



A Literature Review on Driver Behaviour for Road safety

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Abstract

We present literature review related to drivers' behavior for road safety to identify personality, attitude, ability and reliability for road safety. The factors which are taken into account are cognitive behavioral changes during, driving behaviors of the driver. The reasons for the road accidents can depend upon various factors like wreck less 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. Since from personality derives the driver performance, is possible to detect behaviours that tend to result in decreasing driving risk. In this way, we provide useful indications of personality for road safety and conclude very important factors for road safety.

1. Introduction

A literature review aimed at identifying the individual differences that are associated with driving behaviour and road traffic accidents. The aim of this paper is to present a literature review on the effect of certain driver's personal characteristics for road safety. Age, gender, personality, social deviance, stress, life events, fatigue and physiology are related with driving and are effective for road safety. The review concentrates on those studies conducted in the last two decades to investigate the factors related to drivers' behavior for road safety. However, personality is main factor to investigate earlier than other issues such as fatigue, drugs, and alcohol and therefore earlier studies are reported. The main findings from the review related to personality are following:

1.1. Personality profiles

It is evident from the review that certain personality characteristics are associated with unsafe driving behaviour and / or accident involvement. Some of these characteristics include: risk taking, thrill seeking (including Thrill and Adventure Seeking, Boredom Susceptibility, Disinhibition), impulsiveness, hostility / aggression, hasty decision-making, emotional instability, depression, external locus of control, low tension tolerance, immaturity, personality disorder, paranoid conditions, less conformity and more difficulty with authority figures. In addition, high scores on Neuroticism are a strong predictor of stress, which in turn is associated with risky driving behaviour and accident involvement. Various standard personality scales incorporate some of the factors. For example Cattell's 16PF (16 Personality Factor Scale) includes Emotionality, Venturesome, Tension and Conservatism.

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1.2. Stress and Personality

Furnham and Saipe (1993) reported a study by Matthews et al (1991) which investigated personality correlates of driver stress, using Eysenck's EPQ dimensions of personality. Results showed that high scores on the Neuroticism scale were the strongest single predictors of stress (correlating with factors of aggression, dislike of driving, and general stress) and hence minor accident involvement. Eysenck and Eysenck (1975; in Furnham & Saipe, 1993) also suggested that high Psychoticism scores indicate low susceptibility to stress, since a high Psychoticism scorer is said to be lacking in feeling. Furnham and Saipe (1993) subsequently attributed their observed association, between convictions and higher scores on the Psychoticism scale, to this suggestion, arguing that violations would tend to be performed by those who show little stress when driving fast, or when violating the law.

In other research, Donovan et al (1986; in Beirness, 1993) considered depression, as a factor of personality, and its association with traffic crash involvement. Transient forms of depression are related to crash involvement and these temporary depressive states might arise as a result of a major life stress. Consequently, Donovan et al (1986; in Beirness, 1993) proposed that, in such circumstances, depression might be a measure of the extent to which stressful life events are interfering with normal functioning, including driving. Dobson et al (1999) also observed that stress was associated with higher thoroughness (in decision-making) scores in the younger age group (aged 18-23 years), but not in the mid-age group (aged 45-50 years).

1.3. Personality and Physiology

Szlyk (1995) investigated the relative effects of age and compromised vision, on driving performance, and found that older drivers (aged 50 and above) and those with compromised vision had reduced risk-taking scores, as measured by a self-report questionnaire. This finding suggests an association between personality and physiology, as risk-taking has been closely linked with various measures of personality in the literature (e.g. Beirness, 1993; Furnham & Saipe, 1993; Zuckerman, 1979).

1.4. Personality and Gender

The literature consistently demonstrates that males are more likely to exhibit the risk-taking factors of personality (e.g. Jonah, 1997; Meadows & Stradling, 1996b; NHTSA, 1995; Meadows, 1994; Furnham & Saipe, 1993; Evans, 1991; Tsuang et al, 1985; Zuckerman, 1979). Again, the majority of research considers the effects of personality using Zuckerman's Sensation Seeking Scale (SSS). According to Zuckerman (1994; in Jonah, 1997), Sensation Seeking (SS) "is a trait defined by the seeking of varied, novel, complex, and intense sensations and experiences and the willingness to take physical, social, legal, and financial risks for the sake of such experiences". Analyses have shown that SS is made up of four dimensions, which are: (1) Thrill and Adventure Seeking (TAS), (2) Experience Seeking (ES), (3) Boredom Susceptibility (BS); and (4) Disinhibition (Dis). Although these four dimensions of SS are modestly correlated, they have been found to relate differently to various risky behaviours (Zuckerman, 1994; in Jonah, 1997), SS is therefore often not only considered as a whole, but also as a sum of its parts.

Zuckerman (1979; in NHTSA, 1995) observed that young males who are likely to engage in risky driving (including drink driving) are often characterised by high scores on the Thrill and Adventure Seeking (TAS), Disinhibition and Boredom Susceptibility (BS) subscales of the SSS. Furthermore, Meadows and Stradling (1996b), Meadows (1994), and Evans (1991; all in Meadows et al, 1998),

all found evidence suggesting that young and male drivers were more likely to behave in a risk-taking and thrill-seeking manner than other types of drivers.

Furnham and Saïpe (1993) conducted a study investigating the personality correlates of convicted drivers and found that males with more convictions and higher scores on Eysenck's Psychoticism dimension and Zuckerman's TAS and BS scales also scored highly on the risktaking factor in the Driver Behaviour Questionnaire utilised. Overall, findings showed that males tended to score more highly on Psychoticism, TAS, and BS, but lower on Neuroticism and they also had more convictions than females. These observations were corroborated by Parker et al's (2001) study which not only reported that female drivers scored more highly on the Neuroticism scale than did males, but that the males in the study again tended to score higher on the Psychoticism scale. In addition, however, Parker et al (2001) also noted that the females scored more highly on the Extraversion and Lie scales than did the male drivers.

Craske (1968; in Beirness, 1993) conducted a study of clinic patients with minor trauma, finding an association between Extraversion and crash rates, which was again apparent for males, but not for females. Jonah (1997), in his literature review, also observed Sensation Seeking (SS) to be higher in males than infemales. The vast majority of the 40 studies Jonah reviewed showed positive relationships between SS and risky driving, and these relationships were particularly apparent for males. Additionally, Jonah's review also found that the relationship between SS and drinking and driving was generally stronger among men than women.

Tsuang et al (1985; in NHTSA, 1995) also conducted an extensive review of the literature, finding that those who were involved in crashes displayed a tendency towards risk-taking, and that this relationship was stronger for males rather than females. Similarly, Storie's (1977; in Elander et al, 1993) study also reported that males were more likely to be involved in crashes caused by unwarranted risk-taking.

1.5. Personality and Risk Perception

Several of the studies investigated, in Jonah's (1997) literature review, noted that those participants scoring high on Sensation Seeking (SS) showed a tendency to perceive less risk, in various driving situations, and that perceived risk and risky driving are negatively correlated (Horvath & Zuckerman, 1993; Yu & Williford, 1993; Heino et al, 1992; Arnett, 1990b; all in Jonah, 1997). Those scoring high on SS or risky driving therefore tended to have low risk perception. Jonah (1997) argued that these findings suggest that risk perception may mediate the relationship between SS and risky driving. Additionally, Jonah also proposed an alternative explanation whereby high SSs initially partake in risky driving to experience the thrill of it, and then lower their perceived risk of the situation when the risky driving does not result in negative consequences - therefore engaging in the behaviour more frequently.

Alm and Lindberg (2000) also investigated perceived risk and personality characteristics, however they employed very different personality characteristics in their study, meaning the results are not comparable to the SS findings observed in the above studies reviewed by Jonah (1997). The personality characteristics measured consisted of ratings for 'safety awareness', 'personal control over events', 'ability to take care of oneself', 'nervousness', 'ability to handle new situations', 'shyness', 'self-confidence', 'insecurity' and 'general feeling of safety' (Alm & Lindberg, 1999; Spielberg, 1983; both in Alm & Lindberg, 2000). Overall, Alm and Lindberg (2000) found that the relationship between these different personality characteristics and the ratings of perceived risk were generally quite weak. However, Hendrickx et al, (1992; in Alm & Lindberg, 2000) found that participants who had an internal locus of control (the belief that the participant can control certain

events her / himself) reported a lower degree of perceived risk than those with an external locus of control (belief that the control is positioned outside the individual).

1.6. Personality and Driving Violations

The majority of the literature investigating personality and driving violations / convictions has investigated Zuckerman's Sensation Seeking (SS) factor and / or Eysenck's Personality Questionnaire (i.e. the EPQ, which consists of the Extraversion, Psychoticism, Neuroticism, and Lie subscales). Generally speaking, the literature demonstrates that those drivers committing more traffic violations tend to have higher scores on Psychoticism, and SS, and lower Neuroticism scores (e.g [Johnson & White, 1989; Wilson & Jonah, 1988; Zuckerman & Neeb, 1980; Jamison & McGlothlin, 1973; all in Beirness, 1993]; [Loo, 1979; Fine, 1963; both in Elander et al, 1993]; [Matthews et al, 1991; Mayer & Treat, 1977; both in Furnham & Saipe, 1993]; also Jonah, 1997; Beirness, 1993; Furnham & Saipe, 1993;).

Furnham and Saipe (1993) found that convicted drivers attained high Psychoticism and low Neuroticism scores, as well as high Thrill and Adventure Seeking (TAS) and Boredom Susceptibility (BS) scores. The Extraversion and Lie scales did not correlate with convictions in this study. The number of convictions, however, were seen to increase with increasing scores on the 'risk factor', i.e. a driver with a high risk factor score tended to have committed more driving convictions. Furthermore, the authors also noted that 'law breaking', 'self confidence', and BS discriminated most between those with and without convictions - convicted drivers tended to show confidence and nonchalance about breaking traffic laws. As stated, convictions correlated negatively with both TAS and BS, although more strongly with BS, leading Furnham and Saipe (1993) to suggest that convicted drivers seek higher levels of thrill and arousal, in order for them to reach their optimal level of stimulation. The authors further proposed that the convicted drivers' propensity to take risk on the road can be accounted for by their "dislike for dull and predictable routine and a preference for excitement and thrill" (p.333). In terms of their findings of both high Psychoticism and low Neuroticism scores, the authors suggested that such drivers are more indifferent towards certain traffic laws, making it more likely for them to drive in an illegal or risk-taking manner. Mayer and Treat (1977; in Furnham & Saipe, 1993) corroborated Furnham and Saipe's (1993) study, by demonstrating that high Psychoticism scores were associated with impulsiveness and 'law-breaking', specifically with respect to driving.

Although Furnham and Saipe (1993) did not find a significant association between Extraversion and traffic violations, a study by Fine (1963; in Elander et al, 1993) demonstrated that Extraverts committed more violations than Introverts, subsequently suggesting that Extraverts may be less bound by society's rules. A further contradiction of Furnham and Saipe (1993) is apparent in Matthews et al's (1991; in Furnham & Saipe, 1993) study, which surprisingly found no significant relationship between any of the EPQ scales and speeding convictions.

With respect to personality factors other than those in the EPQ, Zuckerman and Neeb (1980; in Beirness, 1993) observed that high Sensation Seekers tended to choose higher driving speeds. Donovan et al (1985, 1990; both in Beirness, 1993) also observed high levels of the SS trait in various types of high-risk drivers, including those committing 3 violations within 1 year, or 4 violations in 2 years. Additionally, Pelz and Schuman (1968) and Schuman et al (1967; both in Beirness, 1993) demonstrated that risky driving behaviour was three times more common among those with high violation records, when compared to those drivers with no violations. Pelz and Schuman (1968) and Schuman et al (1967; both in Beirness, 1993) again also found a positive

relationship between ‘impulse expression’ and traffic violations, in a sample of young, unmarried, male drivers.

1.7. Personality and Risky Driving

The majority of the personality literature reviewed demonstrates relationships between certain personality factors and various aspects of risky driving. Again, Zuckerman’s Sensation Seeking (SS) factor, and the SS subscales, appear frequently in the research, with higher Sensation Seekers (SSs) being associated with a more risky driving behaviour (e.g. Arnett et al, 1997; Lajunen & Summala, 1996; Rimmo & Aberg, 1996; Beirness, 1995; Burns & Wilde, 1995; Horvath & Zuckerman, 1993; Yu & Williford, 1993; Heino et al, 1992; McMillen et al, 1992a, b; Arnett, 1990; Donovan et al, 1990; Moe & Jenssen, 1990; Wilson, 1990; McMillen et al, 1989; Wilson & Jonah, 1988; Donovan et al, 1985; Clement & Jonah, 1984; Donovan & Marlatt, 1982; Zuckerman & Neeb, 1980; all in Jonah, 1997; also NHTSA, 1995; Furnham & Saipé, 1993; & Beirness & Simpson, 1988, in Beirness, 1993).

‘Risky driving’ may be represented by a variety of indices, such as traffic violations, drinking and driving, crash involvement, speeding, risky driving practices / behaviour, or even seat-belt usage. Jonah’s (1997) extensive review found that, of the 40 studies investigated, only 4 did not find significant positive relationships between Sensation Seeking (SS) and some aspect of risky driving. Jonah observed stronger relationships with either observed or reported driving behaviour, rather than with traffic violations or collision involvement. All 15 studies investigating SS and ‘other risky driving behaviours’ (other than drink driving) evidenced an association of high SS with higher risky driving tendencies. Of the 12 studies considering SS and collision involvement, 7 studies observed significant differences between high and low SS on collision involvement, and another study reported a greater number of collisions with high SS. Furthermore, of the 11 studies examining SS and traffic violations, 6 studies reported more violations with increasing SS scores, and 3 studies identified clusters including drivers with high SS scores and violations. Overall, Jonah evidenced that high Sensation Seekers were more likely to experience collisions and violations than low Sensation Seekers, and high Sensation Seekers were also more likely to perceive less danger in risky driving. Consideration of drink driving as an index of risky driving showed that, of the 18 studies within Jonah’s review, all but 5 either found that, as SS score increased, reported ‘driving while impaired’ (DWI) also increased, or, reported / convicted DWIs had higher SS scores. (The associations between various personality factors and drink driving, crash involvement, and driving violations, will be discussed in greater detail in following sections of this report).

Although the subscales of the Sensation Seeking Scale (SSS) have not been examined very often, Jonah’s (1997) review noted that, of the positive associations, Thrill and Adventure Seeking (TAS) appears to have the strongest relationship with risky driving, followed by Disinhibition (Dis) and then Experience Seeking (ES). The author also observed that TAS appeared to be most strongly related to driver records. Furnham & Saipé (1993) used a Driver Behaviour Questionnaire to measure ‘risk-taking on the road’, and found that those scoring high on the “risk-taking” factor tended to have higher TAS, Boredom Susceptibility (BS), and Psychoticism scores. Beirness (1993) also conducted an extensive review of the literature concerned with the role of personality factors in road crashes. Beirness found that the six personality factors of: thrillseeking, impulsiveness, hostility / aggression, emotional instability, depression, and locus of control, accounted for up to 35% of the variance in measures of risky driving behaviour.

Research also demonstrated that those drivers who scored high on measures of SS were more likely to engage in risky driving practices such as speeding, impaired driving, accidents, and traffic violations (Johnson & White, 1989; Jamison & McGlothlin, 1973; both in Beirness, 1993). Similarly, faster drivers obtained higher scores on SS (Clement & Jonah, 1984; Zuckerman & Neeb, 1980; both in NHTSA, 1995) and the SS trait was observed to be related to 'driving risk', which was defined as the sum of responsible accidents, traffic convictions, and license suspensions, within the previous 3 years (Wilson & Jonah, 1988; in Beirness, 1993).

Another factor of personality that 3 studies investigated was that of depression, whereby Wilson and Jonah (1988; in Beirness, 1993) found a relatively weak relationship between depression and risky driving. Donovan et al (1986; in Beirness, 1993), however, observed that the depressed group displayed a reduction in the level of 'driving risk', with improvements in their affective state. Beirness (1993) therefore suggested that, "the type of depression associated with problem driving may be a more transient, state-like form of depression rather than associated with a more enduring trait".

1.8. Personality and Crash Involvement

Associations, in the literature, between personality factors and crash involvement appear to be mixed and vary according to the different personality factors. Wilde (1994; in Jonah, 1997) contended that personality has little role to play in collision involvement, and that where these relationships are found, they are generally weak and inconsistent. The research pertaining to the Extraversion and Neuroticism scales of Eysenck's Personality Questionnaire (EPQ) has generally been mixed, yet some studies did observe a relationship between higher Extraversion and / or Neuroticism and traffic accidents (Loo, 1978; Shaw & Sichel, 1971, 1970; Craske, 1968; Fine, 1963; all in Elander et al, 1993; & Eysenck, 1961, in Furnham & Saipe, 1993). Eysenck (1961; in Furnham & Saipe, 1993) argued that Extraverts would tend to be less socialised than Introverts (i.e. having formed weaker conditioned responses), and therefore more prone to accidents and errors. Shaw and Sichel (1971; in Furnham & Saipe, 1993) investigated a sample of bus drivers, with good and bad safety records, finding that the latter group tended to be more extraverted, and also scored higher on Neuroticism. It is being noted that, whereas most accident-prone drivers were neurotic Extraverts, most of the safe drivers tended to be stable Introverts. Craske (1968; in Elander et al, 1993) reported an association between Extraversion and crash rates in a sample of clinic patients with minor trauma, yet this relationship was only apparent for males and not females. Another study investigating Extraversion and traffic accidents (Fine, 1963; in Elander et al, 1993) also observed a significant relationship between the two factors, showing higher Extraversion with those that tended to be involved in crashes, in a study involving male students.

However, another body of research contradicts the observed associations between Extraversion, Neuroticism, and crash involvement. Wilson and Greensmith (1983; in Elander et al, 1993) found no differences in the Extraversion or Neuroticism scores of the crash involved and crashfree drivers, whilst Craske (1968; in Elander et al, 1993) found no correlation between Neuroticism and crash rate. Furthermore, Singh (1978; in Elander et al, 1993) reported an association between Introversion and crash involvement. On the other hand, Furnham and Saipe (1993) and Matthews et al (1991; in Furnham & Saipe, 1993) conversely found that accident rates were not significantly correlated with any of the EPQ scales. Elander et al (1993) noted the suggestion that more reliable correlations between driver behaviours and personality dimensions could be obtained by using subscales rather than overall scores. Loo (1979; in Elander et al, 1993) investigated this possibility,

by reanalysing data which showed a relationship between Extraversion and detection of embedded traffic signs, crashes, and traffic convictions (Loo, 1978; in Elander et al, 1993). Loo (1979; in Elander et al, 1993) broke down Extraversion into its 'Impulsivity' and 'Sociability' scales and subsequently found that Impulsivity carried the relationships with all 3 of the driving-related measures (when Impulsivity was broken down further into Sensation Seeking / SS and decision-time, SS carried the relationship between Impulsivity and traffic convictions). Overall, Elander et al (1993) argued that the evidence on Extraversion and Neuroticism, with respect to crash involvement, is inconclusive, suggesting that this may be a result of the lack of control in the majority of the aforementioned studies. Powell et al (1971; in Furnham & Saipe, 1993) also suggested that Extraverts might simply report more accidents than Introverts, yet this has to be established (Shaw & Sichel, 1971; in Furnham & Saipe, 1993).

Research has also investigated the associations between the Sensation Seeking Scale (SSS) factors and accident involvement. In a sample of high school students, Beirness and Simpson (1988; in NHTSA, 1995) found that drivers who had been involved in a motor vehicle crash scored higher on the Thrill and Adventure Seeking (TAS) subscale of the SSS than those participants who were either involved in a crash as a passenger, or those who were not involved in a crash at all. Beirness (1990; in Beirness, 1993) also evidenced that differences in SSS scores are evident even prior to licensing, suggesting the predictive value of this personality trait for subsequent crash involvement. In addition, Donovan et al (1990, 1985; in Beirness, 1993) measured high levels of the SS trait among high-risk drivers (which included drivers who had experienced 3 accidents within 1 year, or 4 within 2 years). Personality traits such as SS (thrillseeking), hostility, aggression, and emotional lability have all been shown to be frequently and consistently related to risky driving and crash involvement (Beirness et al, 1993; Beirness & Simpson, 1991; Wilson, 1991, Donovan et al, 1988; all in Beirness, 1993). Beirness' (1993) literature review argued that the six personality factors of: thrill-seeking, impulsiveness, hostility / aggression, emotional instability, depression, and locus of control account for as much as 10 to 20% of the variance in driver crash involvement. Furthermore, Pelz and Schuman (1968) and Schuman et al (1967; both in Beirness, 1993) found that higher scores on 'impulse expression' were associated with more accidents in a sample of young, unmarried, male drivers. Schmidt et al (1972; in Beirness, 1993) corroborated this with evidence of a generally elevated level of impulsive behaviour among drivers killed in single-vehicle collisions. Norris et al (2000), however, evidenced that neither depression nor self-reported concentration difficulties were related to motor vehicle accidents (MVAs).

In contrast, both Furnham and Saipe (1993) and Clement and Jonah (1984; in NHTSA, 1995) failed to find a relationship between SS and number of crashes. Jonah (1997) observed that collision involvement has been less strongly associated with SS, suggesting that this may be due to a lack of variance in the collision measure (in that collisions are relatively rare events), and also because being involved in a collision does not necessarily mean that the driver behaved incorrectly. In terms of an individual's propensity towards risk-taking, research has shown that those drivers involved in crashes tend to display more risky aspects of behaviour. Suchman (1970; in Beirness, 1993) found that those participants who were "favourably disposed to taking chances" were four times more likely than others to have been involved in more than one collision in the past year. These findings were supported by Pelz and Schuman (1968) and Schuman et al (1967; both in Beirness, 1993) who discovered that, amongst those drivers who had been involved in crashes, more than half had engaged in risky driving practices such as racing or taking dares. Mayer and Treat (1977; in Beirness, 1993) also found large differences in propensity towards risk-taking

between students who had been involved in 3 or more crashes in the previous 3 years, and those who had not been in any crashes during the same period.

The research in the literature also utilised various other measures of personality in the investigation of with crash involvement. Both West et al (1992b) and Evans et al (1987; both in Elander et al, 1993) examined Type A behaviour, using the Bortner Rating Scale (BRS). West et al (1992b; in Elander et al, 1993) found that higher scores on Type A behaviour were associated with self-reported fast driving, but not with crash rates. Evans et al (1987; also in Elander et al, 1993), however, conversely found that those drivers characterised as Type A had higher crash rates than Type Bs, in both India and the U.S. Evans et al (1987; in Elander et al, 1993) also noted that Type A was associated with more frequent braking, passing, and horn use. It was noted earlier that Beirness (1993) listed locus of control (LOC) as one of the personality factors accounting for the variance in driver crash involvement. However, this has been contradicted by Clement and Jonah (1984; in Elander et al, 1993), who, although initially observed a relationship between an external LOC and the number of crashes reported over 3 years, later found that this relationship did not hold once age, annual mileage, and number of years driving were taken into account. Additionally, Guastello and Guastello (1986; in Elander et al, 1993) found that the number of crashes reported during the previous 3 years correlated negatively with a “transitional” scale of beliefs about the internal control of crashes (i.e. a higher score on internal control was associated with a fewer number of accidents). There was, however, no such association with the original Rotter Locus of Control (LOC) scale.

Further investigations into other aspects of personality show crash involvement associated with “interests of a less intellectual nature”, expression of hostile feelings, increased aggression, “seeking of prestige and social roles oriented toward authority and competition”, and “disruption and conflict in past and previous family relationships” (McGuire, 1972; in Elander et al, 1993). In an extensive review of the literature, McGuire (1976; in Elander et al, 1993) also concluded that highway crashes are just another correlate of being emotionally unstable, unhappy, asocial, antisocial, impulsive, under stress, or similarly labelled conditions. Harano et al (1975; in Elander et al, 1993) found that measures of maturity, risk-taking, driving attitudes, and emotional stability were predictive of multiple crash involvement. In addition, Tsuang et al (1985; in Elander et al, 1993) identified certain personality characteristics as being risk factors for traffic crashes, and these were termed: low tension tolerance, immaturity, personality disorder, and paranoid conditions.

West et al (1992a; in Elander et al, 1993) took a slightly different approach by considering that a driver may have a stable trait of “crash liability”. The odds of having a crash in a 2-year period were doubled in drivers who had had one or more crashes in the preceding year. Thus, it was suggested that the proportion of crash risk attributable to a stable trait of “crash liability” was 50%. Furthermore, when crashes for which the driver was partly responsible were added, there was a fourfold increase in the odds, meaning that the crash risk attributable to a stable trait increased to 75%.

2. Investigation methodology

Given the above considerations, We also need to perform a behavioural or attitudinal evaluation, using psychological methods. In this case, psychology can use two main techniques: interview and questionnaire. The interview consists in a meeting and a talk between the psychologist and the applicant driver. The interview must be structured, i.e. it must consist in a series of pre-prepared questions focusing on his eligibility to drive. The questionnaire consists in the

completion of a grid characterized by a methodological sequence. Both techniques can have certain common characteristics. The questions must be comprehensible, i.e. they must use known terms and be formulated using simple, linear sentences, they must be clear and univocal, i.e. vague and ambiguous expressions should be avoided and no debates should be developed, they must be formulated in a concise manner so that understanding is immediate, they must be concrete to avoid issues referring to reality and, last but not least, they must be pertinent.

In the case of a potential driver, we need to thoroughly investigate his personality to understand its various aspects. The first is that of perception; we must investigate the process by which the brain, obtaining information through the senses, processes it to grasp the reality that must be true and not manipulated and artificial. Then we need to investigate the learning process that conditions behaviour; through this process the individual makes the experiences his and, with his intelligence and sensitivity, he adapts his behaviour to the environmental situations, highlighting and intellectual and/or psychophysical limitations. Lastly, we need to explore the memory mechanisms, i.e. the complex processes that are not merely activities during which information is seen, encoded and stored, but also have the ability to use things acquired previously. With these investigations, we can identify the individual's personality and therefore his behaviour considering his actions and/or reactions in emotive and motivational processes.

3. Physiology and Crash Involvement

The research in this area was also sparse, but Elander et al (1993) reported a useful study by Mourant and Rockwell (1972) who found differences in visual fixation and scanning patterns, between novice and experienced drivers. Results showed that novice drivers tended to search the road close in front of the vehicle. Elander et al (1993) subsequently suggested that poorer perceptual processing, in the driving situation, might be partly a function of lack of experience at detecting objects in the traffic environment and predicting their likely behaviour.

Szlyk (1995) investigated the relative effects of age and compromised vision on driving performance and found that compromised vision and visual field loss predicted real-world accidents in their study population. It is worth reiterating Szlyk's point, however, that compromised vision (specifically visual field loss) is not as easily compensated for as some of the age-related losses of driving skills, given that compromised vision predicts accident involvement. Gale (1999; in 'Causes of Road Traffic Accidents Update', 1997-2000) also reported that reduced visual acuity appears to be more important than age as a factor influencing driving restriction and ultimately accident involvement.

The National Highway Traffic Safety Administration (2000) investigated medical conditions and crash risk, considering restrictions on licences, and found that, overall, drivers who were licensed with medical conditions had higher risks of crashes, violations, and at-fault crashes than comparison drivers did. Comparisons were made between medical condition categories, with findings showing that all drivers in the 'vision' and also the 'alcohol and other drugs' categories consistently displayed higher risks for crashes and at-fault crashes. Furthermore, the article identified priority categories for reevaluating the level of licence restriction, due to the high crash risk factors observed, these categories were: learning, memory, and other communication disorders; psychiatric and other emotional conditions; alcohol and other drugs; and musculoskeletal abnormalities.

The majority of associations between driving after drinking and the various individual differences are covered across the other sections of this review. However, Dobson et al's (1999) measure of alcohol consumption related to 'habitual' intake, rather than to driving-related alcohol intake, and thus will be discussed separately in this section. Findings showed that habitual alcohol consumption was associated with riskier driving, and poorer driving behaviour scores. More specifically, higher lapse, violation, and speed scores were associated with higher levels of alcohol consumption. A higher risk level of habitual alcohol consumption was also associated with an increased accident risk, within the younger age group in the study.

In other research, Hakkanen and Summala (reported in Hakkanen & Summala, 2000) analysed trailer-truck drivers' fatal crashes, and evidenced that the probability of being at-fault for the accident was 3.5 times higher if the driver had a chronic illness.

4. Crash Involvement and Speeding

The research consistently shows that hastily made decisions are associated with an increased risk of crash involvement ([West et al, 1993; Reason et al, 1991; West et al, 1991; all in Parker et al, 1995]; [West et al, 1992a, in Elander et al, 1993]; also Parker et al, 1995;). Parker et al (1995) underlined that one would expect that a lack of thoroughness in decision-making would contribute to accident risk, if, for example, a driver pulls out into traffic before looking carefully or considering the consequences of the conditions.

West et al (1992a; in Elander et al, 1993) reported that individuals who frequently made decisions without carefully considering the costs and benefits displayed a higher crash risk. Elander et al (1993) further noted that this relationship has consistently been found to be independent of age, gender, and mileage.

However, the relationship between lack of thoroughness in decision-making and an increased accident risk has also been observed to be mediated by faster driving ([Reason et al, 1991; West et al, 1991; both in Parker et al, 1995]; & [West et al, 1992a; in Elander et al, 1993]). West (1991; in Parker et al, 1995) additionally reported a relationship between faster driving and lower thoroughness in decision-making. Hasty decision-making therefore appears to be linked to both faster driving and higher crash risk (Parker et al, 1995). Reason et al (1991) and West et al (1991; both in Parker et al, 1995) also found that a tendency to commit driving violations, fast driving, and lack of thoroughness in decision-making have all been reliably associated with increased accident risk. Furthermore, West et al (1993; in Parker et al, 1995) revealed an association between lack of thoroughness and social deviance. As social deviance is itself linked with accident risk, Parker et al (1995) subsequently concluded that the relationship between hasty decision-making and higher crash rates is still unclear.

- **CONCLUSION**

This review illustrates the various first of its kind and state of the art data regarding for road safety. 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 neuron- physiological variations and visual topographies. The latter two, are examined and given more importance regarding the prevention of the accidents for road safety.

It is complex as it depends on all those factors referring simultaneously to the driver and the infrastructure surrounded by the environment. It is integrated because the various factors influence and interact with one another. The aim of this paper is to investigate the issues upstream,

i.e. the driver's aptitude when interpreting the driving operation to road safety. This professional would not merely approve individuals as roadworthy but, consequently, also offer planning advice.

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