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Theories, objectives, and methods

Traffic psychology 1
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Matus Sucha

Presentation 1

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I. Traffic system and mobility

Traffic and transport sciences in a general sense concern the *analysis, explanation, and prediction of all manifestations* which are related to the **mobility of people and goods** (Michon, 1989).

The transport system has many components (*road, rail, air*) in which many actors (*haulage companies, public transport providers, infrastructure planners, transport consumers*) can act within certain limits of freedom (*economics, traffic law and transport regulations).*

Psychology can contribute to the traffic and transport sciences with *predictions and explanations of human behaviour in traffic*, e.g. choice of mode of travel, the traffic behaviour of road users, and the traffic demand imposed on the traffic system by its users.

I. Traffic system and mobility

The *psychological approach* is, in that respect, complementary to the other traffic and transport sciences, such as *engineering, planning and economics*, and it shares their *objectives* = **to optimise the transport system in the sense of fulfilling the demand for transport with minimum damage to the environment and human life (incl. safety and quality of life)**.

Mobility means (in the sense of traffic): "*the movement of people in a population, as from place to place*" (British dictionary, 2013). The traffic system should provide the best possible (highest) mobility for all traffic users.

In a sprawling city where most streets are designed for fast traffic, the mobility of some people (fast drivers) is undoubtedly very high. But the mobility of others is not. In such places, streets are dangerous and uncomfortable for pedestrians, which means that in fact, non-drivers cannot easily move from place to place and are thus not so mobile after all.

Commuting homeostasis – it seems that people all over the world are willing to commute about 45 minutes per day. If traffic modes are faster they commute longer distances. Time seems to be relatively independent.

II. Modes of transport

Mode of transport is a term used to distinguish substantially different ways to perform transportation. The dominant modes of transport are *aviation, land transport, which includes rail and road, and ship transport*. Other modes also exist, including *pipelines, cable transport, and space transport.*

Transport using more than one mode is described as intermodal. Transportation that carries around many people and can be used by the public is known as public or mass transportation.

Worldwide, the most *widely used modes of passenger* transport are the automobile (16,000 billion passenger/km), followed by buses (7,000), air (2,800), railways (1,900), and urban rail (250).

The most widely used modes of freight transport are sea (40,000 billion ton/km), followed by road (7,000), railways (6,500), oil pipelines (2,000), and inland navigation (1,500) (Cooper *et al.*, 1998).

III. Traffic psychology

Traffic psychology is primarily related to the study of **the behaviour of road users** and the **psychological processes underlying that behaviour** (Rothengatter, 1997) , as well as to the **relationship** between human and other aspects of traffic system.

The task of **traffic psychology** is to *understand, predict, and provide measures* to modify road user behaviour, with the general objective being to *minimise the harmful effects of traffic participation (*Rothengatter, 2001)*.*

III. Traffic psychology

In the broader sense traffic psychologists don't deal only with human behaviour. They work with a **holistic approach and understand traffic as a very complex system**. In the broader sense, traffic psychology considers these connected issues:

1. Quality of life
2. Public and individual health
3. Environmental issues
4. Safety
5. Land use
6. Economic sustainability

All the above-mentioned issues must be considered when deciding about traffic measures.

III. Traffic psychology

1. Quality of life

QoL is a multidimensional construct (Cummins, 1999; Snoek, 2000; Hagerty, Cummins, Ferriss, Land, Michalos, Peterson, Sharpe, Sirgy & Vogel, 2001) that reflects the personal values of individuals (Snoek, 2000) and/or states whether the needs of the individual in various fields were satisfied or not (Wunsch & Risser, 2002).

Three dimensions:

- *1 physical:* health
- *2 psychological*: self-control, self-perceived competence, love, satisfaction, joy, morale, confidence, control over one's life, life expectation, beliefs, desires
- *3a social (private)*: social network, support, income, education, job
- *3b social (public)*: community, social climate, social security, housing quality, environment, aesthetics of the environment, traffic, crime rate, equality, justice

III. Traffic psychology

1. Quality of life

Traffic indicators:

- Mobility for all (availability, accessibility, & usability)
- A safe environment (safety)
- A comfortable environment (comfort)
- A secure environment (security)
- A clean environment (cleanliness, no pollution)
- An appealing environment (aesthetics)
- A busy environment (availability of facilities)
- A lively & comfortable environment (social aspects)
- Public participation in decision making

III. Traffic psychology

2. Public and individual health

Road traffic injuries are the **eighth leading cause of death globally**, and the **leading cause of death for young people aged 15-29**. More than a million people die each year on the world’s roads.

Current trends suggest that by **2030 road traffic deaths** will become the **fifth leading cause of death unless urgent action is taken**.

Other impacts on health besides crashes are:

- Traffic air pollution
- Noise and vibrations
- The impact of traffic congestion on public health
- Diseases caused by lack of movement
- Heart attacks (elevated heart rate and blood pressure, and the ultimate adverse effect, cardiac arrest)
- Stress (irritability, muscle tension and mild fatigue to depression or sleeplessness)

III. Traffic psychology

3. Environmental issues

The **environmental impacts of traffic** (both positive and negative) include the local effects of roads, such as *noise, water pollution, habitat destruction/disturbance, and local air quality*; and the wider effects, which may include *climate change resulting from vehicle emissions*. The design, construction, and management of roads and parking and other related facilities, as well as the design and regulation of vehicles, *can change the impacts to varying degrees.*

4. Safety

More than *90% of all road traffic accidents are caused (or partly caused) by human error.*

Issues *concerning the improvement of traffic safety*, including road users, the traffic environment, vehicles, and their communication, are discussed at length at different places in this series of presentations.

III. Traffic psychology

5. Land use

A land use conflict occurs when there are conflicting views on land use policies, such as when increasing traffic creates competitive demands for the use of land, causing a negative impact on other land uses nearby (e.g. an arterial road is good for commuters, but not for residents).

One of the major problems caused by land use conflicts is **traffic congestion**. A paradox occurs here = if we build more roads (invest land in traffic infrastructure), heavier traffic occurs ➔ more congestion.

Land use is closely connected to **quality of life**.

III. Traffic psychology

6. Economic sustainability

All planned measures and interventions within the traffic system must be **feasible in that they won't have negative consequences for other parts of the system** (safety, land use, health etc.).

For example – building a tunnel may have a positive effect on land use and quality of life, but if this solution is too expensive, we have to consider another alternative.

Economic sustainability must be consistent over time (e.g. money for further maintenance must be secured).

IV. Transport and mobility sustainability

Sustainable transport systems make a positive contribution to the **environmental**, **social,** and **economic** sustainability of the communities they serve.

Transport systems exist to provide social and economic connections, and people quickly take up the opportunities offered by increased mobility. **The advantages of increased mobility** need to be weighed against the *environmental, social, and economic costs* that transport systems pose.

Transport systems have significant impacts on the **environment,** accounting for between **20% and 25% of world energy consumption** and carbon dioxide emissions. Greenhouse gas emissions from transport are increasing at **a faster** rate than any other energy-using sector. Road transport is also a major contributor to local air pollution and smog (World Energy Council, 2007).

IV. Transport and mobility sustainability

The social costs of transport include *road crashes, air pollution, physical inactivity*, time taken away from the family while *commuting, and vulnerability to fuel price increases*. Many of these negative impacts fall disproportionately on those social groups who are also least likely to own and drive cars.

Traffic congestion imposes economic costs by wasting people's time and by slowing the delivery of goods and services.

Traditional transport planning aims to improve mobility, especially for vehicles, and may fail to adequately consider wider impacts. But the real purpose of transport is **access** – to work, education, goods and services, friends and family – and there are proven techniques to improve access while simultaneously reducing the environmental and social impacts and managing traffic congestion.

Communities which are successfully improving the sustainability of their transport networks are doing so as part of a wider programme of creating **more vibrant, liveable, and sustainable cities**.

IV. Transport and mobility sustainability

The term **sustainable transport** is used to describe modes of transport, and systems of transport planning, which are **consistent with wider concerns of sustainability**. The definition from the *European Union Council of Ministers of Transport* defines a sustainable transportation system as one that (Litman, 2009):

1. allows the **basic access and development needs of individuals, companies, and society to be met safely** and in a manner consistent with human and ecosystem **health**, and promotes equity within and between successive generations *(social issue)*;
2. is **affordable, operates fairly and efficiently**, offers a choice of transport mode, and supports a competitive economy, as well as balanced regional development *(economic issue)*;
3. **limits emissions and waste to within the planet's ability to absorb them**, uses renewable resources at or below their rates of generation, and uses non-renewable resources at or below the rates of development of renewable substitutes, while minimising the impact on the use of land and the generation of noise (*environmental issue).*

Equilibrium between all three issues is crucial for transport sustainability.

IV. Sustainable traffic safety

The goal of sustainably safe traffic is to prevent crashes and, where this is not possible, to reduce the chance of *deaths and severe injury to zero*.

This approach recognises **people's physical vulnerability**, but also what they are **capable** of (people make errors, after all) and what they are **willing** to do (people do not always abide by the rules).

The proactive approach of sustainable safety means that measures are taken in the **chain from "system design" to "traffic behaviour"** as early as possible. By preventing system errors, the probability of human error and/or serious outcomes of crashes can be reduced.

IV. Sustainable traffic safety

Road safety thus becomes less dependent on the **individual choices of road users.** This implies that responsibility for safe traffic lies not only with *road users* but also with those who design and manage the elements of the traffic system, such as infrastructure, vehicles, education, training, and testing.

Traffic should be sustainably safe **for everybody** and not just for car drivers.

IV. Sustainable traffic safety

There are five principles that lead to sustainably safe traffic:

1. Functionality of roads/the environment (monofunctionality of roads)
2. Homogeneity (of masses and speed and direction)
3. Predictability (of road course and road user behaviour)
4. Forgivingness (of the environment and road users) – injury limitation through a forgiving road environment and anticipation of road user behaviour
5. State awareness (by the road user) – the ability to assess one's own task capability

(Advancing sustainable safety, SWOV, 2013).

In terms of traffic psychology, the last of these is of most interest.

V. 3 Es

1. Education and training

- Popular with those who receive it
- Popular with those who deliver it
- Politically uncontroversial
- Authorities seen to be acting

But there is no general evidence that they produce a public health benefit.

Brown et al. (1987);
Christie (2001);
Christie (2007);
Ker et al. (2005);
Mayew et al. (1998);
Mayew & Simpson (2002);
Vernick et al. (1999)

V. 3 Es

Harm mechanism = normalising risky behaviour, risk exposure, overconfidence. Skills training without understanding leads to risky behaviour. Increase confidence without competence. Driver education can lead to an increase in crash involvement (Roberts et al., 2001; Mayew & Simpson, 2002; Vernick et al., 1999)

Thought, education, and training must play an important role. All education and training must be **evaluated and it must be ensured that it leads to an evident public benefit.**

Education may have an important role in enabling and expanding interventions that **work** and that they should be designed and evaluated accordingly.

V. 3 Es

Education and training should be:

- driven by theory and evidence
- designed to avoid
    - overconfidence
    - increased risk exposure
    - normalising risky behaviour
- evaluated

(McKenna, 2012)

V. 3 Es

2. Engineering

Concept of self-explaining road/environment – helps humans to act according to the situation.

We act as the surroundings tell us to act.

We have to construct roads and the environment in a way which allows them to **absorb human errors** and let us stay alive and learn from our mistakes.

V. 3 Es

3. Enforcement

Strong evidence that enforcement in **traffic leads to benefits in public health** (Tay, 2005).

Deterrence assumptions:

- people must know the rules
- must be able to use this knowledge
- benefits of rule breaking must be less than cost of threat

Deterrence increases as a function of:

- certainty
- severity
- imminence of punishment

VI. Theories and models in traffic psychology

Road user behaviour is not driven **only by rational considerations**, or, at least, it has a different rationale than efficiency and safety.

Thus, psychologists have dealt with this by using different models of road user behaviour **simultaneously** (unlike mathematicians ,for example).

The various road user behaviour models have, to a large extent, determined the topics that have been addressed in traffic psychology. The various approaches can, for the purposes of this lesson, be summarised as:

i. Performance approaches
ii. Motivational approaches

VI. Theories and models in traffic psychology

Methods used in traffic psychology are not specifically traffic psychology methods but are generally used in empirical social sciences. As for the psychology , the fields of social *psychology and personality psychology* are of the greatest importance.

Traffic psychology mostly uses:

i. experimental designs (laboratory, simulators, on-road studies)
ii. observations (naturalistic driving studies, on-road studies)
iii. introspection and self-reporting (questionnaires, qualitative methods)

VI. Theories and models in traffic psychology

Theories in *general psychology are not able to adequately explain driver behaviour*. These theories are either so general that the special aspects of vehicle driving cannot be considered or are so specific that only certain aspects of driver behaviour are touched upon.

For example, learning theory can provide explanations of how certain abilities and skills necessary for driving a car can be acquired, or the reception and processing of information while driving can be explained using theories of perception. But driving itself is so complex that neither of these theories can cover it.

On the other hand, so far, traffic psychology doesn't have a theory, or set of theories, which would sufficiently explain road user behaviour.

VI. Theories and models in traffic psychology

Theories of general psychology often used in traffic psychology:

- Theory of planned behaviour (Ajzen, 1985)
  - Intentions to perform behaviours of different kinds can be predicted with high accuracy from *attitudes toward the behaviour, subjective norms, and perceived behavioural control*, and these intentions, together with perceptions of behavioural control, account for the considerable variation in actual behaviour.
- Situational awareness (Endsley, 1999)
  - A cognitive model of decision making based on perception of the current situation, understanding of the current situation, and anticipation of the future situation. Situational awareness influences decisions and future actions (the way we understand reality).
- Theory of subjective and objective safety (Mendelsohn, 1964)
- Theory of social imitation/Social learning theory (Bandura, 1969)
- Lurie (1968) – Game theory perspective (Formal and informal norms)

VI. Theories and models in traffic psychology

Travel and traffic – hierarchical connections

The generalised problem-solving task of the road user may be further divided into three levels of skills and control: strategic (planning), tactical (manoeuvring), and operational (control) respectively (Janssen, 1979).

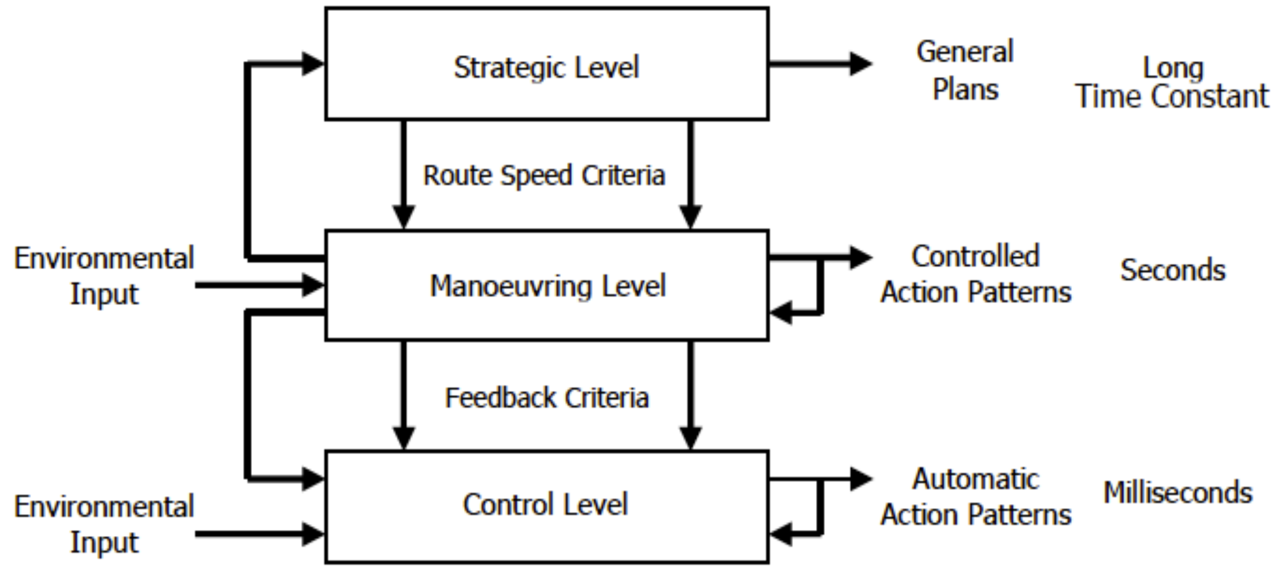

Figure 2 The hierarchical structure of the road user task. Performance is structured at three levels that are comparatively loosely coupled. Internal and external outputs are indicated (after Janssen, 1979).

VI. Theories and models in traffic psychology

Type of models in traffic psychology: those that are input-output- or behaviour-oriented, and those that are motivation-oriented. In the second place, let's distinguish between taxonomic and functional models which represent systems whose components respectively do and do not dynamically interact.

	Taxonomic	Functional
Input-Output (Behavioral)	Task Analyses	Mechanistic Models Adaptive Control Models - Servo-Control - Information Flow Control
Internal State (Psychological)	Trait Models	Motivational Models Cognitive (Process) Models

VI. Theories and models in traffic psychology

1. Taxonomic models – facts and factors

A taxonomic model is essentially an inventory of facts. No dynamic relations can be expressed between the elements in a taxonomy and empirical connections are at best correlative. Taxonomic models of driver behaviour are exemplified by *trait models* and by *task analysis.*

Trait Models — The story of classical test-based models (e.g. Conger et al., 1959).

Task Analysis — A driving task analysis is essentially a description of facts about the driving task (task requirements), the behavioural requirements (performance objectives), and the ability requirements (enabling objectives) for performing that task. The outstanding example in this category remains the task analysis by McKnight and Adams (1970a, 1970b; McKnight and Hundt, 1971).

VI. Theories and models in traffic psychology

2. Psychological functional models

Compensation Models – One of the first formulations of the risk compensation principle was *Taylor's "risk-speed compensation model"* (Taylor, 1964). Its basic tenet is: the larger the perceived risk is, the lower a driver's chosen speed will be. The accepted level of risk is determined individually, partly on the basis of external factors (time pressure) and partly on internal factors (age, perhaps neuroticism, etc.).

A substantial extension of the principle that drivers attempt to establish a balance between what happens on the road and their level of acceptable subjective risk can be found in *Wilde's Risk Homeostasis Theory* (Wilde, 1978; 1982; Wilde and Murdoch, 1982). Wilde's model assumes that the level of accepted subjective risk is a more or less stable personal parameter.

VI. Theories and models in traffic psychology

2. Psychological functional models

Risk Threshold Theory – Klebelsberg (1971; 1977) adopted a somewhat different view of dealing with risk by postulating a control process that would enable a driver to maintain a stable balance between *subjective,* perceived safety (S), and *objective,* physically or statistically determined safety (0). If the system settles at a level where S=O, an ideal situation ensues. Traffic behaviour is exactly commensurate with the prevailing circumstances and improvements in 0, whenever they are perceived, will result in a corresponding improvement in S.

Individual road users differ in their personal balance between S and 0, for a variety of reasons, which are cognitive, motivational, and physiological.

Any equilibrium in which S>O, that is, when the road user tends to judge situations as being safer than they in fact are, is dangerous. On the other hand, if S<O there is a surplus safety margin.

VI. Theories and models in traffic psychology

2. Psychological functional models

A more advanced threshold model was proposed by Näätänen and Summala (1974; 1976). Their **subjective risk control model** states that the perceived risk in traffic (R) depends on both the level of subjective probability of a hazardous event (P) and the subjective importance of the consequences (B) of the event and, more specifically, on the product of these two factors: R = P x B. Behaviour is assumed to be directly related to the level of R. In most circumstances R is perceived to be effectively equal to zero; that is, under normal road conditions traffic participants feel and act as if they are not running any “real” risk at all. In other words, there is a threshold for risk perception, and only if that threshold is exceeded are risk compensation mechanisms called upon in an attempt to lower the prevailing risk level.

In contrast with Wilde’s position, Näätänen and Summala consider their model as indicating that methods of influencing people by education, campaigns, or enforcement are not effective. The risk perception threshold turns out to be highly resistant against such influences. Consequently, a genuine improvement in traffic safety should be expected only as a result of better vehicles and better roads.

VI. Theories and models in traffic psychology

2. Psychological functional models

The Threat Avoidance Model – Fuller (1984) put forward a model which incorporates a satisfactory number of characteristics of the preceding models, and which has the further advantage of being formulated in terms of a (behaviouristic) paradigm: avoidance learning.

As Fuller argues, “the experience of subjective risk is aversive and so drivers are motivated to escape from situations which elicit the experience or to avoid those situations.”

Thank you for listening!