

CIRCULAR

Safety of All-Terrain Vehicles

Discussion of Problems
and Needs



THE SAFETY OF ALL-TERRAIN VEHICLES:
DISCUSSION OF PROBLEM AND NEEDS

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THE SAFETY OF ALL-TERRAIN VEHICLES:
A DISCUSSION OF PROBLEM AND NEEDS

This circular is the product of a conference held on August 15, 1985 in Washington, D.C. under the sponsorship of the Motorcycles and Mopeds Committee of the Transportation Research Board. Participating in this conference were: A. James McKnight, National Public Services Research Institute (Chairman); George Brosseau, National Science Foundation; Lewis S. Buchanan, National Highway Traffic Safety Administration; Penny Iobst, Motorcycle Industry Council; Roy Janson, All-Terrain Vehicle Association; Jon McKibben, McKibben Engineering Company; Richard F. Pain, Essex Corporation; Melvin Stahl, Speciality Vehicle Institute of America; Jane Stutts, University of North Carolina; David Taylor, Illinois Department of Transportation; Gary Winn, American Motorcyclist Association; Terry Van Houten, Consumer Products Safety Commission. The contents of this report summarize the information and opinions presented at that meeting.

PROBLEM

All-terrain vehicles (ATVs) are among the fastest growing forms of transportation over the past five years. Sales figures reported by the Speciality Vehicle Institute of America (SVIA) indicate a growth from approximately 250,000 sold in 1982 to about 575,000 sold in 1985.

With the increase in sales and use of ATVs has come a rise in accidents and some expressions of concern over the safety of those who operate the vehicles. This concern appears to be focused primarily upon the small vehicles designed for single-occupant use for recreation and utility. The scope of this circular will be similarly circumscribed. It will now include large vehicles designed to carry more than one passenger and for which "All-Terrain" includes public highways (e.g., "dune buggies" or four-wheel drive automobiles).

Magnitude of Safety Problem

The primary source of public concern over ATV safety is the apparently rapid rise in injuries resulting from their use. Table 1 shows the year to year increase in estimating injuries, fatalities, and estimated vehicles in use.

Table 1. ATV Related Estimated Injuries, Fatalities and Use

Year	Estimated Hospital Emergency Room Treated Injuries	Fatalities	Vehicles in Use
1982	8,600	26	750 thousand
1983	26,900	79	1 million
1984	63,900	136	1.6 million
1985	85,900	174	over 1.6 million ?

Injury and fatality data on All Terrain Vehicles (ATVs) have been provided by the Consumer Product Safety Commission (CPSC), while use data are provided by the Specialty Vehicle Institute of America (SVIA).

These estimates indicate a steady rise in injuries, fatalities, and use. Although exposure data are sparse, the rate at which injuries have risen seems to exceed increases in vehicle use. However, it is important to recognize that the injury reports are estimates based upon a statistically representative yet relatively small sample of hospital emergency room reports furnished under the National Electronic Injury Surveillance System (NEISS). In addition, fatality statistics for the early years may be low due to reporting lags and problems in correctly identifying accidents as ATV-related.

Expressions of concern for the number of ATV injuries do not necessarily imply that the vehicles present any greater hazard than other vehicles. Unfortunately, we simply do not know enough about the extent and conditions of ATV use to compare ATV accidents with those for other vehicles. Without such information there is no way of knowing whether ATVs present a greater risk than other forms of recreational utility transportation, such as motorcycle riding, snowmobiling, bicycle riding or skiing. Justification for studying the safety of ATVs lies simply in the fact that a substantial number of injuries are occurring and the hope that the number of injuries can be reduced through better understanding of the vehicle and the way it is operated.

Nature of ATV Accidents

Because ATV accidents occur primarily off of the public highways, there is no uniform system for reporting their occurrence. Law enforcement agencies are not routinely required to report ATV accidents in most jurisdictions. For this reason, information concerning the nature of accidents is sparse.

To gain more information, CPSC conducted a hazard analysis study in the early 1980's involving approximately 300 telephone interviews with consumers who were involved in some type of incident with ATVs. From the telephone interviews, approximately 110 indepth interviews were conducted. Although a complete hazard analysis based on the interviews has not been completed at this time, a preliminary look at information from the study indicates that the most frequent injuries were to limbs. However, the most serious injuries involved head, neck, and internal injuries in that order.

A primary factor in many of the ATV accidents appears to be misuse of the vehicles. The following are five major forms of vehicle misuses:

Passengers--The ATVs studied were single passenger vehicles. They are not designed to carry passengers and lack footrests and handholds for passengers. Carrying passengers changes the weight distribution of the vehicle from that designed and inhibits the ability of the operator to shift position on the vehicle for control and stability. Most of the injuries involved youngsters transporting one another. The next most common problem was adults carrying children.

Excessive Speed--Speed that is excessive for the terrain being negotiated, and the skill of the driver, is a frequent factor in accidents. The desire for speed may be a natural consequence of using vehicles for sport rather than transportation. The problem is one of learning the limits of the vehicle.

Improper Surface--ATVs are designed primarily for off-road use. For good traction, and for other reasons, they are provided with solid axles rather than differentials. Operating over a paved surface complicates handling because both rear wheels drive continuously.

Excessive Terrain--There are limits to the degree of up-, down-, and side-slope that ATVs can handle without capsizing. These limits are often not apparent to untrained or inexperienced riders.

Inadequate Sight Distance--The terrain over which ATVs operate is not landscaped to provide the sight distances that characterize highway travel. Therefore, ATVs often approach one another concealed by hills, trees, and tall grass. Also, engine noise may drown out auditory cues of approaching vehicles. Sometimes, operators don't see one another until it is too late to avoid a collision. Another sight-limiting factor is surface vegetation which covers up rocks, logs, furrows, and such.

There is evidence that alcohol plays a role in many accidents involving adolescents and adults. In view of the extent to which alcohol is involved in serious injuries, and fatalities to operators of other types of vehicles, it would not be surprising if alcohol were a factor in ATV accidents as well. However, the actual extent of alcohol involvement in ATV accidents is as yet undetermined.

NEEDS

The discussion of ATV needs can be conveniently divided into the traditional safety categories: engineering, education, and enforcement.

Engineering

Engineering countermeasures are concerned with making ATVs inherently safer. Because of the interactive relation between vehicle and rider, this necessarily involves human factors issues as well. Engineering characteristics include: stability, seating, speed limiters, steering, and occupant protection. The design of ATVs has had many years to mature in terms of both performance and safety. The extent to which ATVs can be made inherently safer without compromising their all-terrain performance is an unresolved question.

Stability

One contributor to injury is rollover accidents occurring when the vehicle is turned too sharply in relation to its speed. These rollovers have led to concern that ATVs may be "unstable".

Certainly the ability to capsize when turned sharply at a high speed can be a characteristic of three-wheel vehicles, as well as four-wheel vehicles with a narrow front wheel base. However, it is also characteristic of two-wheel vehicles and can happen to any vehicle that is improperly operated. As yet, there is no evidence that ATVs are particularly unstable if operated in the manner in which they were designed to be operated.

ATVs like any other vehicle, could be rendered more stable by lowering the center of gravity and/or increasing the wheel base or track. However, to do so might compromise the ability of the vehicle to handle the kinds of terrain for which it is intended.

Drive Train

With the lack of a differential, the inside wheel of an ATV tends to drag across the surface during a tight turn. This can lead to handling difficulties on pavement. While the problem can be minimized by operating at appropriate speeds and transferring body weight to the outside wheel, the addition of a differential has been proposed. However, a differential would degrade stability and performance on the rough and low friction surfaces that make up the general domain of ATVs.

Seating

Since many injuries result from carrying passengers, it has been suggested that the passenger carrying ability of ATVs be limited by reducing the size of the seat. However, the ability to traverse a variety of terrains demands that the operator be able to shift weight backwards and forwards on the seat, and therefore necessitates an elongated seat.

Occupant protection

Because of the relatively high incidence of rollover accidents, the use of rollbars has been suggested. However, such a feature would only protect riders if they remained on the vehicle and inside the roll cage, further requiring the use of safety belts or other restraints. Whether use of restraints would actually protect riders in ATV accidents is debatable. Moreover, by restricting body movement, these restraints would greatly decrease the operator's ability to handle and stabilize the vehicle, and ride it in the way that it is designed.

Speed Limiters

Many ATV accidents can be attributed directly or indirectly to speed that is excessive for circumstances. This has led to suggestion that speed be limited by means of an engine governor, throttle stop, or exhaust insert. However, most such devices are easily defeated. Moreover, while reducing top speed, they would also reduce power and hence stability when it would be needed to handle difficult terrain features.

Steering

During a turn, an operator's weight may unintentionally be thrown against the handlebars in such a way as to increase the rate of turn and the danger of capsizing. A steering wheel has been suggested as a way of overcoming this problem. However, the handlebars, in addition to serving as a steering device and a convenient place to put controls, also give the operators something to hold onto to keep from falling off the vehicle. Handlebar controls are also better suited to the force/displacement requirements of controlling a vehicle with a front fork. The steering wheel is not nearly so well suited for this purpose, particularly in rough terrain.

Summary

Some of the engineering changes that have been suggested might succeed in reducing the hazard of all-terrain vehicles, but they would involve some sacrifice of the ability of the vehicle to handle "all-terrain". Engineering changes that overcome ATV accidents by

reducing the ability of the vehicle to handle a variety of terrain might be expected to reduce its utility and performance as a means of transport.

Education

If ATVs are not hazardous when operated properly, then education aimed at enabling and encouraging proper operation of the vehicles offers a potential avenue to improve ATV safety. This view gains some support from experience in competitive events where well-trained operators show an injury rate that is no higher than that experienced in competition involving two-wheel vehicles.

Education would encompass such topics as safe handling techniques, speed, braking, terrain reading, weight distribution, passengers and cargo, equipment requirements, protective gear, and alcohol and drugs. Educational efforts can be divided into two broad categories: public information and instruction.

Public Information

A variety of public information materials have been developed for distribution to the ATV riding public. Material has been prepared by individual ATV manufacturers and through the Speciality Vehicle Institute of America (SVIA), for example.

While there is an abundance of public information material, means of assuring that it reaches ATV operators could be improved. The primary delivery mechanism at the present time is ATV and Motorcycle dealers, who distribute materials at point-of-sale to actual as well as prospective buyers (many of whom currently own ATVs). More information concerning hazards and countermeasures might be prepared to assess parents in providing adequate supervision.

Delivery mechanisms include owners manuals, promotional literature, magazines, news media, and warning labels on the vehicle. While the safe operation of many vehicles is fostered through driver license manuals and tests intended to assure that operators are suitably informed, these means of delivering information cannot be applied to ATV operators, except in a few jurisdictions, who need not be licensed for off-road operation. However, if driver licensing or vehicle registration/titling is required for ATV owners, another avenue for dissemination of information is provided.

Instruction

A number of efforts have been made to develop instructional programs for ATV operators. The most ambitious of these is that launched by the SVIA, which has not only developed courses but trained instructors in teaching the courses. As yet, the number of

ATV operators who have completed instruction represents a small fraction of the total number of people operating ATVs. One reason for the small enrollment may be a lack of a clearly observable need--the vehicle appears easy to operate and its hazards are not obvious. Another may be the lack of any official requirement for instruction comparable to the requirement for automobile instruction applied to high school age youth in many states. A final reason may be the lack of any state subsidy for ATV instruction such as that which is provided for other vehicles through license and registration fees.

While no states require operator's licenses for off-road operation of ATVs, some states have instituted the practice of requiring all those who would operate ATVs on state property to complete an approved training program. A sizeable enough segment of the ATV riding population operating on public lands might lead to fairly widespread enrollment in training. The requirement for certification is, at the present time, not very widespread.

Enforcement

As one of three safety disciplines, "enforcement" includes both enactment and enforcement of regulations regarding the way vehicles are used (regulations concerning how they are made can be considered an aspect of engineering). Any regulations covering use of ATVs would generally be limited to their operation on public lands.

Generally speaking, ATV regulations are somewhat sparse, at least in comparison with regulations covering on-road operation of motor vehicles. A few regulations are aimed at avoiding obvious hazards, such as the use of spark arresters where there is a danger of fire. However, most of the regulations regarding vehicle use are quite general, e.g., "will operate in a safe manner". The relative lack of regulation can, in some measure, be attributed to a desire not to restrict operation unnecessarily, particularly on private property, coupled with absence of information as to what are truly necessary and effective restrictions.

Underlying the lack of operator regulations is a lack of specific information as to the hazards of ATV use. Regulations applied to on-road vehicles (motor vehicle codes) have evolved over decades of experience and accident information. Similar information could be developed to lead to establishment of regulations to assure the safety of both ATV operators and the environment. Such regulation might cover (1) operation under the influence of alcohol or other drugs; (2) maximum speeds relative to terrain, sight distance, and surface conditions; (3) types of terrain, surface conditions, and weather conditions under which ATVs may and may not be operated; (4) prohibition of specific hazardous maneuvers; (5) vehicle size limitations in relation to the operating environment and operator characteristics (skill, height, weight, age); (6) use of protective equipment and clothing; (7) installation and use of equipment to prevent accidents, fire, and excessive noises; and (8)

vehicle registration and financial responsibility.

The effectiveness of regulations is only as good as their enforcement. It would appear that, at present, few jurisdictions devote anywhere near the same effort to enforcement of regulations covering off-road vehicles as they do in enforcing their motor vehicle code. This is due, in part, to the relative sizes of the vehicle and driver populations. Generally speaking, it appears that enforcement of ATV regulations:

- o Is assigned to individuals with a variety of other responsibilities rather than to enforcement specialists.
- o Is not subject to a formal system apprehension and adjudication.
- o Does not involve routine documentation such as warnings or citations.
- o Does not involve the maintenance of records on individual operators or vehicles.
- o Lacks a well-defined system of sanctions against those violating regulations.

It is probably more difficult to maintain surveillance of ATV operation over the large areas that define off-road public lands than it is over public streets and highways. However, the lack of organized enforcement may also reflect the lack of any perceived problem. Yet, with the rise in the use of motorized vehicles off road, and an apparent rise in accidents involving their use, there may now be a need for a more formal uniform system of enforcing regulations.

Information Needed

Underlying needs for engineering, education, and enforcement is the need for more information about almost all aspects of ATV safety. The need includes information concerning:

- o Use data (Vehicle and operator exposure)
- o Accidents to operators
- o Countermeasures effectiveness

ATV Use Data

Very little information is available concerning the nature and extent of ATV use. The Consumer Product Safety Commission is currently undertaking some surveys of exposure. Such information is critical in ascertaining the conditions that lead to ATV accidents.

Exposure statistics will help determine whether there is a danger in how ATVs are used and whether ATVs themselves are dangerous (vehicle vs. use).

The exposure data could be used in turn to target countermeasure efforts. Generally speaking, countermeasure efforts have the greatest prospects of success where they focus upon characteristics of operators, vehicles, or environment that are involved in accidents to a greater degree than can be attributed to exposure alone. "Overinvolvement", if observed, suggests that the characteristics in question is contributing to accidents and, hence, becomes a reasonable target for countermeasures. For example, youth represent a fruitful target for automobile accident counter-measures because their involvement in automobile accidents exceeds their exposure. While ATVs are operated by very young age groups, the involvement of age-related factors in ATVs cannot be estimated until the differential exposure of riders in different age groups has been determined. An exposure study is the single most useful first step for any ATV countermeasure program.

Accident Reporting

There appears to be no uniform mechanism for reporting ATV accidents. Certainly, there is nothing equivalent to the accident reporting required by all 50 states for highway vehicles. This lack could be overcome by regulations requiring the completion of accident reports of ATVs involved in accidents on public lands in which there is an injury or property damage exceeding some specified minimum. Even so, some accidents meeting the specified criteria will not be reported particularly with alcohol involvement. If such a requirement were instituted, the usefulness of the data would be constrained by the problems inherent in any self-reporting system. Involving land managers and county sheriffs in the reporting process might improve the under-reporting problem. However, requiring the reporting and description of ATV accidents could furnish a wealth of information that might be used to target engineering, education, and enforcement efforts.

Effectiveness

The effect of any countermeasures hinges upon reliable baseline data and careful follow up studies. Because of the difficulties with adequate accident data (non-uniformity, incompleteness) and no exposure data to date, countermeasure evaluation must wait.

CONCLUSIONS AND RECOMMENDATIONS

Based upon the information presented at the Conference, the following conclusions can be offered:

1. There has been a marked increase in the use of ATVs and in injuries associated with their use.
2. The lack of a uniform system for reporting ATV accidents has resulted in a lack of reliable, comprehensive information concerning the nature of ATV accidents, their users and factors contributing to them.
3. Available information indicates that the overwhelming majority of ATV injuries result from vehicle misuse, that is, from failure to operate vehicles in the manner for which they were designed, and within their operational limitations.
4. Some ATV operators are unfamiliar with the vehicle's operating limits, hazards of operation, and safe operating procedures.
5. At present, there is no way of knowing how effective or pervasive are the systems available for informing or educating ATV users concerning safe operation.
6. Vehicle and operator regulations are sparse for ATVs compared to other types of motor vehicles.

It is recommended that:

1. Manufacturers of ATVs continue to examine the design of their vehicles with an eye to making them more forgiving of operator error without compromising their ability to handle a variety of terrains.
2. State and local jurisdictions establish procedures to require detailed reporting of ATV injuries occurring on public lands.
3. States and localities enact and enforce regulations to prevent hazardous ATV operation.
4. The federal government continues to investigate the nature and magnitude of ATV use, identify factors contributing to ATV accidents, and develop and evaluate countermeasures designed to reduce the incidence and severity of ATV injuries.

EPILOGUE: REGULATORY SUMMARY 1986-1989

In 1986, the PSC ATV task force reported its general findings to the full Commission. Subsequent to this report, the CPSC filed suit against the major manufacturers of ATVs. After a period of negotiations, two consent decrees were signed by the CPSC and the ATV manufacturers. The balance of this discussion concerns the provisions of those decrees.

Two consent decrees were established, one for the foreign manufacturers and one for the major domestic ATV manufacturer. The only difference between the documents concerns the ATV training programs where the domestic manufacturer used a different training program because of a different marketing approach.

There are essentially six major elements in each decree. They concern 1) Labels, 2) Owners Manuals, 3) Point of Purchase Materials, 4) An ATV hotline, 5) Media and Marketing Materials, and 6) Training.

New labels are being required to provide warning messages in four areas; 1) General hazards, 2) Age recommendations, 3) A message warning against passengers, and 4) Tire inflation instructions.

The General Hazard label concerns 8 items: driver only (no passengers), the need for ATV rider training, no driving on paved surfaces, no driving on public roads, the need for protective equipment such as helmets, boots, eye protection, etc., the avoidance of alcohol and/or drug consumption, avoidance of excessive speeds, and the avoidance of stunt riding.

Age recommendation labels use 12 and 16 years of age as break points. Children age 12-15 years can use ATVs with an engine displacement of up to 90 cubic centimeters and those ATVs with an engine displacement in excess of 90 cc's are recommended for children 16 years and older. The remaining two labels are self explanatory.

Each of the four labels must conform to specific requirements. In each decree there is specific wording which the manufacturers must follow. The format of the labels must follow the American National Standard Institute (ANSI) Z535 which has requirements for color, signal words, etc. Placement requirements for each of the labels are intended to put the most important warning messages within easy viewing of the driver. There are durability requirements which follow the Environmental Protection Agency requirements. Finally, each label had to be tested for its potential effectiveness on the user population.

The second major element of the decrees concerned the ATV owners manuals. Each such manual must now contain 26 specific warnings with specifications for format, color scheme, wording, and the need for illustrations pertaining to certain hazards. Manuals

must now also contain definitions of the signal words "Warning", "Caution", and "Note" so that consumers can determine the relative importance of the different messages. For those ATVs specifically made for children, there are specific message requirements to parents regarding safety warnings, supervision, and training. There are also requirements concerning proper operating procedures for turns, operation on hills, etc. Finally, the CPSC has the responsibility to review the manuals for conformance to the decrees.

The third element of the decrees concerns point-of-purchase materials which includes posters, hang tags, safety video tapes, and ATV safety alerts. In each of these areas there are specifications for content. Again, CPSC has the responsibility for review of these materials for conformance to the decrees. The decrees also required the establishment of ATV hotlines to respond to consumers general questions about ATV safety.

There are also general guidelines for media and marketing materials such as magazine advertisements and television commercials. In general these must emphasize the need for training and the age recommendations as appropriate. The initial group of advertisements subsequent to the consent decrees had to be tested for public effectiveness.

Finally, in each decree there are extensive provisions for training. Each manufacturer must establish a nationwide training program with a proper administrative structure. The requirements in the consent decrees differ from each other since the largest domestic ATV manufacturer designs its products for adult use only and is relying on its dealers to provide the necessary training. The foreign manufacturers are using a trade association to provide the training in this country. In each case, the appropriate consent decree contains a specific course outline and requires the use of incentives to increase consumer participation. Each of the training programs must be coordinated with state laws where appropriate.

One other immediate effect of the consent decrees was the prohibition of sale of three wheel ATVs. Manufacturers would repurchase existing inventory at the dealer level.

The consent decrees recognized that future work needed to be completed before an ATV standard could be finalized. An interim standard is currently in the American National Standards Institute review process. This standard includes provisions for standardized controls and the placement of these controls, certain stability requirements, and provisions for footguards. The industry and the CPSC continue to work on the more difficult problem of lateral stability. It is estimated that this work will continue thru 1990.