

A model of driver behaviour adaptation

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Abstract

A general model of driver behaviour is presented that emphasises the interactions between the operational and the tactical level of the car driving task. The problem of the elderly driver is analysed in terms of individual differences in perceptual-motor abilities resulting in effects on operational performance. The effects of alcohol and drugs (marijuana) are analysed in terms of state-related factors that result in transient degradation of operational performance. The operational and the tactical levels of behaviour are connected with the concept of safety margins. Two experiments serve to illustrate the application of the model of driver adaptation to the domain of individual differences in driving behaviour. The first example concerns the lateral control task of curve negotiation and steering while the second example concerns the longitudinal control task of car following and braking.

Introduction

During the last decade the field of driver behaviour modelling has suffered from limited progress. This has been attributed to a number of different causes, the most important one being the preoccupation of traffic psychology with accidents and accident causation (Ranney, 1994). As a result it has never been clear whether driver theories should explain accidents or everyday driving. In addition motivational models have failed to generate testable hypotheses (Ranney, 1994), mainly because of the confusion between individual and aggregate levels of analysis (Michon, 1989). Michon (1985) emphasised the failure to incorporate the results from the 'cognitive revolution in psychology' as a contributing factor to the limited progress in driver behaviour modelling. He divided the task of car driving into three levels of skills and control: strategic (planning), tactical (manoeuvring) and operational (control). The *strategic* level includes trip planning and the selection of trip goals and route. On the *tactical* level, sometimes referred to as the manoeuvring level, the driver negotiates prevailing circumstances. It includes, for example, obstacle avoidance, gap acceptance, overtaking, choice of headway during car-following and speed choice. The *operational* level relates to lateral and longitudinal control of the vehicle. A comprehensive model of driving should take these levels into account, and specify the relations between them. However, all existing models have focused almost exclusively on one level. Ranney (1994) regarded the hierarchical control structure between these levels of behaviour as one of the most significant developments in the field of driver modelling. It forms a basis for the development of modern driver behaviour theories.