TAB F

UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
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Memorandum

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SUBJECT : Analysis of ATV-Related Fatality Data for CPSC Petition CP 02-4/HP 02-1

Background

An all-terrain vehicle (ATV) is a three- or four-wheeled motorized vehicle with low-pressure tires, a seat that is straddled by the user and motorcycle type handlebars. ATVs are intended for off-road use on non-paved terrain.

In 1988, the U.S. Consumer Product Safety Commission (CPSC) entered into agreements with the distributors of ATVs to communicate age recommendations for ATVs in a number of ways, to stop the distribution of three-wheeled ATVs completely, to label four-wheel ATVs in specific ways, and to provide training to consumers on the safe operation of their new vehicles. These agreements were known as the "consent decrees." The distributors agreed to represent affirmatively that only ATVs with engine sizes between 70 and 90 ccs (inclusive) should be used by the 12- to 15-year-old age group, and ATVs larger than 90 ccs should be used by consumers aged 16 and older. The distributors agreed to use "their best efforts" to see that ATVs would not be purchased by or for the use of people not meeting those age recommendations (U.S. District Court, 1988). The consent decrees expired in April 1998. Some manufacturers have agreed to continue to observe some parts of the consent decrees on a voluntary basis. The Consumer Federation of America, along with other groups, in 2002 petitioned CPSC to take several specific actions regarding ATVs. CPSC's Office of the General Counsel docketed the part of the request that asked the Commission to ban the sale of ATVs with adult-sized engines for use by children under 16 as CPSC Petition CP 02-4/HP 02-1.

Tab E of this briefing package contains the 2002 Annual Report on ATV-Related Deaths and Injuries, which details the number of deaths and injuries associated with ATVs before, during and after the consent decree period. This memorandum gives further statistics needed for consideration of parts of the petitioners' request. These statistics are based on a subset of known fatalities of children under 16 that occurred while the children were riding ATVs.

Methodology

CPSC compiles reports of deaths associated with ATVs in two major databases. Death certificates that are purchased from the states are compiled in CPSC's Death Certificate database (DTHS), while reports from most other sources (news clips, reports from consumers, attorneys, medical examiners, etc.) are catalogued in the Injury or Potential Injury Incident database (IPII). A few fatal incidents are also gleaned from the National Electronic Injury Surveillance System. CPSC's field staff investigates most fatal ATV incidents reported to the Commission from any source. Data from the reports and the investigations are then compiled in CPSC's In Depth Investigation file (INDP) and the ATV database (ATVD), which includes a variety of coded information specific to ATVs, including engine size, driver characteristics, terrain, etc. Duplicate cases existing in both DTHS and IPII are eliminated from ATVD annually. CPSC has been collecting data on fatal ATV incidents since the early 1980s.

As of December 31, 2002, CPSC was aware of 1,706 fatalities of children under 16 years old that occurred between 1982 and 2002 inclusive (Ingle 2003), representing 33 percent of all ATV deaths. As of that time, reported fatalities of children under 16 since January 1999 alone numbered 434 (Ingle, 2003). CPSC staff chose to review and analyze fatalities for the most recent substantially complete years, 1999 and 2000. As of the end of 2002, data collection for 1999 was complete, and collection for 2000 was 75 percent complete. We have no reason to believe that the deaths of children under 16 that are not yet reported for 2000 differ in characteristics from the deaths already reported. (For more details on the 2002 database, see the 2002 Annual Report on ATV-Related Deaths and Injuries, included at Tab E of this package.)

Staff searched the 2002 ATV fatality database and INDP in June 2003 for cases that occurred in 1999 or 2000 in which children under 16 died. Two-hundred eight cases were identified. This differs from the 216 noted in the 2002 Annual Report on ATV Deaths and Injuries for a variety of reasons:

• The annual report used all reports of and investigations into fatalities available to CPSC as of Dec. 31, 2002. This analysis uses data on deaths reported by Dec. 31, 2002 and includes information from completed or terminated investigations available as of June 2003 in order to utilize the most recent data.

• During the review of investigation reports for this analysis, a very few miscodings were identified among the group of cases that may have been counted in the annual report figures (for example, one adult coded as a child was identified). Staff corrected these during the review of fatalities for this analysis. The next annual report will reflect these minor database changes.

• One case included in the annual report figures was eliminated from this analysis due to the possible influence of the medical history of the decedent on the outcome of the incident. This case was included in the annual report figures because the ATV incident was a major factor in the death. We deleted it from this analysis because we couldn't conclusively determine that the victim would have died had the ATV incident been the *only* factor in his death.

Of the 208 cases identified, we also excluded from this analysis 17 cases in which the ATV was a confirmed three-wheeler, as well as seven cases in which the decedent was the driver of another type of vehicle or in which the ridership status (e.g. driver, passenger, etc.) of the decedent could not be determined. The resulting pool of cases included 184 fatalities. Three CPSC staff members reviewed

each of the 184 cases and coded information such as hazard pattern, helmet usage, whether an adult was present, and other variables of interest. Statistical analysis software was used to analyze the resulting data set.

The 184 cases included here represent a minimum count of deaths of children under 16 during 1999 and 2000. As mentioned above, CPSC's ongoing collection of death data for the year 2000 was about 75 percent complete at the time the cases were reviewed (1999 was complete). In addition, there may be a small number of fatal ATV incidents that are never reported to CPSC. As a result, conclusions can be drawn only about the 184 incidents. Likewise, the 184 cases do not constitute a probability sample of all ATV-related deaths of children under 16, and cannot be used to produce estimates or make projections about the wider ATV-riding population. They do, however, provide a reasonable and useful two-year snapshot of the population of ATV child fatalities.

Results

Age and Gender

Of the 184 cases included in the analysis, 39 percent of the victims were under 12 years old at the time of their death and 61 percent were between 12 and 15 years old. In every age category, victims were mostly males, accounting for 81 percent of the total. Table 1 gives the distribution of age and gender of the 184 fatalities.

Table 1: Child Deaths Associated with Four-wheel ATVs, 1999-2000
Distribution of Age and Gender of Decedents

Age of Decedent	Male Decedents	Female Decedents	Total
0 to 4 years	5	2	7
5 to 7 years	14	7	21
8 to 11 years	32	11	43
12 to 15 years	98	15	113
Total	149	35	184

Source: U.S. Consumer Product Safety Commission Directorate for Epidemiology, 2003.

The 184 fatalities considered were not all to drivers of ATVs. (An analysis of the ridership status of the decedents is given later in this report.) Some children who died were riding as passengers on ATVs driven by other children or adults who survived. While Table 1 gave an analysis of *decedents*, Table 2 gives the distribution of age and gender of *drivers* in incidents involving child fatalities. Only drivers of ATVs on which the deceased was riding are included (i.e., if another ATV was involved in addition to the child's ATV and no one riding on the second ATV died, the driver of the second ATV is not included here).

Among the drivers, 90 percent were under 16 years old and 30 percent were under 12 years old. Eighty-four percent were males. Nearly 60 percent of the fatalities involved a driver in the 12- to 15-year-old age group. One driver was four years old.

Table 2: Child Deaths Associated with Four-wheel ATVs, 1999-2000
Distribution of Age and Gender of Drivers

Age of Driver	Male Drivers	Female Drivers	Unknown	Total
0 to 4 years	1	0	0	1
5 to 7 years	12	2	0	14
8 to 11 years	32	6	2	40
12 to 15 years	95	14	0	109
16 to 22 years	6	1	0	7
23 to 29 years	1	1	0	2
30 to 39 years	2	2	0	4
40 years and older	2	0	0	2
Unknown age	4	1	0	5
Total	155	27	2	184

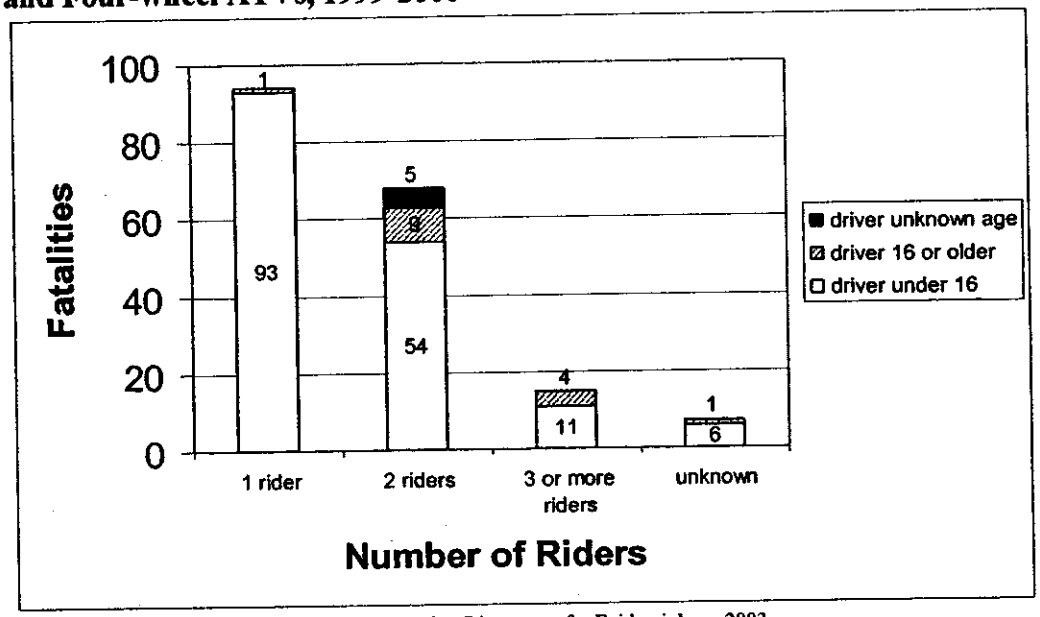
Source: U.S. Consumer Product Safety Commission Directorate for Epidemiology, 2003.

Ridership

One hundred thirty-nine (76 percent) of the deceased victims were driving an ATV at the time of the incident. The remaining 45 (24 percent) were passengers on an ATV. (This analysis included only drivers and passengers, not bystanders or occupants of other vehicles.)

Most new ATVs are sold with a label warning against passengers riding on the ATV. Even among the incidents where the deceased child was driving the ATV, many of the involved ATVs were carrying more than one person. Figure 1 below shows the number of riders (including drivers) involved in the 184 incidents. Although two-seater ATVs are now on the market, this analysis only uses data related to single-rider ATVs.

Figure 1: Number of Riders in Incidents Involving Child Fatalities and Four-wheel ATVs, 1999-2000



Source: U.S. Consumer Product Safety Commission Directorate for Epidemiology, 2003.

Staff confirmed multiple riders in 45 percent of the 184 fatal incidents. Figure 1 and Table 2 also show that children under 16 were killed more often on ATVs being driven by children under 16 (themselves or others) than on ATVs on which the drivers were over 16.

One atypical case was difficult to classify in regard to number of riders and the ridership status of the decedent. The 3-year-old male victim and his father were riding a four-wheel ATV. The victim was sitting on the seat with his father. The father stopped the ATV and got off in order to speak with a neighbor, leaving the victim on the seat and the ATV running. The victim touched the throttle of the ATV, accelerating the vehicle across the street and into an embankment. The father chased after the vehicle, but was unsuccessful in reaching it. The ATV flipped over, and the victim was thrown from it. He sustained fatal head injuries and expired 24 hours later. In this case, the driver's age was over 16, the deceased was classified as a passenger, and there was only one person on the ATV at the time of the incident. This case is represented in Figure 1 by the one case in the left column in which the driver was over 16.

Hazard Pattern

Staff identified six distinct hazard patterns in the group of fatal ATV incidents, as well as several sub-patterns. They are presented in Table 3 on the next page.

In many cases hazard pattern was difficult to determine because of the interplay of many different events such as overturning, ejection, collision, etc. For instance, cases in which the ATV hit another vehicle, the victim was ejected, and the ATV overturned (in various sequences) are not unusual. In such cases if the collision happened first, the incident was classified as a collision in Table 3. However, a better picture of these types of incidents is given by a chronological listing of the multiple events involved in the fatality. Such listings for each of the 184 cases are given at the end of this report in Appendix A.

The 74 incidents classified as overturnings in Table 3 are not the only cases in which the ATV overturned. In some other cases, the precipitating event was determined to be something other than overturning, even though in the course of the incident, the ATV may have overturned. For example, ATVs overturned in 40 percent of the incidents classified as collisions, 38 percent of the incidents classified as ATVs hitting stationary objects, and 54 percent of the cases classified as thrown, fell or jumped off. Of all 184 incidents in this analysis, 122 (66 percent) involved an ATV overturning.

Because there has been concern over the number of riders on an ATV influencing the number of overturnings, staff examined the relationship between the two factors. When all overturnings are considered (whether or not overturning was the hazard pattern), 71 percent of those ATVs with one rider overturned, and 63 percent of those with multiple riders overturned. When only overturning as hazard pattern is considered, overturnings occurred in 47 percent of the cases involving one rider per ATV, and in 30 percent of the cases with two or more riders.

The collision category in Table 3 includes any incident in which the ATV collided with another vehicle in motion, including instances in which two ATVs collided. Note that cases in which an ATV

hit an object not in motion are not included in the collision category but rather in the "hit stationary object" category.

Table 3: Child Deaths Associated with Four-wheel ATVs, 1999-2000
Distribution of Hazard Patterns

Hazard Pattern*	Fatalities	Percent of Total
Overturned	74	40%
Flipped forward	*7*	*4*
Flipped backward	*15*	*8*
Rolled sideward	*6*	*3*
Overturned, unknown direction	*46*	*25*
Hit stationary object	40	22
Collision	35	19
ATV hit other vehicle	*5*	*3*
Other vehicle hit ATV	*17*	*9*
Other or unspecified collision	*13*	*7*
Thrown, fell or jumped off	28	15
Thrown off	*21*	*11*
Fell off	*6*	*3*
Thrown, fell or jumped (unknown which)	*1*	*1*
Extreme change in terrain	4	2
Contact with handlebar	1	1
Unknown	2	1
Total	184	100%

Source: U.S. Consumer Product Safety Commission Directorate for Epidemiology, 2003.
* Determined by precipitating event. See Appendix for chronological summaries of multiple events occurring during incidents.

Hazard patterns are of particular interest when analyzed by age group. For instance, deaths in the under-12 age group were more likely to involve an overturning (as hazard pattern) than deaths in the 12- to 15-year-old age group. In 55 percent of the deaths reviewed in the under-12 age group, staff determined that overturning was the precipitating event, while 31 percent of the deaths in the 12-and-over groups fell into that category. Deaths in the 12- to 15-year-old age group were more likely to involve the hitting of a stationary object than those in the under-12 group. Table 4 gives the percentage of each age group classified by hazard pattern.

Table 4: Percentage of Child Deaths Associated with Four-wheel ATVs, 1999-2000
Distribution of Hazard Pattern by Age Group of Decedent

Hazard Pattern	[redacted]	Percent 0-11 years old	[redacted]	Percent 12-15 years old	[redacted]	Percent Total
Overturned		55%		31%		40%
Hit stationary object		14		27		22
Collision		17		20		19
Thrown, fell or jumped off		11		18		15
Extreme change in terrain		3		2		2
Contact with handlebar		0		1		1
Unknown		0		2		1
Total		100%		100%*		100%

Source: U.S. Consumer Product Safety Commission Directorate for Epidemiology, 2003.
* Some totals do not sum to 100 percent due to rounding.

Many factors may have contributed to fatal incidents, including the number of riders on the ATV at the time of the incident, loss of control of the vehicle, terrain, and size of the vehicle. In an effort to determine to what degree loss of control affected the fatal incidents, staff attempted to classify incidents according to whether a loss of control occurred. Such classification was problematic and relied heavily on police investigators' and medical examiners' reports of the incidents. If law enforcement or medical examiners used the phrase "loss of control" in their reports, the incident was coded as a loss-of-control incident. If not, CPSC staff made a judgment call. In some of these cases (e.g., very young children on very large machines), it was difficult to determine if the driver ever had control in the first place. In 86 of the 184 fatal incidents (47 percent), staff determined that the driver of the ATV lost control. In 84 cases (46 percent), staff determined that the driver did not lose control, and in 14 incidents (8 percent), staff could not determine whether or not the driver lost control.

As an aid to understanding the different hazard patterns, typical case scenarios are presented below for each of the four main hazard patterns identified among the 184 cases.

Overturning

A 7-year-old female was riding as a passenger on an ATV with a 250 cc engine driven by her mother's boyfriend. She was of average size for a seven-year-old and had ridden on four-wheel ATVs before without incident. The victim's mother was present. The victim was not wearing a helmet. The 38-year-old driver attempted to go up a slope, but the ATV stalled and flipped backwards. The victim and the driver were ejected, and the ATV struck the victim as it rolled back down the slope. She died of blunt force trauma to the chest. The driver survived. *(Case 4528)*

Hit Stationary Object

An 11-year-old boy was riding singly on his father's ATV with a 300 cc engine in a field owned by a neighbor. The boy's father and the neighbor both told the boy to go home and put on a helmet. Several minutes later, the boy was traveling downhill on a nearby farm road, going into a turn, when he lost control and hit a roadside tree. He died from a massive skull fracture. *(Case 4772)*

Collision

A 34-year-old father was driving his ATV (engine size unknown) on a dirt road with his 10-year-old son riding as a passenger. The father allowed his son to steer the ATV, warning him to watch out for trucks. A semi-truck going 25 miles per hour and pulling a tanker trailer came around a corner on the dirt road. The truck driver applied his brakes, but could not stop in time. The father grabbed the handlebars, but the ATV struck the left side of the trailer near the rear wheels. The 10-year-old victim was thrown off the ATV and under the trailer, which ran over him. The father stayed on the ATV and survived. The boy died from multiple blunt trauma. *(Case 6158)*

Thrown, Fell or Jumped Off

A 13-year-old male was driving a four-wheel ATV with a 335 cc engine on a power line right-of-way with two teenage male passengers. They had been taking turns driving the driver's four-week-old ATV. While going 10 to 15 miles per hour, the driver hit a rut and lost control of the ATV. The two passengers yelled for the driver to turn, and he responded that he couldn't. All three riders were ejected. As the driver was thrown from the vehicle, his neck struck a guy wire bracing a power pole on the right-of-way. The impact broke his neck and he died. The two passengers were injured but survived. *(Case 4843)*

Engine Size

The petition before the Commission specifically addresses the use of ATVs with adult-sized engines by children under 16. The current voluntary agreements with the distributors stipulate ATVs with engine sizes between 70 and 90 ccs should be used by children between 12 and 15.

ATVs with child-sized engines (that is, those ATVs with engine sizes of 90 cc or less) have not been specifically excluded from this analysis, though only nine were identified in the fatalities. It should be noted that such small-engine ATVs may not have been in widespread use by children during 1999 and 2000; they were beginning to enter the market after having been absent for several years (Leland 2004). According to CPSC's 2001 Exposure and Injury Studies, only seven percent of the ATVs in use in 2001 were ATVs with engine sizes of 90 ccs or less (Levenson, 2003a). The small numbers of these ATVs in use as well as the small numbers of deaths involving ATVs with engine sizes known to be in the child range make comparable risk analyses among engine sizes problematic.

Table 5 shows the numbers of child deaths with a breakdown of victim age and the engine size of the involved ATV. Of those fatalities where engine size was known, 93 percent (118 of 127) occurred

while children under 16 were riding ATVs with adult-sized engines. The shaded area in the table represents those deaths.

Table 5: Child Deaths Associated with Four-wheel ATVs, 1999-2000
Distribution of Age of Decedent and Engine Size

	Age of Decedent				
Engine size	**0-4 years**	**5-7 years**	**8-11 years**	**12-15 years**	**Total**
50 cc or less	1	0	0	0	1
60 to 90 cc	1	5	1	1	8
110 to 250 cc					
275 to 400 cc					
425 to 600 cc					
Unknown	1	4	12	40	57
Total	7	21	43	113	184

Source: U.S. Consumer Product Safety Commission Directorate for Epidemiology, 2003.
Shaded area represents deaths that occurred while a child under 16 was riding an ATV with an adult-sized engine.

Table 6 below shows the numbers of deaths by engine size and driver age. The shaded areas in both Table 5 and Table 6 represent deaths that occurred while a child under 16 was using an ATV with an adult-sized engine.

Table 6: Child Deaths Associated with Four-wheel ATVs, 1999-2000
Distribution of Driver Age and Engine Size

	Age of Driver				
Engine size	**0-11 years**	**12-15 years**	**16 and up**	**Unknown**	**Total**
50 cc or less	1	0	0	0	1
60 to 90 cc	7	1	0	0	8
110 to 250 cc			2	1	50
275 to 400 cc			7	0	56
425 to 600 cc			0	1	12
Unknown	12	36	6	3	57
Total	55	109	15	5	184

Source: U.S. Consumer Product Safety Commission Directorate for Epidemiology, 2003.
Shaded area represents deaths that occurred while a child under 16 was driving an adult-sized ATV.

Of those fatalities where engine size and driver age are known, 86 percent (107 of 125) occurred while an under-16 child was driving an ATV with an adult-sized engine.

Terrain

Table 7 gives the distribution of types of terrain traveled by the victims who died in the 184 incidents. Roads – either paved or unpaved – accounted for nearly half the incidents. The "other" category includes desert, shallow water, a golf course, powerline right-of-ways, an unpaved parking lot, dirt mounds at an industrial facility, a frozen lake, a ditch, a logging trail and several other unspecified trails.

Table 7: Child Deaths Associated with Four-wheel ATVs, 1999-2000
Distribution of Type of Terrain

Type of Terrain	Number of Fatalities	Percent of Fatalities
Paved road (public or private)	46	25%
Non-paved road (public or private)	45	24
Field, pasture, farmland, ranchland	45	24
Yard or lawn	13	7
Forest, woods	8	4
Off-highway vehicle park or special ATV track	6	3
Other	16	9
Unknown	5	3
Total	184	100%*

Source: U.S. Consumer Product Safety Commission Directorate for Epidemiology, 2003.
* Total does not sum to 100 percent due to rounding.

Head Injuries and Helmet Usage

State laws on helmet usage vary in content and the degree to which they are enforced. In 2001, only four states had helmet laws affecting ATV riders (SVIA, 2001). Table 8 below gives a distribution of head injuries and helmet usage among those who died. Individual cases were coded as head-injury cases if the head injury the victim experienced was significant, though not necessarily the cause of death.

Table 8: Child Deaths Associated with Four-wheel ATVs, 1999-2000
Distribution of Helmet Usage and Head Injuries

	Head Injury	No Head Injury	Unknown Head Injury	Total
Helmet	19	13	2	34
No Helmet	92	29	11	132
Unknown Helmet Usage	6	8	4	18
Total	117	50	17	184

Source: U.S. Consumer Product Safety Commission Directorate for Epidemiology, 2003.

Of the 184 fatalities reviewed, 18 percent were wearing helmets at the time of the incident; 72 percent of the victims were not wearing helmets. In ten percent of the cases, helmet usage was unknown.

Staff also identified 117 head injuries among the fatalities, accounting for 64 percent of the total. Of those victims who suffered head injuries, 79 percent were not wearing helmets.

Presence and Permission of Adult

Staff reviewed each case to determine whether an adult or parent of the victim was present at the time of the incident. Adult presence was defined as the proximity of a person aged 18 or older who was able to see the ATV involved. If an adult was nearby but could not see the ATV, then that adult was not deemed to be "present". In 121 of the 184 cases (66 percent), no adult was present. In 32 cases (17 percent), an adult was present, and in 19 of those (10 percent of the 184 total), the present adult was a parent or guardian of the victim. In 31 cases (17 percent), adult presence was unknown.

Staff also attempted to determine whether the victim had parental permission to be on the ATV at the time of the incident. A distinction was made between permission for the specific time frame in which the incident occurred and a broader permission for riding ATVs in general. Only the more specific variety of permission was coded. Permission was more difficult to determine than adult presence, as it is not often noted on law enforcement or medical examiners' reports. In 112 cases (61 percent of the 184 total), permission could not be determined. In 63 cases (34 percent), the victim had the permission of an adult to be on the ATV; in 42 of the 63 (23 percent of the 184 total), the permission came from a parent or guardian. Only nine cases were determined to involve a specified lack of permission from an adult.

Alcohol or Drug Involvement

Cases were classified as including alcohol or drug usage if alcohol or legal or illegal drugs may have been ingested by the driver prior to the incident, whether or not the driver was legally impaired. Alcohol and drug usage are often cited as possible contributing factors in adult ATV deaths. Analysis of the 184 child fatalities revealed that alcohol and drug usage reportedly played very little part in these incidents. Three of the 184 incidents reviewed reported alcohol usage by the driver. Two of these drivers were under 16 years old, and one was over 16. Five cases involved illicit or legal drug usage by the driver; four were under 16, and one was over 16.

Discussion

Children under 16 years old accounted for 26 percent of ATV-related fatalities in 1999 and 2000 (Ingle, 2003), and 22 percent of all riding hours in 2001 (Levenson, 2003a). Children's share of the fatalities suggests that children are at least as vulnerable to the hazards of ATV riding as adults.

The distribution of the 184 deaths reviewed for this report differs from the distribution of riding hours in the under-16 population of ATV riders. Data from recent injury and exposure studies show that in 2001, 51 percent of the riding hours of children under 16 were spent by the 12- to 15-year-old age group. (Levenson, 2003a) However, 61 percent of the deaths reviewed for this analysis occurred to children in the same age group (Table 1). The high incidence of risk-taking behavior among teenagers may be responsible for part of the difference (Johnson, 2003). Because exposure and fatality figures are from different years, a decrease in the percentage of riding hours attributable to the 12-15 age group between 1999 and 2001 might also contribute to the difference, though CPSC has no data on such a decrease, if one exists. The high percentage of males (81 percent) among the under-16 deaths is not surprising. Males accounted for 79 percent of the ATV riding hours in 2001 (Levenson, 2003a).

CPSC has long recommended against the carrying of passengers on ATVs, and yet 24 percent of the deceased children were riding as passengers, and 45 percent of the fatalities occurred in multiple-rider situations (Figure 1). Certainly, if CPSC's recommendations had been followed, the deaths of at least the 45 child passengers would not have occurred.

In the cases reviewed, children under 16 were killed more often on ATVs being driven by children under 16 (themselves or others) than on ATVs driven by adults (Table 2). The numbers of deaths on adult-sized ATVs does not appear to be the result of adults driving with child passengers, but rather it is largely the result of children driving adult-sized ATVs or riding as passengers on ATVs driven by other children. Few of the child fatalities occurred on ATVs driven by adults.

Overturning was the most common hazard pattern in the child fatalities reviewed, accounting for 40 percent of the fatalities (Table 3). The low percentage (30 percent) of multiple-rider incidents classified as overturnings compared to the percentage (47 percent) of single-rider incidents classified in the same way suggests that multiple riders did not substantially increase the likelihood of overturning. However, it is conceivable that the presence of multiple riders on an ATV could impair a driver in terms of attention and the "rider-active" mobility needed to maintain control of the vehicle. While not necessarily leading to overturning, such impairment may lead to other hazard patterns, and so the percentage of multiple-rider incidents classified as overturnings may be understated. Deaths in the under-12 age group were more likely to involve an overturning (as hazard pattern) than deaths of children between 12 and 15 (page 6).

The other major hazard patterns identified included hitting a stationary object (22 percent); collisions (19 percent) and being thrown from, falling from or jumping off the ATV (15 percent) (Table 3).

Ninety-three percent of the fatalities reviewed for which engine size is known occurred on the type of ATVs the petitioners seek to ban for children (Table 5). If the definition of child use of an ATV is restricted to driving only, the figure drops only slightly, to 86 percent (Table 6).

Roads (both paved and unpaved together) constitute the most common terrain for child ATV deaths, comprising 49 percent of those reviewed. Paved roads accounted for 25 percent of the fatalities. In CPSC's 1997 ATV exposure study, 26 percent of drivers said they frequently or sometimes drove on paved roads (CPSC 1998), so the percentage of child fatalities there is not disproportionate.

Among the deaths reviewed, 72 percent of the victims were not wearing helmets (Table 8).

In summary:

- 93% of the child fatalities reviewed occurred on ATVs with adult-sized engines. CPSC and the major ATV distributors agree that these ATVs should not be sold for the use of children.

- 72% of child fatalities reviewed involved children who were not wearing helmets. CPSC recommends and the major distributors agree that ATV riders wear helmets.

- 45% of the child fatalities reviewed involved multiple riders. CPSC recommends and the major distributors agree that ATV drivers should not carry passengers.

• 25% of child fatalities reviewed occurred on paved roads. CPSC recommends and the major distributors agree that ATVs should not be ridden on pavement.

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Appendix A

Four-Wheel ATV Child Fatalities
1999-2000

Case Listing

The case listing in this appendix makes use of the following codes in the hazard pattern column:

00 or 0 = unknown
10 = overturned
11 = flipped forward
12 = flipped backward
13 = rolled sideward
15 = vehicle encountered extreme change in terrain
20 = tipped
30 = collision
31 = collision with another vehicle (ATV hit another vehicle)
32 = collision with another vehicle (other vehicle hit ATV)
33 = hit stationary object
34 = collision with person
35 = collision with animal
40 = thrown, fell or jumped off ATV
41 = thrown off
42 = fell off
43 = jumped off
50 = contact with the ATV itself
51 = entrapment
52 = contact with handlebar
53 = contact with wheel
54 = contact with peg
55 = contact with hot surface
60 = contact with surroundings
80 = other operation
90 = non-operating
91 = repairing ATV
92 = transporting ATV

Rec No.	Hazard Pattern	Age	Sex	Incident summary	Number of riders	Helmet	Loss of control	Reason for loss of control	Ridership of victim
4391	12	2	F	child put hand on throttle, up embankment, overturned	2	Y	Y	child put hand on throttle	Passenger
4409	33	3	M	hit embankment, overturned, thrown	1	N	N		Passenger
4923	10	3	M	hit rut, overturned onto victim	2	N	U		Passenger
4967	10	4	M	hit tracks in field, overturned, ejected	2	N	N		Passenger
4977	13	4	M	overturned onto victim, little else known	1	Y	U		Driver
5141	10	4	M	going up 46% grade, overturned, ejected	2	N	N		Passenger
5463	32	4	F	hit by flat bed truck, pinned	3	N	U		Passenger
4523	33	5	F	went off road, hit tree	2	N	N		Passenger
4796	11	5	M	hit shallow wash, flipped forward, ejected	1	Y	Y	drove into shallow wash	Driver
5169	33	5	M	child pushed throttle, ATV hit tree, overturned	2	N	Y	child pushed throttle	Passenger
4413	41	6	M	hit steps, house, ejected, overturned	2	N	Y	intended to back up, went forward instead	Driver
4521	33	6	M	drove over road, into tree, no attempt to stop	2	N	N		Driver
4534	12	6	M	flipped over on steep hill	3	N	N		Driver
4755	12	6	M	stalled, restarted, throttle, flipped backward	4	N	N		Passenger
5165	10	6	M	ATV overturned, little else known	2	U	U		Driver
5185	13	6	F	lost control, overturned, thrown	2	N	Y	speed on turn, hill	Passenger
6168	11	6	M	over 1 ft bump, airborne, ejected, overturned onto driver	1	Y	Y	airborne	Driver
4528	12	7	F	on steep slope, flipped backward, ejected	2	N	Y	terrain (steep slope)	Passenger
4570	30	7	M	head-on collision with car	2	Y	N		Passenger
4744	10	7	M	up embankment, overturned, landed on victim	1	U	N		Driver
4785	31	7	M	hit car at intersection, ejected, overturned	1	N	N		Driver
4787	33	7	F	going down steep embankment, tire hit object, overturned	2	N	Y	terrain (steep slope)	Passenger
4804	15	7	F	drove off 10 ft embankment, overturned	2	N	N		Driver
4880	30	7	F	collision with other ATV, ejected	1	N	N		Driver
4944	13	7	M	turning, overturned to side, thrown	1	N	Y	unknown	Driver
5068	42	7	M	fell off, trapped under ATV, little else known	2	U	U		Passenger
5175	10	7	F	up levee, overturned onto 2 riders	2	U	N		Passenger
5790	10	7	M	coming downhill, overturned, pinned	1	N	U		Driver
4415	10	8	M	lost control, overturned onto victim	1	N	N		Driver
4536	32	8	M	struck by truck, ejected	1	N	N		Driver
4563	41	8	M	jumping 10-inch rise, lost control, ejected	2	N	Y	jumping	Passenger
4722	33	8	M	lost control, hit fence	2	N	Y	unknown	Driver

Rec No.	Hazard Pattern	Age	Sex	Incident summary	Number of riders	Helmet	Loss of control	Reason for loss of control	Ridership of victim
4900	13	8	M	driving in circle, overturned onto victim	1	N	U		Driver
5461	13	8	M	uphill, rolled back down, overturned	1	N	N		Driver
5782	41	8	M	driver and passenger ejected, little else known	2	N	Y	unknown	Passenger
4416	10	9	M	rolled over creek embankment into creek, pinned	2	N	N		Driver
4546	10	9	M	rode over hill, lost control, overturned onto victim	1	N	Y	unknown, possibly airborne	Driver
4575	41	9	M	lost control in turn, left road, thrown into tree	1	N	Y	speed, curve	Driver
4704	12	9	M	in ditch, flipped backward, pinned	1	Y	N		Driver
4761	10	9	F	child passenger pressed throttle during sharp turn, overturn	2	N	Y	child passenger pressed throttle	Passenger
4766	10	9	M	climbing out of ditch, overturned, ejected, pinned	2	N	N		Driver
4885	12	9	M	up steep embankment, flipped backward, ejected	3	N	N		Passenger
4898	41	9	M	lost control on rough roadd, ejected, overturned, struck tree	1	Y	Y	rough terrain	Driver
4979	10	9	F	lost control, overturned, struck embankment and tree, ejecte	1	N	Y	unknown	Driver
5046	10	9	F	lost control, overturned onto victim	2	U	Y	unknown	Passenger
5090	10	9	M	lost control, overturned onto victim	1	N	Y		Driver
5174	10	9	F	overturned while attempting to U-turn	2	N	Y	uturn on hill	Passenger
5197	32	9	F	hit by truck,overturned, ejected	3	N	N		Passenger
5335	10	9	M	overturned onto victim, little else known	1	N	N		Driver
5536	30	9	M	hit another ATV, rolled	1	N	Y	collision with ATV	Driver
5638	32	9	M	broadsided by auto, passenger ejected into windshield	2	Y	N		Passenger
5705	10	9	F	turned sharply, overturned, thrown	1	N	Y	turned too sharply	Driver
4429	10	10	M	on steep slope, overturned onto victim	1	Y	Y	terrain (steep slope)	Driver
4743	30	10	M	head on collision with car, ejected	2	N	N		Driver
4893	10	10	F	overturned into ditch, onto driver	1	U	N		Driver
4912	12	10	F	up steep hill, flipped backward, pinned	3	N	N		Driver
4933	10	10	F	overturned into creek, pinned, drowned	2	U	Y		Passenger
5022	33	10	M	hit low tree branch, overturned	1	N	Y	hit branch	Driver
5300	10	10	M	mistakenly in reverse, overturned off of hill	2	N	N		Driver
5303	33	10	F	hit pole, then fence	1	N	N		Driver
5697	42	10	M	hit hole, fell off back, run over	2	N	N		Passenger
6157	10	10	M	into ditch, flipped, landed on driver	2	N	U		Driver
6158	30	10	M	collision with semi-truck, ejected, run over	2	N	N		Driver
4390	10	11	F	making sharp downhill turn, overturned, ejected	5	N	N		Passenger

Rec No.	Hazard Pattern	Age	Sex	Incident summary	Number of riders	Helmet	Loss of control	Reason for loss of control	Ridership of victim
4532	31	11	M	attempting to cross street, hit side of car	2	N	N		Passenger
4772	33	11	M	going downhill into turn, hit tree	1	N	Y	downhill, turning	Driver
4848	41	11	M	stalled, moved, ejected, hit victim in head	1	Y	N		Driver
4878	10	11	M	overturned onto victim	2	N	Y	speed on turn	Driver
5018	33	11	M	failed to negotiate curve, hit fence, ejected	2	N	Y	speed	Driver
5430	32	11	M	hit by car while turning onto road	1	N	N		Driver
5471	15	11	M	unintentionally hit throttle, drove off cliff	2	N	Y	unintentionally pressed throttle while getting	Driver
4549	33	12	M	downhill into curve, hit 2 trees, ejected, overturned	2	Y	Y	speed, curve	Driver
4597	0	12	M	unknown	1	N	Y	unknown	Driver
4760	41	12	F	in reverse when started, accelerated backward, ejected into	2	N	N		Driver
4777	13	12	M	tipped sideways, ejected, overturned	1	Y	N		Driver
4780	41	12	M	lost control, up small embankment, ejected, overturned	1	N	Y	distracted, drinking soft drink	Driver
4791	33	12	M	hit rut, lost control, hit tree, ejected	1	Y	Y	hit rut	Driver
4934	11	12	F	flipped forward, ejected	1	N	N		Driver
4987	11	12	F	flipped forward, ejected	2	N	N		Passenger
5191	10	12	M	wouldn't start, rolled downhill, overturned	2	N	Y	down hill, no motor, no brakes	Driver
5744	10	12	F	crossing ditch, overturned	1	N	Y	terrain (ditch)	Driver
6153	31	12	M	struck other ATV from behind, airborne, ejected, overturned	1	N	N		Driver
4412	41	13	M	skid plate hit jump, ejected, overturned	1	N	N		Driver
4426	10	13	M	lost traction on muddy incline, overturned, thrown	3	N	N		Passenger
4562	33	13	M	failed to negotiate turn, hit tree, ejected	1	U	Y	curve	Driver
4601	10	13	M	on curve, overturned, ejected	1	N	Y	terrain (curve)	Driver
4703	31	13	M	hit rear of other ATV, overturned	1	Y	N		Driver
4727	30	13	M	entering road, ran stop sign, hit by car, ejected	2	Y	N		Driver
4728	10	13	M	hit log or drove over it, overturned into ditch	1	U	N		Driver
4757	10	13	M	downhill, skidded, overturned, ejected	1	Y	N		Driver
4758	12	13	F	climbing embankment, flipped backward	2	N	N		Passenger
4807	33	13	M	down hill, airborne, struck fence, tree, ejected	2	N	Y	terrain (steep hill) and turn	Driver
4843	41	13	M	hit ruts, ejected into guy wire	3	U	Y	terrain (ruts)	Passenger
4853	41	13	F	hit accelerator instead of brake, hit ruts, ejected, overturned	2	N	Y	hit accelerator instead of brake	Passenger
4864	10	13	M	hit dip, overturned, ejected	1	N	N		Driver
4883	33	13	M	brakes failed, over embankment, ejected, hit tree	3	N	Y	brakes failed	Passenger

Rec No.	Hazard Pattern	Age	Sex	Incident summary	Number of riders	Helmet	Loss of control	Reason for loss of control	Ridership of victim
4899	33	13	M	hit branch, ejected	U	U	U		Driver
4964	42	13	F	fell off, little else known	2	U	U		Passenger
5047	41	13	F	hit mound, airborne, ejected, overturned	2	Y	Y	unknown	Passenger
5205	33	13	F	brakes failed, hit phone pole, ejected into pole	2	N	Y	brakes failed	Driver
5221	12	13	M	going up hill, ATV flipped backward onto victim	1	U	N		Driver
5421	33	13	M	face hit branch, ATV then hit tree, ejected	2	N	Y	speed, hit branch	Driver
5438	41	13	M	drove into ditch, ejected, overturned	1	U	U		Driver
5439	42	13	M	turning, slid, fell off, overturned	1	N	N		Driver
5465	11	13	M	hit hole, overturned, ejected	1	N	Y	terrain	Driver
6095	10	13	M	going uphill, flipped backward and to side, ejected	2	Y	N		Driver
6202	32	13	M	hit broadside by truck while crossing road	2	N	N		Passenger
4442	10	14	M	over mound, overturned onto victim	1	N	N		Driver
4537	32	14	M	hit by pickup truck	1	N	U		Driver
4542	42	14	M	jumped hill, airborne, nose dive, ejected	1	Y	Y	airborne nose dive	Driver
4544	10	14	M	going uphill, overturned onto victim	1	N	N		Driver
4598	32	14	M	ran stop sign, hit by car	1	Y	N		Driver
4623	15	14	M	over embankment, flipped forward, ejected	1	N	Y	speed	Driver
4720	41	14	M	on curve, ran off road, ejected	2	N	Y	curve	Driver
4732	12	14	M	going up steep bank, flipped backward onto victim	1	N	N		Driver
4749	41	14	M	over small rise, into ditch, ejected, overturned	2	N	Y	speed and small rise in street	Driver
4751	33	14	M	hit curb, into intersection, hit truck, overturned	1	Y	Y	speed and hit curb	Driver
4764	30	14	M	hit dump truck in intersection, ejected	3	N	Y	no brakes	Driver
4775	10	14	M	lost control, overturned into fence	1	Y	Y	unknown	Driver
4778	33	14	F	lost control on curve, hit tree	2	N	Y	curve	Driver
4781	32	14	M	pulled onto road, hit by car	1	N	N		Driver
4793	33	14	M	possibly avoiding dog, swerved on turn, hit bush, overturned	1	N	Y	swerved to avoid dog	Driver
4798	12	14	M	going up hill, overturned backward onto passenger	2	N	N		Passenger
4806	33	14	M	looked back, forward, hit guardrail, ejected	3	Y	N		Passenger
4831	33	14	M	went off road, hit tree, ejected into tree	1	N	Y	unknown	Driver
4839	12	14	M	climbing hill, flipped backward	1	Y	N		Driver
4858	10	14	M	up hill, overturned onto driver	2	U	N		Driver
4871	10	14	F	hit bump, left road, overturned, thrown	2	N	Y	terrain (hit bump)	Passenger

Rec No.	Hazard Pattern	Age	Sex	Incident summary	Number of riders	Helmet	Loss of control	Reason for loss of control	Ridership of victim
4876	33	14	M	high speed into trun, lost control, hit tree	2	N	Y	speed on turn	Driver
4904	33	14	M	around curve, lost control, hit tree, ejected, overturned	1	N	Y	sandy path	Driver
4907	31	14	M	racing, hit other ATV, lost control, overturned, ejected	1	N	Y	rearended another ATV	Driver
4910	40	14	M	on incline, lost control, thrown	1	N	Y	unknown	Driver
4940	11	14	M	drove off road into swamp, flipped forward, pinned	1	Y	U		Driver
4956	33	14	M	collision with tree, little else known	U	U	U		Driver
5027	33	14	M	tire went off road, hit pole, ejected	2	N	Y	went off road	Driver
5048	41	14	F	hit mound, airborne, ejected, overturned	2	Y	Y	unknown	Driver
5052	33	14	M	hit chain across road, lost control, off road, overturned	2	N	Y	unknown	Driver
5069	33	14	M	struck ditch bank, airborne, struck guy wire, overturned	1	N	Y	unknown	Driver
5160	10	14	M	coming down small hill, turned wheel, overturned	1	N	Y	downhill turning	Driver
5166	10	14	M	riding out of a ditch, overturned	1	U	N		Driver
5201	33	14	M	ran into barbwire fence, lacerated neck	1	Y	N		Driver
5222	12	14	M	going up steep embankment, flipped backward	1	N	N		Driver
5295	33	14	M	hit chain with neck, ejected	2	Y	N		Driver
5459	33	14	F	struck embankment and tree, ejected	1	N	Y	unknown	Passenger
5599	42	14	M	fell off ATV, victim hit by car	2	N	N		Passenger
5733	33	14	M	on curve, hit embankment, overturned, ejected	2	N	Y	unknown	Driver
5841	11	14	M	applied brakes, flipped forward	1	N	N		Driver
5859	10	14	M	over large bump, airborne, ejected, overturned	1	N	N		Driver
6027	33	14	F	lost control on curve, left road, hit tree, ejected	2	N	Y	curve	Passenger
6061	30	14	M	hit by car, ejected, overturned	2	N	Y	unknown	Driver
6089	30	14	M	hit truck head-on on curved road	1	N	Y	unknown	Driver
6093	33	14	M	ran off road, hit guy wire, ejected, overturned	3	N	N		Driver
6205	30	14	M	swerved into other lane, hit truck head on, ejected	1	N	N		Driver
4455	10	15	M	lost control, overturned into stream, pinned	1	N	Y	excessive speed	Driver
4548	41	15	M	went off road on curve, thrown into tree	2	N	Y	looking back on curve	Passenger
4576	12	15	M	going uphill, flipped backward	1	N	N		Driver
4602	33	15	M	went off race track, hit tree, ejected into tree	1	Y	Y	terrain (moguls)	Driver
4713	33	15	M	over berm, airbone, hit bridge, ejected	1	N	Y	speed (eluding police)	Driver
4765	30	15	M	hit dump truck in intersection, ejected	3	N	Y	no brakes	Passenger
4767	10	15	M	up incline spraying weeds, overturned	1	N	N		Driver

Rec No.	Hazard Pattern	Age	Sex	Incident summary	Number of riders	Helmet	Loss of control	Reason for loss of control	Ridership of victim
4879	33	15	M	racing, hit guy wire, ejected	1	N	N		Driver
4894	30	15	M	collision with truck, overturned, ejected	2	Y	N		Driver
4976	32	15	M	thru stop sign, hit by car, ejected	1	Y	N		Driver
4982	0	15	M	drove off road into ditch, thrown	1	N	Y	drugs, speed	Driver
5005	32	15	M	hit from behind by car, ejected, overturned	2	N	N		Driver
5035	41	15	M	going over dirt mound, lost control, ejected, overturned	2	N	Y	terrain (mounds)	Driver
5058	30	15	M	head-on collision with car, ejected	1	N	N		Driver
5075	52	15	M	over mounds, hit head on handlebars, fell off	1	N	N		Driver
5171	15	15	M	lost control, drove off of embankment, ejected	2	N	Y	unknown	Driver
5172	32	15	M	car hit ATV while ATV turning, ejected	1	N	N		Driver
5190	10	15	M	overturned. Little else known.	1	N	Y	unknown	Driver
5199	10	15	M	turning sharply, overturned	1	U	Y	sharp turn	Driver
5216	33	15	M	lost control, head hit utility pole	4	Y	Y	unknown	Driver
5400	41	15	M	hit dip, became airborne, ejected, overturned	1	N	Y	airborne	Driver
5404	32	15	M	struck by car, ejected	U	N	N		Driver
5432	32	15	M	ran stop sign, hit by SUV, ejected	1	N	N		Driver
5441	32	15	M	hit from behind by semi truck	1	N	N		Driver
5462	41	15	M	ejected while coming out of curve, struck tree	2	N	Y	curve	Passenger
5474	12	15	M	attempting to climb incline, flipped over	1	N	N		Driver
5699	10	15	M	lost control, overturned, ejected	1	N	Y	unknown	Driver
5801	33	15	M	avoiding tree, airborne, ejected, struck guy wire	2	Y	Y	swerved to avoid tree	Driver
5863	41	15	F	lost control, ejected, hit rock pillar	1	Y	Y	unknown	Driver
6338	32	15	M	hit by truck, ejected into car	1	N	N		Driver
6351	32	15	M	entered road, hit by truck	2	N	N		Driver

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A Preliminary Evaluation of the Effects of a Ban on the Sale of Adult-Size ATVs for Use by Children

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Introduction

In August, 2002, the Consumer Federation of America (CFA) and eight other organizations petitioned the US Consumer Product Safety Commission (CPSC) to take several actions to address the hazards associated with the use of all-terrain vehicles (ATVs) by children, including banning adult-size four-wheel ATVs "which may be used by and/or sold for children under age sixteen..." (CFA et al., 2002).[1] In support of their request, the petitioners cited the large number of ATV-related injuries and deaths involving children, the fact that 95 percent of child injuries occur on adult-size ATVs, and the absence of any feasible standard that would address the risk to children posed by three-wheel and adult-size four-wheel ATVs.

After evaluating the petition, the CPSC's Office of the General Counsel docketed only the portion requesting a ban on the sale of adult-size four wheel models intended for use by children under age 16 (CPSC, 2002).[2] The sales ban being considered would not directly regulate the way in which children use ATVs, the primary goal of the petition. Rather, it would affect how ATVs are sold in the new product market. A sales ban would not prevent children from using ATVs after they are in the hands of consumers. Nor would it have a direct impact on the usage patterns of the great majority of adult-size ATVs already in use. Nor would it likely affect sales between private individuals in the active secondary market for used ATVs. Available data suggest that secondary market sales between individuals account for almost 40 percent of all ATV sales (Rodgers, 1999; Levenson, 2003).

The purpose of this report is to describe some of the possible effects of the proposed sales ban, as well as a preliminary discussion of the types of benefits and costs that would result. Insufficient information is available, however, to make any firm comparisons between the benefits and costs of the petition.

Benefits of a Sales Ban

The benefits of the ban under consideration would be the reduction in the societal costs of fatal and nonfatal injuries involving children that would result from a ban. The extent of the benefits would depend upon three factors: (1) the costs of injuries involving children; (2) the net reduction in the risk that would accompany the reduction in the use of adult-size ATVs, and (3) the effectiveness of the ban in getting children off adult-size ATVs.

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[1] The petitioners also requested that the Commission ban all three-wheel ATVs in use or available for resale, and require that manufacturers offer refunds for all three-wheel ATVs and adult-size four-wheel ATVs "purchased for use by children under sixteen." (p. 9 of petition).

[2] For a discussion of why the remaining portions of the petition were not docketed, see the letter from Stephen Lemberg of the CPSC's Office of the General Counsel to Rachel M. Weintraub, Esq., of the Consumer Federation of America, September 25, 2002.

Potential Reductions in the Costs of Nonfatal and Fatal Injuries Involving Children

This section discusses the first two factors mentioned above: the costs of injuries and deaths and the net reduction in risk that would result from the reduced use of adult models. The results show that, if successful, efforts to get children off adult-size ATVs, and onto youth models, could lead to substantial reductions in the costs of injuries. (The next section discusses the potential effectiveness of the ban in getting children off ATVs.)

Possible reductions in the costs of nonfatal injuries. The societal costs associated with nonfatal injuries involving ATVs can be estimated with the CPSC's Injury Cost Model (ICM), a computer model fully integrated with the National Electronic Injury Surveillance System (NEISS) and designed to estimate the costs of product-related injuries. The ICM estimates the four major costs of injury: the costs associated with medical treatment, work loss, the intangible costs associated with pain and suffering, and liability costs (Miller et al., 2000).

In addition to estimating the costs of injuries treated in U.S. hospital emergency departments (ED) and reported through NEISS, the ICM model uses empirical relationships between ED injuries and medically attended injuries treated in other settings (e.g., physicians' offices, clinics, ambulatory surgery centers, and direct hospital admissions) to estimate the number, types, and costs of injuries treated outside of hospital EDs. Thus, the ICM allows us to expand on NEISS to estimate the total number of medically attended injuries and their costs, across all treatment levels.

Based on estimates from NEISS and the ICM, there were about 76,100 ATV-related medically attended injuries involving children under age 16 during 2001, including 34,300 treated in US hospital emergency rooms (Ingle, 2004). The societal costs associated with these medically attended injuries amounted to $2.5 billion, or about $33,000 per injury. Medical costs and work losses (i.e., work losses of parents, caregivers, etc.), the primary economic losses from injury, accounted for about 32 percent of the total societal costs; pain and suffering (i.e., the intangible costs of injury) accounted for about 68 percent. Liability costs amounted to less than 1 percent.

Based on the results of the 2001 injury survey, about 81 percent of the children injured were either drivers or passengers on ATVs driven by children. Additionally, according to the 2001 exposure survey, there were about 2.8 million drivers under the age of 16 (Levenson, 2004). Thus, the societal costs of child injuries averaged to about $723 per driver under age 16 in 2001 ([$2.5 billion * 0.81] / 2.8 million drivers).

To the extent that a ban reduces the use of adult-size ATVs by children, the overall injury risk is likely to decline, but not by the full amount of the risk associated with the adult ATVs. The hazard analysis prepared by the Directorate for Epidemiology suggests that if children drove children's models rather than adult models the risk of nonfatal injury might be reduced by about half (Levenson, 2004).[3] Given that an estimated 25 percent of children under age 16 drove youth

[3] The hazard analysis estimates that youth drivers who drove youth models had half the injury rate of youth drivers who drove adult models. The difference in injury rates may be due to multiple factors, but for the purpose of this analysis, we assume a 50 percent reduction in injuries from youths driving youth models as compared to adult

models (Levenson, 2004), it can be shown that a 50 percent reduction in the nonfatal injury risk on child-size models would reduce the annual expected injury costs by roughly $413 per child driver.[4] About $131 (32 percent) of this prospective injury cost reduction is associated with possible reductions in medical costs and lost wages; $282 (68 percent) is associated with reduced pain and suffering, and about $1 (< 1 percent) is associated with reduced legal and liability costs.

Possible reductions in the costs of fatal injuries. Getting children off adult-size ATVs may also reduce the likelihood of fatal accidents. For 2001, there were 128 reported deaths involving children under age 16 (Ingle, 2004).[5] Based on an analysis of 1999 and 2000 data, about 86 percent of the deceased children were either drivers or passengers on adult-size ATVs driven by children (Ingle, 2003). Thus, about 110 of the reported deaths (0.86 * 128 deaths) may have involved child drivers on adult ATVs. If we assume a societal cost of $5 million for each death, a cost estimate that is consistent with estimates of the value of a statistical life in the existing literature (Viscusi, 1993), the societal costs of these deaths may have amounted to about $550 million. And, since there were about 2.8 million children driving ATVs in 2001, the average fatality costs were about $196 per child driver ($550 million / 2.8 million drivers).

We have no firm estimates of the impact of engine size on the child death rate. However, if we assume the impact is similar to the impact on the nonfatal injury rate, then the use of youth models rather than adult models might also reduce the risk of death by about half. Assuming that 25 percent of children drove youth models, a 50 percent reduction in the risk of death on youth models would suggest a reduction in the fatality costs of about $112 per child driver.[6]

Impact of Sales Ban on the Sale and Use of Adult-Size ATVs by Children

While the possible benefits of getting children off adult-size ATVs may be substantial, we cannot quantify the extent to which a ban would reduce the sales of adult ATVs for the use of children. However, we describe below how such a ban would differ from the existing agreements with industry and how consumers might respond.

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models. Note also that this analysis assumes that the most likely alternative to driving an adult-size ATV is to drive an appropriate youth model. If, however, the alternative was to ride an off-road motorcycle or a bicycle, the expected risk reduction would be the difference between the risk on an adult-size ATV and the risk on an off-road motorcycle or a bicycle.

[4] This can be shown as follows. Let IC_y represent the expected injury costs per child driver associated with youth ATV models, and let IC_a represent the expected costs per child driver associated with adult models. Since about 25 percent of children drive youth ATV models, and the expected injury costs averaged over all ATV types amounts to about $723, we can write the equation: $0.25(IC_y) + 0.75(IC_a) = \$723$. Additionally, if the costs of injuries, when they occur, are not substantially affected by ATV size, and if the risk on a child model is about half the risk on an adult model (as discussed above), then $IC_y = 0.5(IC_a)$. Solving for IC_y and IC_a, we have $IC_a = \$826$, $IC_y = \$413$, and $IC_a - IC_y = \$413$.

[5] The reporting of deaths for 2001 is incomplete. Consequently, 128 deaths represent a minimum count, based on cases documented as of December 31, 2002. The number of deaths may increase by the time the next CPSC Annual Report for Deaths and Injuries is prepared (Ingle, 2004).

[6] Let DC_y represent the expected per child driver costs associated with deaths on youth models, and let DC_a represent the expected per child driver costs associated with deaths on adult models. Since about 25 percent of children drive youth ATVs, and the expected per driver death costs amount to about $196, we can write the equation: $0.25(DC_y) + 0.75(DC_a) = \$196$. Furthermore, if the risk on a child model is about half the risk on an adult model), then: $DC_y = 0.5(DC_a)$. Solving for DC_y and DC_a, we have $DC_a = \$224$, $DC_y = \$112$, and $DC_a - DC_y = \$112$.

Age Recommendations under Consent Decrees. Under the consent decrees between the CPSC and the major ATV distributors,[7] which were effective from 1988 to 1998, ATVs with engines of more than 90 cubic centimeters (cc) of displacement were defined as adult models and were not recommended for use by children under age 16 years.[8]

The consent decrees required that the age warnings and recommendations be communicated to consumers in a number of ways, including a warning label and hang-tag affixed to each ATV at the point of sale; information provided in the owner's manual; a four-foot square safety poster displayed at each dealership providing risk information explicitly linking ATVs to deaths and injuries involving children; all promotional media ads; a safety video available for viewing at each dealership; and a CPSC *ATV Safety Alert* provided to all new ATV buyers. The redundancy of warnings was intended to make it virtually impossible for anyone to purchase a new ATV without being aware of the age recommendations. Although not part of the consent decrees, the distributors also required that buyers of new adult-size ATVs sign a statement at the time of sale indicating they had been informed by the dealer, and understood, that children should not operate adult-size ATVs.

Additionally, the consent decrees required that distributors prohibit their dealers from selling adult-size ATVs for the use of children and that distributors use their best efforts to ensure that their dealers made "affirmative" representations about the age recommendations to prospective buyers. Because of an initial lack of compliance with this provision (Ford, 1989; Gilbert, 1989), the CPSC staff conducted a series of undercover inspections in 1989 and found that about 56 percent of all ATV dealers were making statements or recommendations that were not consistent with the age recommendation requirements of the consent decrees (Ford, 1989). After further negotiations, distributors agreed to begin conducting annual undercover investigations of their own randomly selected dealers, to determine dealer compliance with the recommendations, and to take actions against dealers who were not complying. Subsequent undercover investigations by the CPSC staff in the early 1990s found an improvement in dealer compliance.

Age Recommendations Under ATV Action Plans. After the consent decrees expired in 1998, the CPSC entered into follow-up agreements with each of the major distributors.[9] In these agreements, called the ATV Action Plans, distributors agreed to abide by most of the requirements of the consent decrees, including many of the age warnings and the contractual arrangement with their dealers by which distributors prohibit the sale of adult ATVs for the use of children under 16. All of the major distributors also continue to require dealers to have buyers of new adult-size ATVs sign a statement at the time of sale indicating that they have been told, and understand, that children should not operate adult ATVs.

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[7] The major distributors included in the consent decrees were American Honda Motor Company, Kawasaki Motors Corp., USA, Polaris Industries, Inc., American Suzuki Motor Corp., and Yamaha Motor Corp, USA.

[8] ATVs recommended for 12- to 15-year-old children were limited to the less powerful ATVs with engines of 70 cc to 90 cc. ATVs recommended for 6- to 11-year-old children were limited to ATVs with engines under 70cc.

[9] Agreements were also made with Arctic Cat Inc.and Bombardier as well as the five major distributors mentioned above.

There are, however, several components of the consent decrees that are not included in the action plans. The dealerships no longer display the four-foot square safety posters containing explicit risk information, and one distributor does not require its dealers to distribute CPSC *ATV Safety Alerts* to new buyers. Additionally, while all of the distributors have continued monitoring dealer compliance with the age recommendations by means of undercover investigations, one distributor does not monitor randomly or specify a minimum number of dealers that will be monitored in a given year.

CPSC staff has conducted undercover inspections of the dealerships since 1989. Based on staff monitoring, roughly 90 percent of dealers were in compliance with the age recommendations during the period covered by the consent decrees.[10] Compliance appears to have declined in recent years, however, from 85 percent in 1998 to about 60 percent in 2002 and 2003 (Cerruti, 2003; Ivins, 2004).[11]

Additionally, it should be noted that there have been a number of new producers and distributors selling ATVs in the US since the expiration of the consent decrees. Most of these new firms are not carrying out the same actions as the major manufacturers. However, at least in the past, most of these new distributors have limited sales to the youth models.

Trends in Adult-Size ATV Use by Children. The declining rate of dealer compliance with the age recommendations may be related to the reduced stringency of the ATV Action Plans, relative to the legally binding consent decrees. However, available data on driver usage patterns shows no parallel decrease in the proportion of children who drove youth models. In fact, the proportion of children driving youth models appears to have increased. While the CPSC's 1997 ATV exposure survey indicated that only about 4 percent of children drove youth models (Rodgers, 1999), the 2001 exposure survey indicated that 25 percent of children drove the youth models (Levenson, 2004).

Impact of a Sales Ban on Children's Use of Adult ATVs. As noted, the requirements of the ATV Action Plans make it seem unlikely that adults can buy new ATVs without being aware of the age recommendations. The question then becomes: Why would a formal ban reduce the use of adult ATVs by children more than the current warnings, recommendations, and dealer obligations under the ATV Action Plans?

One possible answer is that a federal sales ban could, for some consumers, function as a strong warning and lead some to take the age recommendations more seriously than they would have in the absence of federal requirements. Advocates for banning the sale of adult four-wheel ATVs for use by children, for example, believe that parents are not generally aware of the dangers of ATV use by their children and that a federal sales ban would "send a powerful message to parents about how dangerous large ATVs are for children" (CFA et al., 2003, p. 16).

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[10] During undercover inspections, an adult usually tells the ATV salesman that he/she wants to purchase an adult-size ATV for a 14-year-old.

[11] ATV distributors also conducted undercover monitoring, and found 73 percent compliance. The difference in estimated compliance between the CPSC staff and distributor monitoring efforts may be attributable to the method of selecting the dealerships for undercover visits. Whereas most distributors use a random selection procedure, without regard to state, the CPSC selects dealerships by state, monitoring the states with the highest rates of injury and ATV usage more heavily.

A federal sales ban might also increase dealer compliance with the age recommendations, since ignoring federal regulations might result in more serious sanctions than is likely to be the case under the Action Plans.[12]

However, the likely impact of a federal ban on the sale of adult ATVs for the use of children, relative to the current age recommendations of the Action Plans, is unclear. Given the redundancy of the warnings now given, buyers of new ATVs are almost certainly aware of the age recommendations at the point of sale, and many buyers apparently choose to ignore them. Additionally, according to the Division for Human Factors, there is little research available that indicates consumers would view a government warning as more credible than others (Johnson, 2004a). Consequently, if, contrary to the views of advocates of a federal sales ban, consumers are generally aware that ATVs are risky products (or are at least aware of the age warnings) and choose to let their children ride them anyway, a ban might have little impact on consumer decisions. And if parents want to purchase an adult ATV that their children can use, there is little that a ban can do to stop them: all the parents need to do is to refrain from telling dealers of their intentions.[13]

Some of the other factors that go into consumer ATV purchase decisions may also mitigate against the effectiveness of a ban. For example, according to the 2001 ATV exposure survey, there were about 1.55 drivers per ATV in ATV-owning households (Levenson, 2003). Thus, in many cases, purchasers buy ATVs for use by multiple family members. These buyers may resist buying children's models if some of the household drivers are adults. Additionally, since ATVs are relatively expensive consumer products, some parents may not want to purchase a youth model for a 14-year-old when they think it may be too small physically for the child or may be outgrown within a couple of years. Similarly, some children will not want their parents to buy a children's model for their use, even if the parent is inclined to do so. While the impact of these types of factors cannot be quantified, it is likely that they will affect the purchase decision of some parents, and tend to reduce the likelihood that parents will purchase youth models.

Costs of a Sales Ban

There would be two primary monetary costs of a sales ban: the added costs of purchasing and using youth models that would not otherwise be purchased, and the costs of enforcing a sales ban to make sure dealers were complying with the requirements. A third non-monetary cost involves the possible losses in the utility for some consumers (i.e., the value consumers get from using a product) who would no longer be able to purchase and use the products they prefer. As discussed below, the possible losses in utility for children might be discounted under the assumption that young children lack the strength and coordination to operate powerful ATVs

[12] Additionally, the CPSC could deal directly with non-complying dealers, instead of working through the distributors.

[13] In fact, as of July 2003, one ATV state rider association suggested that buyers consider not telling dealers that youths may be riding an adult ATV they are trying to purchase because (due to restrictions placed on dealers by manufacturers) dealers are not supposed to sell ATVs that are outside of the manufacturers listed age size recommendations.

safely, or that children under 16 are unable to efficiently integrate risk information into their decision making process. However, losses in utility might still result from an inability of well-informed parents to purchase the ATVs they prefer for their children.

Added Cost Associated with the Purchase and Use of Youth ATV Models

If a sales ban were to be successful in getting children off adult models, and onto youth models, parents would have to buy the youth models that they would not have otherwise purchased. Since the youth models are likely to be used only for a few years, the annual usage costs in some cases could be substantial.[14] We cannot say with available data what the added costs of purchasing and using a youth ATV model would be to an average family. However, we can provide an illustration of the types of costs that would be encountered.

Based on available market information, the retail prices of new youth models in 2001 ranged from about $1,800 to $2,500 (Leland, 2004), and may depreciate by roughly half after two years (National Automobile Dealers Association, 1998). Consequently, if a youth model was purchased for $2,200 and sold in the used market after two years (after the child outgrew it or turned age 16), the costs associated with its purchase and maintenance might be as much as $550 or more per year. The annual costs per child might be lower if an older model were purchased in the used market, if it were used for more than two years, or if it were used by more than one child. Conversely, the per child annual costs could be higher if it were used less than two years, or ended up being stored in the family's garage rather than being resold in the used market.

It should be noted that the gross annual purchasing costs of youth models would be offset somewhat by the costs that would have been incurred by purchasing and using the alternative adult models, the models that would have been purchased in the absence of the stop sale.[15] Nevertheless, the net annual costs associated with purchasing the youth models would likely remain positive, in most cases, since the adult models not purchased would probably have been used for a longer period of time (since they wouldn't be as likely to be outgrown) or would probably have been used by a larger number of family members (e.g., adults as well as children).

Additionally, the purchase of youth models would entail additional transaction costs: the additional costs in time and effort that would be needed to conduct the transaction of buying and selling the youth models and, when the youth models were outgrown, their replacement with adult models. These costs cannot be quantified in any precisely, but they would require advertising the sale of the ATV, scheduling appointments for prospective buyers to check out the

[14] As a result of the sales ban, some parents might decide not to buy any ATV for the use of their child. If this were the case, the societal benefits would reflect the difference between ATV injury risk and the risk in the child's substitute activity (e.g., bike riding); the costs would reflect the reduced utility (i.e., use value or enjoyment) of the child that would be associated with not being able to ride any ATV, even an ATV of appropriate size.

[15] This analysis assumes that the impact of the sales ban, if successful, would result in the purchase of a youth ATV for the child, rather than an adult model. However, if the household decided to purchase both a youth model and an adult model (perhaps because the ATV was to be used by multiple household members), the costs of using the youth model would not be offset by what they would have paid to use the alternative adult model since they would be paying to use both.

ATV, waiting around for customers, and negotiating the final resale price. These transaction costs may be similar in type to those associated with buying and selling used automobiles.

In summary, to the extent that a sales ban is successful in getting parents to purchase youth ATVs that they would not otherwise have purchased, the annual costs of using ATVs will probably increase. In some cases the increase in costs may be substantial and may, in fact, help explain some of the evasion of the current age recommendations on the part of parents buying adult-size ATVs for the use of their children.

Enforcement Costs

The enforcement costs consist of resources that would have to be used to monitor compliance to a sales ban and would vary depending upon the degree of effectiveness the CPSC would find acceptable. For the most part, enforcement costs would probably consist of resources spent by the CPSC.[16] While it is unlikely that there would ever be full compliance, publicized undercover inspections on a small proportion of dealers annually, in combination with substantial sanctions applied against violators, might be sufficient to prevent overt or large scale violation on the part of dealers.

While the increase in agency enforcement costs cannot be estimated with precision, it might consist of an extension of the agency's current program of undercover investigations. Estimates of the expansion of the monitoring program that might be required, in conjunction with estimates and costs of staff time that would be needed to support the investigations (and assuming there were no major litigation costs), suggests that agency enforcement costs might increase by as much as $350,000 per year.[17]

Forgone Benefits

General Considerations. Setting aside for the moment the issue of age, if consumers are generally aware of the risks of driving ATVs, and choose to drive them anyway, a sales ban would likely reduce the utility of consumers (i.e., the value consumers receive from the use of the product) who would no longer be able to purchase and drive the models they prefer. Conceptually, lost utility would be reflected in the forgone benefits resulting from the sales ban. These forgone benefits equal the difference between the value-in-use of the product to a consumer and the amount the consumer would have to pay to use it. This difference is called "consumer surplus" and represents a benefit for which the consumer does not have to pay.[18]

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[16] The impact of a sales ban on industry monitoring is unclear.

[17] This estimate is based on the projected costs of CPSC staff time (i.e., time spent by field investigators, compliance officers, and attorneys) that would be needed to conduct about 750 dealer investigations annually. Given the roughly 5,000 dealerships affiliated with the major ATV distributors in the US, 750 investigations would result in the monitoring of about 15 percent of dealerships each year.

[18] For example, suppose the value-in-use of a bicycle amounts to about $1,500 per year for a consumer, but that the annual usage costs (i.e., maintenance costs plus the amortized purchase price over the bicycle's expected product life) were only $300. In this case the consumer surplus, the benefit for which the consumer did not have to pay, would be $1,200 ($1,500 minus $300) per year.

While the loss in consumer surplus associated with an ATV sales ban can be described conceptually, it cannot be measured with available data. However, it should be noted that the potential loss described above does not take into account the expected costs of injury associated with the use of risky products. The true cost of a risky product to consumers is the sum of usage costs and the expected injury costs.[19] Consequently, if consumers are unaware or underestimate the risks of driving ATVs, the actual loss in consumer surplus associated with a sales ban would be less than the difference between the value-in-use and the usage costs.

Considerations for Applying the Concept of Forgone Benefits to Children. The primary impact of the proposed sales ban would be on children under age 16 years. While there is no theoretical reason to value the utility (or enjoyment) of children less than that of adults, the possible losses in the utility of children might be discounted under the assumption that young children lack the strength and coordination to operate powerful ATVs safely, or that children under 16 are unable to efficiently integrate risk information into their decision making process.

ATVs have complex and sometimes unexpected handling characteristics, and require a high degree of skill and attentiveness to operate safely (Allen et al., 1988). The Division of Human Factors has indicated that children under age 12 are not generally able to operate ATVs safely because of inadequate strength, cognitive abilities, and motor skills (Johnson, 2004b). Child developmental theory also suggests that many children may not reach a fully mature stage of cognitive ability, a stage which is necessary for thinking abstractly and for integrating multiple factors with the understanding of complex phenomena (such as risk and health), until about age 15 or 16 (Trickett and Benel, 1986).

These physical and cognitive considerations played an important role in the development of the age guidelines of the consent decrees, and in the ultimate agreement by the distributors to not sell adult-size ATVs for the use of children under age 16. From an economic standpoint, they suggest that many children under age 16 may overestimate their abilities to drive and control the powerful adult-size ATVs. Consequently, they may systematically underestimate their risks or the consequences of injury. Since understanding risk, and being able to integrate this understanding into the decision making process, is an important factor in making an informed decision to engage in a risky activity (and in evaluating the true usefulness of a risky product), many children may overestimate the net benefits that they derive from ATV driving.

Parental Considerations. While it may be reasonable to discount the preferences of children for the reasons described above, discounting or ignoring the preferences and choices of well-informed parents may be a different matter. One of the primary responsibilities of parenting is to make decisions that are in the interests of children. Parents are not, of course, allowed to make all the decisions that affect their children. Society limits, for example, the ability of children to drive automobiles on public roads, a limitation that is presumably in the interests of other drivers as well as the children who are kept off the roads. Nevertheless, since parents are the primary guardians of the well-being and safety of their children, their preferences are usually given considerable latitude in making the decisions that affect their children.

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[19] Following the bicycle example, if the expected injury costs associated with bicycle use amounted to about $200 per year, the actual consumer surplus would be $1,000 per year (i.e., the $1,500 annual value-in-use, minus the $300 in annual usage costs, minus the $200 in expected injury costs).

Based on the testimony and comments of parents and others at the ATV public hearings during 2003, many parents apparently believe their children should be allowed to drive adult-size ATVs. Some believe that youth models are physically too small for their children to drive comfortably or safely. The Human Factors analysis provides some support for this contention, especially for children who tend to be large (i.e., tall or heavy) for their age. In fact, the analysis suggests that some children may begin to be overweight for the correct ATV as early as age 7, and by age 11 most children may be too heavy for many child ATVs. Moreover, it points out that an ATV driver with an "uncomfortable" fit may be distracted by discomfort and may not drive as safely because the need for weight shifting and balance may be adversely affected (Johnson, 2004b).[20] Additionally, while an organization such as the National 4-H generally supports the CPSC age recommendations, it nevertheless advocates fitting children "anthropometrically" to the appropriate size machine and, recognizing that children do in practice ride adult ATVs, provides training for children on the adult models.

Given these considerations, if parents are aware of the risks of riding ATVs and choose to let their children ride adult ATVs anyway, it may be reasonable to give some weight to their preferences when evaluating the costs of a sales ban. On the other hand, if parents are not aware of the risks on adult-size ATVs, it may be reasonable to discount the potential for lost utility that would be associated with a sales ban. If they are not aware of the risks on adult ATVs, they might mistakenly decide to buy an ATV for a child that they would not have purchased if they had known the risks.

Information about risk plays a key role in this evaluation. While we cannot measure the risk awareness of parents, we note that ATVs have been in use for more than 30 years, and that injuries and deaths involving children have been highly publicized since at least the mid-1980s. Additionally, given the age warnings required under the ATV Action Plans, and the redundant measures used to communicate age warnings to prospective buyers, it seems unlikely that many parents would be able to buy a new ATV from any licensed dealer without being aware of the risk warnings. To the contrary, based on reports from the West Virginia Public ATV hearings, there are parents who purposefully do not tell sales personnel that they are buying an ATV for their child since they know the dealer would be obligated under the Action Plans to refuse the sale.

Other Costs. While the primary impact of a sales ban may be on children, some adults may also be directly affected. This might be the case if an ATV would have been purchased for the use of more than one family member, including adults. If the family had no other ATV and an adult-sized model was not purchased because of the ban, there would likely be some utility loss for the adult household members.

Additionally, many ATVs are used in nonrecreational activities. In 1997, for example, almost three of every four drivers reportedly used ATVs in at least one nonrecreational activity

[20] Some of these problems related to the child-ATV fit might be alleviated if manufacturers made available larger youth models than are currently produced (i.e., larger ATVs with engines sizes of 90 cc or less). If this were the case, some parents might not feel the need to purchase the adult models to get the appropriate size ATVs for their children.

during the preceding year; 51 percent used them in farming or ranching, 63 percent used them for household chores such as lawn and garden work, and 8 percent used them for occupational or commercial tasks (Rodgers, 1999). Children participate in these nonrecreational activities, especially in rural and farming communities. Consequently, a stop sale, to the extent that it would be effective, could reduce the ability of children to assist their parents in nonrecreational activities. The staff has found that the risks associated with ATV use are substantially lower in nonrecreational activities (Rodgers and Adler, 2001; Levenson, 2003).

Summary

Because of the large number of child injuries and deaths on adult-size ATVs, the benefits of getting children off adult ATVs (the primary goal of the petition), would be substantial. However, the effectiveness of a sales ban in achieving this goal is uncertain, for several reasons. First, because the Commission cannot regulate or enforce consumer behavior, a sales ban will not directly affect the way in which ATVs already in use are used by children. Nor will it directly affect how new ATVs are used after they are sold. Second, its impact will likely be limited to the new product market; it will probably not affect sales of used ATVs between individuals, a market that accounts for roughly 40 percent of all ATV sales. Third, the impact of a sales ban in the new product market is unclear since, under the existing ATV Action Plans, contractual agreements between distributors and dealers already prohibit dealers from selling adult-size ATVs for the use of children. Additionally, purchasers are already informed in a number of ways at the point-of-sale that adult ATVs are not intended for the use of children.

Since parents would still be able to purchase the adult models for use by their children under the ban (as long as they do not tell the dealer about the intended use), the ban's effectiveness depends upon consumers taking the sales ban more seriously than the current warnings. The petitioners believe that a federal sales ban would send a powerful message to parents about the risks of ATV use. However, if parents are already generally aware of the risks, or if the "message" provided by a federal sales ban is not more effective in communicating risk than existing warnings, a ban might have relatively little impact on the purchasing behavior of consumers.

There may also be other, non-risk-related, considerations that might reduce the likelihood that parents will purchase youth models for their children. Many purchasers buy ATVs for use by multiple family members and may be reluctant to purchase a youth model if some of the household drivers are adults. Additionally, since ATVs are relatively expensive consumer products, some parents may not want to purchase a youth model for a child when they think it may be too small physically for the child or may be outgrown within a couple of years.

These factors are reflected in the primary costs of a sales ban to consumers: the added costs of purchasing the youth models (that they would otherwise not have purchased), and possible losses in the utility of households that would no longer be able to purchase the ATVs they prefer. While these costs cannot be quantified precisely, they may be perceived as substantial by many consumers. They may also help explain why many parents apparently disregard existing warnings.

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UNITED STATES
CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, DC 20207

Memorandum

Date: July 14, 2004

TO : Elizabeth Leland, Project Manager
Directorate for Economic Analysis

THROUGH: Hugh M. McLaurin, Associate Executive Director
Directorate for Engineering Sciences
Robert B. Ochsman, Director, Division of Human Factors
Directorate for Engineering Sciences

FROM : Hope E. Johnson, Engineering Psychologist, Division of Human Factors
Directorate for Engineering Sciences

SUBJECT : Developmental Characteristics as related to All-Terrain Vehicles and Petition CP-02-4/HP-02-1

I. Introduction

The Consumer Federation of America petitioned the Consumer Product Safety Commission (CPSC) to ban the sale of adult All-Terrain Vehicles (ATVs) intended for the use of children under the age of 16. It has long been the position of CPSC staff that children under the age of 16 do not possess the developmental skills to safely ride adult ATVs, which can weigh up to 850 pounds and reach speeds of upwards of 60 miles per hour (mph). Recent CPSC staff studies have shown that many children are riding adult ATVs, and that the injury and death rates are climbing (Levenson, 2003).

The majority of child developmental information presented to the Commission in 1986[1] remains reasonably consistent with current research on the topic. This memorandum will discuss relevant recent research that is not fully consistent with the 1986 assessments, summarize developmental skills related to ATV driving, and respond to criticism based on child anthropometrics to CPSC's ATV age recommendations.

II. Perceptual Skills of Children

Distance, Speed, and Traffic Gap Estimation

Collisions with other vehicles are a significant source of death and injury, accounting for 19 percent of the ATV-related child deaths in 1999 and 2000 (Ingle, 2004). One possible reason for the large percentage of collisions is that children often have difficulty estimating crossing gaps in traffic. Benel and Mavor's (1986) review of child development literature found research that suggests children are able to estimate the relative distance traveled between two objects fairly

[1] Benel and Mavor (1986) and Trickett and Benel (1986)

accurately by age 12, and they concluded that children are fairly good estimators of speed and distance by age 12.

The terms "traffic gap" and "crossing gap" describe the distance between automobiles on the road that is often studied in relation to pedestrian crossing and in vehicle left-hand turning. Hoffman, Payne, and Prescott (1980) reported that by age 12, children would reach adult performance for estimating vehicle approach times. However, the children in this study ranged in age from 5 to 10, therefore the estimate of age 12 is merely an extrapolation from data. A more recent study (Connelly, Conaglen, Parsonson, and Isler, 1998) on pedestrian crossing gaps with approaching cars showed that by age 12, children could make reasonably safe estimations regarding crossing in front of a car. This research, however, showed that two-thirds of children used distance rather than speed to judge crossing gaps, which is the least adequate strategy. In a study of male drivers estimating traffic gaps for left turns, Cox, Cox, and Tuite (2001) found that newly licensed adolescents (mean age 16.8 years) both detected cross traffic later and estimated traffic speed to be slower than did experienced adult drivers, which allowed traffic to get an average of 70.4 ft closer. Together, these studies indicate that estimating a vehicle's approach time improves with age and experience. Twelve year olds may be able to estimate pedestrian crossing gaps, but it does not appear that this knowledge transfers to vehicles since 17-year olds were still making estimation errors in vehicular crossing gaps. One possibility is that inexperienced drivers will assume that a motorized vehicle is significantly faster than a pedestrian, and will assume vehicular crossing time will be much faster than pedestrian, but a lack of vehicular experience means they cannot quantify "much faster" and estimates may not be accurate. It appears, however, specific experience allows persons to learn to judge crossing time accurately. This is directly related to ATV riding, as children under age 16 have virtually no experience estimating traffic gaps for an ATV crossing, and may assume that the ATV they are driving will get them across the street faster than it can. While they may be able to estimate a traffic gap for ambulatory crossing by age 12, it is clear that this does not directly translate to motorized vehicular crossings.

This research leads to the conclusion that at age 12, children are probably not capable of properly estimating their speed on an ATV relative to other moving vehicles. It suggests that experience is needed to properly estimate distance and speed and that by age 12, many children had significant experience as pedestrians crossing the road to properly estimate if there is enough crossing time by foot. Yet when 16-year olds are put in a car, it appears their skills of distance and speed estimation must be re-learned relative to their new speed and acceleration in a car. It is reasonable to assume a child will need to learn this skill when riding an ATV, and therefore it is unclear at what point a child would be able to accurately estimate speed, distance, and traffic gaps when he or she is on an ATV. It will, however, likely take a large amount of experience, just as it does for young automobile drivers to adjust to the new speed in an automobile.

III. Cognitive Skills

0 to 4 year olds

In general, children under five do not possess any of the needed skills to drive an adult ATV. However, at this age, their parents may drive with the child as a passenger on the ATV. This violates one of the safety rules of ATVs: "Do not carry passengers," but it is clear from the incident data that people can and will carry passengers[2], including children under five. These young children will enjoy riding the ATV with an adult, and would likely ride in the lap of the driver. At this young age, the children will not likely comprehend the consequences of all the actions of the driver, and they are likely to try to "help" by pushing buttons, pulling the handlebars, or other actions that could interfere with the driver. CPSC In-Depth Investigation reports show that this very behavior has contributed to some fatalities.

According to the CPSC Age Determination Guidelines (Therrell, Brown, Sutterby & Thornton 2002), by age three, children have developed the coordination required to use handlebars, but they do not have the balance required for two-wheeled scooters and bicycles. In general, ride-on vehicles with wider spaced wheels and more wheels are more stable; therefore they require less balance and can be ridden by younger children (Therrell et al., 2002). Therefore, some parents may feel that a 4-wheeled ATV will provide more stability than other two-wheeled ride-on toys. However, ATVs still require significant balance and coordination, which is generally not possessed by children under five. Children at this age cannot use hand brakes in a consistent, reliable manner. By age four or five, children wish to discard the foot-pushed ride-on toys of the three-year-old and move on to vehicles more like those used by older children and adults. They will therefore be excited at the prospect of riding as a passenger on these vehicles and will be eager for the time they can ride these vehicles by themselves.

5 to 7 year olds

By age five, children will be eager to ride faster vehicles than the tricycles of three- and four-year-olds. Five-, six- and seven-year-olds will be able to learn some of the basic skills needed to drive ATVs. This is about the age when children will begin to ride bicycles, and parents may feel they could begin to ride ATVs also. Children of this age like to imitate adult behaviors, and may wish to ride an ATV like an older brother, sister, parent, or relative (Therrell et al., 2002). By age six, most children will have enough balance to ride two-wheeled vehicles, and should be able to ride very slow-moving, child-sized four-wheeled motorized vehicles. At this age, they generally are able to understand two different controls, such as a throttle and one type of brake, although they may not be able to use them at the same time and may be confused by other controls (handle and foot brake, gear shift). They are not, however, familiar enough with traffic and rules of the road to be allowed to ride anywhere near other vehicle traffic (including bicycles, automobiles, and other ATVs), and must be supervised constantly (Therrell et al., 2002).

One skill that is needed to ride ATVs with other vehicles around is the ability to visualize what other people are seeing. Without this skill, children will not understand that other drivers can or cannot see them. Traditional developmental psychology holds that children in the pre-

[2] e.g. CPSC's All-Terrain Vehicle Exposure Study (Levenson, 2003)

operational phase of development (preschool age) are not able to accurately visualize the visual perspective of others, and that this skill does not develop until age seven. More recent research has shown this may not be completely true, and that some children as young as three can visualize others' perspectives (Berger, 1994). This research, however, fails to show that children are consistent in viewing the perspective of others across all situations until age five or six. Therefore, CPSC Human Factors staff feels that the research is not strong enough to suggest that children younger than seven can consistently and accurately visualize what others are seeing.

8 to 11 year olds

This age group is developing awareness of safety rules and can follow these rules fairly consistently; however, they are very likely to engage in high-risk behaviors such as stunt-riding (Therrell et al., 2002). The Age Guidelines (Therrell et al., 2002) also confirm that children nine to 12 can generally operate motorized vehicles requiring gear shifting that do not exceed 10 miles per hour; however they generally do not posses enough skills to successfully balance and steer vehicles moving faster than 10 mph. Child ATVs are equipped with governors that can be set to certain speeds; however, adult ATVs are not equipped with these and can reach speeds in excess of 60 mph.

12 to 15 year olds

Children in this age group have generally been riding bicycles many years. They appear to be very good drivers, because they seem to have the balance, strength, and agility needed to control ATVs. In fact, many children 14 to 15 who have been riding ATVs for several years will appear to be expert riders, mastering skills such as jumps and fast cornering; however, children at the younger end of this age group (12- and some 13-year-olds) still do not posses the balance and coordination to ride vehicles that travel over about 10 mph (Therrell et al., 2002). Adolescents are also lacking in the cognitive skills needed to successfully recover from their errors. Adolescents are generally aware of the risks they are taking but are rewarded by the feelings of power, independence, and peer recognition that come from the appearance of mastering risks (Williams, 1998). However, according to Macdonald (as cited in Williams, 1998) children of this age may not be able to identify *all* the potential risks and hazards with an activity, and may not possess the hazard recognition and cognitive skills of most adults. Additionally, adolescents may feel as though they possess the skills needed to ride their ATVs safely, and like inexperienced automobile drivers, they will not be likely to recognize when they are in trouble. They are likely to overcorrect or otherwise react inappropriately when confronted with an unexpected situation, such as an unexpected bump in the road or an oncoming automobile.

Summary

There are many changes and improvements in children's cognitive skills between ages 5 and 15. During this period, children develop and refine the concepts of causality, reversibility, and logical reasoning (Shaffer, 1999). As these skills are developing, they may not be perfected until later, and this immature cognitive processing may lead to mistakes being made while riding an ATV. Additionally, processing time in cognitive operations decreases with age while efficiency increases (Shaffer, 1999). Therefore, a younger child riding in a new area for the first time may not be able to process the new riding surface, trees and fences along the trail, other riders, an ATV driving by, and a rock in the road. Some of this information will be lost in processing, and may result in the child hitting the rock. The child is simply not aware of it, because he or she

was distracted by something bigger. Children's ability to concentrate improves dramatically through the grade school years, but in the meantime they are easily distracted (Shaffer, 1999). Passengers are likely to be sources of distraction and children should never carry passengers on ATVs, no matter what the size of the ATV they are riding.

Table 1 summarizes the discussion of children's cognitive development and ATV riding skills and behaviors, while Table 2 interprets this information related to nine skills and behaviors.

Table 1. Developmental Skills by Age

Age	Rider Type	Summary	Cognitive Stage
0-4	Primarily Passengers	• Neither perceptual, cognitive, nor motor skills are developed enough to allow for driving motorized vehicles • Enjoys riding as a passenger	Sensorimotor (0-2) Preoperational (2-4)
5-7	Rudimentary Driver	• Physically capable, but perceptual, cognitive, and motor abilities are not developed enough. • Likely can master certain skills, but can only use one at a time, i.e. can go, but not steer or stop • May not remember basic safety skills • Easily distracted	Preoperational
8-11	Developing Driver	• Around age 8 or 9 perceptual and motor skills will be developed enough to be a passenger, however, cognitive skills are not developed enough to drive • Can master go, steer, and stop • Grasps concepts of gears, parking, basic safety • May gain some advanced skills • May become more confident and attempt simple stunt maneuvers (i.e. wheelies) • Limited foresight • Inconsistent rule remembering • Inability to see the future and ramifications of actions • Impulsive • Should be limited to motorized vehicles slower than 10 mph	Concrete Operational
12-15	Adept Driver	• Masters most needed riding concepts • Poor reaction to unfamiliar situations • Adept driver until something goes wrong • Lacks judgment of several key factors, such as safe speed and proper terrain • Ability to see the future and ramifications of actions, however, inconsistent in using that ability to make proper judgment • Impulsive, especially adolescent males	Formal Operational

Table 2. Approximate age when ATV driving skills are acquired

Age	Rider Type	Start	Go	Steer	Stop	Gears	Park	Safety	Stunts[3]	Error Recovery
0-4	Primarily Passengers	Some	Some	No	No	No	No	No	No	No
5-7	Rudimentary Driver	Yes	Yes	Some	Some	No	No	No	No	No
8-11	Developing Driver	Yes	Yes	Yes	Yes	Yes	Yes	Some	Some	Some
12-15	Adept Driver	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Some	Some

Definitions: Yes – most children will master this skill; No – This skill is too advanced for most children in this age group; Some – 1) Some children will attempt this skill, and some may seem to master and/or 2) Execution is inconsistent

IV. Children's Risk Taking and Judgment

Stunt Riding

ATV riding skills will improve with age and experience to the point that some older children may be considered quite proficient. As children become more confident, they may be inclined to attempt higher risk activities, such as jumping, driving fast, racing, and controlling skids to test their new skills. Children get great internal satisfaction from practicing and performing these stunts (Hughes, 1991). This risk taking is characteristic of development of children who grow up in the US and helps the child to establish independence and adult status (Trickett and Benel, 1986). Children, especially boys, are likely to imitate older adolescent and adult driving behavior they have seen as a way to refine and test their skills, build their confidence, and impress their peers. However, even the children that appear to be proficient may not be able to react appropriately when something goes wrong, due to lack of adult reasoning and judgment.

Some children may begin driving ATVs with adult supervision when they are young, and as the parent watches the child progress in skills, they may allow more unsupervised riding time. This is true with bicycles, where older children often ride without direct parental supervision, and parents may not be aware of the degree of risk-taking their children engage in nor the small bumps and bruises experienced (Morrongiello and Rennie, 1998). It is reasonable to assume that this would also be true of ATV riding behavior, and that many parents are not aware of the risks their older children (age 12 to 15) are taking. Therefore, it is foreseeable that children may be allowed ATV driving time with limited parental supervision.

[3] Statements in this column do not imply an endorsement of stunt riding by children. Instead, it is intended to acknowledge that some children will attempt them, and some children will be relatively successful some of the time.

Peer Influence

Children look up to adults and their older peers and are drawn to ATVs that appear similar to those ridden by adults and older peers. A larger ATV will be seen as better to this child because he or she will stand out from the crowd and give the child so called "bragging rights." Convincing a parent to buy an adult ATV ridden by an older friend or favorite stunt rider may help a child gain acceptance with peers. For these reasons, many children may want to have a bigger ATV similar to what they see driven by older teens and adults. Some children may not even want to have a child ATV, especially if he or she is the only child in the neighborhood with a child ATV. Therefore, it may be difficult to get all children to ride child ATVs, simply because they desire to ride bigger ATVs.

Acceptance is very important in early adolescence, and being good at stunts and tricks can also improve adolescent's social status with their peers (Hughes, 1991). In the grade school years, children who are coordinated and skilled are usually viewed as more popular by peers (Bukatko and Daehler, 2001). Children are often challenged by their peers to attempt new tricks by taunts such as "I dare you" (Hughes, 1991). Once challenged, the child feels they must attempt the stunt or face the shame of their peers. Therefore, peer influence will likely lead children to attempt stunts.

Gender Differences in Risk Taking

From about age 6, children are aware of the dangers involved in their behaviors, but risk taking is to be expected and is unlikely to be prevented, especially in young boys who tend to take more risks than girls do. Hillier and Morrongiello (1998) found that 6- to 10-year-old boys, in general, decided whether to take a risk based on their judgment of the severity of injury. Girls' intentions to take risks were based on whether they would be injured at all. Boys may also be more likely than girls to participate in a risk taking activity after seeing a friend get injured in the same activity. This may be attributed to boys having more of an optimism bias than girls, that is, they tend to attribute accidents to bad luck rather than their behavior (Morrongiello and Rennie, 1998).

V. Training

It has long been recognized that consumers who wish to ride ATVs benefit from training specific to ATV riding; this was the impetus behind the ATV Safety Institute RiderCourse™ and other training available from ATV dealers and manufacturers. However, this course requires an appropriate ATV for participants, that is, children under 16 cannot take this course on an adult ATV. Several comments to the CPSC regarding this petition indicate that there needs to be training specifically for children regardless of the size ATV they ride. It is clear that currently some children are riding adult ATVs, and there is no formal training available for these riders. A study among Indiana youth (Tormoehlen and Sheldon, 1996) found that approximately 1% of youth (age 10 to 19) learned to ride with certified ATV instructors. The most common source of instruction cited was a "friend" (27.3%), closely followed by a father (21.9%). The survey also found a correlation between adult instruction and helmet use, significantly increasing regular helmet usage from 36.9% of those taught by a peer to 44.2% of those taught by an adult.

VI. Anthropometrics and Machine Size

There is a concern among consumers expressed in several comments[4] to the *Federal Register* notice regarding this petition that older children do not "fit" currently available child ATVs (90cc and under). Despite CPSC and manufacturer warnings that children under 16 should not ride "adult-sized" ATVs, there may be some confusion among consumers due to terminology. The CPSC and manufacturers have traditionally categorized ATVs by engine size, leading to terms such as "adult-sized" (greater than 90 cc engine) and "child-sized" (under 90 cc engine) ATV. Many consumers, however, upon hearing the word "sized" may associate the term with physical size, not engine size. Therefore, it is foreseeable that the parent of a large child may feel that since the child is close to adult size (physically), he or she should ride the "adult-sized" ATV.

Although the CPSC terminology "adult-size" and "child-size" was not intended to refer to physical size, current child ATVs with engine sized under 90 cc are much smaller than adult ATVs and appear to be "child sized" both in engine size and in physical dimensions. The first ATV introduced to the US market, however, was a 90cc three-wheeled ATV with an adult-sized frame. This demonstrates that a 90cc machine fitted to an adult or large child is possible but is not available in the US today. Anecdotal evidence suggests that some young adolescents (age 12 to 15) may be too tall or heavy for the child ATVs that are marketed in the US today. For example, a child who is too tall may not be able to steer properly because his or her knees interfere with the handlebars, or a child who is tall and heavy may increase the ATV's propensity to tip by raising the system's center of gravity.[5]

Determining the proper fit of an ATV is not simple. The following factors are used in determining fit (see Appendix A for figures representing each factor):

1) Proper sizing inside the "rider leg envelope" consisting of the seat, footrests, and handlebars. A leg envelope that is too small will place the knees too near the handlebars to steer properly and may force the knees and feet away from the ATV.
2) Sufficient space to move forward and backward on the seat. Too little space will prevent proper weight shifting on hills and turns.
3) Crotch clearance (between the crotch and the seat when standing straddling the seat) that exceeds the suspension travel. If there is not sufficient crotch clearance, the seat could bounce into the child on a bump, possibly propelling the driver forward.[6]
4) Handlebar height such that the driver does not need to lean forward when standing and grasping the handlebars. If the driver is too tall, he or she may have to lean forward significantly over the handlebars to steer when raised off the seat. In some circumstances, this may shift the system's center of gravity forward and increase the likelihood of the ATV tipping forward.[7]

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[4] Comments 1,7, 11, 17, 18, and 27 to *Federal Register* notice Vol. 67, Number 202, p.64353-64354
[5] The center of gravity of the combination of the rider and the ATV is the "system's center of gravity."
[6] Personal Communication with Richard Rondeau of the Michigan ATV Association. July 23, 2003
[7] ibid.

5) Arm reach sufficient to sit comfortably on the seat and reach all the controls, including sufficient length to shift body weight toward the rear and still turn handlebars freely.
6) Leg length sufficient to sit on the seat and place feet flat on the footrests.

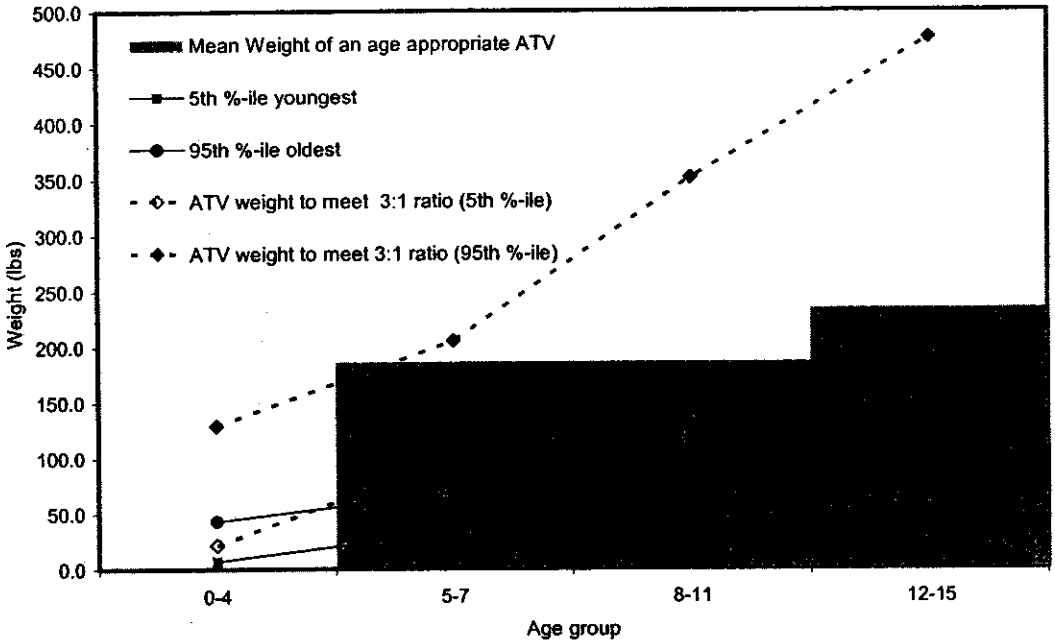
When a driver physically fits on an ATV, the driver is comfortable; conversely, a poorly fit driver is distracted by discomfort and he or she cannot drive as safely because weight shifting and balance may be affected.

The specification data on ATV models available from the manufacturers is not sufficient to show that there may be a discrepancy in the anthropometrics of children and the physical size of the ATVs intended for children under 16. Human Factors staff obtained data regarding seat height and overall height from marketing materials, but data on measurements critical to the "rider envelope" were unavailable. Without ATV rider envelope dimensions, staff cannot determine the range of children that properly fit a given ATV; however, anecdotal evidence suggests many children do not physically fit CPSC recommended ATVs[8].

The relationship between a child's weight and the ATV weight plays an important role in handling. A child who is too heavy may affect the system's center of gravity and decrease the stability, according to CPSC Mechanical Engineering staff. One suggested appropriate child-to-ATV weight ratio is 1:3.[9] Figure 1 shows how the weights of the lightest and heaviest children in each age group compared to the average weight[10] of an ATV appropriately sized by CPSC guidelines (<70 cc for under 12, 70-90 cc for ages 12-16). It appears that some children may begin to be too heavy for the correct ATV as early as age 7, and by age 11 most children may be too heavy for many child ATVs.

[8] According to comments #1, 11, and 27 to *Federal Register* notice Vol. 67, Number 202, p.64353-64354; Richard Rondeau (Michigan ATV Assoc.)
[9] Recommended by Offroad.com: http://www.off-road.com/atv/kidskorner/50/chasis.html
[10] Average ATV weight based on 18 currently available Y-6 ATVs and 17 currently available Y-12 ATVs. Weight of children from ChildData, datasheet 1 based on 1977 US data.

Figure 1: Weights of Children and ATVs



VII. Summary

Research on children's developmental skills suggests that most children under 16 are lacking some skills that would allow them to safely ride ATVs in all situations. Younger children (under 6) especially lack the physical and mental skills needed to safely control a moving vehicle with multiple speeds and controls. By age 6, some children will be able to learn the basic skills needed to ride ATVs with simple controls restricted to low speed with constant supervision. These children will be too young to grasp gear shifting and will have difficulty remembering safety rules, especially in situations where quick recall is needed. These skills will develop slowly, and by age 12 to 13, many children will be able to drive an ATV reasonably safely at speeds over 10 mph, but should not be trusted over about 25 mph and at speeds as fast as many adult ATVs can reach. Older adolescents who have been riding for some time will start to master many skills, but still cannot be trusted to make quick judgments. These older adolescents will also have the highest tendency to push the limits of themselves and their ATV. There is some indication that training by an adult authority may increase safety awareness, at least as far as helmet use is concerned.

Anecdotal evidence suggests that some portion of the population of children under 16 may physically be too large to ride the average child ATV. Forcing a child who is too large to ride an ATV may make him or her significantly uncomfortable and may negatively affect handling. On the other hand, a significant portion of the under 16 population will be physically too small for many adult machines, posing a different set of risks. Human Factors staff believes that currently, there is a discrepancy between children's anthropometrics and ATVs under 90cc intended for these children. Although it is clear that children under 16 do not have all the necessary developmental skills to safely drive adult machines, there do not appear to be child ATVs designed to physically fit some adolescents under 16.

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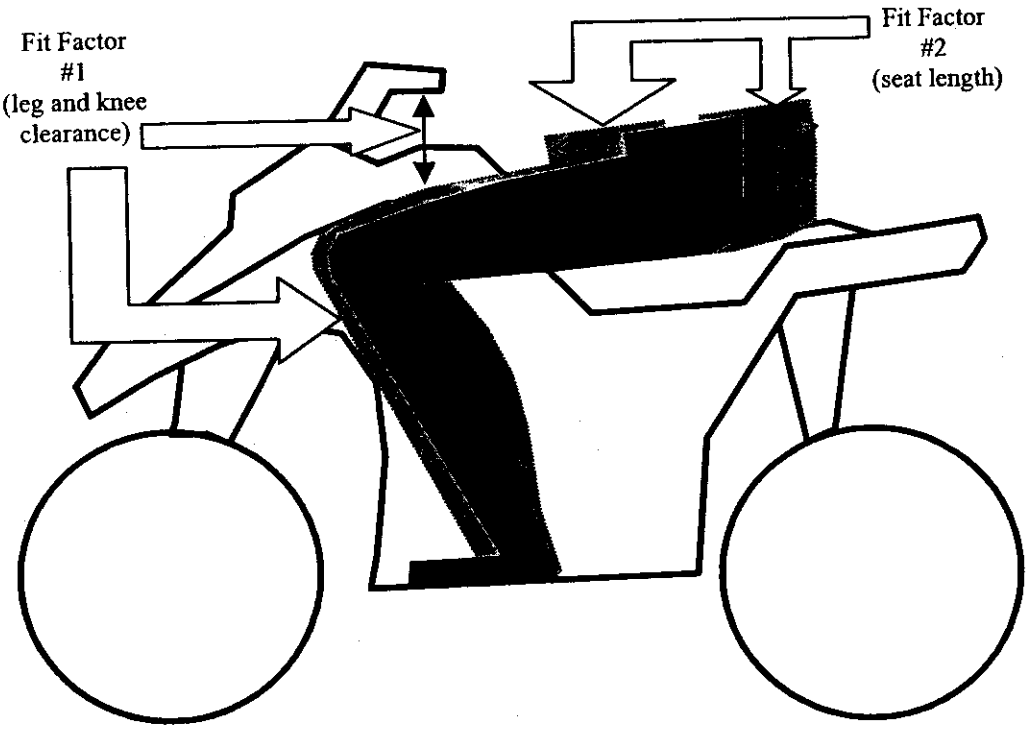
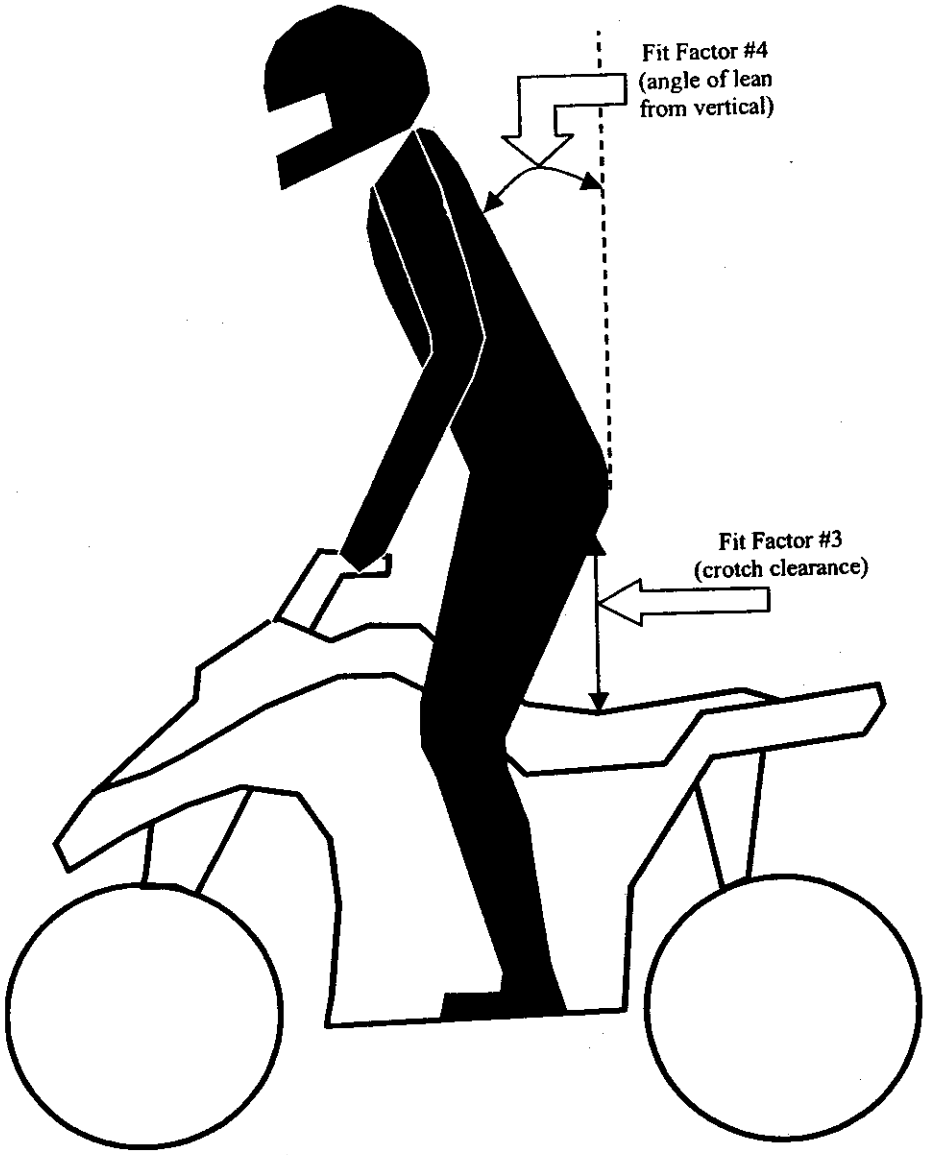
Appendix A

Illustrations of Fit Factors for determining proper physical fit of an ATV



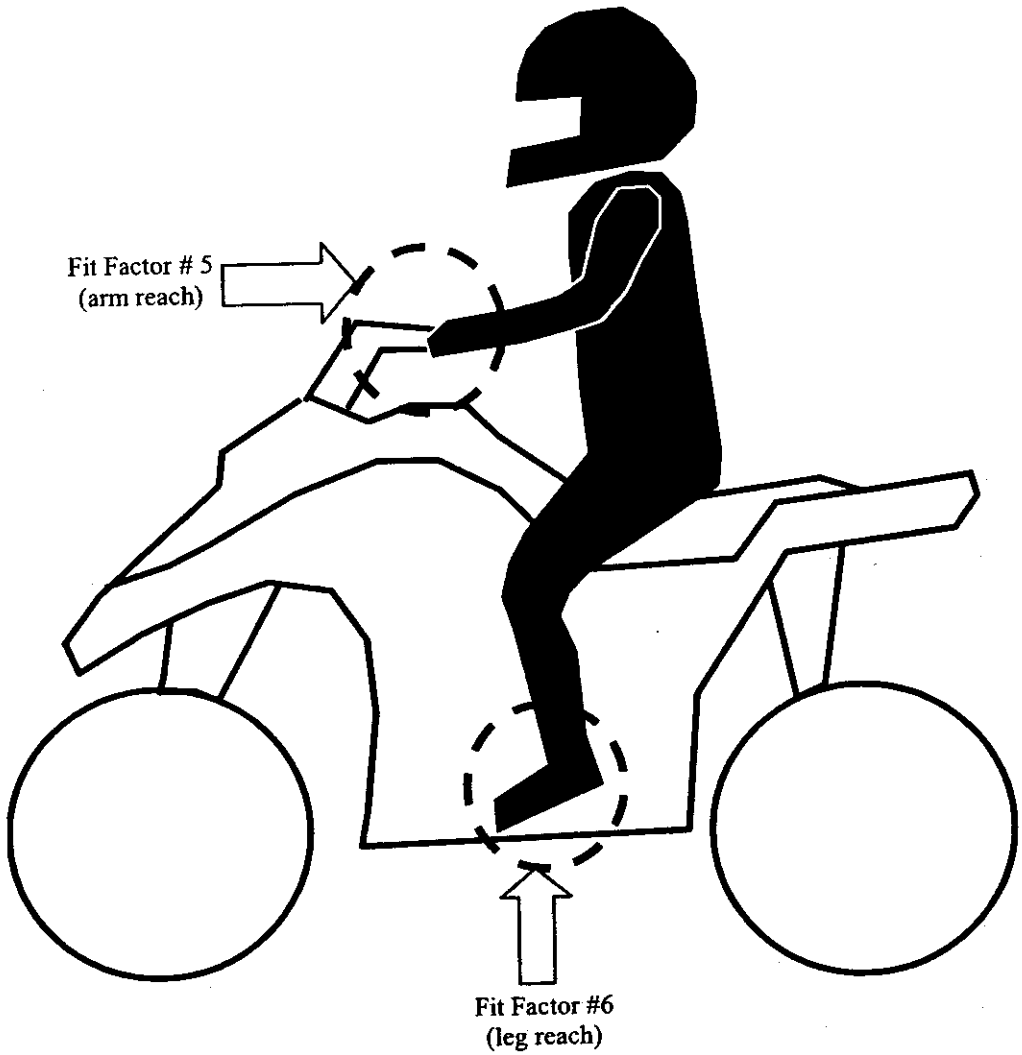
1) Proper sizing inside the "rider leg envelope" consisting of the seat, footrests, and handlebars.

2) Sufficient space to move forward and backward on the seat.



3) Crotch clearance (between the crotch and the seat when standing straddling the seat) that exceeds the suspension travel.

4) Handlebar height such that the driver does not need to lean forward when standing and grasping the handlebars.



5) Arm reach sufficient to sit comfortably on the seat and reach all the controls, including sufficient length to shift body weight toward the rear and still turn handlebars freely.

6) Leg length sufficient to sit on the seat and place feet flat on the footrests.