent with the examination of the driver's mental capacity, but it is not aimed at predicting his safety, but at a content-defined event that has already happened and in which he has already manifested himself as dangerous. The expert is required to explain why. He therefore examines what his perception, attention and responsiveness were at the incriminated time, what his situational awareness was, what his state of mind was and what motivated him. He investigates whether he was multitasking and divided attention at the time of the accident, whether and what secondary activities he was engaged in, the divergence of his attention just before the accident, and the possible effects of distraction and preoccupation. The expert needs to understand how the accused thinks and also to gain insights into his 'soft' cognitive abilities such as sense-making, understanding and assessing risk, the formation of adequate mental models, especially the model of safe or dangerous driving, and last but not least, his endowment with tacit knowledge. In the conclusion of the report, the expert answers the questions posed in a concise and comprehensible manner.

LITERATURE

- Adams, J. G. U.: Risk and freedom: The record of road safety regulation. Transport Publishing Projects, Cardiff, Wales, 1985, p. 202.
- Ajzen, I.: From intentions to actions: A theory of planned behavior. In: Kuhl, J., Beckmann, J.: Action control: From cognition to behavior. New York: Springer-Verlag, 1985, pp. 11-39.
- Ajzen, I.: Nature and operation of attitudes. *Annual Review of Psychology*, 52, 1, 2000, pp. 27-58.
- Allen, T. M., Lunefeld, H., Alexander, G. J.: Driver information needs. *Highway Research Record*, No. 366, 1971, pp. 102-115.
- Bandura, A.: Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84, 2, 1977, pp. 191-215.
- Bandura, A.: Self-efficacy mechanism in human agency. *American Psychologist*, 37, 2, 1982, pp. 122-147.
- Bekiaris, E., Amditis, A., Panou, M.: DRIVABILITY: A new concept for modelling driving performance. *International Journal of Cognition Technology and Work*, 5, 2, 2003, pp. 152-161.
- Caprara, G. V., Gargaro, T., Pastorelli, C., Prezza, M., Renzi, P., Zelli, A.: Individual differences and measures of aggression in laboratory studies. *Personality and Individual Differences*, 8, 6, 1987, pp. 885-893.
- Damasio, A. R.: Descartes' error: Emotion, reason and the human brain. G. P. Putnam's & Sons, New York, 1994, p. 312.
- Douglas, M., Wildavsky, A.: Risk and culture: An essay on the selection of technical and environmental dangers. Berkeley, University of California Press, 1982, p. 221.
- Dunbar, F.: Psychosomatic diagnosis. Paul B. Hoeber, New York, 1943.
- Endsley, M. R.: Toward a theory of situation awareness in dynamic systems. *Human Factors and Ergonomics Society*, 37, 1, 1995, pp. 32-64.
- Fuller, R.: A conceptualization of driving behaviour as threat avoidance. *Ergonomics*, 27, 11, 1984, pp. 1139-1155.
- Fuller, R.: Psychology and the highway engineer. In: Fuller, R., Santos, J.A. (eds): *Human Factors for Highway Engineers*. Pergamon, 2002, pp. 1-10.
- Gibson, J. J., Crooks, L. E.: A Theoretical field-analysis of automobile-driving. *The American Journal of Psychology*, 51, 3, 1938, pp. 453-471.
- Hofstede, G., Hofstede, G. J.: *Cultures and Organizations. Software of the human mind*. LINDE, s.r.o., Prague, 2007, p. 335.
- Goldstein, W. M.: Introduction to Brunswikian theory and method. In: Kirlik, A. (ed.): *Adaptive perspectives on human-technology interaction*. Oxford University Press, New York, 2006, pp. 10-24.
- Hatakka, M., Keskinen, E., Gregersen, N. P., Glad, A., Hernetkoski, K.: Results of EU-project GADGET, Work Package 3. In: S. Siegrist (ed.): *Driver training, testing and licensing - towards theory based management of young drivers' injury risk in road traffic*. BFU-report 40, Berne, 1999.
- Hatakka, M., Keskinen, E., Gregersen, N. P., Glad, A., Hernetkoski, K.: From control of the vehicle to personal self-control; broadening the perspectives to driver education. *Transportation Research Part F*, 5, 3, 2002, pp. 201-216.
- Hollnagel, E.: Understanding accidents - from root causes to performance variability. *Proceedings of the IEEE 7th conference: Human Factors and Power Plants*, 2002, p. 4.

- Hollnagel, E., Nåbo, A., Lau, I. V.: A systemic model for driver-in-control. Proceedings of the Second International Driving Symposium on Human Factors in Driver Assessment, Training and Vehicle Design, Park City, Utah, 2003, pp. 86-91
- Horrey, W. J., Lesch, M. F., Mitsopoulos-Rubens, E., Le, J. D.: Calibration of skill and judgment in driving: Development of a conceptual framework and the implications for road safety. *Accident Analysis and Prevention*, 76, 2015, pp. 25-33.
- Huguenin, R. D.: The concept of risk and behaviour models in traffic psychology. *Ergonomics*, 31, 4, 1988, pp. 557-569.
- Kahneman, D., Tversky, A.: Prospect theory: An analysis of decision under risk. *Econometrica*, 47, 2, 1979, pp. 263-291.
- Klebensberg, D.: Risikoverhalten als Persönlichkeitsmerkmal. Hans Huner Verlag, Bern, 1969, p. 170.
- Kucek, P., Kuceková, L.: Silver Methodology, Novidea, 2024, p. 268.
- Loewenstein, G. F., Weber, E. U., Hsee, C. K., Welch, N.: Risk as feelings. *Psychological Bulletin*, 127, 2, , pp. 267-286.
- Michon, J. A.: A critical view of driver behavior models. In: Evans, L., Schwing, R. C. (eds.): *Human behavior and traffic safety*. New York, Plenum Press, 1985, pp. 485-520.
- Näätänen, R., Summala, H. A.: Model for the role of motivational factors in drivers' decision-making. *Accident Analysis and Prevention*, 6, 1974, pp. 243-261.
- NHTSA: *Automated Vehicles for Safety*, 2018. US Department of Transportation, Washington, DC, 2018.
- O'Neill, B.: A decision-theory model of danger compensation. *Accident Analysis and Prevention*, 9, 3, 1977, pp. 157-165.
- Oppenheim, I. (ed): *Critical review of models and parameters for driver models in different surface transport systems and in different safety critical situations*. European Commission DG Research, 2010, p. 188.
- Peltzman, S.: The effects of automobile safety regulation. *J. Political Economy*, 83. 4, 1975, pp. 677-725.
- Prochaska, J. O., Velicer, W. F.: The transtheoretical model of health behavior change. *American Journal of Health Promotion*, 12, 1, 1997, pp. 38-48.
- Rasmussen, J.: Skills, rules and knowledge; signals, signs and symbols, and other distinctions in human performance models. *IEEE Transactions Systems, Man, and Cybernetics*, 13, 3, 1983, pp. 257-266.
- Rasmussen, J.: Mental models and the control of action in complex environments. In: Ackermann, D., Tauber, M. J. (eds.): *Mental Models and Human-Computer Interaction*. Elsevier Science Publishers, North-Holland, 1990, pp. 41-46.
- Reason, J.: Generic error-modeling system (GEMS): A cognitive framework for locating common human error forms. In: Rasmussen, J., Duncan, K., Leplat, J. (eds.): *New technology and human error*. John Wiley and Sons, New York, 1987, pp. 63-83.
- Reason, J., Manstead, A., Stradling, S., Baxter, J., Campbell, K.: Errors and violations on the roads: a real distinction? *Ergonomics*, 33, 10-11, 1990, pp. 1315-1332.
- Rogers, R. W.: A protection motivation theory of fear appeals and attitude change. *Journal of Psychology*, 91, 1, 1975, pp. 93-114.
- Shinar, D., Oppenheim, I.: Review of models of driver behaviour and development of a unified driver behaviour model for driving in safety critical situations. In: Cacciabue, P. C., Hjalmdahl, M., Lüdke, A., Riccioli, C. (eds): *Human modelling in assisted transportation*, Springer, 2011, pp. 215-223.
- Schneider, W., Shiffrin, R. M.: Controlled and automatic human information processing: I. Detection, search, and attention. *Psychological Review*, 84, 1, 1977, pp. 1-66.

- Slovic, P., Fischhoff, B., Lichtenstein, S.: Why study risk perception? *Risk Analysis*, 2, 2, 1982, pp. 83-93.
- Starr, C.: Social benefit versus technological risk. *Science*, 165, 3899, 1969, pp. 1232-1238.
- Tanner, W. P., Swets, J. A.: A decision-making theory of visual detection. *Psychological Review*, 61, 6, 1954, pp. 401-409.
- Taylor, D. Drivers' galvanic skin response and the risk of accident. *Ergonomics* 7, 4, 1964, pp. 439-451.
- Theeuwes, J.: The effects of road design on driving. In: Barjonet, P-E. (ed): *Traffic psychology today*. Springer Science and Business Media, New York, 2001, pp. 240-263.
- Vindenes, V., Jordbru, D., Knapskog, A. B., Kvan, E., Mathisrud, G., Slørdal, L., Mørland, J.: Impairment based legislative limits for driving under the influence of non-alcohol drugs in Norway. *Forensic Science International*, 219, 1-3, 2012, pp. 1-11.
- Wiener, N.: *Cybernetics: control and communication in the animal and the machine*. New York, Wiley, 1948, p. 194.
- Wilde, G. The theory of risk homeostasis: implications for safety and health. *Risk analysis*, 2, 4, 1982, pp. 209-225.
- Zuckerman, M.: *Sensation seeking and risky behavior*. American Psychological Association, Washington, DC, 2007, p. 309