Off the beaten track: situation awareness in experienced and novice off-road drivers

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Abstract

Off-road driving describes a driving task undertaken on a surface other than an engineered durable roadway surface such as concrete or asphalt. This may include activities such as driving on beaches, dirt roads, or traversing open country with no designated roadways. It is both a popular pastime and a necessary undertaking for drivers worldwide. Indeed it is conservatively estimated that globally more than 50% of government controlled and managed roadways are unsealed. As with conventional driving, crashes and fatalities occur in off-road driving. Despite this, the study of these common driving environments has been limited (Stevens & Salmon, 2016). A notable aspect of recent fatal crashes in beach driving has been the identified role of inexperienced drivers in causing the crash. This paper presents the results of an exploratory off-road naturalistic driving study which utilised Verbal Protocol Analysis to assess situation awareness in novice and expert drivers. The findings revealed important differences between the novice and expert drivers relating to the information used, the strategies adopted, and the general driving approach. The implications for off-road driving such as beach driving are discussed.

Background

Off road driving, such as on beaches, is a unique driving task. Its description encompasses both recreational and purposive driving on private and public unsealed roadways. These roadway environments often present as loose surfaces which may require specialised vehicles including four wheel drives (4WDs). As such it is a driving task that requires distinct skills to minimise the associated risks of wheel slippage; obstacle avoidance and immobility resulting from the surface inconsistency (Stevens & Salmon, 2016). Perhaps unsurprisingly, off-road driving environments experience fatal crashes. For example, in 2009 three foreign tourists were killed on Fraser Island (K'gari) as a result of two independent motor vehicle rollovers that occurred in April and December. All three of the fatalities were passengers in 4WD vehicles being driven by a fellow tourist, driving in sand for the first time.

Despite this, the factors underpinning off-road crashes remain largely unexplored. Two such factors are the level of off-road driving experience and situation awareness. Whilst both have been identified as key causal factors in beach driving crashes (Stevens & Salmon, 2016), to date there has been no research examining the impact of experience on driver situation awareness and behaviour in beach driving environments. This paper is a response to this, presenting the findings from an exploratory study which aimed to assess, naturalistically, novice and expert beach driver situation awareness.

Method

This exploratory study used a semi-naturalistic on-road study method incorporating Verbal Protocol Analysis (VPA) to capture the thought processes of a novice and experienced off road driver whilst driving in two off-road environments. VPA (Ericsson & Simon, 1993) involves participants providing concurrent verbal protocols during task performance (e.g. Banks et al., 2014). The transcripts can then be analysed to examine situation awareness (e.g. Salmon et al., 2014). The

approach has been used in many areas and is recently becoming popular in studies of driver behaviour (e.g. Banks et al., 2014; Salmon et al., 2014; Young et al., 2013; Walker et al., 2011). In the present study, participants (one novice and one experienced driver) undertook two off-road driving tasks on the world heritage listed Fraser Island (K'gari). The first was a 15km round trip on inland sand tracks, while the second was a 15km drive on the beach of K'gari. The vehicle for the study was a 4WD fitted with four on-board cameras. These cameras captured; the drivers view of the road; the view from the rear of the vehicle; the driver from front-on (audio equipped); and the driver from over the shoulder – revealing the instrument panel; driver gestures and interactions with the vehicle controls.

The verbal transcripts were analysed using the Leximancer content analysis software tool. Leximancer identifies themes, concepts and the relationships by using algorithms and by focussing on features within the transcripts such as word proximity, quantity and salience. The output is a network representing concepts and the relationships between them reflected within the verbalisations (e.g. 'car' has 'speed', 'water' is 'hazard'). Leximancer has previously been used for situation awareness network construction (e.g. Salmon et al., 2014; Walker et al., 2011) and is especially important to analyses of this kind since it provides a reliable, repeatable process for constructing situation awareness networks. The resultant networks were then examined to identify differences in situation awareness between the novice and experienced driver.

Results and Discussion

The situation awareness networks (to be presented in the full conference paper) provide some important conclusions regarding the differences between novice and experienced beach driver situation awareness and indeed the beach driving task. First, the information used by both drivers was markedly different, both in terms of the information itself and the amount of information used. Importantly a number of these difference appear to introduce risks for the novice drivers. Second, a significant portion of the information being used is not related to the primary task of driving and is potentially distracting (e.g. information relating to wildlife, creeks, pedestrian users of the beach). Third and finally, the situation awareness networks show significant differences between those identified previously in studies of on-road driving (e.g. Salmon et al., 2014). This provides further evidence that treatment of beach driving environments as a gazetted road, and the adoption of conventional road safety measures, may not be appropriate.

In closing the practical implications for improving safety in beach driving environments are discussed. In particular, interventions around education, training, 'road' design, and licensing are outlined.

References

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