
What influences youth to operate all-terrain vehicles safely?

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Abstract

The operation of all-terrain vehicles (ATVs) by youth has contributed to the incidence of serious and fatal injuries among children. This study explored factors related to the frequency with which youth wore a helmet and refrained from engaging in three risky driving behaviors (driving at risky speeds, on paved roads and on unfamiliar terrain) while operating an ATV. Youth ($n = 248$) aged 9–14 from central Ohio and one of their parents completed self-report measures of ATV safety behaviors, youth general propensity for risk taking, protection motivation and parental behaviors to facilitate youth safety. Data from two focus groups provided insight on quantitative results. Analyses revealed considerable variation in the frequency with which youth performed the safety behaviors, with 13- and 14-year-olds reporting less frequent safe behavior than 9- to 12-year-olds. Multiple regression analyses suggested that parental behaviors, such as providing reminders to wear a helmet, were associated with more frequent helmet use but were not associated with risky driving behaviors. Youth's general propensity toward risk taking was not associated with helmet use and only associated with risky driving behaviors among the 13- and 14-year-olds. Self-efficacy was an important predictor across both age groups and behaviors. Implications for injury prevention are discussed.

Introduction

All-terrain vehicle operation and injury risk

The operation of all-terrain vehicles (ATVs) by youth causes serious and sometimes fatal injuries. ATVs have three or four wheels with low-pressure over-sized tires, are designed for off-road use and can travel at speeds of over 60 miles/h [1]. Youth often lack the physical strength, motor skills and cognitive maturity to operate ATVs safely, increasing their injury risk [2, 3]. Both the American Academy of Pediatrics and the US Consumer Product Safety Commission have issued official statements that youth under the age of 16 should never operate ATVs [4, 5].

Despite such warnings, youth <16 years of age operate ATVs frequently [6]. ATVs are especially common in agricultural and rural areas. In 2001, almost 40% of farms in the United States reported owning at least one ATV [7]. In a nationally representative sample, about half of youth aged 10–19 living on farms in the US reported having operated an ATV [7].

Children and adolescents account for a disproportionate number of ATV-related injuries and deaths. Between 2001 and 2010, more than 361 000 children under the age of 16 sustained ATV-related injuries that required treatment in an emergency department [8]. ATV operators under the age of 16 are 3.9 times more likely than operators older than 16

years to sustain injuries requiring treatment in an emergency department [9]. Children younger than 16 accounted for almost one-third of all deaths from ATVs between 1982 and 2008, with 11% of deaths experienced by children under 12 years of age [10].

Reducing risk through safer behaviors

Given the current widespread use of ATVs by youth in rural and agricultural areas, a harm reduction approach to reducing ATV-related injuries may be beneficial [11]. Such an approach focuses on increasing safety practices and reducing risky behaviors. A mix of empirical evidence, expert opinion and anecdotal observations has identified several target safety behaviors that can reduce the likelihood or severity of ATV-related injuries. We focus specifically on two types of youth behaviors: wearing a helmet and refraining from engaging in risky driving behaviors (driving at high speeds, driving on paved roads, carrying a passenger and driving on unfamiliar terrain).

Wearing a helmet

For several decades, injury experts have recommended that all youth wear helmets while operating an ATV [12]. Examining data from the National Electronic Injury Surveillance System and fatality figures compiled by the Consumer Product Safety Commission, Rodgers estimated that wearing a helmet can reduce the risk of death from an ATV accident by >40% and could reduce the likelihood that a given injury involves the head by 64% [13]. More recent studies support those findings [14–16] and suggest that helmets may reduce Injury Severity Scores [1].

Refraining from risky driving behaviors

Common risky driving behaviors include driving too fast, driving on paved roads, carrying a passenger and driving on unfamiliar terrain. Refraining from these behaviors can reduce injury risk. Researchers and safety organizations advise young riders to limit their speed when operating ATVs [17, 18], and the American Academy of Pediatrics recommends installing speed governors (devices that

limit maximum speed) on ATVs used by youth [4]. Support for this recommendation comes from epidemiological and clinical studies that have found that excessive speed is a major risk factor in ATV-related fatalities [19]. Operators are also urged to avoid driving ATVs on any public roads, as doing so increases the risk of collision with other vehicles. Most states have legislation prohibiting ATVs from public roads [15, 20, 21, 22]. Driving on paved public roads may be particularly dangerous [17, 18], as ATVs are designed for off-road use only. Several studies have found higher fatality rates in crashes that occur on paved roads compared with off-road crashes [13, 15, 16, 19, 23, 24]. Many ATVs are designed to be operated by a single rider only, and prohibiting youth from carrying passengers while they operate an ATV is also likely to reduce injury risk [6, 9]. Finally, ATV operators are urged to refrain from driving on unfamiliar terrain, where they may be less able to avoid steep or irregular terrain that can cause the ATV to roll over and seriously injure or kill the operator [25].

Influences on safety behaviors

Researchers have identified both parent-level and child-level variables associated with youth safety behaviors. These influences have been studied in a variety of contexts but have not been studied specifically in relation to ATV safety behaviors.

General propensity for risk taking

Longitudinal studies have found that a youth's general propensity to engage in risky behaviors (e.g. how often a child does something dangerous on a dare or breaks a rule set by parents) is associated with specific risk behaviors, including initiation of sexual activity and substance use [26] and with risk for injury [27]. A general propensity for risk taking may be negatively associated with the performance of ATV safety behaviors.

Youth protection motivation

Ronald Rogers developed protection motivation theory (PMT) to explicate the relationships between one's beliefs about potential harm and the likelihood

of taking protective action [28]. PMT states that an individual's intention to perform a specific threat-reducing action (e.g. wearing a helmet while operating an ATV) is a function of two parallel processes: 'threat appraisal' and 'coping appraisal'. In threat appraisal, individuals evaluate the extent to which they: (i) feel personally vulnerable to the health threat ('susceptibility') and (ii) perceive the potential threat as leading to severe negative consequences ('severity'). In coping appraisal, individuals assess: (i) the likelihood that the suggested threat-reducing action will actually reduce the risk of the health threat ('response efficacy') and (ii) the degree to which the individual feels capable of performing the suggested action ('self-efficacy').

PMT constructs have been useful in a variety of health contexts [29]. With regard to youth populations, perceived severity has been found to predict teens' intentions to limit alcohol consumption [30], and threat appraisal has been found to predict seat-belt use among newly licensed teenage drivers [31]. Regarding populations exposed to agricultural hazards, PMT has been used to design interventions to increase adherence with the North American Guidelines for Children's Agricultural Tasks [32]. Although these youth-level variables have been studied in relation to a variety of health behaviors, they have not been studied with regard to ATV safety behaviors.

Parent behaviors

One important parent behavior that may reduce child injury risk is parental monitoring, a construct that refers to the degree to which parents know where their children are, what they are doing and whom they are with when the children are not under the parents' direct supervision [33]. Parental monitoring has been found to be protective against many risk behaviors in children and adolescents, including smoking [34], unprotected and promiscuous sex [35], marijuana use [36] and risky automobile driving [37].

Other parent behaviors may also improve youth ATV safety behaviors. For example, parents can

provide safety equipment (e.g. helmets) for their children and can remind their children of rules and safety concerns. Such reminders can serve as 'cues to action', thereby increasing the frequency of safety behaviors [38]. Parents can also facilitate youth safety behavior by providing appropriate supervision. A distinct construct from parental monitoring (which refers to a parent's overall knowledge of their child's activities), parental supervision refers to specific instances of a parent observing the child's behavior in close proximity to the child [39, 40]. The literature suggests that direct parental supervision can reduce the risk of pediatric injuries through several mechanisms. When parents supervise their children, they can teach and reinforce safety rules, recognize and stop dangerous behavior and prevent children from behaving impulsively [41].

There is limited research on how these parent behaviors affect the safety behaviors of their children, and the studies that have been done have typically focused on very young children, usually no older than the pre-school years [41–45]. Thus, there is a need to examine the extent to which parental behaviors influence ATV-related safety behaviors of older children and adolescents, and to explore how these effects vary with youth age. The present study examines these potential influences on ATV safety behavior in youth aged 9–14 years.

Materials and methods

This study utilized a cross-sectional survey of youth and their parents, augmented by data from focus groups.

Survey methodology

Recruitment and data collection procedures

Survey participants were recruited as part of a larger injury prevention intervention study of children living on farms in central Ohio who operated ATVs and/or worked with horses [46]. Using the statewide 4-H database, research staff mailed recruitment letters to all central Ohio farms with youth aged 9–14 who participated in 4-H.

Research staff then called each household to verify eligibility and to ascertain willingness to participate in the study. At least five phone calls were made during varied hours on weekdays and weekends before discontinuing attempted contact. To be eligible, youth had to be 9–14 years of age at the start of the study period, live on a farm, have no mental or physical disabilities that would interfere with participation, have ridden an ATV or worked with a horse in the past, and plan to ride an ATV or work with a horse in the following 3 months.

One parent and one youth per household enrolled in the study together. Research staff asked that the parent most involved in the supervision of the youth's ATV activities participate in the study. If more than one child in a given household was eligible, it was left up to the household to select which child would participate. Participants could earn up to \$60 by completing all components of the study. Each participating household was mailed two self-administered questionnaires (one for the youth participant and one for the adult participant). Participants filled out the questionnaires at home. Completed questionnaires were collected during a home visit by research staff. The study protocol was approved by the Institutional Review Board of The Ohio State University.

Sample

From the 4-H database, 2359 farms were identified. Of these, 346 had inaccurate phone numbers and 943 were never reached by research staff despite repeated phone calls at various times of the day. Of the remaining 1070 homes with which we did make contact, 500 were determined ineligible. Final recruitment was 401 farms, resulting in recruitment of 70.4% of the total 570 households that were contacted and deemed eligible. Of the 401 total farms, 34 dropped out of the study prior to data collection and home visit, and 7 recruited farms were not visited due to scheduling conflicts. Thus, data were collected from 360 parent–youth dyads. Of these, 248 operated ATVs and are included in the present analysis.

Measures

Youth questionnaires included items on frequency of safety behaviors, protection motivation constructs, youth general propensity for risk taking, youth perceptions of parental monitoring and demographic characteristics. Parent questionnaires assessed parental behaviors to facilitate youth safety, supervision behaviors and demographic characteristics.

Youth ATV safety behaviors

ATV-safety behaviors were measured by asking youths to indicate how often (1 = Never, 2 = Sometimes, 3 = Most of the time, 4 = All of the time) they practiced the specific safety behaviors (wearing a helmet and avoiding risky driving behaviors). Frequency of helmet use was measured with a single item ('When you are driving an ATV, how often do you wear a helmet?'). Youth were also asked how often they 'drive at speeds that you think might be a little risky', 'drive on paved roads', 'drive in places that are unfamiliar to you' and 'let a passenger drive with you'. The passenger item was excluded from analysis in the present study because youth reported driving a mix of ATV models, some of which allowed for safely taking a passenger. To measure how often youth 'refrained' from risky driving practices, the responses to the remaining three items (driving at risky speeds, driving on paved roads and driving in unfamiliar places) were reverse-coded and averaged into a composite score.

Protection motivation

To measure youth protection motivation constructs (i.e. perceived susceptibility, perceived severity, self-efficacy and response efficacy), questions were adapted from Rogers' PMT [28] and applied to ATV safety behaviors. 'Perceived susceptibility to injury' was assessed by asking the youth, 'How likely is it that you will get injured while riding an ATV during the next year?' Responses ranged from 1 = Not at all likely to 4 = Very likely. 'Perceived severity' of potential injuries sustained during ATV operation was measured by taking the average score

from two items (Cronbach $\alpha = 0.84$): ‘Imagine that you did get injured while riding an ATV. How serious do you think the injury would be?’ and ‘How much treatment do you think you would need?’ Youth responded using a four-point scale (1 = Not at all serious to 4 = Very serious; 1 = No treatment to 4 = Treatment at a hospital). ‘Self-efficacy’ was measured by asking the youth to rate on a four-point scale (1 = Very hard to 4 = Very easy) the difficulty of completing each of the safety behaviors (e.g. ‘How hard or easy do you think it would be to always wear a helmet when driving an ATV during the next month?’). Responses to the three risky-driving items were averaged to create a composite self-efficacy score for refraining from risky driving (Cronbach $\alpha = 0.59$). ‘Response-efficacy’ was measured by asking youth to rate on a four-point scale (1 = Protect me not at all to 4 = Protect me a lot) how effective they think a given safety behavior would be at protecting them from injury (e.g. ‘How much would it protect you from getting seriously hurt if you were to always wear a helmet?’). Responses for the three risky driving items were averaged into a composite score for response efficacy for refraining from risky driving (Cronbach $\alpha = 0.69$).

Youth general propensity for risk taking

General propensity for risk taking was measured using an adapted version of the Adolescent Risk Taking Scale [26]. Youth used a three-point scale (1 = ‘Never’, 2 = ‘Once or twice’ and 3 = ‘Several times’) to indicate how often they had engaged in risk-taking behavior such as doing ‘something dangerous/risky on a dare’. Responses to the five items were averaged, and the resulting score had a Cronbach α of 0.58.

Parental monitoring

Youth reported on their parent’s monitoring behavior using the strictness/supervision measure developed by Steinberg et al. [47]. Youth answered six items about the degree to which their parents attempt to find out, and how much their parents actually know, about how the youth spends his or her

time [e.g. ‘How much do your parents (try to/really) know about what you do with your free time?’]. A three-point response scale was used (1 = ‘They don’t know/don’t try to know’ to 3 = ‘They know a lot/they try to know a lot’). Youth also reported on how late they were allowed to stay out on a school night and a weekend night (seven-point scale, 1 = ‘As late as I want’ to 7 = ‘I am not allowed out’). A weighted average of the six monitoring and two curfew items made up the composite scale of parental monitoring (Cronbach $\alpha = 0.72$) [47].

Parental facilitation of youth safety

Parents were asked whether they had provided a helmet for their child to wear while riding an ATV (yes/no) and how often they remind their child to wear a helmet while riding an ATV (five-point scale, 1 = ‘Never’ to 5 = ‘Every time s/he rides’). Parents also indicated on a five-point scale what level of supervision they typically provide when their child is riding an ATV (1 = ‘No direct adult supervision’ to 5 = ‘An adult can see and hear the child the whole time’).

Data analysis

Research staff scanned the self-administered questionnaires into a database using Cardiff TeleForm software [48]. The resulting database was uploaded into SPSS Statistical Software [49] and checked for consistency and missing data. Descriptive statistics were run for all individual items and for all constructed scales. For analysis, we divided the sample into two age groups using a median-split (‘younger’ group was 12 years and under; ‘older’ group was 13 and 14 years of age), to acknowledge that 9-year olds are developmentally very different from 14-year olds [50, 51]. After checking zero-order correlations for potential multi-collinearity problems, regression models were built for each dependent variable using the full sample and separately with the two age groups, with youth sex and parental education controlled throughout.

Focus group methodology

A limited qualitative inquiry explored how parents and youth make decisions about their ATV safety behaviors. In one focus group, youth participants were asked questions about the strategies their parents use to prevent injury while they were operating the ATV as well as their reactions to those strategies. In the other focus group, parents discussed the safety strategies they use when their children operate ATVs, how these strategies change as a child ages and what factors impact their decision-making about safety strategies. Procedures for the focus groups were approved by the Institutional Review Board at Stanford University.

Participants

Participants were recruited during a 4-H ATV competition held in central Ohio during July 2010. Both the youth discussion and the parent discussion had eight participants, within the optimal range of 6–10 participants [52]. The majority of participants were male (youth discussion, 75% male; parent discussion, 62.5% male). Youth were aged 9–15.

Data analysis

Audio recordings of the focus groups were transcribed verbatim. Transcripts were analyzed using multi-pass coding, facilitated by the use of NVivo qualitative research software [53]. The analytic technique used a combination of provisional, pre-determined codes [54], followed by an inductive approach to develop new constructs and identify patterns as they emerged in the data. Analytic memos and data displays were used to assist with analysis [54, 55].

Results

Participant demographics for the survey sample are presented in Table I. The sample was largely White/Caucasian. The proportions of boys and girls were relatively equal, while the majority of parent participants was female. Most parent participants were married and had at least some college education.

Table I. Characteristics of the study sample ($N=248$)

Variable	% (N) ^a
Youth sex	
Female	50.0 (124)
Male	50.0 (124)
Youth race/ethnicity	
White/Caucasian	98.4 (241)
Other ^b	1.6 (4)
Youth age	
9 and 10 years	20.9 (51)
11 and 12 years	40.2 (98)
13 and 14 years	38.9 (95)
Parent sex	
Female	70.9 (173)
Male	29.1 (71)
Parent race/ethnicity	
White/Caucasian	99.6 (243)
Other ^b	0.4 (1)
Parent marital status	
Currently married	94.2 (229)
Not currently married	5.8 (14)
Parent age	
26–35 years	11.0 (26)
36–45 years	61.2 (145)
46–55 years	24.9 (59)
56–65 years	3.0 (7)
Parent educational attainment	
High school degree or less	25.0 (61)
Some college or technical school	38.5 (94)
College degree or higher	36.5 (89)

^aNot all categories sum to 248 due to missing data.

^bIncludes American Indian/Aleut/Eskimo and Hispanic/Latino.

Prevalence of youth ATV safety behaviors

The prevalence of specific ATV safety behaviors, as reported by youth, is shown in Table II. Approximately one-third of both groups reported never wearing a helmet, while only ~32% of younger youth and ~23% of older youth reported wearing a helmet all of the time. Approximately one-third of 9- to 12-year-olds and one-fourth of 13- and 14-year-olds reported always refraining from driving at speeds that 'seemed a little risky'. About half of both age groups reported always refraining from driving on paved roads. Almost three-quarters of both age groups reported always

Table II. Youth self-reported frequency of ATV safety behaviors

	Never (%)	Sometimes (%)	Most of the time (%)	All of the time (%)	χ^2 test, <i>P</i> -value ^a
Helmet use					
Wear a helmet					
Age 9–12 (<i>N</i> = 144)	31.9	18.1	17.4	32.6	0.401
Age 13–14 (<i>N</i> = 95)	36.8	23.2	16.8	23.2	
Refrain from risky driving Behavior					
Refrain from driving at risky speeds					
Age 9–12 (<i>N</i> = 141)	0.0	7.6	57.9	34.5	0.178
Age 13–14 (<i>N</i> = 95)	2.1	6.3	65.3	26.3	
Refrain from driving on paved roads					
Age 9–12 (<i>N</i> = 141)	1.4	4.1	38.6	55.9	0.282
Age 13–14 (<i>N</i> = 95)	0.0	7.4	45.3	47.4	
Refrain from driving unfamiliar places					
Age 9–12 (<i>N</i> = 141)	1.4	0.7	25.4	72.9	0.693
Age 13–14 (<i>N</i> = 95)	0.0	1.1	26.3	72.6	

^aPearson χ^2 -test for homogeneity (two-tailed), comparing ages 9–12 with ages 13–14.

refraining from driving in unfamiliar places. A composite safety score (not shown in table) was created by averaging scores for the four safety behaviors. The 9-to-12-year-olds had a higher average safety score compared with the 13- and 14-year olds (3.26 versus 3.11, $P = 0.01$).

Factors associated with how often youth wear a helmet

Approximately two-thirds of parents reported providing their child with a helmet to wear while riding an ATV, with no differences across age groups. Whether youth were provided a helmet by their parents had a large impact on how often they reported wearing a helmet. Among youth whose parents provided a helmet, 48.9% of respondents aged 9–12 and 32.8% of respondents aged 13–14 reported always wearing a helmet. In contrast, among youth for whom a helmet was not provided, <5% reported always wearing a helmet, whereas approximately three-quarters reported never wearing a helmet, with no differences across age groups.

Because helmet use was minimal among youth for whom a helmet was not provided, we included in regression analysis only youth whose parents provided a helmet. Table III presents the age-specific

means for the independent variables and the regression coefficients for factors associated with frequency of helmet use. Parents reported providing more frequent supervision for the younger children than the older children, but there were no mean differences between the age groups in parental monitoring or in the frequency with which parents reminded their children to wear a helmet. The older age group reported slightly more general risk-taking behavior (mean difference approached significance). Youth-perceived severity and self-efficacy for wearing a helmet were higher among the younger group than the older group.

Regression models were run with the full sample (all ages) and separately for each age group. Parental reminders to wear a helmet were significantly associated with helmet use among youth ages 9–12 years, but not among youth ages 13–14. Parental monitoring, general propensity toward risk-taking and perceived susceptibility were not significant predictors of helmet use in either age group. Parental supervision and perceived severity were significantly associated with increased helmet use when all participants were examined simultaneously, but did not reach significance in the age-specific models. Self-efficacy, but not response

Table III. Age-specific means and regression coefficients for factors associated with frequency of helmet use, among youth for whom a helmet was provided

Independent variables	Mean (SD)		<i>t</i> -test, <i>P</i> -value	β , all ages (<i>N</i> = 142)	β , age 9–12 (<i>N</i> = 84)	β , age 13–14 (<i>N</i> = 58)
	Age 9–12 (<i>N</i> = 86)	Age 13–14 (<i>N</i> = 59)				
Parental behaviors						
Remind youth to wear helmet	3.74 (0.15)	3.38 (0.19)	0.138	0.244***	0.318**	0.100
Parental monitoring	2.66 (0.26)	2.59 (0.26)	0.106	0.102	0.155	0.047
Parental supervision	4.19 (0.94)	3.34 (1.06)	<0.001	0.130*	0.138	0.075
Youth behavior and protection motivation beliefs						
General propensity for risk taking	1.40 (0.32)	1.50 (0.34)	0.055	0.081	0.122	0.093
Perceived susceptibility	1.90 (0.65)	1.97 (0.79)	0.556	0.107	0.114	0.160
Perceived severity	2.14 (0.73)	1.82 (0.67)	0.008	0.139*	0.151	0.089
Self-efficacy: wear helmet	3.66 (0.87)	3.31 (0.13)	0.020	0.420***	0.364***	0.573***
Response efficacy: wear helmet	3.76 (0.45)	3.61 (0.70)	0.101	0.092	0.158	−0.006
Adjusted <i>R</i> ²				0.485	0.401	0.492

Standardized β values are reported for regression models. Youth gender and parental education are controlled throughout all regression models.

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

efficacy, was a highly significant predictor of increased helmet use for both age groups.

The focus groups provided insight into when parents are more likely to remind or require their youth to wear a helmet. Parents reported different behavior depending on aspects of the environment in which their children were riding. For example, several parents reported not requiring their children to wear a helmet in very hot weather. In ATV-riding parks and areas with unfamiliar or hazardous terrain, parents reported they were more likely to require their youth to wear a helmet, even if they did not require a helmet in other situations. For example, one parent, who did not require his children to wear any safety gear when they ride on the family's farm, reported that when his children rode in a local park with ATV trails: 'I make (my kids) wear all their gear... (because) the terrain is just kind of terrible down there... Because you're not riding on flat terrain that you go on everyday'. Conversely, several parents noted that when their child was driving at slow speeds on familiar terrain, they did not ask the youth to wear a helmet. All parents in the focus group provided their youth with a helmet, so the discussion did not provide

insight into why some parents do not provide a helmet to their child.

Factors associated with how often youth refrain from risky driving behaviors

Table IV presents age-specific means for independent variables and regression coefficients for the factors associated with the frequency with which youth refrain from risky driving behaviors. Parental supervision was higher among younger youth, whereas general risk taking was higher among older youth. Self-efficacy for refraining from risky driving behaviors was relatively high in both age groups. Youth aged 9–12 years reported higher perceived severity and higher response efficacy than did their older counterparts.

Regression models were run with the full sample (all ages) and separately with each age group. Parental monitoring and parental supervision were not significantly associated with the frequency of refraining from risky driving behaviors in any of the models. General risk taking was a significant predictor among those aged 13–14 years but not among the younger group. Perceived severity was significantly associated with youth refraining from

Table IV. Age-specific means and regression coefficients for factors associated with frequency of refraining from risky driving behaviors

Independent variables	Mean (SD)		<i>t</i> -test, <i>P</i> -value	β , all ages (<i>N</i> = 217)	β , age 9–12 (<i>N</i> = 130)	β , age 13–14 (<i>N</i> = 87)
	Age 9–12 (<i>N</i> = 130)	Age 13–14 (<i>N</i> = 87)				
Parental behaviors						
Parental monitoring	2.65 (0.28)	2.62 (0.25)	0.349	0.013	0.100	–0.168
Parental supervision	4.14 (0.96)	3.52 (1.01)	<0.001	–0.032	–0.066	0.006
Youth behavior and protection motivation beliefs						
General propensity for risk taking	1.35 (0.30)	1.48 (0.34)	0.003	–0.134*	–0.044	–0.257*
Perceived susceptibility	1.82 (0.68)	1.89 (0.77)	0.491	–0.046	–0.064	0.037
Perceived severity	2.17 (0.83)	1.86 (0.71)	0.005	–0.112*	–0.197*	0.025
Self-efficacy: refrain from risky driving behaviors	3.41 (0.60)	3.32 (0.73)	0.329	0.502***	0.408***	0.601***
Response efficacy: refrain from risky driving behaviors	3.58 (0.49)	3.39 (0.59)	0.013	0.022	0.065	–0.040
Adjusted R^2				0.345	0.281	0.442

Standardized β values are reported for regression models. Youth gender and parental education controlled throughout all regression models.

* for $P < 0.05$, ** for $P < 0.01$, and *** for $P < 0.001$.

risky driving behaviors less frequently for the younger age group, but was not significant among youth aged 13–14 years. Self-efficacy was highly significant for both age groups.

In contrast to regression results, the focus group discussion suggested that youth who perceive they are at risk for severe injury from driving an ATV are less likely to engage in risky driving behaviors. Youth's comments indicated that they understood that risky driving can cause serious injury. For example, one youth shared a story of an acquaintance driving too fast and getting severely injured: '... he was going too fast, and he didn't realize there was fencing and so then he went right into fencing... the fencing cut about half into his neck'. Another shared a similar story in which a pair of children drove at dangerous speeds and suffered serious injuries: '... they were driving too fast in gravel... and once they caught the grass, they ended up turning (the ATV) over, and the girl... she almost cut her foot off. So now she has this big, nasty skin graft and they had to fix tendons'. These statements suggest that these youth understand the potential for ATV accidents to cause serious injury to others. Youth

also stated that they chose not to drive recklessly in order to avoid potentially severe injuries to themselves. One boy explained that he and his sister refrained from driving recklessly because doing so could result in serious injury: 'We both are old enough that we know not to mess around and end up getting seriously hurt'. Here the participant indicates that he refrains from risky driving behaviors specifically because 'messing around' could cause him to get 'seriously hurt'.

Focus group participants also discussed parental supervision. Both parents and youth reported that parents tended to provide less frequent and less direct supervision as their children got older, consistent with the age differences in parent-reported supervision levels seen in the surveys. Youth comments may shed some light onto why parental supervision was not a significant predictor of how often youth refrained from risky driving behaviors. All youth in this discussion reported that they did not engage in riskier behaviors when they were unsupervised, often citing the importance of behaving safely to avoid getting injured. One girl explained that she did not take more risks when she was unsupervised,

because doing so could make her more vulnerable to injury: I'm not going to do anything different (when my parents are not watching) . . . 'cause I know that I wouldn't want to wreck or anything and get hurt really bad'.

Discussion

Analyses revealed considerable variation in the frequency with which youth practice safety behaviors while operating ATVs, both within and across safety behaviors. For example, about one-third of youth reported always wearing a helmet, whereas an approximately equal number reported never wearing one. These findings are comparable with those found elsewhere in the literature [56, 57]. A much higher proportion of youth reported refraining from risky driving behaviors most or all of the time than reported wearing a helmet most or all of the time. This particular finding stands in contrast to other studies. For example, in a study by Burgus *et al.* [56] of youth aged 12–20, only 19% of respondents reported never riding on a paved road, compared with ~50% of respondents in the present study. This discrepancy between our results and previous studies could be a result of differences in the age ranges studied, or of how our questionnaires were administered. Youth participants completed the questionnaires at home. If youth thought that their parents might see their answers, they may have reported safer behaviors than they actually perform. Regardless, all safety behaviors show room for improvement.

Analyses also revealed differences between age groups. The 13- and 14-year-old group reported a lower average safety score, were less likely to report wearing a helmet all of the time and were slightly less likely to refrain from engaging in risky driving behaviors (though not significantly so). These findings are in line with studies suggesting that risk behavior peaks in mid- to late-adolescence [58–60]. Despite the older youth's increased propensity to engage in risky behavior on the ATV, the parents of the older children in our sample reported providing significantly less supervision than the parents of

the 9- to 12-year olds. It is problematic that parents seem to decrease their supervision at precisely the developmental stage when youth are most prone to engaging in risky behaviors. Injury prevention programs should encourage parents to continue to provide appropriate supervision even as their children enter the teen years. As youth enter adolescence, the qualitative nature of the supervision may need to change to allow youth exert more independence. For example, youth might periodically check in with their parents using a mobile device when direct supervision is not or cannot be provided [61]. Future research might examine whether such practices are an effective means of managing injury risk.

Youth's general propensity for risk taking was associated with less frequently refraining from risky driving behaviors, but only among 13- and 14-year olds. One possible explanation for this finding comes from research on adolescent brain development. Research suggests a mismatch during adolescence in the developmental trajectories of different brain systems, such that systems that increase risk-taking and novelty-seeking behavior (*i.e.* the limbic system) mature earlier relative to impulse control systems (*i.e.* the prefrontal cortex). This mismatch may make adolescents less able to carry out safety behaviors, even when they 'know' what they should do [58–60]. It is reasonable to suggest that the 13- and 14-year-olds in our sample, particularly those with greater propensity for risk taking in general, had begun to seek more novelty and be more sensitive to the rewards of engaging in risky ATV driving behaviors, while the 9- to 12-year olds, with comparatively immature limbic systems, had not yet become particularly sensitive to the novelty of taking risks while driving the ATV.

Although the general propensity for risk taking score was negatively associated with the frequency with which older youth refrained from risky driving behavior, it was unimportant in predicting helmet use in either age group. This might suggest that youth do not perceive that driving without a helmet is fun, novel or thrilling in the way that driving on unfamiliar terrain or at fast speeds might be. This finding also underscores that different factors

are important for different safety behaviors, indicating that interventions need to be tailored to the specific behaviors they aim to address.

Several parental behaviors played an important role in increasing youth helmet use. When parents did not provide a helmet, the youth were highly unlikely to wear one while driving the ATV. Among youth whose parents did provide a helmet, parental reminders to wear the helmet were associated with more frequent helmet use, particularly among youth aged 9–12. Parental supervision also appears to increase helmet use. These findings highlight the importance of parental behaviors and suggest that interventions to increase helmet use should target parents in addition to youth. The forms these interventions take should be guided by further research. For example, research is needed to assess why parents do or do not engage in the behaviors that facilitate helmet use in their children. Why do some parents not provide a helmet for their child? Why do some remind their children to wear a helmet while operating the ATV, while others do not? PMT may provide some useful direction. For example, studies of teen automobile driving have indicated that parents who are made aware of the importance of their own behaviors in improving their youth's safety practices (i.e. the response efficacy of their behaviors) are more likely to take actions to influence their youth's behavior [62].

In contrast to helmet use, no parental behaviors were significantly related to how often youth refrained from risky driving behaviors. The present study did not examine any parental behaviors specific to helping youth refrain from risky driving behaviors (e.g. we did not ask parents how often they remind their children not to drive on paved roads). It is possible that such ATV-specific behaviors would be related to less frequent risky driving behaviors in youth, even though general parent behaviors like monitoring and supervision were not. Future research should explore this, especially given the importance of parental reminders in predicting helmet use.

The overall pattern of results suggests coping appraisal is a more important process in predicting youth ATV safety behaviors than threat appraisal.

For both sets of safety behaviors and across both age groups, youth self-efficacy for practicing the behaviors was by far the strongest predictor of how frequently they practiced those safety behaviors. In contrast, perceived susceptibility was not a predictor of either helmet use or the frequency with which youth refrained from risky driving behaviors. Higher perceived severity was not associated with helmet use, but did predict lower frequency of refraining from risky driving behaviors in youth aged 9–12, a finding contrary to focus group data and PMT predictions [28]. Many health education programs focus on increasing perceived threat using fear appeals [30, 63]. Our results suggest that this may not be the best approach to improve youth ATV-related safety behaviors, and that instead, interventions should focus on increasing coping appraisal, and particularly on increasing self-efficacy. Self-efficacy can be enhanced through several mechanisms, including enactive mastery (successfully completing the target activity), vicarious role modeling (seeing others successfully perform the target activity) and verbal persuasion (suggestions or encouragement from others that one can perform the target behavior) [64]. Health departments, injury prevention programs and structured educational opportunities, such as those offered through the 4-H Youth Development Program, are well placed to offer opportunities for youth to gradually build skills (increasing their sense of enactive mastery), provide encouragement (verbal persuasion) and feature role models for safe behavior (vicarious role modeling).

Strengths and limitations

This study is among the first to study the factors related to the frequency with which youth practice ATV safety behaviors and has several strengths. Multiple variables were studied simultaneously, allowing analyses to illuminate the relative importance of different factors in predicting ATV safety behaviors. Data were collected from both youth and parents, allowing a more complete examination of potential influences on youth safety behaviors. The limited qualitative data offered some insight into the relationships uncovered in regression analyses.

Some limitations have already been identified. Others include the cross-sectional design, which precludes making any rigorous causal inferences. The sample size was relatively small and homogenous, including only youth who were 4-H members living on farms in central Ohio. Whether the results generalize to families who are not involved in youth development programs like 4-H, or who do not live on farms, remains to be studied. Additionally, several constructs (e.g. parental supervision and the protection motivation constructs) were measured with only one or two questionnaire items, and might have been more accurately assessed with several items. Finally, some constructs displayed relatively low internal consistency. Most notably for the present study, the composite score for youth's self efficacy to refrain from risky driving behaviors had Cronbach's $\alpha = 0.59$. In light of this low internal consistency, we ran separate regression models with each individual behavior to ensure that it was still appropriate to treat the three items about refraining from risky driving behaviors as one behavior. We found a similar pattern of results across all three behaviors. Future research can address the present study's limitations by examining more diverse youth populations, measuring constructs with several items, and using longitudinal or intervention study designs.

Conclusion

Pediatric ATV-related injury and death is a serious public health problem in the United States. Given the widespread use of ATVs by children, interventions should focus on increasing safety practices among youth ATV operators. The two target safety behaviors studied here (helmet use and refraining from risky driving behaviors) each had a distinct set of predictors, suggesting that interventions must be tailored to specific safety behaviors. Parental behaviors were important predictors of youth helmet use, indicating that programs to increase helmet use should include parents as well as youth. Future research is needed to examine safety behaviors around other injury-related

activities (e.g. driving automobiles, riding bicycles and certain contact sports) in order to develop evidence-based injury prevention efforts. Given that unintentional injury is the leading killer of youth in the United States [65], research in this area is an important public health priority.

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Conflict of interest statement

None declared.

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