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WHAT A MOTORIST CAN DO TO MINIMIZE THE CHANCES OF BEING INVOLVED IN AN ACCIDENT

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16. Abstract

Traffic accidents result every year in over 50,000 fatalities and 4,000,000 injuries. Past research has identified the causal role of human errors in the majority of such accidents. This report briefly summarizes current knowledge of how human factors contribute to traffic accidents, and outlines preventive measures motorists can take to minimize their chances of being involved in an accident.

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THE SCOPE OF THE PROBLEM

In 1979 approximately 7,330,000 traffic accidents in the U.S. resulted in 4,026,000 injuries and 51,083 fatalities (National Highway Traffic Safety Administration, 1981). In all probability, most of these accidents were caused by human errors. A recent in-depth accident-analysis study found that human errors were definite causes in 71% of a large sample of traffic accidents, and were definite or probable causes in 93% of such accidents. The other causes were classified as environmental (12-34%) and vehicular (4-13%) factors (Treat et al., 1977).

This report deals with two aspects of human factors in accident causation: It briefly summarizes what is known about how human factors contribute to traffic accidents, and indicates measures motorists can take to minimize their chances of being involved in an accident.

The following will be treated in this report as human factors:

1. Suboptimal psychological state due to stress, inattention, sleep-deprivation, or fatique.
2. Alcohol intoxication.
3. Impaired vision.
4. Non-utilization of high-beam headlamps and restraint systems.
5. Absence of defensive driving.
6. Unresponsiveness to unfavorable environmental conditions such as snow, rain, sleet, ice, and fog.
7. Insufficient upkeep of the vehicle, evident in worn-out brakes, tires, or wiper blades, and inoperative lights or signals.

PSYCHOLOGICAL STATE: AROUSAL LEVEL

The accident data suggest that psychological state affects the probability of being involved in an accident. For example, Brown et al. (1968) have shown that 80% of the fatalities in their sample had had one stressful event in the 24-hour period preceding the accident. Similarly, McMurray's data (1970) suggest that people involved in divorce proceedings have double the accident rate of control motorists.

Arousal level (general psychological state) is affected by factors such as attention/motivation, sleep deprivation/fatigue, and stress. Attention/motivation increases the level of arousal, as does stress, while sleep deprivation/fatigue decreases the level of arousal. Generally, the relation between arousal and performance is of the form of an inverted U. While the optimal arousal level varies from task to task, it is usually obtained at intermediate arousal level, and both high and low levels of arousal result in inferior performance. Consequently, a high level of stress would be expected to have a detrimental effect on performance, as the limited available data do suggest (e.g., Berkum, 1964; Weltman and Egstrom, 1971). Similarly, fatigue (resulting in a low level of arousal) affects a range of psychomotor skills, such as reaction time (Singleton, 1953), eye-movement patterns (Kaluger and Smith, 1970), decision-making (Brown, Tickner, and Simmonds, 1970), and simultaneous performance of two tasks (Safford and Rockwell, 1967).

The benefits of caffeine and other stimulants in counteracting some effects of fatigue and sleep deprivation have been demonstrated in the laboratory, but "...on the road the benefits of these drugs still remain

to be determined" (Shinar, 1978, p.43). However, "...the stops to get it [the caffeine in coffee and cola-drinks] and the later stops to get rid of it ... help to break driving fatigue" (Rodgers, 1956, p.92). The safest advice is not to drive when fatigued or sleepy, if at all possible. This usually requires planning ahead, so that one does not realize at 3 a.m. (after eight hours of driving) that the intended destination is still several hours away.

Regarding attention/motivation, the advice is to not get too distracted by other activities, whether external (e.g., a heated debate with passengers), or internal (e.g., daydreaming).

Stress and its negative effect present a more difficult problem to cope with. It would be absurd to recommend that persons involved in divorce proceedings stop driving until their case is settled, which could involve months or even years. Similarly, one cannot stop driving after a stressful event in the family, such as a death or job loss. However, one should avoid driving immediately following a stressful event. This applies not only to situations involving "negative" stress (such as those mentioned above), but also situations involving "positive" stress (e.g., graduation, promotion, and marriage).

ALCOHOL

Alcohol is identified as the most common single factor involved in fatal traffic accidents, contributing to perhaps as much as 50% of the fatalities (Shinar, 1978; Treat et al., 1977). The accident overrepresentation of alcohol-impaired motorists is well documented. For example, in a study of 13,575 drivers, Borkenstein et al. (1964) found that more accident-involved drivers had a blood alcohol content

(BAC) greater than 0.08 percent than did control (accident non-involved) drivers. (While the accident overinvolvement of heavily and intermediately intoxicated drivers is beyond dispute, drivers with low BAC [less than 0.04 percent] were found by Borkenstein et al. to be slightly less likely to be involved in accidents than control drivers.)

With an increase in the BAC, "...more and more driving-related functions are impaired, beginning with visual and perceptual judgment abilities at low alcohol levels, through cognitive decision making capabilities at intermediate levels, and ending with gross motor incoordination at levels of 0.15 or higher" (Shinar, 1978, p.45). The list of specific alcohol-sensitive abilities is a long one; examples include dynamic visual acuity (Brown et al., 1975), size of the functional visual field (Moskowitz and Sharma, 1974), visual scanning (Moskowitz et al, 1976), and tracking performance (Klein and Jex, 1975). Furthermore, there is some evidence that alcohol reduces inhibition and consequently leads to poor control of aggressive tendencies (Waller and Whorton, 1973).

The lesson here is a simple one, though frequently it is not easy to follow: "When you drink, do not drive." Actually, better versions are: "When you will have to drive, do not drink." and "When you will drink, do not drive."

VISION

While it is obvious that a certain level of visual performance is required for successful driving, assessments of the relations of various specific visual skills (e.g., visual acuity) to accident rates do not,

in general, yield a clear picture. Several studies (e.g., Goldstein, 1964; Burg, 1967; Henderson and Burg, 1974) found rather low correlations between accident rates and performance on a variety of visual tasks. These findings do not necessarily imply that the sought relations do not indeed exist in reality. The lack of obtained high correlations could be the result of (1) the instability of driving record over time (e.g., Goldstein, 1963), and/or (2) the possibility that the laboratory-measured visual skills might not reflect the corresponding on-the-road visual skills, because of the effects of transient states such as fatigue, stress, and alcohol intoxication (Sivak, 1981).

Nevertheless, it is probably prudent (though not proven to be effective) to keep one's vision corrected to the optimal level. This is especially applicable to older motorists who are more likely to have poor or marginal vision (Burg, 1966). Furthermore, for older motorists daytime (high-luminance) visual correction to 20/20 does not guarantee good nighttime (low-luminance) visual performance (Sivak, Olson, and Pastalan, 1981); good nighttime visual performance appears to require good visual correction under nighttime conditions (Sivak and Olson, in press). This might lead to two different visual corrections, one optimal for the daytime and one for the nighttime (see e.g., Leibowitz and Owens, 1977).

USE OF HIGH-BEAM HEADLAMPS AND RESTRAINT SYSTEMS

The high-beam headlighting system, standard equipment on all current automobiles, is substantially underutilized. The high-beam

system can provide up to 50% longer visibility distances than the low-beam system (Mortimer and Olson, 1974). It is designed to be used whenever there is no oncoming traffic, no street lighting, and no fog, rain, or snow. Nevertheless, most drivers continue using low beams even under conditions where high beams would provide substantially increased visibility and would not inconvenience other motorists (e.g., Hare and Hemion, 1968).

Another standard safety device that is underutilized is the restraint system; according to a recent estimate, it is used by only about 8.5% of U.S. drivers (Phillips, 1980). Wearing restraint systems will not reduce the likelihood of an accident, and therefore this measure differs from others reviewed in this report. On the other hand, the evidence of the overall effectiveness of restraint systems in preventing and minimizing injury given an accident is widely recognized (e.g., Griffin, 1973), although restraint systems can themselves cause injury (e.g., Sato, 1979).

The solution here is simple and inexpensive: Use the high-beam headlamps whenever possible and prudent, and always use the available restraint system.

DEFENSIVE DRIVING

Defensive driving traditionally involves expecting other motorists to do everything incorrectly, and therefore being on the alert and taking preventive measures in anticipation of the errors. This involves checking the crossroads even on a green light, taking the first available lane in turns, maintaining ample following distance, etc.

These aspects of defensive driving are particularly important when driving after midnight on weekends, when an unusually high percentage of motorists on the road have been drinking alcoholic beverages (e.g., Hauser, Moore, and Homeyer, 1971).

Another aspect of defensive driving involves route selection, especially for repetitive trips such as to work or shopping. If the standard (or shortest) such trip involves a high-risk situation (e.g., performing a left turn across a busy multilane roadway), one should investigate an alternative route that eliminates this potentially dangerous situation. Additional examples of situations to be avoided (if possible) are the following: merging into traffic with limited visibility in one or both directions (as on a hill crest), hilly areas with known slow traffic spots (applicable during icy conditions), and sections of roadway with known poor drainage (applicable during or immediately following heavy rains). Using a limited-access highway whenever possible is another way of avoiding high-risk situations, because such roadways minimize chances of traffic conflicts. Consequently, they have a much lower death rate per mile travelled than any other type of road: The National Safety Council (1980) estimates that the death rate per mile travelled on the U.S. Interstate System is less than one half of the rate on all of the nation's roads.

RESPONSIVENESS TO ENVIRONMENTAL CONDITIONS

In addition to sudden, transient environmental conditions (e.g., a sudden view obstruction) where the motorist is at the mercy of others, there are relatively steady-state environmental conditions (e.g., snow,

rain, icy roads) where proper action on the part of the motorist can minimize the adverse effects of the conditions. The primary such action is a speed reduction. However, in several situations (e.g., where visibility is limited by fog or snow) this speed reduction must not be too drastic; otherwise there is increased likelihood of being struck from behind by another vehicle.

UPKEEP OF THE VEHICLE

A substantial proportion of accidents categorized as resulting from vehicular malfunctions could more appropriately be classified as being due to human errors. Human as opposed to vehicular factors are involved in accidents resulting from, for example, decreased braking power caused by worn-out brakes; decreased directional control caused by worn-out or improperly inflated tires; reduced conspicuity caused by inoperative lights and signals; and reduced visibility caused by the use of worn-out wiper blades in a rain, or by misaimed or dirty headlamps. In general, if proper maintenance would eliminate the "vehicular factor," it is not a vehicular factor in the present context. (Examples of specifically vehicular factors are mechanical failures due to metal fatigue or poor workmanship, and reduced visibility caused by the location of body pillars or rearview mirrors.)

The advice here is to find a reputable mechanic, and to get periodic maintenance of the vehicle. That money is money well spent. Furthermore, some preventive measures, such as a tire-pressure check and cleaning of dirty headlamps, can readily be done by the motorist without the help of a mechanic.

WHAT A MOTORIST CAN DO: A SUMMARY

The primary actions to be taken by motorists to minimize the chances of being involved in an accident are as follows:

1. If going on a long trip, plan ahead. Do not get stuck fatigued far away from the intended destination. If fatigued or sleepy, do not drive.

2. Do not get too distracted by other activities, whether external (e.g., a heated debate with passengers), or internal (e.g., daydreaming).

3. Do not drive immediately following a stressful event.

4. When you will have to drive, do not drink. When you will drink, do not drive.

5. Take care of your daytime and nighttime vision, especially if you are over 50 years of age.

6. Use high-beam headlamps whenever there is no oncoming traffic, street lighting, fog, rain, or snow.

7. Use the available restraint system. After a week's use, it becomes habit. (While use of the restraint system will not reduce the likelihood of an accident, it will reduce the probability of receiving fatal or critical injuries from an accident.)

8. Drive defensively: Be on the lookout for other motorists to err, and anticipate the possible errors. Plan repetitive trips by avoiding high-risk situations. Use limited-access highways whenever possible.

9. Adjust your driving to unfavorable weather conditions.

10. Maintain the vehicle in good repair.

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