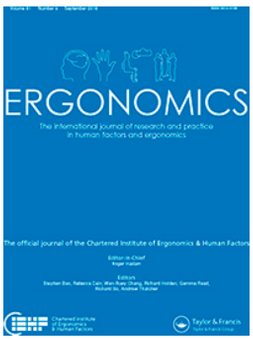

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Risk perception and decision taking during the transition between novice and experienced driver status

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Young drivers are statistically overrepresented in road accidents. Their elevated risk is a complex function of chronological age and driving experience, both of which are associated with acceptance and misperception of risk on the road. A better understanding of the cognitive changes which accompany their transition from novice to experienced driver status should allow us to elucidate the factors underlying their acceptance and misperception of traffic risk. With such an understanding, we would be in a better position to take decisions about improving their safety via training and education schemes rather than via legislative constraints on their exposure to risk.

This paper considers evidence that young drivers underestimate certain traffic hazards and overestimate their own driving abilities. The potential contribution of these misperceptions to their faulty decision taking during skills acquisition is discussed in the light of recent findings from relevant research. Some implications for future research and the development of accident countermeasures are indicated.

1. Introduction

Acceptance and misperception of risky traffic manoeuvres appear to be commonplace among drivers. Harvey *et al.* (1975) listed a wide range of such 'errors' observed on British roads. They also reported significant positive correlations between severity scores for those errors and the incidence of injury accidents recorded on the routes under observation. In addition, Evans and Wasielewski (1982) have shown that risky driver behaviour and accident involvement are associated at the individual level. Sabey and Taylor (1980) have quantified the general contribution of drivers' perceptual and decision errors to British road accidents. Research of this kind thus demonstrates that acceptance and misperception of traffic risks present a relatively serious problem for road safety. However, it provides little insight into the fundamental nature of the problem. If we are to design more effective countermeasures against accidents associated with acceptance and misperception of risk by drivers, we need to investigate the extent to which the problem is a generalized function of ergonomic issues relating to the design and use of the road traffic system and the extent to which it is a more specific function of certain purposes of driving (e.g. the result of commercial pressures) and of the behaviour exhibited by certain categories of driver (e.g. the 'dissociated' individuals identified by Quenault (1967)).

There is accumulating evidence that young drivers contribute substantially to the problem. For example, Jonah (1986) and Mayhew *et al.* (1986) have recently reviewed a range of empirical findings which support the view that young drivers (defined in these studies as those under 20 years of age) are overrepresented in road accidents.

Their risk of involvement in casualty accidents is higher than that of older drivers, even when the quantity and quality of their exposure to such risk is statistically controlled. On a priori grounds, one would expect young people to have a higher probability of misperceiving and misjudging traffic hazards, because of their limited driving experience. One might also expect young people to accept and initiate more risky manoeuvres than older people in driving situations because of the associations reported between youthfulness and sensation-seeking (Zuckerman 1979) and autonomy development (Douvan 1974). Indeed, Jessor (1984) and Lewis (1985) view risky driving by young people simply as one expression of their 'developmental behavioural health syndrome'. Jonah's (1986) review of traffic accident risk among the young supports this expected effect of youthfulness on accident involvement.

It therefore seems reasonable to conclude that young drivers present a special problem in relation to errors of risk perception and decision taking on the road. They are doubly at risk of incurring such errors, because of their youthfulness and relative inexperience, and they have a greater objective risk of involvement in casualty accidents. The precise causal relationships between this type of error proneness and accident involvement are uncertain. Furthermore, the independent and combined contributions of chronological age and driving experience to risk among young drivers are unclear, because these characteristics are usually confounded among the population in question. What is clear is the need for further research on these issues, because of their potential importance in relation to the development of countermeasures aimed at reducing accident risk among young drivers via training and education. This paper will therefore concentrate on the possible determinants of risk perception and decision taking in traffic by young novice drivers, i.e. the processes underlying the assessment, initiation and monitoring of specific manoeuvres (see also, Groeger 1986, Groeger and Brown 1988).

2. Definitions and estimates of risk

The concept of risk is widely used, although loosely stated and imperfectly understood. As Haight (1986) has pointed out, there is even no general agreement on a technical definition of the term. (Indeed, its meaning has varied in the foregoing Introduction between 'probability','hazard' and 'danger'). Any approach to research in this field must, therefore, begin with definitions, if we are to avoid confusion during the communication of ideas (see also Brown 1985).

It may suffice, initially, to define risk as: 'the ratio between some measure of adverse consequences of events and some measure of exposure to conditions under which those consequences are possible'. This definition, in common with that provided by most dictionaries, distinguishes risk from probability by the connotations of 'seriousness' and 'harmfulness' attached to the consequences in question. It distinguishes risk from hazard and danger, because the latter are not ratios but characteristics of objects and events which have the potential to contribute to accidental consequences.

This definition also makes it clear, again as Haight (1986) has pointed out, that: 'risk is a quantity to be estimated rather than deduced'. The validity and reliability with which quantity of risk can be estimated will clearly depend upon the relevance and amount of information contributing to the ratio computation. Traffic authorities with well-developed systems for recording accident and exposure data will claim to estimate risk 'objectively', using purely factual information. Their estimates will

clearly be useful for comparing societal risks between and within transport systems, for monitoring changes in risk which accompany seasonal perturbations in weather and traffic flow, and for assessing the need for and evaluating the effects of modifications to system hardware and software. Estimates of objective risk will, however, be of limited usefulness to the individual road user. They may contribute to strategic decisions, such as choice of transport mode. They may even play a part in certain tactical decisions taken by drivers; for example, about the greater safety of driving to work on a route which minimizes turning across oncoming traffic. However, their effects on drivers' decision taking in the long term appear to be relatively ineffective. For example, Anderson (1978) has shown that factually based traffic safety materials did not reduce drivers' involvement in accidents and offences during the six months after exposure to those materials, even when it was targetted specifically at age and sex subgroups of drivers. This may be because objective estimates, by definition, describe risks associated with past events. Their value to the individual road user for determining present and future actions within the traffic system will therefore be suspect. They may actually negate attempts by individuals to improve their level of road safety: for example, when published 'black spot' statistics simply cause accidents to migrate to another site. They may even operate counter-productively on subjective risk perception, by reinforcing the view that 'accidents happen to other people, not to me; therefore I must be safer and more skillful than most other road users'.

Findings from studies of 'accident migration' (Wright *et al.* 1985) and evidence on the more general behavioural mechanisms described by 'risk homeostasis theory' (Wilde 1982) are consistent with the view that drivers employ objective risk estimates, when they do so at all, simply to identify specific categories of traffic hazards (for example: child pedestrians, drinking and driving, close following in fog). Indeed, it is difficult to envisage any other process by which objective risk estimates could contribute to risk perception. Such estimates are usually expressed in terms of exposure distance or time, or in terms of the size of the population at risk (see Somers and Benjamin 1982, for discussions of risk exposure measures). These denominators provide information of little value for perception of the risk associated with specific driver behaviours in traffic. Information is, of course, available from police reports on the specific behaviours which have contributed to road accidents. However, again, such 'objective' facts serve merely to identify potential hazards rather than to quantify risk, because no general 'exposure' data are collected on the number of times such behaviours are exhibited *without* producing accidental consequences.

If objective risk estimates simply identify hazards for the individual driver, to what extent do they contribute to subjective risk estimates? There is some evidence that their contribution is small. Objective risk estimates are average values, based on summary statistics. As shown by Finn and Bragg (1986), Matthews and Moran (1986), Svenson (1981) and Svenson *et al.* (1985), the majority of drivers tend not to equate their own traffic risk with that of the average person; believing themselves to be more skillful and safer than average. Therefore objective risk estimates will tend to be viewed as somewhat irrelevant by most drivers, when assessing their own behaviour, except as confirmation of their superiority. The questions remain, how do drivers take decisions about initiating or accepting traffic manoeuvres; to what extent, if at all, are their decisions based on subjective estimates of risk; and, if they are, how are such estimates arrived at?

3. The elements of risk perception

3.1. *Determinants of perceived risk*

Michon (1985) has recently provided a critical review of existing models of driver behaviour, identifying those which attempt to include explanations of the cognitive processes which contribute to such behaviour. The most important of these, in the present context, are Näätänen and Summala's (1976) 'zero risk' model, Wilde's (1982) 'risk homeostasis' model, and Fuller's (1984) 'threat avoidance' model. To these has been added van der Molen and Bötticher's (1986) 'hierarchical risk' model. Our paper is much less ambitious than those in scope. It does not attempt to deal with the complete process of decision taking by drivers, at all levels; it simply considers the elements of risk perception which feed into their decision taking in real time about specific manoeuvres. It is, however, consistent with Michon's (1985) conclusion that the way forward with driver behaviour modelling is via representational and computational theories which specify the structures underlying drivers' perception and cognition. An understanding of the structures and processes which determine this level of risk perception seems essential to our understanding of the higher levels of tactical and strategic risk perception and acceptance.

There are clearly two main inputs to the process of risk perception by drivers:

(1) Information on potential hazards in the traffic environment.
(2) Information on the joint abilities of driver and vehicle to prevent that hazardous potential being transformed into actual accidental outcomes.

Risk perception, as considered here, is thus the detection by drivers of any shortfall in their ability to avoid realizing the potential of immediate task and environmental hazards. Safe driving is the monitoring and elimination of this discrepancy. The two inputs to this process of risk perception may be considered separately, although they are frequently confounded in discussion of subjective risk.

3.2. *Hazard perception*

Hazard can be presented by any fixed, stationary or mobile object in the driver's vicinity within the traffic system. It can also be presented by traffic manoeuvres, both those being performed by other road users and those performed by the driver under consideration. How does the driver identify these hazardous objects and events, and quantify their dangerous potential? Clearly this is a learned process, as Benda and Hoyos (1983) have demonstrated; involving the transfer of skills from prior perceptual–motor activities and the acquisition of skills specific to the traffic system. It seems important to understand the changes which occur in the internal representation of traffic hazard during the learning process, if we are to optimize it and thus improve road safety.

The identification of potential hazards must be represented internally in spatio–temporal terms. As drivers become familiar with the traffic system, they learn to associate hazardous objects and events with specific parts of the system. This may partly account for Mourant and Rockwell's (1972) finding that novice drivers have a different visual fixation and scanning pattern from that of experienced drivers. Novices will also learn the dynamic characteristics of vehicles and pedestrians, which allows them to predict the trajectories and nature of hazard presented by moving objects. The 'adaptive control' models of driver behaviour, developed by McRuer *et al.* (1977) and others, and recently reviewed by Reid (1983), throw some light on this

process. Other research on drivers' steering control (McLean and Hoffman 1971) suggests that the higher-order steering cues which drivers learn to use as they gain experience helps to direct their gaze farther ahead, thus increasing the probability that upcoming hazards will be identified early. There is support for this view from research reported by Brown (1982), showing that young novice drivers are relatively poor at identifying distant traffic hazards, although they compare well with older experienced drivers in identifying near hazards.

The internal processes by which traffic hazards are identified thus appear to change in complex ways, as drivers acquire experience on the road. The nature of hazard and its spatial dynamic characteristics will be learned from exposure to 'objective facts' on accident causation and from personal experience of objects and events on the road. But the process by which hazards are searched for and identified will be a joint function of this specific hazard learning and the more general acquisition of traffic and vehicle control skills. This suggests that further research on visual scanning during the acquisition of driving skills may help us better to understand the process by which drivers internalize the identification of traffic hazards.

A potential hazard does not, of course, necessarily represent actual danger for a driver. It may, for example, be an object which is not currently on a collision course, or it may be a manoeuvre by other drivers in a parallel traffic lane. Hazard perception therefore involves not only the identification of hazard, but also some quantification of the potential for danger if existing traffic manoeuvres do not proceed as expected and if the driver takes no avoiding action. Clearly, this too is a process which drivers learn as they acquire knowledge of and experience in traffic. As mentioned earlier, they may acquire information from objective risk estimates on the hazardous potential of certain routes, driving practices, and other road users' presence in the traffic environment. But their assessment of hazardous potential will largely be determined by personal experience of such objects and events. How can we understand the internal representation of this process of hazard evaluation and the way it is acquired?

Can we, in fact, research the evaluation of traffic hazard independently of drivers' assessments of their ability to deal with such hazard? Is it important to do so if the two processes always coexist in practice? There is some evidence that it is, indeed, both possible and important to make this distinction. For example; Brown and Copeman (1975) reported that young male drivers rated a given series of traffic offences as potentially less hazardous when they were notionally responsible for committing them, than when the offences were notionally committed by other drivers. Thus these drivers *were* able to agree on ratings of the hazardous potential of traffic manoeuvres, independently of their own intervention. It was thus possible to quantify separately their undervaluing of traffic hazards, compared with other subgroups of drivers, and their overrating of their own abilities. The obvious importance of the distinction is that it identifies the need for different types of accident countermeasure among young drivers, aimed at improving their self-knowledge, as well as their assessment of danger.

Research reported by Watts and Quimby (1980) indicates another, less direct, but more realistic, approach to the distinction between hazard evaluation and self-assessed ability to cope with hazard. By measuring speed and distance during drivers' approaches to different road features (e.g. bends, bridges, etc.) and then calculating safety margins during those approaches, using known vehicle-stopping character-

istics, it was possible to associate each road feature with a positive or negative safety margin. This effectively indexed the extent to which the drivers had overvalued or undervalued, respectively, the hazardous potential of those features of the road environment. Again, the importance of distinguishing hazard evaluation from self-assessed ability in this way lies in its value for the design of accident countermeasures. Watts and Quimby's findings suggest that we might well devote more effort towards reducing the discrepancy between real and apparent hazard presented by certain road features, rather than attempting to improve the attitudes and skills employed by drivers when negotiating those features.

Further discussion seems necessary on the development of methodology which will allow us to explore the internal representation of hazard and thus develop more effective methods of ensuring that learner drivers internalize appropriate information efficiently.

3.3. *Self-assessment of driving ability*

The need for self-assessment is common to many fields of human activity and psychologists have formalized techniques for recording such assessments. However, it is only in fairly recent years that such techniques have been applied systematically to the study of subjective risk among drivers. Näätänen and Summala (1976) reported some preliminary efforts in this field, but current interest probably developed from the first small study reported by Svenson (1981). This confirmed the impression, reported above from Brown and Copeman (1975), that overrating of their own abilities may contribute to drivers' misperception of risk and thus to accident causation. Using a rating scale technique, Svenson showed that the majority of drivers in his sample regarded themselves as more skillful and less risky than the average driver within the group in which they were tested. In addition, our re-analysis of Svenson's findings showed that his sample of younger drivers (median age 22) overrated their skills and safety more than his older sample (median age 33). Although this effect is statistically significant ($p < 0{\cdot}01$, Kolmogorov Smirnov test), it does not provide conclusive support for an age effect on self-assessments of driving ability because, as Svenson *et al.* (1985) pointed out in a later study, the younger sample was drawn from the USA and the older from Sweden. Cultural differences may therefore have influenced the self-reports obtained from these drivers.

Further evidence suggesting that age may affect self-assessed driving ability is reported by Finn and Bragg (1986). Using a variety of questionnaire and rating techniques, these authors showed that young drivers perceived their own risk of accident to be significantly lower than that of their peers and of older male drivers. The latter perceived their accident risk as comparable with that of their male peers and lower than that of younger male drivers. Unfortunately, this study too does not provide conclusive support for an age effect on self-assessments, because the data were collected as risk estimates which confounded hazard perception and self-assessment.

These variables were assessed separately in a study reported by Matthews and Moran (1986), who obtained ratings of perceived driving ability among subjects in relation to overall ability, vehicle handling skills, driving judgement and driving reflexes. They showed, contrary to the age effect apparent in Svenson's data, that young drivers consistently rated their own abilities as mostly equal to those of older drivers, although better in the case of driving reflexes. Young drivers did, however, rate their own abilities higher than those of their peers, except in the case of driving reflexes. Matthews and Moran point to evidence showing that, contrary to these self-

perceptions, the skills and abilities of younger drivers are actually inferior to those of older drivers. These authors are properly cautious in inferring a causal relationship between road accidents and this observed discrepancy between actual and perceived abilities. However, they acknowledge the importance of self-assessed ability in the perceptual processes underlying drivers' decision taking and they emphasize its importance in future research, particularly in relation to effects of age and driving experience.

The effect of experience on self-assessment of driving ability is brought out clearly in a study reported by Spolander (1982). He showed that novice drivers initially underrated most of their abilities (apart from carefulness and smoothness of driving). With a year's experience they were already rating themselves better than average on traffic manoeuvres, although they considered themselves average in terms of defensive driving. After three-years' experience, they rated themselves better than average in most respects. It may be significant that the high-risk group of male drivers overrated their vehicle control skills more than the group of female drivers.

The present authors (Groeger and Brown, unpublished work) have obtained comparable but slightly different findings on the effects of experience, using a replication and extension of the paradigm reported by Svenson (1981). Three groups of drivers, of average age 25, 40 and 58 were compared. Their driving experience was roughly 5, 17 and 29 years, respectively. There was, as Svenson reported, a general tendency for all age-groups to overrate their safety and driving skills. However, the younger drivers tended to do so *less* than the other groups. They also rated the safety of their driving comparable with the older group. It was the middle age-group that overrated their safety more than the younger. Thus, although these findings reflect the previously recorded tendency for most drivers to overrate their abilities, the extent to which people think they are 'above average' varies with age and experience. Younger and less-experienced drivers tend to provide more variable self reports, whereas older and more experienced drivers' self-reports are more homogeneous.

Whether these and earlier findings on self-reported ability speak specifically to the question of traffic risk perception is open to question. In the present authors' study, overrating of one's attributes was found to be a very general tendency, applying across a range of everyday skills, rather than being specific to driving skills, suggesting that findings in this area may largely have been artifactual, reflecting perhaps a wish to appear in a good light, rather than a genuine attempt to assess one's abilities.

Further doubt is thrown upon laboratory investigations of self-reported driving ability by findings published by Wilson and Wilson (1984). These authors compared drivers' self-ratings of their abilities with ratings produced by two observers whilst they were being driven in traffic by the subject. Where observers' and subjects' ratings differed significantly, the drivers rated themselves *worse* than did the observers. However, as Wilson and Wilson point out, their subjects may, for the purpose of the test, have inhibited certain behaviours which would have reduced, or even reversed, the discrepancy between self-reports and observers' ratings.

Clearly there is a need to clarify these uncertainties in the validity and measurement of self-reported driving ability, if we are to research it independently of hazard perception.

3.4. *Perceiving risk*

How do drivers relate perceived hazards to perceptions of their own coping abilities, in order to perceive risk? There is little research which speaks directly to this issue, because we are dealing with a complex self-paced task performed in a potentially

dangerous dynamic environment. Laboratory studies are thus largely inappropriate for investigation of perceived traffic risk (although perhaps not for hazard perception) and field studies are often difficult to run with the appropriate level of safety and experimental control.

What seems clear is that the quality of information employed in risk perception is poor. The number of potential hazards present in traffic will limit the amount of time which can be devoted to scanning them and evaluating their potential for danger. This is demonstrated by Benda and Hoyos's (1983) finding that drivers associate traffic hazardousness with high information loads. In addition, speeds and direction of motion in traffic are seldom stable. Therefore the potential for hazard is continually changing and drivers' evaluations of hazard must be continually updated, if they are to remain useful in perception of risk. The quality of information on a driver's ability to cope with traffic hazards will also be poor, since it will be based on memory of past events, which are unlikely to be identical with the current traffic situation. It will also reflect subjective impressions of events, which are unlikely to be consistent over time. Novice drivers fare even worse by this analysis, since they are insufficiently experienced to evaluate hazards adequately and inclined to assess their abilities inaccurately.

Given these unreliable inputs to risk perception, it is unlikely that subjective risk is computed from a comparison of predicted motion trajectories in order to identify potential collisions. The following scenarios appear more plausible:

(1) For relatively stable traffic conditions, risk perception could simply be employed to maintain a 'safe space' around one's vehicle, when faced with identifiable hazards. This could be represented and perceived in terms of the appropriate memorized stopping or avoidance characteristics of one's vehicle and one's own abilities.
(2) For unstable traffic conditions, risk perception could involve, in addition to the maintenance of a 'safe space', a variety of comparisons between likely manoeuvres by nearby road users and a repertoire of memorized hazard-avoidance actions, represented in terms of the joint abilities of oneself and one's vehicle.
(3) For the initiation of specific manoeuvres, involving risk *taking* rather than the risk reduction or avoidance implicit in (1) and (2) above, risk perception could comprise a two-stage process: first, a comparison between the spatio–temporal demands of the manoeuvre and the memorized characteristics of relevant performance by oneself and one's vehicle, in order to assess the probability that the manoeuvre might be completed without accident; second, where that probability is less than unity, a comparison of potential accident avoidance demands and the memorized abilities of driver and vehicle to meet those demands. (See Brown 1980, for a more detailed assessment of error-correction probability as a determinant of drivers' subjective risk).

Thus the emphasis in this view of risk perception is on the comparison between representations of spatio–temporal characteristics experienced with traffic hazards and driven vehicles, rather than a computational process which integrates predictions of motion trajectories. It seems possible that drivers develop a repertoire of schemata representing the range of spatio–temporal conditions under which traffic hazards and their own behaviour have been experienced, and that these schemata are fitted to the observed traffic scene in order to perceive, influence, or accept risk, as described above.

This view of risk perception emphasizes the importance of driving experience in the development of schemata which accurately represent the spatio–temporal characteristics of vehicles and road traffic. It brings out the relative importance of schemata representing the joint abilities of driver and vehicle to avoid hazard, since these are the internal representations by which risk is perceived and opportunities for risky manoeuvres declined or accepted. It also acknowledges that the hazardous potential of traffic objects and events can be perceived independently of perceptions of the driver's own abilities. Finally, this view of risk perception emphasizes the importance of the learning process by which schemata are developed, thus identifying the transition from novice to experienced driver as a prime topic for research and application of ideas in this field.

4. Future research and application

Six lines of research can be identified as being in need of development, if the contribution of risk perception to drivers' decision taking is to be further understood and translated into accident countermeasures:

(1) Hazard identification;
(2) Hazard evaluation;
(3) Self-assessment of driving abilities;
(4) Comparisons between internal representations of (2) and (3) which comprise the process of risk perception;
(5) Acquisition of effective risk perception;
(6) Improved teaching of risk perception to learner drivers.

Methods for the study of hazard identification and evaluation are fairly well developed (e.g. see Benda and Hoyos 1983), although further work seems required on techniques which satisfactorily distinguish hazard from risk perception. Hazard evaluation, in particular, requires the development of techniques which can be employed on the road, where traffic manoeuvres, rather than static objects, are a prime source of hazard.

Techniques for studying the self-assessment of driving ability also require further development. The use of questionnaires and rating scales provides an overview of self-assessed abilities and the more detailed information obtained in this way (e.g. see Spolander 1982) throws some light on the factors which contribute to the overrating of ability. However, these laboratory techniques (e.g. see Svenson *et al.* 1981, 1985, Groeger and Brown, unpublished work) may produce findings which are artifacts attributable to the psycho–social dynamics of the experimental situation.

There is some evidence that it may be feasible to study self-assessments of driving ability off the road, under safer and experimentally controlled conditions. For example, Dreyer and Janke (1979) showed that drivers' accident and conviction frequencies were reduced following retraining on a 'driving range'. Since training of this kind cannot have improved drivers' evaluations of real traffic hazards, their less risky behaviour may well have resulted solely from their improved knowledge of their own abilities and limitations. If it proved valid to research drivers' self-assessments offroad, this would clearly be more instructive for our understanding of risk perception and also more ethically acceptable than studies of risky driving in traffic. However, there remains a need and also considerable scope for the development of experimental methods, similar to that reported by Watts and Quimby (1980), by which hazard evaluation and self-assessed ability are investigated indirectly, on the road,

under conditions in which drivers take their own decisions about the initiation and control of traffic manoeuvres.

Because hazard and risk perception have been confounded in many previous studies of subjective risk, there is a need for methodology to explore the process and learning of risk perception. Approaches based on computational models of brain functioning (e.g. see Groeger 1986), which attempt to explore the cognitive structures underlying drivers' risk perception and decision taking, seem promising here. However, there still seems a place for certain earlier techniques (e.g. see Pelz and Krupat 1974) which attempt to measure outputs of the risk perception process, such as 'caution' or 'impulsiveness'. The use of certain other, fairly well-developed, psychological techniques, such as repertory grids, may also identify important factors in the process and acquisition of risk perception in traffic.

Research on methods of improving the teaching of risk perception to novice drivers may obviously have to await the outcome of more fundamental studies, although manipulation of the experiential variable may be considered as a research topic in its own right. We might, for example, pursue certain interesting yet isolated findings such as those reported by Soliday and Allen (1972), suggesting that novice drivers fail to recognize traffic hazards because they tend to concentrate on static objects in the road system.

Some general applications of research findings in this field have already been identified. Teaching risk perception is obviously a major application. However, there are also clear applications to traffic engineering. Equating the real and perceived hazard presented by traffic features seems to have promise for accident prevention. Most promising appear to be methods of increasing perceived risk, where hazard is a product of normal perceptual phenomena, such as adaptation to sustained high speed. Helliar-Symons (1981) and Shinar *et al.* (1980) have shown that such approaches can be quite simple to implement, but effective in reducing accidents.

5. Conclusions

A prime need in research on drivers' decision taking is to distinguish perception of risk from perception of hazard. Essentially, this involves studying drivers' evaluation of hazard independently of their assessments of their own abilities. Only by making this distinction explicit will it be possible to increase our understanding of the risk perception process and hence devise more appropriate remedial measures against acceptance and misperception of traffic risk.

The target group for research in this field should be the learner driver, because of experiential effects on the process of risk perception and because young novice drivers are a high-risk group.

Experimental methods which explore the cognitive structures and processes underlying risk perception appear to represent the most promising way forward in research on this topic.

A greater understanding of the process of risk perception at the level of real-time manoeuvring should have important implications for research and application in the fields of perception, acceptance and control of traffic risk at higher levels.

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Les jeunes conducteurs sont sur-représentés dans les statistiques des accidents de la route. Leur risque élevé est une fonction complexe basée sur l'âge chronologique et l'expérience de la conduite, les deux étant associés avec l'acceptation et la mauvaise perception du risque sur la route. Une meilleure compréhension des modifications cognitives qui accompagnent le passage entre leur statut de conducteur novice vers celui de conducteur expérimenté devrait permettre d'élucider les facteurs qui sont à la base de l'acceptation et de la mauvaise perception des risques. On serait alors mieux armé pour prendre des mesures destinées à améliorer leur sécurité, telles qu'un entraînement plus approprié et un plan de formation à la sécurité, en comparaison avec les contraintes règlementaires.

Dans cet article on montre que les jeunes conducteurs sousestiment les dangers du trafic et sur-estiment leurs propres aptitudes à la conduite. On argumente, à la lumière de résultats récents, la contribution possible de ces perceptions erronées dans leurs décisions fallacieuses lors de l'apprentissage. On fournit des indications pour des recherches futures ainsi que des recommandations pour l'élaboration de mesures de prévention des accidents.

Straßenunfälle junger Fahrer sind statistisch überrepräsentiert. Dieses erhöhte Risiko ergibt sich aus einer komplexen Verknüpfung von chronologischem Alter und Fahrerfahrung und resultiert in Akzeptanz und Fehleinschätzung der Verkehrsrisiken. Eine bessere Kenntnis derjenigen kognitiven Veränderungen, die bei der Entwicklung vom Verkehrsneuling zum erfahrenen Fahrzeugführer maßgeblich sind, könnte die Zusammenhänge aufzeigen, die der Akzeptanz und Fehleinschätzung der Verkehrsrisiken zugrundeliegen. Es wäre dann besser möglich, Vorgaben zur Erhöhung der Verkehrssicherheit zu treffen, die -verglichen mit den verkehrsrisikobezogenen legislativen Maßnahmen- über effektivere Trainings- und Verkehrserziehungsschemata durchgeführt würden.

Die vorliegende Studie untersucht, inwiefern junge Fahrer Verkehrsrisiken unterschätzen und das eigene Fahrkönnen überschätzen. Die Abhängigkeit von Fehleinschätzungen und Fehlentscheidungen im Laufe der Fähigkeitsentwicklung wird anhand von Ergebnissen der jüngeren relevanten Forschung diskutiert. Einige Hinweise werden für zukünftige Untersuchungen und für die Entwicklung von Unfallverhütungsmaßnahmen gegeben.

若年運転者は道路事故統計にその人口割合よりも大きく表れている。彼らの高いリスクは暦年齢と運転経験の複雑な関数で，いずれも路上のリスクの是認と誤認に関係している。初心者から経験者への移行に伴う認知的変化がよく理解できれば，交通リスクの是認と誤認の根拠をなす要因を解明できるはずである。そうすれば，交通事故のリスクに関する法的規制と比較して，より適切な訓練・教育法による安全向上に関して決定を下す立場が良くなる。

本論文は若年運転者がある種の交通危険を過小評価し，自分の運転能力を過大評価すると言う証拠を考察する。技能獲得中の誤った意志決定へのこれら誤認の貢献を関連研究から最近の知見に照らして考察する。将来の研究と事故対策の開発に対するいくつかの意義を示す。