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Concepts from research literature and practical assessment of risk awareness: The Swedish driving test from the perspective of cognitive psychology

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ABSTRACT

The Swedish driving test (SDT) was compared to theoretical concepts found in research literature (CRLs) with respect to the rated importance of the CRLs for the overall assessment of risk awareness and the five specific assessment areas used in the SDT. 116 traffic inspectors responded to questionnaires. Results show that visual search was the CRL given the highest rating, and that the assessment of risk awareness can be conceptualised as assessment of lower-order and higher-order cognitive functions. The assessment areas taxing higher-order cognitive functions were rated as most important for risk awareness, and visual search behaviour can be regarded as the best indicator of higher-order cognitive skills.

1. Introduction

Risk awareness is fundamental for safe driving. If a driver is aware of present and potential risks, he or she can plan and act in order to eliminate or reduce them. Risk awareness is therefore what driving tests are intended to measure. In order to get a driving licence, the driver must demonstrate theoretical knowledge about traffic rules, be able to drive predictably in accordance with the traffic rules and in harmony with the surrounding traffic, and ultimately be able to predict and avoid risks. Some alternative and closely related terms in the literature are *risk perception*, *hazard perception*, *hazard detection*, *anticipatory attention*, and *anticipation of hazards*. Another central and closely related concept is *situation awareness*, which is defined as "perception of environmental elements in terms of time and spatial measurements, understanding their meaning and foreseeing their state in the immediate future" (Endsley, 1995, p. 36). The Swedish Driving Test (henceforth abbreviated as SDT) is intended to measure risk awareness (Vv 205.002; VVFS 1996:168). Risk awareness thus exists as a term in the practical setting of the SDT as well as in research literature on traffic safety. One question is whether well-applied experience from clinical practice and theory are in agreement with regard to how risk awareness is achieved. The driving test could possibly be supplemented with factors revealed by research. Another possibility is that theories could be revised according to practical experience in order to improve validity.

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The research literature provides a large number of factors that have been scientifically validated, from many different areas within psychology. The SDT, on the other hand, seeks to assess risk awareness by using five "assessment areas" (The Swedish Road Administration, 2000; Vv 205.002), which are derived from well-applied experience from clinical practice. In turn, these assessment areas are construed by concepts that have sprung from clinical practice.

The purpose of this study was to evaluate the SDT, its assessment areas and practical concepts from the theoretical perspective of cognitive psychology. This was done by asking Swedish traffic inspectors to rate the importance of theoretical concepts relative to the five assessment areas of risk awareness.

1.1. Concepts from the SDT

Concepts from the SDT are to be found within the course plans for the driving test (VVFS 1996:168), course materials (The Swedish Road Administration, 2000) and the driving test protocol (Vv 205.002).

Risk awareness is a criterion of the SDT (The Swedish Road Administration, 2000; Vv 205.002). The assessment of risk awareness is performed by using five assessment areas, which taken together are intended to provide a valid and reliable measure of the candidate's risk awareness. All the items in the test protocol "should reflect [be permeated with] risk awareness during the assessment" (The Swedish Road Administration, 2000, p. 1). This means that risk awareness is assessed within all five assessment areas. In order for a candidate to pass the driving test, he or she must demonstrate adequate risk awareness within all the assessment areas.

The assessment areas are as follows (The Swedish Road Administration, 2000; Vv 205.002): *Speed*, which must be adapted to present circumstances; *Manoeuvring,* which is intended to assess motor skills and the candidate's ability to handle the vehicle technically; *Position,* which means the distinctiveness of intentions required during driving (the car's position on the road must signal the driver's intentions); *Traffic behaviour,* which refers to planning and rule application; and *Attention,* which refers to visual search and attention in "treacherous situations".

Other concepts, some of which also exist in the research literature related to the SDT, are used by The Swedish Road Administration (2000). For example, visual search and attention are also found within cognitive psychology and traffic psychology (e.g. Castro, 2009; Pashler, 1998; Pollatsek, Narayanaan, Pradhan, & Fisher, 2006; Trick & Enns, 2009).

1.2. Concepts from research literature

There exist a vast number of concepts from research literature (henceforth abbreviated CRLs) on cognition and traffic psychology. An exhaustive investigation was not practically possible; so thirteen CRLs were strategically sampled, according to the following principles. Firstly, the CRLs should be designated as important for safe driving, based on either empirical findings, or on theoretical models of driving. Secondly, we wanted variation in these ratings. Therefore, some chosen CRLs should preferably yield relatively low ratings to ensure valid and reliable data. *Strategic planning* was for this reason included as a contrast to the hypothetically more relevant concepts *automatisation* and *tactical planning*. In order to avoid potential ceiling effects, the CRLs *situation awareness*, *risk perception* and *hazard perception* were avoided, since they could be interpreted as almost synonymous with the criterion of risk awareness. Thirdly, the study was explorative. Therefore, we wanted the CRLs to represent qualitatively different aspects of psychology, with regard to domains (e.g. cognitive, perceptual, personality, and social psychology) as well as to specificity (e.g. the relatively specific concept *visual search* vs. the composite concept *application of traffic rules*; or the generic concept *working memory*, vs. the subordinate concept *focused attention*). Finally, the CRLs should be as comprehensible as possible to the traffic inspectors, when presented in a questionnaire format. The thirteen CRLs are presented below. Appendix C shows the specific examples included in the questionnaire.

Working memory is a system that handles the most recently activated items of long-term memory and moves these items in and out of a temporary and short-term store (Baddeley, 2000). Driving requires a great deal of information processing and numerous decisions must be made and carried out simultaneously. Working memory is the theoretical unit that organises and processes all of this information. The working-memory capacity may theoretically determine the relative cognitive effort in traffic situations (see Brouwer & Fasotti, 1997; Groeger, 2000; Lundqvist, 2001; Recarte & Nunes, 2003, 2009; Wickens & Hollands, 1999).

Automatisation (automaticity) means that an activity that originally required attention and concentration can be carried out with much less attention (Groeger, 2000; LaBerge, 1990; Logan, 1988). Automatisation occurs as a function of practice and repetition (Anderson, 1995; LaBerge, 1990; Logan, 1988). As the skill is automatised, attention resources can be saved and used for other purposes, such as visual search (cf. operational level, Janssen, as cited in Michon, 1985; see also Matthews, Davies, Westerman, & Stammers, 2000).

Visual search refers to an active search of the visual field for targets and events, when it is uncertain when and where they may appear (Mourant & Rockwell, 1972; Pashler, 1998; Posner & DiGirolamo, 1998; Ranney, 1994; Underwood, 2007; Wickens, Alexander, Ambinder, & Martens, 2004; Wolfe, 1994). Visual search is required to detect hazards in good time and to coordinate driving with the surrounding traffic (Recarte & Nunes, 2003, 2009; Underwood, Crundall, & Chapman, 2002). The term is also used by The Swedish Road Administration (2000).

Focused attention (selective attention) means that certain stimuli are focused on while other stimuli are ignored (Cohen, 2003; Duncan, 1999). While driving the driver needs to focus on relevant information, and ignore other information (see e.g. Hole, 2007; Lees & Lee, 2009; Trick & Enns, 2009; Trick, Enns, Mills, & Vavrik, 2004; Underwood, 2007; cf. vigilance and