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DIFFERENTIAL ACCIDENT INVOLVEMENT: A LITERATURE SURVEY

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NATIONAL INSTITUTE FOR PERSONNEL RESEARCH
Council for Scientific and Industrial Research

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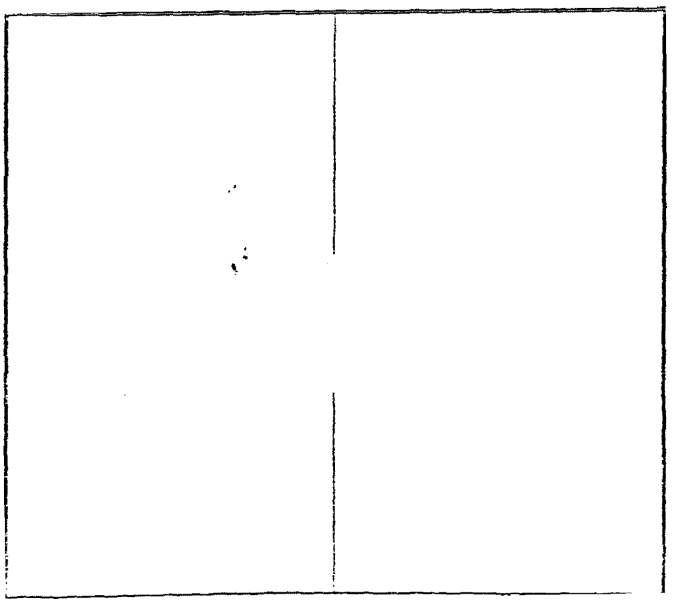

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FOREWORD

For some years the National Institute for Personnel Research (NIPR), as well as the National Institute for Transport and Road Research (NITRR), both of which are CSIR institutes, have conducted research in the area of road safety, sponsored to a considerable extent by the National Road Safety Council.

The NIPR's investigations have concentrated chiefly on the role in accident causation of such factors as individual differences in the ability to assess vehicle velocity, and the importance of information processing. Currently the Institute is carrying out a large-scale intensive study of the effects of fatigue on performance in a "driving simulation", more precisely a computer controlled visual field generator.

At a meeting of the Personnel Research Advisory Committee in November 1982 Professor Simon Biesheuvel expressed the view that the human factor in accidents was a complex interaction of a number of variables, especially those of a non-cognitive kind.

The Committee recommended that the NIPR survey the literature in this area as soon as possible, with a view to identifying specific areas requiring research. This report by A P Golding is the result of this recommendation. The findings of his survey comprise a valuable contribution to the planning of future research on human factors in the causation of road accidents.

G K Nelson
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ACKNOWLEDGEMENTS

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SUMMARY

This survey is an overview of the literature on human factors in traffic safety. More specifically it examines the individual differences which predispose some people to have accidents and others not to in order to identify the population at risk.

The areas covered are many and diverse, and the part some factors play in the driving task may seem initially obscure. However, driving is just as much a form of social behaviour as other everyday activities demonstrated in a person's response to family life, the work situation and to being a citizen. It is argued that deviance in these areas is frequently accompanied by deviance in other areas.

With respect to the issue of screening drivers who are at risk traffic researchers have yet to find the answers. The driving situation, as we know, is very complex and the probability of an individual having an accident exceedingly low; so low in fact that the probability of him having an accident through negligence approaches the probability of him having one by sheer chance. It could thus be concluded that accident involvement may be an inappropriate measure to use and many failures to find significant relationships have indeed been attributed to this. Rather, it could be argued, investigators should pursue the relationship between deviant forms of driver behaviour such as reckless driving and a human factor such as personality.

The findings of this review suggest that certain human factors which differentiate drivers are associated with specific forms of driver behaviour either leading to accidents or hazardous situations. If research aimed at identifying individual driver characteristics and types of accident or road behaviour is successful then training schemes could be implemented to remedy some of the deficits noted.

OPSOMMING

Hierdie ondersoek is 'n literatuuroorsig in verband met padveiligheid. Dit ondersoek meer spesifiek die individuele verskille wat sommige mense meer vatbaar maak om ongelukke te maak en andere nie. Die riskante populasie word sodoende geïdentifiseer.

Die areas wat gedek word is baie, asook uiteenlopend van aard, en die rol wat sommige faktore by bestuur speel, mag aanvanklik onduidelik lyk. Bestuur is egter net soveel 'n vorm van sosiale gedrag soos ander alledaagse aktiwiteite wat gedemonstreer word in 'n persoon se reaksie teenoor familie-lewe, die werksituasie en om 'n burger te wees. Daar word gereken dat 'n afwyking in hierdie areas gewoonlik gepaard gaan met 'n afwyking in ander areas.

Betreffende die kwessie van die sifting van riskante bestuurders, moet verkeersnavorsers nog 'n antwoord vind. Die bestuursituasie, soos ons weet, is baie ingewikkeld en die moontlikheid dat 'n individu 'n ongeluk sal maak is uiters laag; so laag inderdaad dat die moontlikheid vir hom om 'n ongeluk te maak as gevolg van nalatigheid net so goed is as om toevallig 'n ongeluk te maak. Daar kan dus tot die gevolgtrekking gekom word dat ongelukbetrokkenheid 'n ontoepaslike maatstaf is om te gebruik. Baie mislukte pogings om 'n beduidende verband te vind is hieraan toe te skryf. Daar kan eerder geargumenteer word dat navorsers die verband tussen afwykende vorme van gedrag van bestuur moet opvolg, byvoorbeeld, roekelose bestuur en 'n menslike faktor soos persoonlikheid.

Die bevindige van hierdie oorsig voorsien dat sekere menslike faktore wat bestuurders onderskei, in verband gebring kan word met spesifieke vorme van bestuurders gedrag wat of lei tot ongelukke of gevaarlike situasies. Indien navorsing wat gerig word op die identifisering van individuele karaktertrekke en tipes ongelukke of padgedrag, suksesvol is, dan kan opleidingprogramme daargestel word om sommige van die nadelige faktore te bekamp.

1. INTRODUCTION

As far as the human factor in trafic accidents is concerned the ability to make decisions and take appropriate action is particularly dependent upon the affective state of the driver at the time. This may be a relatively enduring state related to his personality and the way in which he perceives stimuli in everyday life, or it may be a transient state brought about by stress at home or at work.

Additionally, the fact that driving is only one of many forms of an individual's social activities means that his behaviour and experience in other situations may exercise a powerful influence on his driving behaviour. This complex interaction has largely escaped investigations in the field of accident research. Consequently in order to identify and examine the population most at risk the perspective of the investigator must be widened from the driver-vehicle-environment to encompass the complex variety of values, emotions, motivations, stresses and perceptions that the driver brings with him when he gets behind the wheel of a car.

The problems and complexities of research into driver behaviour are manifold and seem to increase exponentially with the quantity and cost of research. Since this line of investigation has not been seen to be successful in terms of accident reduction the emphasis has moved somewhat to modifying the driving environment.

Here it is undeniable that certain engineering solutions to problems have been both cost-effective and successful. A good example is where original hardware solutions or legislative constraints had eliminated drivers' scope for flexible decision-making. In Great Britain the introduction of mini-roundabouts (Green 1977) at sites previously controlled by priority makings or traffic lights resulted in 46 percent and 62 percent reductions in fatal and serious accidents respectively. In other words, the safer system is one in which the driver, rather than the road system, implements priority procedures (Brown 1979).

However, there are limits to what can be achieved without the cost of safety measures exceeding the costs of the accidents themselves. Sabey and Taylor (1980) give the road safety budget as £1000 million per annum in Great Britain and recently Fernie (1982) has quoted the cost of accidents in South Africa as exceeding R2000 million per annum. It can be seen that the figures are comparable in scale at least.

Although certain measures work in the short term there is as yet no evidence of any long term successful measures and one persuasive argument is that no real reduction in accident frequency will be evidenced until the level of risk on the road tolerated by individuals and society as a whole is reduced (Wilde 1976).

The focus on risk taking subsumes many interactions with other factors i.e. alcohol consumption, and also emphasises the importance of motivational variables on driver behaviour. The model of Wilde has been adopted here because it describes the approximate relationships existing between the factors to be surveyed in this review.

The model shown (see Fig 1) deals with the interactions between Cognitive criteria and Motivational States and the crucial factors which moderate these inputs. The emphasis in this report will be on Moderating Factors rather than on information processing because in so many instances these appear to limit or circumscribe the quality and quantity of the direct inputs to the information intake.

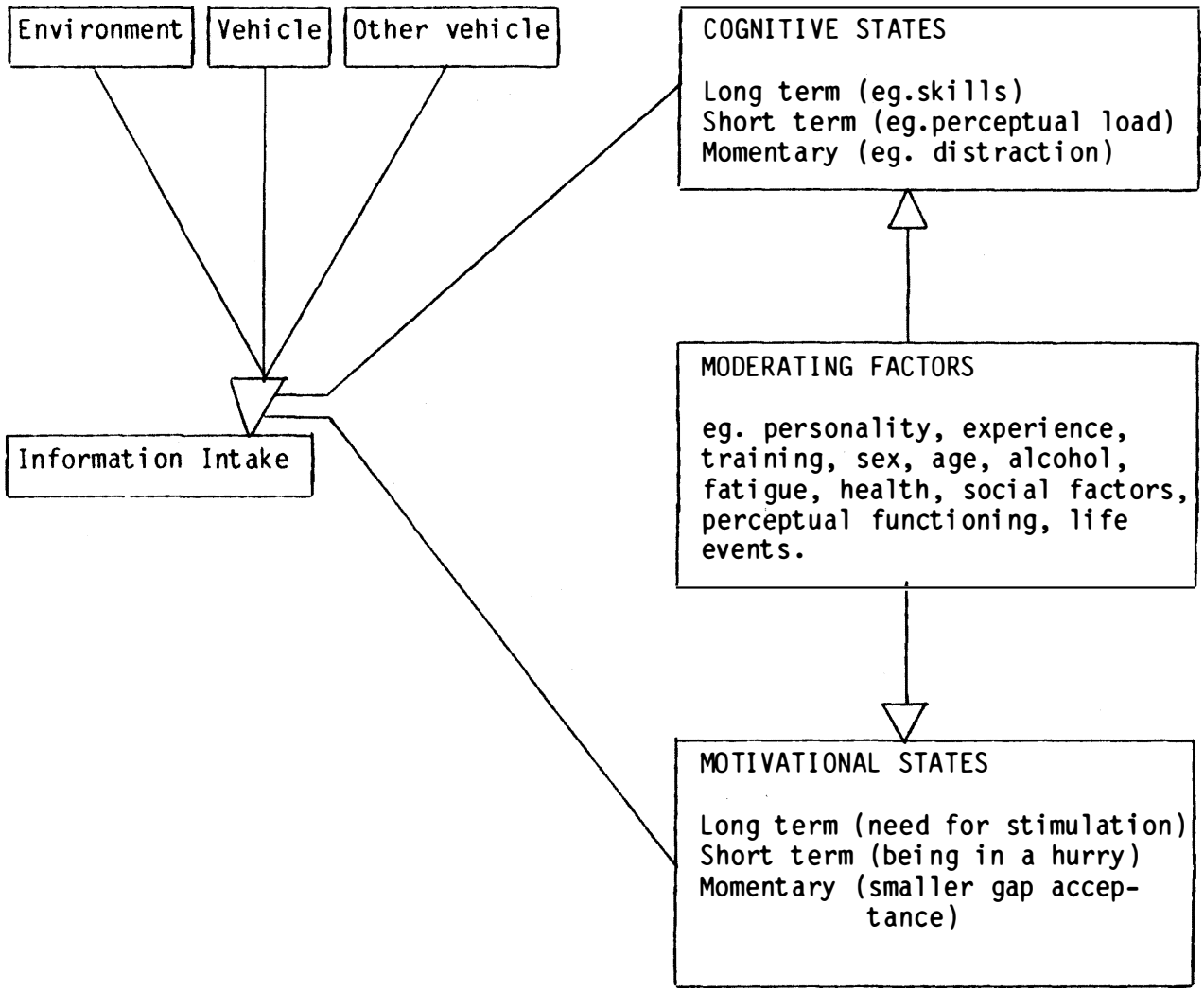

Fig 1. Part of Cognitive and Motivational Model of Driver Behaviour (after Wilde 1976)

Much research has overlapped the different areas, ie. field dependence being part cognitive and part personality, yet the common thread running through all the literature is that of individual differences in accident involvement.

1.1 Accident Proneness

In 1919 two statisticians, Greenwood and Woods, found an unequal accident liability in munitions workers. The data had been amassed during the First World War under fatiguing conditions so the researchers were cautious about any definitive intepretation. Nevertheless upon this foundation Farmer and Chambers (1926) constructed the concept of 'Accident Proneness' which rapidly became a catch-phrase used for explaining why accidents occurred when no other reason could be deduced. Certain people were said to be inherently prone to accidents although the concept never revealed why they were.

Vilardo (1967) reviewed the area and concluded there was little evidence for consistent accident-prone traits: those people who have accidents one year are not the same as those who have them the next year. Rather, there seem to exist accident-prone characteristics which are present in all persons and all environments at certain times.

McGuire (1976) finds that individuals will be accident prone for generally short periods of time for different reasons - medical, social, psychological, demographic. For instance, drivers under the age of 25 are more 'accident prone' than when they exceed this age. There are others who, by virtue of the fact that they possess certain characteristics, remain accident repeaters throughout the greater part of their lives.

The most telling criticism of the statistical approach to accident proneness, according to McKenna (1982), is that it provides no information on the causal antecedents of accident involvement which is fundamental to the scientific study of traffic accidents.

2. DIFFERENTIAL ACCIDENT INVOLVEMENT

This approach is considered as an alternative framework to that of accident proneness. It examines the question of whether it is possible to predict or discriminate on the basis of psychological tests those who will be involved in accidents from those who will not. The aim is a theoretical understanding of those characteristics which are associated with high accident involvement among individuals in order to identify the population at risk.

2.1. General

Early attempts concentrated on factors like simple reaction time and vision. While some correlations between vision and accident involvement have been found (Hills 1980), there seems to be little relationship with simple reaction time (Goldstein 1961). With the benefit of hindsight it seems that these tests are generally too simple. Drivers could easily compensate for deficiencies in either of these abilities. When more complicated tests have been used more promising results have been obtained. Kahneman et al (1973) found that performance on a test of selective attention successfully discriminated between bus drivers with high and low accident involvement.

With regard to vision Hills (1975) found a significant association between accident involvement and movement perception (dynamic visual acuity). Dynamic visual acuity was found to decrease exponentially with age. Significant increases in decision time with age were also found. Hills concluded that in future driver vision research consideration should seriously be given to including higher order visual tests, such as a Hazard Perception test especially as such tests would be more exacting for the younger driver.

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This is supported by 'interactional' studies. Whilst Adams et al (1975) found that static visual acuity is unaffected by alcohol intoxication, Brown et al (1975) found a significant effect of alcohol on dynamic visual acuity. Dynamic visual acuity has been shown to be more affected by frequently present transient human states such as alcohol, fatigue, 'life events', than static visual acuity and therefore would be rated as more critical to safe driving than the latter. The involvement of these interacting factors in site-specific accidents ie. on bends, is noticeable and future research should explore such relationships.

2.2 Field Dependence

People vary in the extent to which they can perceive an object independent of its surroundings. This dimension has been termed 'Perceptual Style' by Witkin et al (1954). In the roadway environment an occluded sign, an obscured car moving out of a row of parked cars, or a child jumping off the curb may often constitute an 'embedded figure' which only a 'field independant' person would perceive. People who have difficulty in perceiving a target against its background - 'field dependent' people - will encounter difficulties in driving.

All the studies that have investigated driving behaviour have documented a significant relationship between field dependence and various aspects of safety-related driving capabilities. This has been demonstrated in the ability to recognise developing hazards under stress (Barrett and Thornton 1968), the recognition of particularly obscure road signs (Mihal and Barrett 1976, Loo 1978) and defensive driving in platoon driving traffic conditions (Olson 1974). Two studies by Shinar et al (1978) provide support for the suggestion that one of the underlying problems of field dependent people lies in their ineffective visual search.

Barrett and Thornton (1968) looked at the hypothesis that field dependent drivers are slow in reacting to certain emergencies using a simulator. Field independent drivers were found to identify the hazard more quickly and responded more effectively. Field dependent subjects hit the hazard more frequently, had longer brake reaction times and rates lower deceleration rates.

Harano (1970) used the embedded figures test (EFT) to determine degree of field dependence and found those subjects having difficulty finding the target had more driving accidents. While Harano et al (1975) failed to replicate this result Mihal and Barrett (1976) did replicate it. Two alternative hypotheses suggest themselves.

It may be that the ability to extract information from a complex background correlates with accidents in a fairly direct way. Loo (1978), for example, has found that those who do poorly on the EFT take longer to respond to traffic signs viewed in their natural setting. Mihal and Barrett (1976) suggest that we may expect that violations and accidents involving the failure to heed road signs may be more frequent amongst field dependent than field independent drivers.

Alternatively, Goodenough (1976) has characterised those who perform poorly on the EFT as processing information in a passive way while those who do well are thought to process information in an active manner. The latter may be using cues which the former are not. They may be anticipating the road situation and preparing to respond accordingly. Those who perform more passively and respond as things happen may be more vulnerable. This is similar to the distinction made by Quenault (1967) between the 'cognitive style' of 'safe' and 'dissociated' drivers in his typology of driving styles.

The work by Olson (1974) has a bearing on this issue. He looked at skid control and found that field independent drivers improved their performance over a course of trials whereas the field dependent subjects failed to learn from this visual and vestibular-kinaesthetic feedback. In the second part of his study Olson found that field dependent drivers concentrated more on the car directly in front than on the leading vehicle in a queue of cars and followed more closely than feld independent drivers.

It seems that field dependent drivers are less actively involved in using the available cues to predict what will happen on the road. Quimby (McKenna 1982) has found that drivers doing well on the EFT detect more road hazards that those who do poorly, again suggesting that these people may be actively involved in predicting the road situation.

Olson (1974) concludes that the prediction that field dependent subjects will likely be in the following car in a collision pair may be made together with the suggestion that rear-view collisions are caused by field dependent individuals. The field dependent individual has a reduced capability for detecting significant manoeuvres by vehicles further ahead. Therefore an investigation of actual collision involvement by different perceptual types could be rewarding.

Goodenough (1976) finds that while degree of field dependence may be related to accident rates the field dependent driver behaviours that may cause accidents remain to be specified. Similarly the reasons for the relationship between perceptual or cognitive style and auto safety are not completely understood.

Some of the latest findings in this field by Shinar et al (1978) suggest that field dependent subjects have less efficient visual search patterns and require more time to process the available visual information. In curve negotiation and visual search the field dependent driver had more concentrated fixations which meant that he was less able to adapt to the changing environments encountered when moving from a straight to a curved road.

The field dependent individual's visual search is rigid and slow and his fixations maintain a narrow field of view much like a mild form of tunnel vision or reduced peripheral vision. Consequently he has less 'spare visual capacity' for processing visual information especially when the perceptual load is increased. If reduced visual search efficiency is at the root of field dependence then it may be possible to train people to improve their visual search behaviour and thus increase their safety.

Although the results of studies investigating the relationship between field dependence and specific driver behaviour ie. perception of partially hidden traffic signs, have tended to be positive, those comparing perceptual style and accident involvement per se have tended to produce equivocal findings. The reasons for this may be the sampling (too selective or too random), the fact that accidents are low probability events often triggered by a combination of factors which may be irrelevant to the driver's perceptual style and the fact that the type of accident has not been specified (Shinar et al 1978).

It is suggested that future research should concentrate on selecting certain types of accidents and proceed from this end so that only particular accidents would be included. A prime candidate for such a study might be the typical 'tailgating' rear-end collision or the loss of control on a bend accident.

However it has to be remembered that perceptual style as measured by the EFT or Road and Frame Test (RFT) is affected by other factors - alcohol (Barrett and Thornton 1968), age, sex (Uhr 1959), fatigue, brain damage (Goodenough 1976) and many other variables such as personality (Loo 1978). For example, as people age they become more field independent and since young drivers are relatively field dependent this may be a major factor in accident involvement.

In sum, field dependant drivers do not quickly recognise developing hazards, are slower in responding to embedded road signs, have difficulty in learning to control a skidding vehicle and fail to drive defensively in high-speed traffic. Detailed analysis of the implications of cognitive style for driver behaviour suggest that certain types of accidents will frequently occur among field dependent drivers. These suggestions may be tested by reconstructing actual accidents on the basis of existing records. If these approaches lead to a clear understanding of the field dependent driver's contribution to accidents then it may be possible to develop instructional programs designed to train around the cognitive problems involved.

2.3 Driving Style

Two of the difficulties with predictive methods of identifying unsafe individuals are the accuracy and credibility of the predictors. Many studies of individuals have been based on accidents, traffic violations or performance in driving related tasks. These can be rather gross predictors looking at consequences of behaviours for associations.

By contrast Driver Typology studies designed to find ways of identifying unsafe individuals tend to concentrate on direct observation of driving style. Such studies can also throw light on the general question of what it means to drive and take risks on the road (Taylor 1964) and the social aspects of road use (Wilde 1976).

Quenault (1967) observed driver action during test drives and classified them according to a two-dimensional typology of cognitive and affective styles. Three observational categories were employed using a process of elimination. If there were no near misses, risks or unneccessary manoeuvres the driver was classified as 'safe'. The remainder were 'unsafe'. If these used the rear-view mirror in more than 25 percent of manoeuvres they were classed 'injudicious'. If not they were termed 'dissociated' - "showing lack of full awareness of the situation and of the consequences of their own actions". Of these, those who overtook more vehicles than overtook them were called 'dissociated active' and those who were overtaken more often than they overtook 'dissociated passive'.

Quenault's findings at TRRL were quite unequivocal. Drivers with a history of conviction for careless driving were twice as likely as non-convicted drivers to be classified in one of the three unsafe categories (Quenault and Harvey 1971).

Cognitive Style	Affective Style: Low	Affective Style: High
High	Safe	Injudicious
Low	Dissociated Passive	Dissociated Active

Fig 2 Quenault's Typology

Fell (1976) adopts a conventional view when he maintains that, "Risk taking behaviour, in effect crucial disregards pre-danger-signal information to the point that it is too late to react to the crucial stimuli. Examples include speeding, violating stop signs and signals, making improper manoeuvres and following too close. The driver is typically aware that he is taking a chance. However, for some reason or other (eg. attitude, mental state, experience) he chooses to proceed with the action in the hope that he will get away with it".

Whilst this view may pertain to some instances it seems somewhat simplistic and generalised. Is the speeding, tailgating, improper 'manoeuvrer' necessarily aware of what he is doing wrong and of the chances he is taking? An awareness campaign by the NRSC suggests that many drivers are not aware of these dangers.

The 'Danger Compensation Theory' of Peltzman (1975) states that road users adjust their behaviour to compensate exactly for perceived risk in the driving environment. Thus safety benefits from the wearing of seat belts etc. will not be realised because drivers will take more risks. Ganton and Wilde (1971) suggested a similar idea by first finding that drivers' oral risk ratings were independent of traffic conditions. Wilde (1972,1975) then inferred from the short-term effect of road safety propaganda that a 'risk-homeostatic' mechanism operates in the longer term, in addition to the shorter term responses within a specific trip.

O'Neill (1977) showed that rational drivers may react so that a safety innovation makes matters worse, concluding that this puts the emphasis for research on driver judgement and motivation, rather than on the engineering of cars and roads.

All this follows if the danger compensation theory is correct - namely that whatever safety improvements are made the individual will trade them off against other personal gains such as increased speed. Experimental evidence pertaining to the theory is limited and results at present, while suggestive, are not conclusive.

Näätänen and Summala (1976) have argued that subjective risk perception (ie. leading towards greater driver caution) can be adjusted by engineering the road environment so as to give the driver the impression that the situation is potentially hazardous. However, Michon (1973) maintains this kind of manipulation would lead to inappropriately high levels of arousal and impaired performance.

Quimby and Watts (1981) observing drivers in the real-life situation found risk taking to be the most highly related to various measures of driving performance including past accident history. It was not clear whether inappropriate speeds were adopted because of failure to recognise potential hazards or because of 'calculated' risks, or a combination of both. However a significant correlation existed between subjects' risk ratings on the drive and their safety index, which suggests the greatest risk-takers tended to consider the danger or risk to be low. Driver behaviour may be changed by suitable training and it is interesting that the 'risky' subjects tended to be the youngest. This again reinforces the work on 18-25 year old target groups for driver improvement schemes.

In much road safety research risk taking is invariably found to be associated with personality and other social factors and the suggestion is made that it is more of a characteristic dependent on other factors than a trait on its own. Central to the Danger Compensation Theory is a 'risk-cost caluculus' in which it is assumed that individuals can monitor the probabilities of very infrequent events (accidents) and then calculate a trade-off between the benefits of risky behaviour and the cost of accidents. The result is a level of 'Tolerated Risk'. While this notion may be feasible in terms of the risk a society is prepared to accept and measures to implement it seems somewhat unrealistic when applied to the ordinary driver.

2.6 Transient States

Transient human states are known to affect a whole range of driving skills such as perception, decision-making, attention, visual search and psychomotor co-ordination. Precipitating states (eg. fatigue, 'life events' stress, alchol intoxication) can place an otherwise 'safe' driver in a high-risk category. As it seems that accident involvement is not a highly stable characteristic of individual drivers (Goldstein 1963) then any condition of a temporary nature leading to impaired human faculties can be viewed as a likely candidate for fruitful research. Here the three best documented transient states of fatigue, stressful life events and alcohol intoxication are examined.

2.6.1 Fatigue

Fatigue has been shown to affect visual contrast sensitivity (Hartman 1963), risk taking and decision making (Brown et al 1970), perception (Brown 1967) and a range of psychomotor skills (Welford 1968, Dureman and Boden 1972). Fatigue has been cited as responsible for between 14 and 24 percent of all single vehicle accidents on rural highways (O'Hanlon 1978), whilst Hulbert(1972) has suggested even 35-50 percent of highway fatalities may be attributed to it.

Näätänen and Summala (1976, 1978) note some of the difficulties in assessing the contribution of fatigue. Fatigue is likely to be implicated in accidents because it increases the probability of sleep but it is only the relationship between sleep and accidents which is clear. The relationship between fatigue and accidents in an awake driver is much less clear because though decrements in measures of performance occur the relevance of these measures to accidents is not proven.

2.6.2 Stressful Life Events

Emotional stress such as anxiety or anger can lead to narrowed attentional bandwidth and neglect of peripheral cues (rigidity, 'blind spots' etc.). A reduced tolerance of ambiguity and uncertainty occurs prevalent in stereotyped habitual responses and premature decision-making.

Studies have shown that fluctuations in personal adjustment - reflected in crisis or stressful life events such as bereavement or divorce - correspond closely to fluctuations in the likelihood of being involved in a traffic accident.

Selzer et al (1968) reported greater social stress in drivers who had caused accidents. In a controlled study Brown and Bohnert (1968) 80 percent of the drivers in fatal accidents but only 18 percent of the controls were reported as being under serious stress involving the interpersonal-marital and vocational-financial areas prior to the accident.

Onset of stress prior to accidents has been revealed in studies by Rahe (1969), Rahe et al (1964) and Finch and Smith (1970). In the latter study 80 percent of 25 drivers killed in vehicle crashes suffered one or more significant stresses within 24 hours of their fatal accident. Only 12 percent of an equal number in a control group had such difficulties.

McMurray (1970) found that, during the year of their divorce, all of his groups of divorced subjects, except male plaintiffs, had significantly higher accident rates than they had had during the previous 7 year period. The 410 drivers experiencing divorce proceedings had an accident involvement twice as high as that of the average driver and an even higher rate during the 6 months before and after the divorce.

The notion that life stresses may be reflected in driving behaviour has led to the suggestion that many highway collisions are not accidents but rather premeditated suicide attempts. Death by automobile conceals the suicide component which, if known, may bring disgrace to self and family and impede the payment of life insurance. Suicide may be due to a deliberate or impulsive, irrevocable decision when accompanied by high speed and common potential sources of collision eg. high density and fast traffic (McGuire 1961, Tabachnick 1966).

Selzer and Payne (1962) found those patients admitting to suicide attempts in a psychaitric sample had twice the amount of accidents as the controls.

Crancer and Quiring (1970) examined 915 persons hospitalised for suicidal gestures compared with the total driving population in the country. They found the suicidal patients had an 81 percent higher accident rate and 146 percent higher violation rate. The violations included drunken driving, reckless driving, driving while suspended and negligent driving.

This last finding especially reinforces what may be obvious - that life events stresses tend to predominate amongst those individuals who are most susceptible generally. The interactions between such factors form clusters of precipitating characteristics which will be dealt with later.

2.6.3 Alcohol

Drew, Colquhoun and Long (1959) established how far performance deteriorated with relatively low blood alchohol concentrations (BACS). Information acquisition and processing is slower and the ability to time-share in a divided-attention task is seriously impaired (Johnston 1978).

One in three persons killed and one in five injured has a BAC equal to or greater than 50 mg/100 ml. These high incidences are not found in the general on-road population as revealed by numerous random sample surveys (eg. Stroh 1974, McLean et al 1970). It is thus a gross over-simplification to assume that the pharmacological effects of alcohol provide a full explanation.

For instance, Borkenstein et al (1964) looked at the type of driver who drives after drinking, finding alcohol three times more prevalent in the crash sample than in the control sample and that high BAC's were over-represented in young age groups, non-whites, the separated and divorced, low social class and problem drinkers.

The role of risk taking in the causation of alchol-related crashes is unresolved as yet. There are two major views. Firstly, that decrements in skilled performance are overshadowed by the disinhibiting effects of alcohol leading to deliberate risk taking. Secondly that the ability to assess risk is lowered. This is supported by the finding that alcohol-related crashes tend to occur on curves (Allen et al 1978).

Yet another view, combining elements of the others, is that an alcoholic risk taking personality exists where alcohol leads to 'deliberate' reckless driving and, obviously, to lowered perception of specific road hazards. These views of Selzer and others will be discussed in the section on interactions between factors.

2.7 Personality Testing

Several attempts have been made to relate safe or unsafe driving to scores on personality inventories but the findings have been inconsistent. This may be partly attributable to sample size and to other methodological limitations as well as to the specific types of measuring instruments used - the tests themselves.

The Minnesota Multiphasic Personality Inventory (MMPI) is a clinically-based test with which researchers have produced conflicting results. While some studies (Conger 1957, McFarland and Moseley 1954, Moffie, Symmes and Milton 1952) have indicated no relationship between MMPI scores and accidents, others (Brown and Berdie 1960, McGuire 1956) have reported significant relationships.

Suhr (1961) used Cattell's 16 Personality Factor (16PF) Questionnaire on a sample of 60 commercial drivers and reported finding discrimination between accident-involved and uninvolved drivers. Bracy's (1970) findings suggest the accident-involved driver is more outgoing and more happy-go-lucky but also more apprehensive and group dependent. Quimby and Watts (1981) found one of the 16 factors to be correlated ($r = + 0,06$) with performance in a real driving test. This was factor Q1 which measures the degree of social conformity to established ideas such that the relatively 'experimental' drivers committed more errors.

The other scales used most frequently are those developed by Eysenck.- Quenault (1967) reported a tendency towards extraversion measured on the Maudsley Personality Inventory (MPI) in drivers convicted of careless driving compared with drivers selected at random. A study by Fine (1963) using 937 male college students found that extraverts as measured on the Eysenck Personality Inventory (EPI) tended to have more traffic violations and accidents, than did introverts. Fine argued that extraverts are less socialised, consequently less bound by males, and therefore likely to have more accidents and violations.

Williams et al (1974) however found no differences between convicted and non-convicted drivers on either the extraversion or neuroticism scales. This may have been due to the small sample size.

Loo (1978) examining the role of primary personality factors in the perception of traffic signs, found driver violations and accidents, and the factors of impulsivity, sensation-seeking and decision time from Eysenck's extraversion dimension in the EPI related significantly. Extraverted subjects also had longer reaction times to embedded traffic signs than introverts and field dependent subjects had longer reaction times likewise. Greater impulsivity seems to be associated with greater field dependence and shorter decision time. Loo concludes that the primary dimensions are more useful in studying risk taking behaviours, accident involvement, traffic violations and sleepiness under driving conditions.

The main criticism of personality testing in traffic accident research has been that the predictors of driving performance ie. accident/no accident, have been too gross and that the personality styles have been too broad. Signori and Bowman (1974) suggest that it may be more fruitful to study the relationship between defined personality styles eg. the impulsive personality and kinds of driving behaviour eg. tendency to tailgating, weaving amongst lanes etc. in which personality may be more directly implicated.

3. THE SOCIAL PERSPECTIVE - driving as social behaviour

The logic of studies here is that driving is a social activity as well as being a rule-following one and that therefore people who violate traffic laws and norms are also apt to be inadequately adjusted to society's norms in other areas. Such studies have revealed this hypothesis to be frequently correct.

Tillman and Hobbs (1949) found that accident repeaters in a sample of 70 male taxi drivers were more likely to have a history of involvement with criminal courts, social service, public health agencies and credit bureaus than accident-free drivers. By contrast "stable individuals whose life is marked by caution, tolerance, foresight and

consideration for others would drive in the same manner". Tillman concluded that the driving hazards and high accident record were simply one manifestation of a method of living demonstrated in their personnel lives and that "a man drives as he lives". This much quoted phrase has been the background of this form of research since the 1950's.

Shaw (1965) initiated her project in 1953, designed to devise methods of selecting low risk bus drivers. More that 500 Black drivers were employed driving 85 passenger buses more than 19 million kilometers a year. The potentially bad accident risk was identified as: extremely unobservant and unadaptable, emotionally unstable and extremist, lacking control, exhibiting uncontrolled aggression, possessing pronounced antisocial attitudes, criminal tendencies, selfish, over-confident, harbours grudges, grievances and resentments, intolerant, inadequate with a driving need to prove himself, chronically indecisive etc. The methodology used here may be questioned for its practicability in selecting bus drivers since the 'bad accident risk' is generally only revealed as such after the event ie bad accident, when it is too late. Nevertheless, Shaw's list of negative characteristics would appear to be relatively easy to identify in any individual given an appropriate test.

3.1 Social Maladjustment

The extension of the social perspective to focus on correlates or antecedents of social maladjustment has proceeded in more recent studies.

Carlson and Klein (1970) found that college students who were academic underachievers, having frequent arrests for traffic and non-traffic violations, also had fathers with a similar history of offences and experiences. Lower levels of job satisfaction were also reported.

Waller (1971) found those culpably involved in shooting accidents highly represented in traffic violations, arrests for assault etc.

Haviland and Wiseman (1974) compared the driving records of 114 jailed criminals with those of the normal population and found that the average criminal driver had an average of 3,25 as many violations and was involved in 19,5 as many fatal accidents as the average non-criminal driver. Major traffic offences seemed related to major crimes and minor traffic offers to minor crimes so that the degrees of deviation from societal norms was similar in different areas.

Signori and Bowman (1974) in a review find involvement of personality in accidents supported by findings from psychopathology and social psychopathy. Psychopaths tend to be unaware of safe speeds, inattentive to hazards, have poor control of hostility and have low tension tolerance. Social psychopaths generally have a history of maladjustment following upbringing in a broken family and a background of childhood aggressiveness or phobias. Their driving record is one of accident repeats related to immaturity and concern only for the immediate future. This form of 'accident proneness' is probably more common than that of the paranoid psychopath first mentioned.

McGuire's (1956) study using the MMPI revealed that compared with the 'safe' driver the accident repeater is less mature, less responsible, more asocial/anti-social; having a disturbed history, unhappy childhood, delinquency, family disruption and uneven work record. He concludes that highway accidents are just another correlate of being emotionally unstable, unhappy, asocial, anti-social, impulsive, under stress and/or a host of similar conditions under different labels.

Mayer and Treat (1977) compared an accident and non-accident group, finding the former poorer in citizenship, more anti-social, having negativistic attitudes, attributing responsibility and control for events to external sources (locus of control) and having a more negative schooling experience (school socialisation). As this was a college sample one may question its applicability to the general driving population.

3.2 Biographical Data

Harano et al (1975) found socio-economic data the most significant predictor of accident involvement. Low socio-economic status was associated with greater likelihood of being in a high accident group. Subjects in this category had inferior education, poor vocabulary scores and high social deviance scores. Unmarried drivers were more accident-involved than married drivers though the addition of divorced or separated did not add to the prediction perhaps surprisingly.

Quimby and Watts (1981) found a similar picture in Great Britain. Drivers in higher socio-economic categories were less involved in accidents. Also drivers of high performance and higher insurance category cars, who tend to be in a higher socio-economic group, tend to be involved in fewer accidents than drivers of low performance cars who are likely to be in a lower socio-economic group.

3.3 Social Attitudes

Harano et al (1975) in their mammoth study showed that accident 'types' had more negative evaluations of parental relationships and stricter parents which generally leads to a negative attitude to law and citizenship. The six most important variables were conviction frequency, socio-economic status, marital status, mileage, age and personality/attitudinal factors.

Low socio-economic scores were associated with emotional instability, impulsivity, irresponsibility, poor parental relations and arrests ie social deviance. Socialisation, social conformity and risk taking seem to be the dominant person-centered factors underlying accident liability.

In a study on the social-role correlates of driving accidents by Clark et al (1979) it emerged that drivers with less respect for the law, less adequacy in taking the role of others (empathy) and more openness to influence from peers encouraging risk taking were more prone to

accidents than drivers lower on these characteristics. This reinforced the view of Clark (1976) that peer groups rather than the driver himself should be the target for change in safety campaigns.

Dissatisfaction with work or life outside it, family disorder plus membership of a drinking peer group all predispose towards accidents.

3.4 Road Attitudes.

The reflection of social maladjustment and social attitudes in accident involvement indicates that driving behaviour is often influenced by moods and motives not necessarily related to getting from one place to another.

Harano et al (1975) found that drivers who used their car as a means of emotional expression were more likely to be involved in the 3 + accident group.

Driving provides us with the opportunity to satisfy needs such as excitement, risk, power and status. It is therefore likely that driving behaviour is influenced by non-transporting motives.

A cross-national road user attitude survey (Van der Nest 1978) sponsored by the International Drivers' Behaviour Research Association and including data from 15 countries revealed that, despite differential accident rates from one country to another, essentially the same attitudes and opinions were expressed. In general most people thought that human error was to blame for accidents but it was nearly always made by the 'other party'.

This last point is somewhat disquieting as it suggests people are not telling the truth or, most probably, actually mistakenly believe their 'diagnosis' of the situation, which must by the laws of probability be manifestly false. This disquiet is supported by psychological research which shows that people's unconscious attitudes towards driving are radically different from their overtly stated concerns and

attitudes. For instance, Black (1966) interviewed a cross-section of drivers from all ages and professions who thought road safety a good thing (in short, all the desirable and socially-acceptable attitudes). However, when interviewed under hypnosis they revealed the opposite desires for riskiness, speed and recklessness.

The findings could relate to the uphill battle which has been fought by society in the forms of legislation, safety campaigns and enforcement against its own members. Many drivers still no doubt strongly believe that 'highway freedom' is an inalienable right to do as they please.

3.5 Culture

Groups are prepared to take greater risks than individual members would take on their own and therefore group values, norms, pressures and sanctions are important for understanding safety behaviour. Clark et al's (1979) study with peer group influences shows how risk taking may be valued by a sub-culture like the young 'macho'. Similarly the macro-culture may value risk taking as a mark of strength, entrepreneurship, or aggression and the level of acceptable risk is reflected in individual behaviour and in a society's laws or standards. However, what is judged as 'acceptable' is unrealistic because of the perception of risk by Mr Citizen. Rigorous standards are set for situations which are imagined to be dramatic ie. nuclear power stations but the standards are low for undramatic events which occur in a random fashion and affect one or two people at a time like road accidents.

Whether the 'Shift-to-risk' principle applies to the road user en masse or whether drivers simply follow the example of others the end result is that, following the driving test, the new driver is exposed to a milieu which promotes incorrect or inadequate behaviour that is subsequently reinforced and established. Such habits become typical factors in accidents. Examples on the freeway such as inadequate headways, 'blocking' the overtaking outside lane and weaving amongst lanes should be the targets for public awareness campaigns.

The motivational component of such actions is described by Wilde (1976). The presence of other drivers in cars, say in rush hour, has an arousing effect possibly leading to frustration and acceptance of smaller gaps between cars and therefore of a higher level of risk. His risk-cost calculus is depicted in fig 3. below.

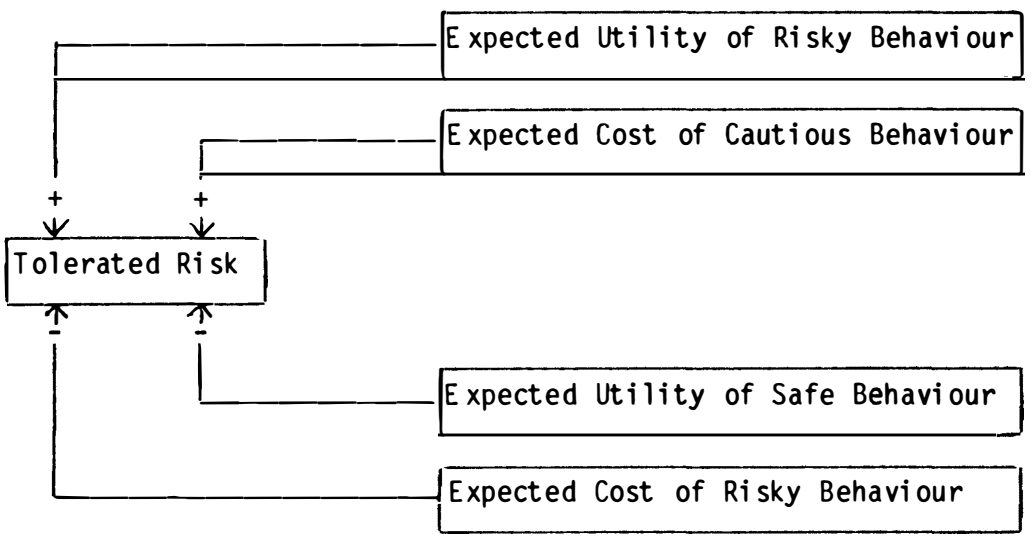

Fig 3. Factors influencing Risk Acceptance (after Wilde 1976)

Wilde has argued that a reduction in risk tolerance may be the only factor which is capable of bringing about a long term reduction in the frequency and severity of accidents, while changes in the other factors, (perceptual, decisional and control skills) can only have a temporary influence on accident rates. More recently Wilde and Murdoch (1982) have extended these temporary influencing measures to safety belts and engineering improvements of roads. They argue for a "social manipulation of tolerated risk" by implementing incentive schemes for accident-free driving etc.

McKenna (1982) in a review has argued that there are many flaws in Wilde's theory, notably that his risk-cost calculus (see Fig 3) assumes that people can and do make a trade-off between personal benefits from risky behaviour and the personal cost of accidents and that individuals monitor the probabilities of infrequent events. These assumptions seem unlikely especially in view of the fact that the majority of motorists regard themselves not only as more skilful but also safer than the average road user (Svenson 1981).

However, safety campaigns, such as that in Great Britain when the legislation on drinking and driving came into force, are unfortunately only of temporary efficacy and no doubt the only long term measure which will be successful is something like Wilde's reduction of risk/accidents tolerated by society.

Sabey and Taylor (1980) find that little progress will be made in the field of accidents and risk until attitudes to risk and understanding the perception of risk by the public are adequately taken into account.

3.6 Society's attitude to road accidents

Road accidents must be seen in their social context and not sui generi as a little interactive complex involving only the driver, car and roadway. Transport in any form is logically a 'Socio-Technical System' groomed by technology for the needs of society. However, in the case of the motor car the driver uses it as an instrument for his own ends - too often to inflict 'social violence'. It is no good blaming the car for the crimes perpetrated by individuals, we know that 80 - 90 percent of accidents are due solely to human error.

Kay (1972) finds the driver's social situation unique. No other situation exists where the ordinary citizen is placed in such a position where he feels so free to express himself without the embarrassment of a social audience and where his actions may have such appalling consequences.

Many people use their cars as toys - to express themselves, to display, act as if they were 'kings of the highway'. But at some point the game on the public highways has to stop and the toy has to became a piece of transportation - as with the railways and the aeroplane.

It is a question of how much effort we wish to devote to this area. Any Martian visiting us and inspecting how little research we expend on the driver might conclude cars were already controlled by automation. Looking at the accident statistics we have no choice. The cost in terms of human suffering, in medical resources and economic losses is enormous.

4. INTERACTIONS

As has been suggested previously in the report, and this must be obvious from the research already cited, many accidents appear to result from a combination of factors. For instance, man has argument with wife, goes to work and finds from his bank manager that he is overdrawn to a large tune. Being an impulsive sort of person he gets thoroughly drunk to forget his woes and crashes on the way home. Here there is an interaction of two transient states (alcohol and stressful life events) and personality.

In a study of patients admitted to hospital after accidents (Van der Nest 1979) a breakdown of factors showed that taken individually or in combination alchohol, life stress and personality were involved in 70 percent of cases.

4.1 Field Dependence and Personality

These two could be termed 'cognitive style' and 'affective style' respectively and perhaps it is not surprising that studies have revealed an interaction between the two. The main focus is on the relationship between field dependence and extraversion. Loo (1978) revealed that Eysenck's second order dimension of extraversion, comprising sociability and impulsivity, showed an association with

poor performance on the EFT. However when only the impulsivity factors of stimulus-seeking and decision-time were used a substantial relationship was found. 'Impulsive' extraverts exhibit risky behaviours, recklessness and tendency to make quick decisions which are inadequately processed.

Shinar et al (1978) found that field dependent subjects have less efficient visual search patterns, slow reaction time to embedded stimuli and thus require more time to process visual information. Thus a field-dependent impulsive-extravert would clearly seem a potential accident risk, having less spare visual processing capacity, yet making quick inadequate decisions.

Other general points which are held in common are the extravert's 'need' for arousing sensation outside of himself in order to maintain optimum arousal level, avoidance of boredom and tendency to sleep, and the field dependent individual's dependence on the environment outside him which reduces his visual search to a rigid style akin to a 'mild form of tunnel vision'. Hazard perception would be poor and the resultant driver behaviour full of risky manoeuvres.

4.2 Transient States and Personality

Williams et al (1973) compared 100 persons guilty of serious traffic offences with 99 controls. They differed in terms of:

a) having more exposure to adverse 'life events' in the prior month,
b) likely to have more minor psychiatric symptoms like anxiety, depression and functional somatic complaints,
c) likely to have impulsive personalities and be lacking in social conscience.

Selzer and Payne (1962) noted that the basic personality of the alcoholic's drinking releases underlying traits which cause accidents.

Smart (1969) finds great similarity between the personality of accident-involved drivers and that of alcoholics, both groups being described as egocentric, hostile and intolerant of tension by various investigators.

Regarding alcohol and personality the findings support the proposition of Signori (1973) that it may be worthwhile to differentiate between the personalities of those who drive and those who do not, after taking alcohol.

It does seem that the transient state of alcohol releases traits in the problem drinker which are mildly psychopathic, resulting in broadly hostile driving behaviour. By contrast the person with depression who has been affected by a 'life event' may drive in a passive dissociated 'totally lost to this world' manner.

5. CONCLUSIONS AND RECOMMENDATIONS FOR RESEARCH

The last sections on interactions are merely some examples from a pool of potential possibilities which perhaps reveal some of the complexities of research. Obviously the whole gamut of this review cannot be made the subject of experimentation but it is hoped to focus on several key areas which hold the most promise.

The main thrust of the approach suggested would be to investigate individual differences which predispose some people to have accidents and others not to - in other words, to identify the population at risk. To this end a program could include Field Dependence, Personality, a 'Biographical' to look at 'life events', socio-economic status, degree of social conformity etc. Additionally measures of Information Processing should be considered such as a Hazard Perception test incorporating road hazards on film to be rated by subjects for their degree of risk.

A central problem is the choice of population to be sampled. In studies such as Harano et al (1975) a 'target' accident group with over-involvement in accidents was compared with an accident-free control group but as we have seen this procedure has in many cases failed to elucidate relationships because of the gross nature of the predictors and failure to examine specific types of accident.

Thus a different approach could examine specific types of accidents such as the tailgating collision from the rear or the loss of control on bends. The categories of accident chosen could be related to the findings quoted in this review. For instance, Olson's (1974) paper suggests that people doing poorly on EFT or RFT measures of field dependence should be over-involved in rear end collisions. Shinar's work suggests that the style of visual search adopted by field dependent drivers leaves them at risk when approaching any hazard and notably in curve negotiation. By comparing field dependent and field independent subjects on a given type of accident these suggestions could be evaluated.

It should be recognised that at present these ideas are in embryonic form. Nevertheless, if any hypothesis was validated ie. that tailgaters are field dependent and cannot anticipate impending hazards from visual cues, then such an identified population could be screened for driver improvement schemes aimed specifically at remedying the deficiencies noted.

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A. Aard van die werk.

1. Is u werk hoofsaaklik herhalend? (d.w.s. doen u elke dag feitlik dieselfde werk?) JA | NEE

* Indien u antwoord op vraag 1 "NEE" is, watter een van die volgende stellings is dan op u werk van toepassing?

2. - Werk is semi-herhalend, d.w.s. aktiwiteite word slegs enkele kere elke maand verrig. JA | NEE

3. - Werk is hoofsaaklik nie-herhalend nie. JA | NEE

* Is u werk

4. administratief van aard? JA | NEE

5. tegnies van aard? JA | NEE

6. Navorsingsgerig/akademies JA | NEE

7. Beklee u toesighoudende funksies? JA | NEE

8. Formuleer u die organisasie se beleid? JA | NEE

9. Watter van die volgende funksies in die organisasie moet u hanteer?

- Administratiewe funksie JA | NEE
- Produksiefunksie (wat o.a. instandhouding insluit) JA | NEE
- Finansiële funksie JA | NEE
- Bemarkingsfunksie JA | NEE