



## From Gibson and Crooks to Damasio: The role of psychology in the development of driver behaviour models<sup>☆</sup>



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### ARTICLE INFO

#### Article history:

Received 23 January 2013

Received in revised form 17 February 2014

Accepted 17 February 2014

#### Keywords:

Driver behaviour

Models

Psychology

History

Risk compensation

### ABSTRACT

This article presents a brief history and perspective of behavioural model development in traffic psychology. As one specific example of a key behavioural model, [Gibson and Crooks \(1938\)](#), in their classic field theoretical study, offered the first scientific attempt to deal with the issue of compensation. Two central theoretical concepts were developed: “Field of safe travel” and “Minimum stopping zone”. The interplay between the two was used to describe and explain risk compensation and illustrated by observing the impact of brakes on driver behaviour: Better brakes could make the field of safe travel – i.e. the distance to the car in front – shorter. Nearly 50 years later, the launch of Wilde’s Risk Homeostasis Theory (RHT) gave rise to a profound debate about risk homeostasis and risk compensation. The core issue in the debate was Wilde’s strict assertion that all individuals, not only car-drivers, carry an inherent target level of risk that they are seeking to maintain or restore. Gibson and Crooks fell well within psychological theories of the time, while Wilde’s RHT emerged more from control theory and economic utility theory than from psychology. In the 1990s neuroscience emerges, especially by Damasio who introduces a paradigm that has proven fruitful as a framework of more recent driver behaviour models. But neuroscience also had its forerunner in Taylor’s proposal that driver behaviour is governed by a constancy in Galvanic Skin Response (GSR) which makes driving a self-paced task aiming at keeping the GSR at a constant level. Näätänen and Summala’s integrated Taylor in their “Zero-risk model” which has persisted and still prevails as a solid and well accepted model. Psychological learning theory has, however, rarely been adequately dealt with which is quite odd given the prevalence of speeding and risk compensation which cannot escape explanations based on operant conditioning. The paper discusses the emerging role of psychology and psychological concepts that has been proposed and evolved through the development of driver behaviour models since Gibson and Crooks’ study of 1938. The views presented are subjective, they do not represent any attempt to describe the objective reality of the time.

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<sup>☆</sup> Editor’s Note: This paper was invited and peer-reviewed for a special section on History of Traffic Psychology. The special section included a wide range of manuscript styles, from those typical of this journal to other styles just as important for sharing the discipline’s history. Authors contributed reasoned viewpoints from experience and literature on where the discipline has come from and where it may be heading, to an investigation of trends and topics in the discipline since the early 20th century.

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## 1. Some personal background

I must emphasize that what is put forward here is by no means any attempt to describe the objective reality of how traffic psychology has emerged. It is indeed a subjective opinion developed after I began working at the Institute of Transport Economics (TØI) as a research psychologist in 1988. At that time, the issue of risk compensation, and specifically Wilde's Risk Homeostasis Theory (RHT), was heavily debated by my colleagues at TØI. This topic continued to be discussed into the 1990s at international conferences addressing road safety. The topic of risk compensation was probably at its most intense during these peak years, it has since declined, but not ceased, although the debate has been converted to the broader topic of behavioural adaptation. In my view, risk compensation should be regarded as a special case of behavioural adaptation and is best understood under this umbrella (Vaa, 2013). My work at TØI started just a couple of weeks before the conference "Traffic safety theory and research methods" was held in Amsterdam in April 1988 (SWOV, 1988). This was a great event, many big names were there: Frank A. Haight, Ezra Hauer, John A. Michon were all invited speakers, and Talib Rothengatter, Wiel Janssen, Ray Fuller, Matthijs Koornstra, John Groeger, and Rune Elvik, all presented their papers. Remember, this was years before the 1st ICTTP-conference in Valencia (1996) and also before the first issue of Transportation Research Part F (1998), meaning that traffic psychology had not yet fully emerged as an independent and leading discipline in road safety research although there were earlier attempts by Näätänen and Summala's book "Road-user behavior and traffic accidents" (1976), Shinar's "Psychology on the road" (1978) and Klebelsberg's "Verkehrspsychologie" (1982). At that time in 1988, at my institute at least, social scientists from several disciplines worked together on joint projects discussing and solving problems of theory and method in a melting pot of different perspectives from which psychological thinking about the behaviour of drivers in the road traffic system evolved.

## 2. Missing concepts of the 1980s

Having a background in clinical psychology and psychodynamic theory, I missed psychological thinking, especially theories of *personality* and *personality traits*, when I began working with road safety issues. The understanding of the driver was felt as shallow, it was as if a driver was either a sensation seeker or "normal". Discussions of aggression and aggressive driver behaviour were not frequent either, it was not very pronounced until the second half of the 1990s where the debate of "road rage" peaked. The understanding of driver behaviour was felt as being isolated from other disciplines of psychology. One example was the lack of explicit use of Skinnerian *operant conditioning* (Chaplin & Krawiec, 1979), which, as far as I can see, was not represented in any driver behaviour models of the time. A separation of *conscious* and *unconscious* routes to decision-making and the interaction between the two was lacking. Too much focus, in my view, was put on cognitive theories as with Theory of Reasoned Action and Theory of Planned Behaviour to the expense of the role of the unconscious, which I think is inevitable when one wants to understand automated driving, implicit learning, and deep motivation rooted in unsolved emotional conflicts. *Motivation* was addressed in a group of theories labeled "motivational models", but I regard *emotions* as a more important concept. It was then not addressed as much as motivation, but it was central in Taylor's GSR-constancy theory of 1964 as a governing principle in terms of the amount of fear a driver wishes to tolerate, a conception that was further integrated and developed in Näätänen and Summala's Zero-risk-model of 1974. I focus on these concepts and topics as I regard them as essential building blocks, which must be properly addressed in the development of any driver behaviour model. I would regard the model building as incomplete if any of these topics are missing.

## 3. Background theories and models

Gibson and Crooks (1938) and Damasio (1994) set the frame around the present discussion, but also other theories and models are brought in because they serve as background of the discussion. The models and theories which will serve as basis in the present context are as follows:

- Gibson and Crooks (1938): *A theoretical field-analysis of automobile-driving.*
- Yerkes and Dodson (1908): *The relation of strength of stimulus to rapidity of habit-formation.*
- Miller (1956): *The magical number seven, plus or minus two: Some limits on our capacity for processing information.*
- Taylor (1964): *Drivers' Galvanic Skin Response and the Risk of Accident.*
- Näätänen and Summala (1974): *A model for the role of motivational factors in drivers' decision-making.*
- Wilde (1982): *The theory of risk homeostasis: Implications for safety and health.*
- Damasio (1994): *Descartes' Error: Emotion, Reason and the Human Brain.*

The governing idea here is the topic of risk compensation and how it bridges the gap between Gibson and Crooks' work of 1938 and Damasio's paradigm of 1994. Gibson and Crooks is a real classic, it is the first serious attempt to develop a model of driver behaviour and it foresees several central issues that are still on the research agenda. Taylor's study of 1964 is brought in, not specifically as a classic, but more as a forerunner of findings of neuroscience of the 1990s and because it is a very important base in Näätänen and Summala's zero-risk model of 1974. The objective of the Taylor study was to investigate how the general rate of Galvanic Skin Responses (GSR) varied across road conditions as different as with urban shopping

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