

Psychological Factors Considered During Driving - A Review

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ABSTRACT: This paper reviews the various literatures regarding the factors to be considered during the design of the fatigue and drowsiness detection systems. In recent scenario, it is very common to find the road and vehicle crash accidents in the developing countries like India, china, etc. The reasons for the road accidents can depends upon various factors like wreckless driving, fault of the driver, consumption of alcohol, etc., but evidences from road safety researchers and policy makers states that majority of the accidents happened due to the driver's faults. Among that, fatigue and drowsiness are the worst candidates of road accidents. So it is necessary for the car manufacturers to develop a system to assist the driver in overcoming the fatigue and drowsiness. On considering this in mind, the paper explores a different factor which contributes a lot to the design of fatigue and drowsiness detection systems. The factors which are taken in to account are cognitive behavioral changes during driving, driving behaviors of the driver. This review paper mainly focused on the psychological factors regarding prevention of accidents.

I. INTRODUCTION

Driving a vehicle is an amazing multitasking activity which utilizes all the cognitive resources for the completion of safe journey to the destination. Driver's distraction and attention less driving mainly contributes to the majority of road accidents. The most important fatal crash accidents which are referred as "fatal five", such as speeding, drink driving, fatigue, distraction and not wearing the seatbelt [1], risky driving like racing others drivers /vehicles [2], tailgating, unsafe overtaking [3], and the use of cell phones while driving[4]. Traffic engineering and legislation over automobile safety devices have contributed to a reduction in the death rate, but the crashes of motor vehicle which remains to be the leading cause of casualty in the developing countries like India. Safe motor vehicle management is influenced by a wide range of individual differences among the drivers. Road safety researchers and policy makers are trying to make judgments about what constitutes safe driving.

Psychological factors like motivation, personality, cognitive style, and fatigue and stress level of the driver must also be considered. There are very less evidences available about the unsafe driving behavior, hence it is very difficult to predict the correlation between the various aspects of driving behavior. This judgment mainly relies on the ability to measure the salient performance indicators and combining all these to attain quantitative assessments. Efforts were put on by the researchers and policy makers in order to develop a system that continuously monitor the driver and warn him/her when they are in drowsiness state. This would help them in driving safety. At present, drowsiness tests are administered in occupational settings which are mainly based on the questionnaires or psychomotor vigilance test [5]. Many methods have been developed and some of them are currently being used for detecting the driver's drowsiness including the measurements of physiological features and behaviors of the vehicle. This review paper deals with major requirements and factors to be considered while designing it. The paper consists of two sections, cognitive behavior and driver behavior modeling are considered from various literature.

Cognitive process

1.1 Personality traits

The main factor which is recognized as the reason to predict dangerous driver behavior is the driver's personality. The aim is to examine the independent and combined roles of three personality traits such as conscientiousness, sensation seeking and anger hostility in predicting the risky driving behavior. [6] Explains that there is only one set of traits which is long recognized as relevant to predicting dangerous driver behavior in the driver's personality. Sensation seeking is defined as the desire for and engagement in varied, complex and arousing sensations and experiences [7] and

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is consistently linked to driver's risky behavior in empirical research. Conscientiousness is defined as the tendency to be disciplined, responsible and reliable [8]. Anger and hostility are constructs measured both as stable emotional patterns and as transient dispositional states. The tendency towards hostile, frustrated and angry behavior is often linked to risky driving [9].

Various researchers had described the study which addresses and assesses three individual differences factors of interest like sensation seeking, conscientiousness and anger/hostility within the same sample, and also asked the participants to complete a measure of risky driving within a computer simulated virtual environments. Personality is related to risky driving behavior. The above mentioned 3 behavior patterns each predicted risky driving. [10] Found that anger/hostility play a stronger role in risky driving than conscientiousness or sensation seeking. Considerable amount of research is currently dedicated to analyze the role that the attentional system dominates in determining the driver's behavior. Cognitive process like perception and attention has become more important than action [11] which leads to the kind of error in automation in which the total resource demands were actually not reduced, but redistributed. Today the operators are performing cognitive tasks such as planning, identifying or resolving problems instead of manual tasks [12].

[13] Described the fatigue as an undesirable change in performance that could be linked to continuous activity and it is considered to be similar to muscle fatigue. [14] Described the mental fatigue as the state of reduced mental alertness that degrades the performance. [15] Refers the fatigue as the effects that people experience following and during the course of prolonged periods of demanding cognitive activity requiring sustained mental activity.

1.2 Attention networks

[16] Aimed to reduce the number of attention related accidents. The researchers mainly focused on the influences of difference of in the functioning of 3 attentional networks like executive control, attentional oriented and alerting, when the driver has to deal with some common dangerous situations. Based on the decade of some neurocognitive research on human attention, an easy computer based task has been designed to measure the performance of participants in some basic common tasks of attention. Attention network task ANT [17] is a combination of cued reaction time and the Flanker test [18].

The aim is to determine the efficiency of 3 attentional networks and they are analyzed by measuring the influences on the performance of alerting signals, spatial cues and distracting flankers. [19] [20], proposed that 3 categories of driving hazards could be classified according to the relationship between the precursors and the actual hazard source. These categories can be named as behavioral prediction, environmental prediction and dividing them to focusing attention in hazardous situations. The study presented by the authors was to analyze the relationship between the differences in the functioning of 3 attentional networks like executive control, attentional orienting and alerting the driver's behavior. Multiple measures of the participants' attentional functioning were obtained from a computer based neurocognitive test: the attention networks test for interaction and vigilance (ANTI-V) which were compared by using driving simulators. Lots of researchers had shown that truck driving is among the occupations with the highest risk of fatal accidents [21]. This is not necessarily due to the fault of the truckers. [22] Found that professional truck drivers have a unique set of characteristics compared to that of everyday motorists. Drivers of heavy truck engage in fewer unsafe road behaviors than general drivers [23].

[24] Found that older drivers are more experienced and smarter than young and novice drivers to adjust their driving behaviors to suit road traffic and conditions. [25] Described that young drivers have strong motivations for very risky driving than older. [26], also found that male drivers contribute at the highest frequency rate to the road traffic accidents than female drivers. [27] Investigated and found that young drivers' risky and non-risky behaviors were often linked to the personality characteristics, developmental-features, demographics, driving ability, perceptions and driving environments. [28], mainly focused on the influence of young drivers' perceptions of risk and personality motivational systems of reinforcement sensitivity theory (RST). [29] Found that personality is not a direct prey for road crashes, it has been shown to be the direct influence through risk perceptions and risky driving engagement.

[30] Had linked personality characteristics like sensation seeking, impulsivity with risky driving. [31] Shows that reinforcement sensitivity theory RST forms the conceptual basis for investigating the driving behaviors. This theory is proposed with 3 independent systems like reward, punishment and threat response. 2 important components of RST which regulate "aversive and approach motivation". Aversive motivational system is called as "behavioral inhibition

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system”, referred as negative reactivity and approach motivational system is called as “behavioral approach system” referred as positive reactivity. These motivational systems are designed to assess individual differences in sensitivity regarding the reward and punishment.

[32] Found that BIS helps in avoiding the behavior which could lead to painful or negative consequences and is highly responsible for negative feelings like sadness, anxiety and frustration. [33] Found that BAS has 3 sub-systems like drive, reward responsiveness and fun seeking and is thought to control impulsivity, elation, hope and happiness. It is being very sensitive regarding reward, non- punishment and escape from punishment. [32] Says that the principal functions of BAS are to initiate incentive motivated, goal directed behaviors. [34] Found that BAS is also related to traffic violation. [35] Found that, it is applied to behaviors such as drinking, gambling and driving, individuals who has low BIS and high BAS perceive less risk. [36] Found that RST helps in playing the key role in explaining the individual differences in risk perception. The authors in this study try to explain the relationship between the BIS/BAS motivational system, perceived risk of, and reported engagement in risky driving behaviors.

II. BEHAVIOR MODELING

There are several safety techniques which are developed in the past such as, hazard analysis techniques, instrumented vehicle studies and fleet studies of driving safety interactions. [37] Aimed to use the applications of an innovative approach for analyzing the problems of fatigue in the truck driving industry. Driver fatigue is considered as the major cause of long haul truck crashes [38]. There is no accurate relationship of fatigue casual factors like time on task, circadian effects and low quality of sleep to other crash contributing factors like night visibility or interactions with other traffic. There are many empirical methods which utilize driving simulator test trackers or on-road instrumented vehicles in order to collect the data regarding driving performance and other safety measures [39]. The hazard analysis technique [40] is mainly used in the areas of safety research to determine the relative safety of a system using a smaller and more detailed data set of unsafe acts or near misses. With the help of this technique, the collected data helps in identifying the incidents where significant unsafe actions, behaviors or equipment malfunctions had occurred. They are again classified as either safety related errors or as near crashes. Truck driving is a complex activity which relies on a certain number of cognitive skills, their automation level and mainly on drivers’ expertise [41]. [42] Reported a novel application to investigate the drivers by various professionals about their driving behavior. The changes in drivers’ performance can be analyzed by using certain variables like, speed and its derivatives, lane keeping measures, headway and other safety measures like overtaking or gap acceptance behavior. Many research studies reported about the changes in these variables, indicating either a worsening or improvement in driving behavior.

Impairment due to consumption of offensive drugs leads to poorer car following and abnormal steering behavior [43] and difficulty in taking decision [44]. Driver distraction can be found when he/she exhibits poor tracking strategies and detection of obstacles and avoidance during the usage of mobile phones while driving [45]. Improved driver performance can be monitored by using similar measures like reduction in speed violations, installation of enforcement cameras [46], feedback system which makes the driver to maintain the safer headway to the front vehicle [47] etc. Some measures, such as speed reduction could be interpreted as being either indicative of poorer performance and can be combined by a narrowing of peripheral scanning [48].

Abnormal reaction to the changes in the road environments like changes in weather conditions and challenges in road geometry will also affect the driver performance. The variables which were used to evaluate the changes in driving performance depend not only on the direction of change, but also on the quantitative effect of the change. For each 1 mph reduction in mean speed, there is a conjoined 5% reduction in accidents which should be treated cautiously. [49] Reported it depends on road type and its associated mean speed. Various road safety experts are trying to estimate the models where the main effects are statistically significant.

The 5 performance variables which shows the considerable differences in drivers’ safety such as mean speed, speed variation, variation in lane position, minimum headway and driver awareness. The findings [42] show that there are some tolerances, with respondents allowing a safety margin of approximately 10% above the posted speed limits. This shows that the speeds up to this hypothetical limit are generally accepted to be safe or at least as travelling at the speed limit, above this limit the safety index decreases exponentially. The authors had also attempted to establish the mathematical relationship between the free travel speeds and the relative risk of involvement in a collision. The Delphi study was undertaken to use expert judgment as a way of deriving a first approximation of these thresholds and

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combinatory effects. By the use of the safety preference technique, the judgment can be made by the road safety professionals about the drivers' safe and unsafe behaviors.

III.CONCLUSION

This review illustrates the various first of its kind and state of the art data regarding the psychological factors to be considered in the design of fatigue and drowsiness detection systems. Cognitive process and attentional networks are analyzed from various literatures. From the above speculations, it is concluded that these factors are often analyzed before and after the accidents. There are also some major factors which contribute to the design such as neuro-physiological variations and visual topographies. The latter two, are examined and given more importance regarding the prevention of the accidents.

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