CPSC Staff's Statement on Westat's
"Test Trial Focus Groups on Child-Resistant ATV Ignition Functionality and Usability Study: Final Report"[1]
July 2017

The report titled, "Test Trial Focus Groups on Child-Resistant ATV Ignition Functionality and Usability Study: Final Report," presents the findings of research conducted by Westat under Contract #GS-23F-8144H. This work addresses item five of the 2014 Mid-Year Operating Plan adjustment for ATVs:

> Contract to quantitatively and qualitatively evaluate the functionality, usability, and acceptability of a prototype child-resistant ignition for an ATV, including the functionality in preventing children under 10-years-old from starting an ATV while retaining functionality for adults. Also, included in this contract will be work to assess how acceptable a prototype child-resistant ATV ignition is to adults.

The attached report describes the methodology, interview process, and the key findings from the interviews and focus group. Key findings from the contractor include:

- For the participants in the study, fewer children were able to activate the prototype than the standard ignition, while there was no difference for adults.
- Most adult participants felt that the number of steps required to start the CR ignition was not too onerous for an adult to use and they did believe that the CR ignition would probably be successful at preventing all of the children between 7 and 8 years old from starting the ATV.

Staff notes that participants were primarily recruited from the Washington D.C. metro area.

[1] This statement was prepared by the CPSC staff, and the attached report was produced by Westat for CPSC staff. The statement and report have not been reviewed or approved by, and do not necessarily represent the views of, the Commission.

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Contract # GS-23F-8144H

Test Trial Focus Groups on Child - Resistant ATV Ignition Functionality and Usability Study: Final Report

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Table of Contents

Table of Contents (continued)

Table of Contents (continued)

Table of Contents (continued)

Figure **Page**

Introduction 1

1.1 Background

This report describes the detailed methods and findings of focus group research conducted for the U.S. Consumer Product Safety Commission (CPSC) under the project "Child-resistant ATV Ignition Functionality and Usability Study."

From 1982 through 2014, CPSC staff received reports of 3,098 ATV-related fatalities of children younger than 16 years of age. This represents 23 percent of the total number of reported ATV-related fatalities. Of the 3,098 reported ATV-related fatalities of children younger than 16 years of age, 1,342 (43 percent) were younger than 12 years of age (CPSC, 2015). According to Commissioner Adler in a February 2012 statement, "ATVs remain the most dangerous discretionary use product for children within CPSC's jurisdiction[1]." It is important to note that there are many injuries for every fatality; the report's estimate is 24,800 ATV-related injuries for children under 16 for 2014 (CPSC, 2015).

There are numerous aspects to ATV safety, but critical among them is the ability of under-age children to operate an adult ATV. This use by a child might be unauthorized or might occur with the consent of an adult supervisor (generally a parent). The nature of the problem makes developing a child-resistant strategy challenging. There are substantial overlaps in the anthropometric dimensions, as well as cognitive abilities, between the adult user population and children in the target age group. Additionally, adult annoyance and acceptability issues may provide consumer acceptance barriers. These difficulties ought not preclude efforts to develop safer products with improved child resistance, even if the outcomes fall short of perfect. While child behavior, adult behavior, and parent-child interaction may continue to be problematic, design innovations and technological advances may lead to very substantial reductions in deaths and injuries of children younger than 16 years of age.

[1] Statement of Commissioner Robert S. Adler Regarding the Final Rule Amending Mandatory All-Terrain Vehicle Standard (February 14, 2012), available at: https://www.cpsc.gov/PageFiles/121394/adler02142012.pdf

The CPSC staff believes that a child-resistant ignition on ATVs may have the potential to reduce the likelihood that a child could start and consequently operate an adult ATV, and consequently, reduce the number of injuries and deaths for children in this class of vehicle. Virginia Polytechnic Institute and State University's Industrial and System Engineering department designed and did limited testing of a child-resistant ignition prototype. The prototype requires the ATV driver to depress buttons on the handle bars, depress a foot pedal, and sit toward the rear of the vehicle seat. However, as mentioned above, there is always a trade-off between the effectiveness of an operational device in influencing the child's behavior and the willingness of adult users to accept the device. The CPSC is interested in whether the physical requirements of this child-resistant ignition prototype can prevent children under a certain age from starting the ignition of an ATV without affecting adult use. More broadly, could ATVs be designed in a manner such that a child would be unable to start the vehicle, and if so, how would such an ignition system be used and accepted by the adult riding population?

To establish the effectiveness of the child-resistant ignition prototype in reducing the number of child related injuries and deaths on ATVs Westat performed a thorough evaluation of the successes and problems of various groups of children in both qualitative and quantitative terms so that subsequent decisions can be data-driven and objectively supported. In addition, given that the child-resistant ignition prototype is a physical task that will require key anthropometric dimensions to meet certain criteria (ex. physical weight, arm length, leg length) in order to successfully activate the ignition, the prototype was tested to see if it can effectively discriminate between the larger children and the smaller adults. For example, the weight of the 85th percentile 10-year-old boy is approximately the same as that of the 10th percentile young adult female. In addition, the upper leg length of an 85th percentile 10-year-old boy is approximately the same as a 15th percentile adult female. Therefore, challenges and problems experienced by larger children may be similar to those experienced by smaller adults. If the child-resistant ignition prototype is successful at preventing children from operating an ATV, but also presents the same issues for adult users, the perceived usability and acceptance by the consumers may negatively impact their decision to purchase a vehicle with this feature or increase the likelihood that they would look for strategies that will disable it. To address this issue, the study included adults as well as children, and specifically subgroups of larger children and smaller adults. In addition, the experimental design addressed adult annoyance and acceptability issues that may provide consumer acceptance barriers.

To address the above factors, Westat conducted test trial focus groups with recruited adults and children. The focus groups allowed for a hands-on interaction with both the standard ATV ignition and child-resistant ignition prototype. Observing the children as they interacted with the standard

ignition and child-resistant ignition prototype enabled researchers to assess how effective the prototype is relative to the standard ignition at inhibiting children from using an ATV. It also allowed researchers to identify strategies used by the children when attempting to operate the ignition. Permitting adult participants to operate the ignition enabled researchers to provide a more valid evaluation of the technology and its functionality.

1.2 Objectives

The overall goal of this project is to provide CPSC with systematic and objective data to support agency decision making with regard to the effectiveness of a child-resistant (CR) ignition mechanism in preventing children under a certain age from starting the ignition of an ATV without severely and negatively affecting adult use or acceptance.

The research questions depend on the age of the participant, and are as follows:

Children

1. What percent of children can successfully start the CR ignition prototype?
2. Is the percent of children that can successfully start the CR ignition prototype less than the standard ignition?
3. Does "modeling" the start-up procedure affect the percent of children than can successfully start the ignition?

Adults

1. What is the satisfaction rate for adults with the CR ignition prototype, and is it less than the standard ignition?

Methodology 2

2.1 Overall Study Design

A test trial focus group paradigm was used to investigate the overall effectiveness and adult user acceptance of the CR ignition prototype. Both adults (with ATV experience), and children (with and without ATV experience) were recruited for this study. While a majority of the sessions took place in Rockville, Maryland at a Westat facility, some sessions with experienced child ATV users were conducted at Rock Run ATV Recreation Park, in Patton, Pennsylvania. Each focus group session typically included 2 - 4 participants, and was approximately 1½ hours in duration. Portions of the focus group were audio and video taped for review and analysis.

The study design involved the recruitment of 80 child participants between the age of 7-10 years-old, 80 child participants between the age of 11-15 years-old, and 50 adults participants who were at least 18 years of age and had experience riding or driving ATVs. Half of the children were required to have experience riding or driving ATVs and half were required to have no experience with ATVs. Additionally, a portion of each age group was explicitly allocated to the more extreme percentiles (larger children, smaller adults). A more detailed description of the participants is provided in Section 2.6, "Participant Recruitment and Scheduling", of this report.

Upon arrival, participants were provided with an introduction to the study and guided through the consent process. The introduction indicated federal government sponsorship and described each of the three components of the focus group. The introduction also informed participants that the ATV engine would not actually start, and that the engine was disconnected. Instead, the experimenter would ask each participant to operate an ATV ignition simulator, and the experimenter would be able to see whether or not the participant was successful by a series of lights that would illuminate in the data collection program. Adult participants were made aware of the study intent, to test out a CR prototype and were provided visual feedback as to whether or not their attempts were successful. Child participants were kept naïve to the study purpose and not given any feedback. It is important to note that any reference to "starting" the ATV in the report refers to replicating a simulated start.

All participants were asked to sign an Informed Consent form as well as a video release. For child participants, parents were asked to consent for the child and the child was asked to acknowledge

their assent. Once all participants reviewed and signed both forms, the moderator began the discussion. Moderator guides provided explicit procedural details for all aspects of the focus group, including a specific question path. Additionally, each moderator guide was tailored to the age group of the participants and their relative ATV experience.

The initial discussion was followed by a hands-on task portion where participants experienced the standard ignition and the CR ignition prototype. While each participant was waiting for their opportunity to interact with the ATV, a Westat researcher recorded their anthropometric measures. After all participants experienced the hands-on and measurement portion of the focus group, they returned to the meeting space for a follow-up discussion. At this point, the participants were led through a short discussion of their experience with the task.

The structure of the focus group was such that all sessions were led by a trained moderator and study participants were compensated $50 for their time. The study was approved by Westat's Internal Review Board (IRB) and by the U.S. Office of Management and Budget (OMB) (Control No. 3041-0136). The focus group methodology is described in more detail in the following sections.

2.2 Initial (Pre-Task) Discussion

Since participants with varying levels of experience were recruited for the study, three moderator guides were developed (adults with ATV experience, children with ATV experience, and children without ATV experience). For participants with experience riding/driving an ATV, the intent of the pre-discussion was to gain an understanding of the participant's familiarity with ATVs. The pre-discussion for children with ATV experience included the following topics:

ATV ownership, including ownership of a child-sized ATV versus an adult-sized ATV;

Most recent experience riding an ATV;

Riding frequency;

Typical riding behavior, including

- average speed,
- if the participant is usually the passenger or driver,
- use of protective gear,
- typical maneuvers on the ATV, and
- adult supervision.

For child participants without ATV experience the pre-discussion was abbreviated and predominantly focused on ascertaining what they knew, if anything, about ATVs. Topics included: if they had ever seen an ATV; their understanding how it is used and how to ride it; if they know anyone who owns one; and their general impressions of ATVs.

The pre-task discussion with adult ATV riders was also more extensive. In addition to covering the same topics as were discussed with children who had ATV experience, adults were also asked whether or not they ride with any passengers, if any of the passengers are children, if they ever allowed children to ride/drive their ATV, and their general opinions on ATV safety. Furthermore, adults were asked their opinion on child-resistant products both in the home and with respect to ATV use.

2.3 Hands-On Task

Following the initial discussion, participants took part in the hands-on task portion of the session. During the hands-on task, all participants had the opportunity to operate the ignition simulator on the ATV using both the standard ignition and the CR ignition prototype. In order to help preclude the effects of learning and fatigue, participants were counterbalanced so that some experienced the standard ignition first and others experienced the CR ignition prototype first.

Before each participant started the hands-on trial, a Westat experimenter provided a short orientation to inform the participant on what would be expected of them. Then each participant was asked to "start" the ATV (see Appendix C for the Hands-On Script). It is important to note that for the initial trials with each ignition type none of the participants were told how to start the ATV or which of the ignition types (standard or CR Prototype) was being tested.

Each participant was allowed up to 2 minutes to successfully operate the ignition simulator. If the participant was unable to operate the ignition in the time allowed, the experimenter would model the procedure needed to activate the ignition, and the participant was given an additional 2 minutes to try and successfully "start" the ATV. For adults, the experimenter provided both a demonstration and verbal instruction on how to operate the ignition type(s), and then asked the participant to try again. For child participants, the experimenter only modeled the behavior to start the ignition type(s). This strategy of modeling was implemented because many children learn behaviors by simply observing their parents complete a task (e.g., using a TV remote, operating a cell phone, starting a car). Therefore, it is highly likely that the strategies and techniques a child uses to

overcome the CR ignition prototype in a natural setting will come from observing and copying adult behavior.

Note, if the participant was successful on their initial attempt to start either the standard or CR ignition prototype (without modeling), the behavior was not modeled and the experimenter moved on to the next task in the hands-on portion of the study.

During each trial, adult participants received feedback in the form of a green light indicating when they were successful in working either ignition type. Adult participants were oriented to the location and the purpose of the green light prior to their initial trial. Children were given no feedback as to whether or not their attempts to start either ignition type were successful. While another alternative to the research design would have been to also provide children with feedback regarding their success/failure to start the ATV ignition, researchers decided against providing any feedback for two reasons. Primarily, researchers did not want children leaving the study with the knowledge of how to start an ATV, and potentially cause harm to themselves or others at a later date. In addition, researchers elected to not provide feedback to children in order to enhance motivation to try to defeat the child-resistant system and explore all of the approaches to problem solving and strategies that would be employed by the children.

The ability to successfully start the child-resistant ignition prototype and acceptance of the system were important topics to address with the adult participants. After the adult participant had an opportunity to experience both ignition types, they were given a brief survey aimed at capturing acceptability and perceived frustration with the CR ignition prototype. Prior to completing this questionnaire, the experimenter provided another demonstration of the two ignition types and specifically indicated which was which, so that adults would have a clear understanding of what maneuvers are required to activate the CR ignition prototype.

Video was recorded during the sessions and coded afterward to provide insight on how participants may or may not have been successful at activating the CR ignition prototype. Additionally, to prevent participant opinions and reactions from being influenced by the presence of other participants, each participant was asked to describe their experience immediately following each trial outside of the view of other participants. Topics included strategies they used to start the ignition, any frustration they may have experienced, perceived success, etc. Participant responses were both video recorded and transcribed.

Participants were not allowed to watch the other participants work with the ignition types, and were not allowed to interact with the other participants again until all participants had a chance to work with the ignition system. After all participants experienced the hands-on portion of the focus group, they returned to the meeting space for a face to face discussion

2.4 Anthropometric Measurements

While each participant was waiting for their opportunity to operate the two ignition alternatives, anthropometric measurements of each participant were taken. These measures included: height, weight, arm length, leg length, torso length, foot size, hand/finger dimensions, and reach. Standardized and published protocols for anthropometric measurements, such as those used for the National Health and Nutrition Examination Survey (NHANES) were used to collect this information. These variables were analyzed to determine if they contribute to a participant's overall success or failures in turning on the ATV with either ignition systems, to help assess the potential benefits associated with the child-resistant design, and to better understand its limitations.

2.5 Follow-up Discussion

After each person had an opportunity to work with the different ignition types, participants returned to the focus group table for a post-trial discussion based on their experience. Post-trial discussion topics varied based on the age of the participants. Discussions with adults focused heavily on the CR ignition prototype, and included topics of acceptance and usability, design improvements, children's ability to override the system, and influence on purchasing decisions. Whereas the focus of the discussion with both the inexperienced and experienced child participant groups was on the various strategies implemented to start the ATV, the ability to recall what was modeled, and what they might have done differently, or additional strategies they would have employed if at home or given more time.

2.6 Participant Recruitment & Scheduling

Participants were recruited from within the Washington Metropolitan area and areas surrounding Altoona, PA. Participants were screened by telephone or in-person. The bulk of in-person screening took place at the Pennsylvania site. The main eligibility criteria for the study were age and ATV experience. In addition, the screener instrument collected:

Demographic information, including age, sex, height, weight;

ATV Experience, including riding experience; riding frequency; and,

ATV ownership, including make, model, etc.

Recruiting ATV owners and frequent users, especially children and participants within the Washington Metropolitan area proved challenging; therefore, a variety of recruitment strategies were employed. Participants were primarily recruited online through Westat's internal website, Craigslist and targeted Facebook Ads. Study advertisements were also placed in several local newspapers particularly in Frederick, Maryland. At both study sites, referrals were also a strong source of candidates. To target some of the harder-to-reach demographics, which included children with ATV experience, advertisements were developed and distributed through social media (Facebook and Twitter) and postcards. Postcards were distributed at some local events in Maryland and some riding areas, particularly in Altoona, Pennsylvania. All recruitment materials provided a telephone number for candidates who were interested in participating in the study. Neither the recruitment materials nor the screener indicated that the test trial focus group was related to ATV child safety. Rather, it was aimed at addressing use patterns of ATV riders.

Approximately 116 adults and 275 children were recruited and screened for the study. From those, 50 adults, 80 children without ATV experience, and 81 children with ATV experience participated in the test trial focus group sessions. Two pilot sessions were conducted with a total of six children, but these children were not included in the analysis.

Adult participants were between the ages of 18 and 66. Child participants were between the ages of 7-15 years of age and were scheduled for homogenous sessions relative to age and ATV experience. Novice participants were evenly distributed to include equal percentages of males and females. This even distribution of age and gender was slightly more challenging in the adult and experienced ATV user groups. See Table 2-1 for a summary of participant demographics.

Table 2-1. Demographic Distribution of Participants

	ATV Experience		No ATV Experience	
	Male	Female	Male	Female
7-10 years old	6	6	16	7
>= 85th percentile 7-10 years old*	9	4	5	12
Total	**15**	**10**	**21**	**19**
11-15 years old	22	12	14	12
>= 85th percentile 11-15 years old	15	7	7	7
Total	**37**	**19**	**21**	**19**
Adult 18+ years old	28	13		
<= 15th percentile Adult	7	2		
Total	**35**	**15**		

*Children in this category were at or above the 85th percentile weight or height for children in their respective age groups. That is, if a 7 year old child is in the 85th percentile for weight, that means that 85 percent of 7 year old children in the United States weigh the same as or less than the child. Note, these percentiles differ for girls and boys.

Every effort was made to schedule participants with a range of ATV experience and riding frequency. It is noted that child participants from the Altoona, PA area rode ATVs more frequently, which is not surprising as there is more access to larger plots of private property and trails as well as public riding facilities in that area. Similarly, the child participants from the Altoona, PA site were more likely use their own ATV as opposed to sharing ATVs. See Table 2-2 for a breakdown riding frequency and ATV ownership for child participants with ATV experience.

Table 2-2. Riding Frequency & ATV Ownership for Experienced Child Participants

		Washington Metropolitan Area	Altoona, PA
Riding Frequency	Almost Everyday	-	3
	2-3 days per week	4	18
	Once a week	-	9
	Less than once a week	-	1
	Several times a month	7	5
	Once a month	7	3
	Every few months	7	5
	One time	2	-
	Other	7	3[1]
Family Owns ATV		14	10
Child Owns ATV		11	32
Does not own (but regular use)		9	5

[1] Examples of "Other" include: "Four or five times in total", "Once a year", "Two or three times per year", etc.

Data Collection Instrumentation & Analysis Procedures 3

The following section describes the instrumentation, data collected, and the methods used to analyze the data.

3.1 Focus Group Discussions

Data was collected during the focus group discussions through summary note taking, audio recordings, and a questionnaire for adult participants. The audio recordings and notes provided qualitative data for analysis, while the questionnaire provided a quantitative understanding of adult participant acceptance of the CR prototype design. Notes and audio recordings from the different sessions were reviewed and summarized. Items of interest were clustered together by topic and direct quotes from participants were selected. These summary notes enabled the identification of any trends within the different demographics and sessions, as well as highlighted unique or varied perspectives.

3.2 Anthropometric Measurements

Anthropometric measures of each participant were collected for height, weight, arm length, leg length, torso length, foot size, hand size, and reach. These variables were reviewed to identify any physical traits or features that may relate to a child's overall success in overriding the systems, and additionally to help detect if any traits may contribute to adult failures. An understanding of these factors may better help assess the potential benefits associated with a given child-resistant design as well as understand any limitations and potential sources for usability issues in the adult user population.

3.3 Hands-On Task

During the hands-on portion of the focus groups, participant's interactions with the different ignition types were video recorded. The actual maneuvers attempted when trying to start the ATV were recorded through a computer program that was linked to the ATV. The computer monitored and recorded whether or not a participant was successful at starting the ATV for the different trials.

3.3.1 Hardware

The actual ATV ignition was disabled, so the ATV could not start. In its place was an output display box with LEDs that were assigned to each control of interest on the ATV, allowing each control that was activated on the ATV to illuminate the appropriate LED (see Figure 3). The controls of interest to start the standard ignition method were: "Run Switch" in the run position, foot on the brake, and the key fully turned to the right. The controls of interest for the CR prototype were: "Run Switch" in the run position, foot on the brake, sitting far enough back to depress the seat sensor, and pushing the black "Start Button." The output display box, provided by CPSC, was powered by a 9-volt battery. Though this would have been possible to use (with a video camera trained closely on the LEDs), it would have required manual coding of each control activation after trials were recorded, which would have been both cumbersome and cost prohibitive.

Figure 3-1. LED Output Box

Instead of using the output display box, a computer program was developed, and the control outputs were switch closures that were attached to the controls of interest on the ATV that could be read electronically. Using a digital input module, the program could monitor the same signals and feed them into a dataset with very little need for post-processing or manual coding.

Some switches on the ATV were simply connected to the monitoring circuits, while others required switches to be installed (e.g., the seat and the foot brake). The yellow circles in Figures 3-2 through 3-6 highlight the controls for each of the participant inputs registered by the computer program that was monitoring them.

All of the switches were momentary (only active when actively being pressed) with the exception of the Run Switch. Every trial was initiated with the Run Switch set in one of the two *OFF* positions. If the participant slid the Run Switch to the *RUN* position, it would maintain that value/function until it was slid back to one of the *OFF* positions. The Key Switch, like those in automobiles, had an *ON* and *OFF* position, but it was only considered as a successful input to the standard ignition when it was turned clockwise past the *ON* position, where a spring would return it to the *ON* position.

Figure 3-2. Foot brake in right foot well (activation required for both the Standard and CR prototype ignitions)

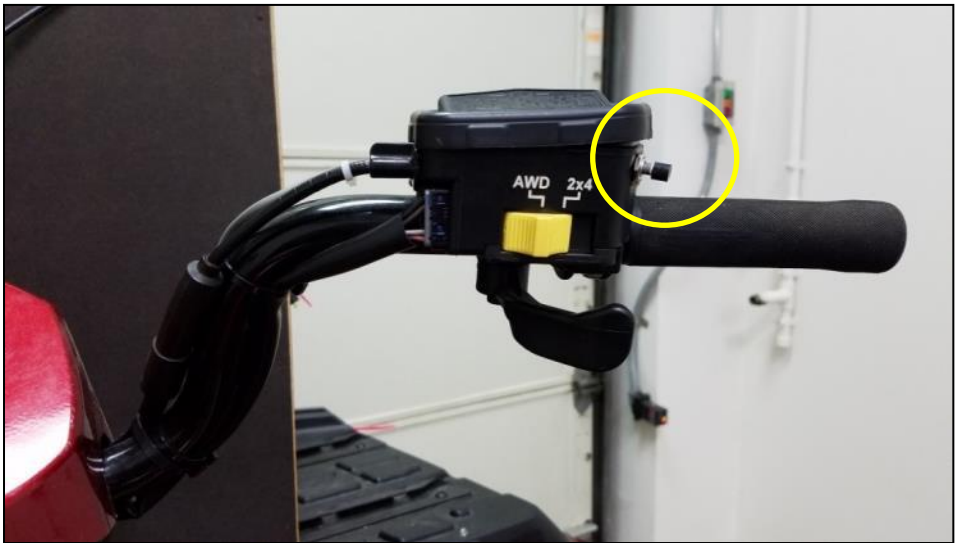

Figure 3-3. "Start" button on right handle bar (activation required for the CR prototype ignition)

Figure 3-4. Engine Run switch on left handle bar (activation required for both the Standard and CR prototype ignitions)

Figure 3-5. Key under center console (activation required for the Standard ignition)

Figure 3-6. Pressure switch under rear of seat (activation required for the CR prototype ignition)

3.3.2 Software

The recording of the switch activations was accomplished using a custom program that also provided counterbalanced order control for each participant, sequence control for naïve (initial trial), modeling and post-modeling trials, constant feedback to experimenters, and timing control to ensure equivalent exposure under each condition.

Figure 3-7 shows the layout of the experimenter's data collection console after completing a failed attempt at operating the standard ignition system. The yellow bar at the upper left corner identifies the participant as an experienced child and the even number in the subject ID indicates that the participant was exposed to the standard ignition first. The orange bar across the ATV seat indicates what trial is in effect "un-modeled/standard ignition". The red and green boxes on the ATV diagram marked "Run", "Key", and "Brake" provide the experimenter a visual indication that the participant has tried a given control. The state shown in the image indicates the Run Switch was activated (green), but the key and foot brake were not (red). These indications were logged into a data file and this image was also fed into the video record from the session as well.

On the right side of the screen, the 119.91 indicates that the child took the full two minute attempting to start the ATV using the standard ignition, but "Failed" to start it. The program was aware of the proper order of trials and demonstrations and stepped the experimenter through each one.

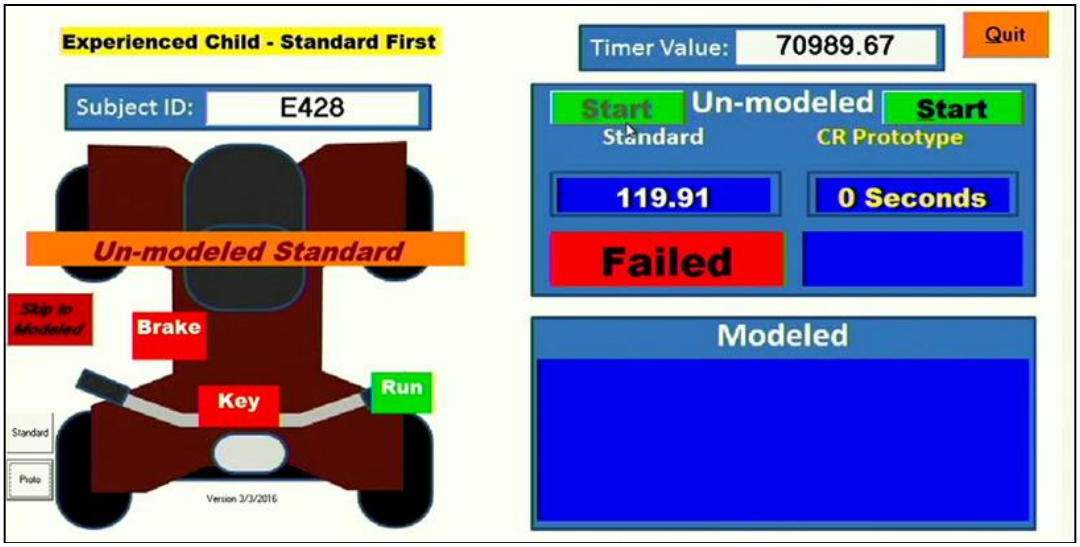

Figure 3-7. Experimenter's Data Collection Console

Figure 3-8 shows the same participant's progress as he/she advanced in the hands-on portion of the session. In this image, the experimenter has modeled the procedures for starting both the standard and the CR ignition prototype, and the participant is partway through his/her attempt to try to operate the CR ignition prototype. In this snapshot, the participant has activated 3 of the 4 necessary controls (Start, Brake, and Run), but has not activated the Seat Switch. If the participant were to succeed, the elapsed time from their 2-minute attempt window would indicate the time it took to successfully operate the ignition. All of this information was logged in a file on the PC that controlled and monitored the sessions, allowing for analysis and reporting.

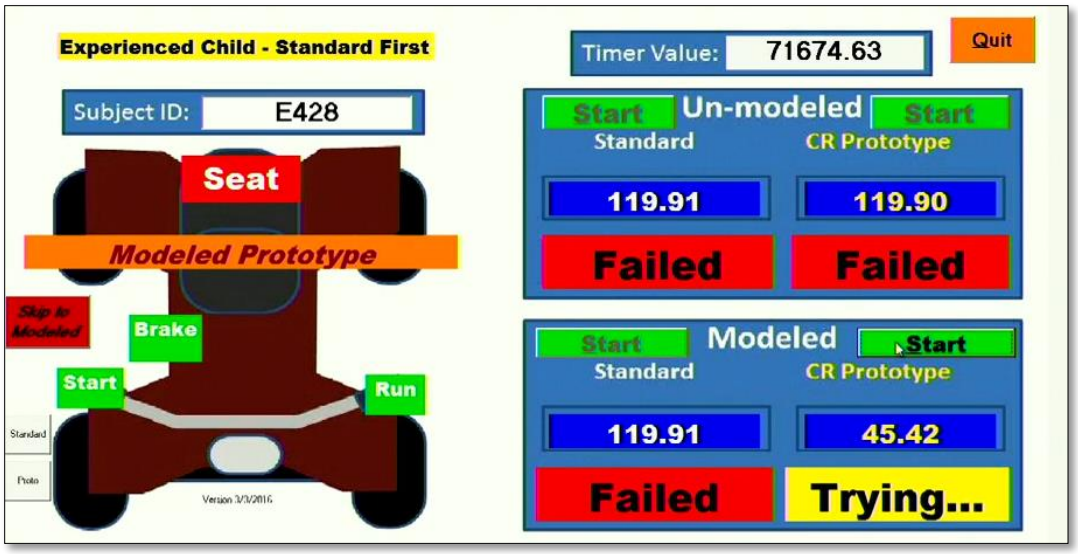

Figure 3-8. Experimenter's Data Collection Console

3.3.3 Audio/Video Recording

All hands-on sessions were recorded and saved in video format for subsequent review and analysis. Three high-definition camera views with audio were captured throughout each session as well as the image from the experimenter's control interface (see Figure 3-9).

Figure 3-9. Example screenshot from session video of a participant

Video was reviewed for a random sample of cases for clarification of unusual data, noting particularly interesting participant interactions/statements, or for identifying cases where

participants' activations were aimed at controls on the ATV that were not being monitored/logged in the dataset. These included: 20 experienced child participants; 20 inexperienced child participants; and 10 adults video files. Overall, experimenters noted that most participants within a given group (experienced children, inexperienced children, and adults) tried similar strategies to start the ATV using different ignition types. So, only a subset of video files were coded.

After videos were edited, video coders uploaded them into a coding program, Morae Manager (v. 3.3.4). Video coders reviewed the data and identified the common controls on the ATV that participants interacted with when trying to start the ATV. Each of these controls was assigned a marker ID and each time the control was manipulated, a marker was placed in the video. Video coders also recorded the participants' comments. Markers for the different interaction controls on the ATV are listed below and indicated in Figure 3-10:

- Start (S) –indicates when the participant is instructed to start the task.
- End (E) –indicates when the participant stops trying to start the ATV using either ignition type. This will be either (a) when the participant runs out of time at 119 seconds (2 minutes) or (b) when the participant successfully starts the ATV.
- Key (K) –indicates anytime the participant touches or turns the key or takes the key out.
- Pull cord (P) –indicates anytime the participant tries to pull the cord on the side of the ATV to start the ATV manually.
- Foot brake (F) –indicates anytime a participant puts their foot on the foot brake pedal.
- Hand brake (H) –indicates whenever the participant squeezes the hand brake.
- Throttle (T) –indicates whenever the participant presses the throttle.
- Black start button (B) –indicates whenever the participant presses or twists the start button.
- Weight seat sensor (W) –indicates whenever a participant visibly moves back or bounces on the seat.
- Yellow speedo/reverse button (Y) –indicates whenever a participant presses yellow reverse button.
- Gear shift (G) –indicates whenever a participant moves the gear shift.
- Red run engine switch (R) –indicates when someone switches the position of the engine run switch.
- Other (O) –is for buttons/steps that were often attempted by the participant (usually by children who are exploring and trying any alternative option). This includes:
  - The grey lights switch (on the left handle bar).
  - Yellow AWD/2x4 switch (on the right handle bar).

- Twisting the gas cap (black plastic cap near the center console).
- Storage latches either on the front or back of the ATV.

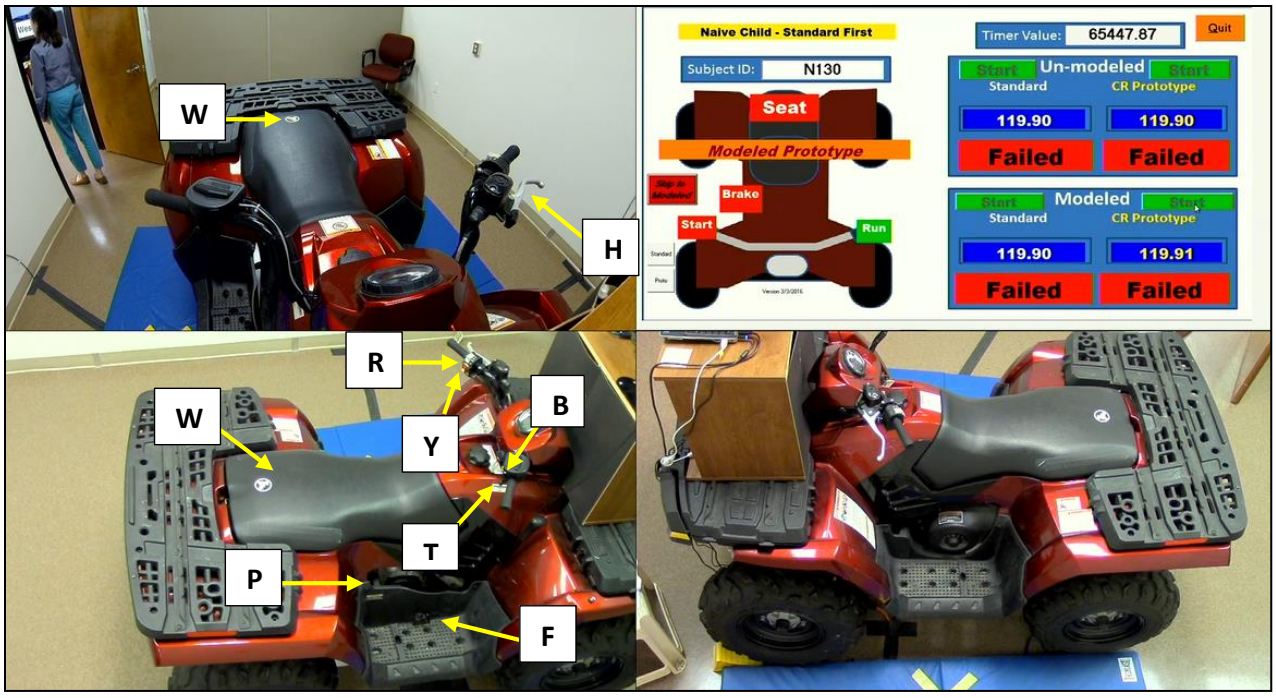

Figure 3-10. Quad View of Video Feed with Interaction Controls

4 Focus Group Findings

4.1 Initial Discussion

The sections below summarize the findings from the initial (pre-task) discussions with participants. Since different moderator guides were developed, based on the age of the participants and ATV experience level, the findings are discussed in a format that reflects the different discussion paths.

4.1.1 Child Participants with ATV Experience

Riding Behavior & ATV Experience

When discussing riding behavior with children with ATV experience, some differences between child participants from the Washington, DC area and child participants in the Altoona, PA area were noted. Typically, children from the DC Metropolitan area ride most frequently on their own property, some indicating that they ride in the woods around their home. The use of public riding trails was not as prevalent for this group relative to those participants in the Altoona, PA area. Children in the Washington, DC area may only ride once or twice a year on public trails. In addition, these children reported that they rode less frequently and fewer children reported having their own ATVs compared to the Altoona, PA participants. Children from the DC area often reported using a shared "family" ATV to ride or going to another family member's home to ride (e.g., uncle or grandfather) The participants in the DC area were more mixed with regard to the age when they started riding; a few started riding ATVs at younger ages (6 - 8 years old), while others were older (11-12 year old)

Many of the children in Altoona, PA indicated that they ride 2 to 3 times per week, usually on their own ATV. In fact, many of the participants from the Altoona area indicated that their family owns multiple ATVs. Additionally, children in the Altoona area groups indicated that they were introduced to ATVs at a very young age, some riding as passengers at ages 3 and 4, and then driving by ages 4 and 5.

While a small number of participants in the DC area reported only being a passenger, most participants in both locations indicated that they are usually the driver when they ride. Child

participants, as young as 8 and 9 years old indicated that they drive, but in these cases it was usually on their own child-sized ATV.

ATV Safety

Parental/guardian supervision varied when riding the ATV. Most children reported riding alone or with a friend when riding on their own property. Usually they only participated in group riding when visiting public trails.

Most of the participants indicated that their parents spoke to them about ATV safety; however, there were a few participants from the DC Metropolitan area that indicated they had never discussed ATV safety with their parents. Typically, participants in the DC Metropolitan area referenced the need for a helmet as the main safety topic. Most of the children in the DC Metropolitan area focus groups thought that a helmet was an important piece of safety equipment, but several admitted that they do not always wear a helmet when riding an ATV. Participants indicated that short rides, for example from their house to a neighbor's home may not warrant wearing a helmet, as well as rides where they plan to travel at lower speeds. There was little mention of other protective gear in the DC Metropolitan area focus groups. However, a few of the DC area participants mentioned the topic of safer speeds for driving on different terrains (e.g. steep hills, sharp curves, etc.) as another safety topic discussed with their parents.

Children in the Altoona groups seemed to differ from DC Metropolitan participants in that they appeared to be more safety conscious. All of the Altoona participants indicated that their parents spoke to them about safety and many of the participants described all of the safety gear (boots, long padded pants, chest plates, padded jackets, and helmets) that they use when riding. In addition, these participants seemed very familiar with the appropriate speeds to ride on different terrain and referenced different technical maneuvers they had practiced with their parents prior to riding on the trails.

4.1.2 Child Participants without ATV Experience

Children without ATV experience generally knew what ATVs were, especially once they saw the vehicle. However, a few participants had never seen one and none of the novice children had ever been on an ATV as a driver or passenger. They typically recognized ATVs from movies and TV shows. For those participants who had seen an actual ATV, it was generally when they were visiting a farm or at a friend's house. It was not uncommon for ATVs to be labeled as "dangerous" by novice participants. Focus group leaders were frequently asked if ATVs had seat belts, as

participants noticed that riders could fall off and hurt themselves. Others suggested that helmets might make riding an ATV safer. However, despite these concerns about safety, many novice participants thought that the ATV would be fun to ride.

4.1.3 Adult Participants

Riding Behavior

As noted earlier, there was some variability in the frequency and purpose with which adult participants reported using their ATVs. Most of the participants indicated that they use their ATV on their property for chores and on occasion for recreational riding (mostly on their own property or on a friend's property). When used for utilitarian purposes, participants mentioned: hauling wood or yard debris, farming related tasks, plowing snow, moving dirt, etc. Fewer adults mentioned riding solely for the purpose of recreation. These individuals indicated that they enjoy riding on public and private trails as part of a weekend trip and using their ATV when hunting. A few participants also mentioned using their ATVs to ride on public streets.

Participants indicated that their speed varied based on the terrain (their yard, a wooded trail, hills, etc.), the type of riding they were engaging in (recreational vs. work), and whether or not they had a passenger. Most participants indicated that they ride about half of the time alone and half with passengers. Only one participant indicated that he always rides alone. Several of the participants who ride with passengers indicated that sometimes the passengers were children, either their own children, grandchildren or a family member's children. Conversely, several participants explicitly mentioned not taking children that are not family on their ATV for liability reasons. Some participants mentioned that they require passengers (both adults and children) to wear a helmet, but may not necessarily wear one themselves.

In most cases, when riding with children the adult participant indicated they were the driver. If the child was seated in front of the adult, the adult may allow the child to have their hands on handle bars, but the adult would maintain control of the ATV.

Several participants mentioned that their children had their own ATVs. These adults indicated that their children were allowed to ride alone, meaning they were responsible for steering their own ATV; however, they were "supervised." Note, supervision did not necessarily mean that the adult was actively watching the child on the ATV. Sometimes supervision meant the adult was simply aware the child was using the ATV. No adults could recall a situation where their child or grandchild tried to use their ATV without first asking permission.

Most adults indicated that they reviewed safety precautions prior to allowing the child to ride the ATV (either as a passenger or a driver). This varied from simple guidance of what speeds to use on certain terrains, to the use of protective gear such as helmets, closed toe shoes, and long pants. One participant, who was also a police officer, explained that he conducts routine ATV safety talks with his children.

Most, if not all of the adult participants said that they stored their ATV in a garage, shed, or barn where the vehicle was accessible to other members of the family. Many of the participants admitted that they usually keep the key with the ATV, either in the ignition or near the ATV for convenience. Fewer participants indicated that they stored the key separate from the ATV, such as in the house. Those who stored the key separately cited theft prevention as their reasoning for doing so. Only a few adults mentioned storing the key in a protected or locked area; and of these, only one or two specifically mentioned child safety as their motivation. Several other participants mentioned their ATVs were older models that did not require a key to start.

Child Resistance Features

All participants were familiar with child-resistant features and were able to list several products that they encountered with a child-resistant component. Items mentioned include: medicine bottles; outlet covers, cabinet locks, doorway gates, and safety locks on guns. A few participants mentioned vehicles that had safety features, specifically riding lawn mowers, tractors, and motorcycles. For these, the participants said that the user had to perform a sequence of steps to start the vehicle or there was some form of a weight-based sensor that had to be initiated for the engine to run.

In general participants were supportive of child-resistant features because they recognized their importance, but many still admitted that they often find them annoying or cumbersome. A few participants noted that child-resistant features don't always solve the problem, and are not a replacement for parental supervision. One person felt that people over rely on child-resistant features and should instead focus on educating their children about potential hazards.

About half of the participants were skeptical about how child resistance could be applied to an adult-sized ATV, citing that some teenage children are the same size as grown adults; and therefore, would make it easy to override if it were a physical or sized-based requirement. Other participants expressed concern and suggested that the design should not be mechanical in nature, indicating, "…it is just one more expensive part that can break." Additionally, participants mentioned that

several ATV manufacturers already require the user to perform a sequence of maneuvers to start the engine, and that these existing designs serve to prevent young children from starting the ATV.

4.2 Hands- On Task

The following section describes the findings of the hands-on task portion of the focus group session.

4.2.1 Experimenter Observational Findings

While participants were working with the ATV, the experimenter recorded notes regarding the participant's behavior. For example, the different controls and maneuvers attempted when trying to start the ATV, any remarks made by the participant, frustration expressed verbally and non-verbally, early departure from the task, etc. In addition, participants were asked to describe the controls they tried when working with the ATV after each trial. Below is a summary of their responses and notes recorded by the experimenter.

4.2.1.1 Child Participants

Un-modeled Trials

During the un-modeled trials, children with ATV experience seemed to adopt fewer strategies when attempting to start the ATV in comparison to children without ATV experience. Overall, experienced children did not try things that were likely irrelevant to starting the engine, such as the lights. Child participants with ATV experience tended to focus on the Key, Run switch, brake, pull start, and gear shift. One exception to this finding was that some participants in the Altoona, PA focus groups frequently pressed the "Speedo /Reverse" button. Many of these participants recognized that the labeling of this button made it seem like an unlikely step for starting the ignition, but the button's placement on the ATV was in the same location as the start engine button on their own ATV.

Another difference between the experienced participants in the Altoona, PA focus groups and the experienced participants in the DC Metropolitan area sessions, is that a lot of the Altoona participants seemed to interpret the instructions of, "there are two ways to start this ATV" to mean the electric start and the manual pull start. Not surprisingly, a lot of participants responded by pulling on the pull starter.

Similar to the adult participants (See Section 4.2.1.2), when child participants were successful at either ignition type without modeling, they were often unsure of which steps attributed to their success and sometimes could not recall what they had tried.

Modeled Trials

Most of the child participants, regardless of ATV experience had to have at least one of the ignition types modeled. Both experienced and novice children appeared to be more successful at starting the standard ignition, and were better at recalling the proper sequence of buttons and switches than with the CR ignition prototype. Not surprisingly, older children were more successful than younger children at starting the ATV and recalling the sequence of events.

For the CR prototype, many of the novice participants did not notice the Start button until it was modeled for them. Even after modeling, many participants did not touch it. It is possible that they did not pay close attention or did not see the experimenter clearly. Several participants engaged the throttle (which is located in close proximity to the Start button) instead. Experienced children seemed to be more perceptive of the Start button, some indicated it was something that they did not have on their own ATV; and therefore, thought it might be relevant to how this ATV starts. The full details of participant success rates are discussed in Section 4.2.2.

4.2.1.2 Adult Participants

Un-modeled Trials

Even though all adults were experienced ATV users, very few adults were able to start the ATV within the first 30 seconds for either the un-modeled standard or un-modeled CR prototype trial. Many of the adults indicated that the ATV was different from the one they owned. Some participants expressed frustration and even embarrassment when they experienced difficulty starting the ATV.

Thirty-six adults were eventually able to start the standard ignition type and 21 were able to start the CR prototype without any modeling. However, many admitted to trying a series of things until they saw the green light illuminate, and were not sure which steps made them successful for either ignition type. Interestingly, only a few participants accurately recited the correct sequence of steps to start the standard ignition, but none were confident in which maneuvers attempted were the necessary ones to start the prototype.

When trying to start the ATV using either ignition type, adult participants mainly focused on the Run Switch, the key, the hand brake, the throttle, the gear shift, and the foot brake. Several also pressed the Speedo/Reverse button. When asked, these adults indicated that they tried the Speedo/Reverse because the location of the button was similar to the location of the button to start the engine on their own ATV.

Most adults also tried the black Start button that was necessary for the CR prototype ignition sequence. Almost all of them admitted that they only tried it because it was something different that they had never seen on an ATV; and therefore, figured it might be important to starting one of the ignition types.

Modeled Trials

Most adults were successful after the demonstration (modeling). Likewise, most adults were accurately able to describe the sequence of steps required to start both ignition types after modeling. Some of the smaller-sized adult participants (15th percentile) may have taken longer to start the ATV than their counterparts, but eventually managed to start both ignition types. For these adults, it appeared to be a struggle to sit far enough back to activate the seat weight-based sensor and still depress the foot brake. When adults were unsuccessful after demonstration, it was usually because the participant did not take note, or forgot one of the steps in the modeling sequence; and therefore, omitted that step from their own trial.

4.2.2 Data Analysis Findings

All statistical analyses were performed separately for children and adult participants. Analyses comparing success rates between groups were performed using two-way contingency tables via SAS's FREQ procedure. All tests performed were two-sided. Many tables had one or more cells with very small or zero counts, in which case Fisher's Exact test is preferable to Pearson's chi-squared test.

However, Fisher's Exact test tends to be conservative, meaning that the reported p-values are somewhat larger than the "true" p-values. If Fisher's Exact text p-values were reported for sparse tables only and Pearson chi-squared test p-values for non-sparse tables, it would not be possible to compare p-values across tables using different tests. Using Fisher's Exact test for all tables means that all reported p-values are directly comparable. Additionally, given the volunteer, non-random selection of study participants, it is appropriate to use a somewhat more conservative test.

For time to successful start, a continuous outcome, first basic descriptive statistics were run by group in SAS's MEANS procedure: means, quantiles, and other selected percentiles. Then tests were performed to look for significant differences between mean time to successful start by group by using contrasts in a linear model, in SAS's GLM procedure.

Finally, a hierarchical logistic regression model was run in the MIXED procedure, with observations clustered by subject. Covariates were all anthropometric measurements (leg, arm, hand, and foot length, height, and weight) as well as experimental factors (ATV experience for children, ignition type, modeling, and order of ignition types). Because the anthropometric measurements were highly correlated with height, weight, and for children, age, we fit two models: a full model containing all covariates and a "basic" model containing only age, height, weight, and the experimental factors. For adults, collinearity was not a serious problem so we were able to fit the full model. However, for children the high correlations caused extreme problems with model fit for the full model, so the basic model is presented in this report.

Note that no explicit adjustment for multiple comparisons was made. Since an alpha of 0.05 was used as the cutoff for statistical significance, this means that if there were no significant differences between the CR prototype and the standard ignitions we would still expect that about 1 out of 20 tests performed would be statistically significant purely by chance. Therefore, these results should be interpreted with the usual caution accompanying any statistical inference.

4.2.2.1 Child Participants

Overall Success

Overall, child participants were less likely start the ATV using the CR ignition prototype in comparison to the standard ignition when collapsing across trials (naïve and modeled). Roughly, 75.6 percent of all the children were able to start the standard ignition, while only 20 percent were able to start the CR ignition prototype during any attempt (see Table 4-1).

Table 4-1. Percent of children that were able to start the standard/CR prototype ignitions, across naive & modeled trials

		Failed	Success	Total
Standard	# of participants	39	121	160
	percentage	24.4%	75.6%	

CR Prototype	# of participants	128	32	160
	percentage	80%	20%	
p <0.0001				

Impact of Experience on Success Rate

While ATV experience had a significant impact on the child participant's ability to start the CR ignition prototype, experience did not have a significant effect on the child's ability to start the ATV with the standard ignition. That is, when trying to start the ATV using the standard ignition type 80 percent of experienced children were successful compared to 71.2 percent of the novice children (p=0.27). Conversely, 35 percent of children with ATV experience were successful at starting the CR prototype ignition relative to 5 percent of naïve children (p<0.0001) (See Table 4-2).

Table 4-2. Percent of children that were able to start the standard/CR prototype ignitions, across naive & modeled by ATV Experience

			Failed	Success	Total
Standard	With ATV Experience	# of participants	16	64	80
		Percentage	20%	80%	-
	Without ATV Experience	# of participants	23	57	80
		Percentage	28.8%	71.2%	-
CR Prototype	With ATV Experience	# of participants	52	28	80
		Percentage	65%	35%	-
	Without ATV Experience	# of participants	76	4	80
		Percentage	95%	5%	-
Standard Ignition : p = 0.2691					
CR Prototype Ignition: p <0.0001					

Impact of Age & Modeling on Success Rates

Table 4-3 shows the impact of age and modeling on the child's ability to start the ATV using either ignition type. Not surprisingly, the age of the participant, which often corresponds with physical size and cognitive maturity, was associated with increased success rates at starting both the standard and the CR ignition prototype.

Regardless of having previous ATV experience or being exposed to experimenter modeling, no 7-8 year olds were successful at starting the CR prototype (see Table 4-3). Conversely 6.7 percent of the 7- 8 year olds were able to start the standard ignition prior to modeling, and 46.4 percent after modeling (p=0.0007).

Similarly, none of the 9–11 year-old children were successful at starting the CR prototype prior to modeling; however, after modeling they were more likely to be successful (15.4 percent). However, these same children were significantly more likely to start the standard ignition after the experimenter had modeled the behavior (68.1 percent) when compared to the success rate of the CR prototype ignition after modeling (15.4 percent)($p < 0.0001$).

Following the same trend, 12-15 year-olds were more successful than their younger counterparts at starting the CR prototype during both pre-and-post modeling trials (4 percent vs.29 percent, $p<0.0001$). However, compared to their performance with CR prototype, this age group had significantly more success in starting the ATV using the standard ignition. That is, 31.6 percent of this age group were able to start the standard ignition prior to modeling and 82.7 percent after modeling ($p<0.0001$).

Table 4-3. Impact of Age and Modeling on a Participant's Ability to Start the ATV

			Standard Ignition Success Rate	CR Prototype Ignition Success Rate	P Value
Ages 7- 8	Before Modeling	# of participants	2	0	0.4915
		Percentage	6.7%	0%	
	After Modeling	# of participants	13	0	<0.0001
		Percentage	46.4%	0%	
Ages 9 – 11	Before Modeling	# of participants	5	0	0.0565
		Percentage	9.6%	0	
	After Modeling	# of participants	32	8	<0.0001
		Percentage	68.1%	15.4%	
Ages 12 – 15	Before Modeling	# of participants	24	3	<0.0001
		Percentage	31.6%	4.0%	
	After Modeling	# of participants	43	21	<0.0001
		Percentage	82.7%	28.8%	

Impact of 85th Percentile on Success Rates

Table 4-4 examines the success rates of the 85th percentile children relative to their cohorts for both ignitions types. Seventy-eight percent of children that were in the 85th percentile or greater for height / weight for their gender and their age group, were successful at starting the standard ignition type, while 74.5 percent of smaller children were successful ($p=0.712$). Similarly, 24.2 percent of children that were in the 85th percentile or greater for height/weight for their gender and age group, were successful at starting the CR prototype ignition, compared to smaller children (17.0 percent) ($p=0.316$). The differences for either ignition type were not significant.

Table 4-4. Percent of 85th percentile children that were able to start the standard/CR prototype ignitions, across naive & modeled

			Failed	Success	Total
Standard	< 85th Percentile	# of participants	24	70	94
		percentage	25.5%	74.5%	
	≥ 85th Percentile	# of participants	15	51	66
		percentage	22.7%	77.3%	
CR Prototype	< 85th Percentile	# of participants	78	16	94
		percentage	83%	17%	
	≥ 85th Percentile	# of participants	50	16	66
		percentage	75.8%	24.2%	
Standard Ignition : p = 0.7127					
CR Prototype Ignition: p = 0.3165					

Failed Attempts to Start the CR Ignition Prototype

Several of these children who were unable to start the CR ignition prototype (pre-modeled and post-modeled trials) were able to successfully activate three of the four key steps in the sequence at one-time. The two most common combinations that were registered by the program were: (1) the Run switch, the Brake, and the Seat switch and (2) the Run switch, the Brake, and the Start button. It is important to note, that only one participant also tried and was able to activate the combination of Run switch, Seat, and the Start Button.

Prior to modeling, about 2 percent of all child participants who were unsuccessful at starting the CR Prototype, were observed to initiate the Run switch, the Brake, and the Seat (i.e., three of the four required actions) at the same time, whereas after modeling, 11 percent of participants triggered three of the four actions (p= 0.1896). Similarly, about 14.7 percent of participants who were unable to start the CR Prototype, were observed to activate the Run Switch, Brake, and Start button combination prior to modeling and after modeling this number increased significantly to 61 percent of participants (p <0.0001).

When looking at the effect of ATV experience on performance, those with experience were more likely to get 3 of the 4 controls activated compared to those participants without ATV experience (see Table 4-5). Regardless of experience level, participants seemed to be more successful at activating the Run switch, brake, and start button compared to the Run Switch, Brake, and Seat.

Table 4-5. Impact of ATV Experience on Participant's Ability to Activate 3 of the 4 Controls Required for CR Prototype Ignition

CR Prototype Ignition Type			Activated the Run switch, Brake, and Seat	Activated the Run switch, Brake, and Start button
With ATV Experience	Before Modeling	# of participants	3	13
		percentage	3.9%	16.9%
	After Modeling	# of participants	5	36
		percentage	9.6%	69.2%
	p- value		0.2669	<0.0001
Without ATV Experience	Before Modeling	# of participants	0	10
		percentage	0%	12.5%
	After Modeling	# of participants	9	42
		percentage	11.8%	55.3%
	p-value		0.0012	<0.0001

When looking at age, it appears as age increases, so does the likelihood that participants are able to activate 3 of the 4 controls required to start the ATV for the CR Prototype ignition (see Table 4-6).

Table 4-6. The Impact of Age on Participant's Success at Activating 3 of the 4 Controls Required for CR Prototype Ignition

CR Prototype Ignition Type			Activated the Run Switch, Brake, and Seat	Activated the Run Switch, Brake, and Start button
Ages 7- 8	Before Modeling	# of participants	0	3
		percentage	0%	10%
	After Modeling	# of participants	1	12
		percentage	3.3%	40%
	p-value		*	0.0153
Ages 9 – 11	Before Modeling	# of participants	0	7
		percentage	0%	13.5%
	After Modeling	# of participants	2	30
		percentage	4.6%	68.2%
	p-value		*	<0.0001
Ages 12 – 15	Before Modeling	# of participants	3	13
		percentage	4.1%	17.8%
	After Modeling	# of participants	11	34
		percentage	21.2%	65.4%
	p-value		0.0039	<0.0001

* The cell sizes are so small that the p-values aren't reliable

Predictive Factors

A basic logistic regression was performed in order to examine the relationship between certain categorical dependent variables (e.g., age, weight height, ignition type, trial order, ATV experience,

etc.) and a child's success rate at starting the ATV (see Table 4-7). After controlling for other variables in the model, relative to the standard ignition type, children were 20 times less likely to successfully start the CR ignition prototype ($p<0.0001$). In addition, prior to observing the experimenter complete the task, children were 20 times less likely to be successful at starting the ATV regardless of the ignition type ($p<0.0001$). Children without previous experience with ATVs were only 60 percent as likely to be successful when compared to children with experience ($p=0.0470$).

Trial order seemed to have an effect on success rate for children, in that children who were exposed to the standard ATV first were only half as likely to be successful ($p=0.0176$). It is possible that participants became fixated or perseverate on the few steps they thought they had observed when the experimenter modeled the procedures and continued to try the same actions repeatedly.

While height ($p=0.2218$) and weight ($p=0.9212$) did not significantly contribute to the child's success, age had a significant effect on success ($p=0.0452$). That is, for each year older, a child is 1.28 times more likely to be successful at starting either ATV ignition type.

Table 4-7. Logistical Regression Analysis

Effect	Exp (Estimate)	Estimate	Standard Error	Pr > |t|
Intercept	0.0151	-4.1961	1.9680	0.0346
Age	1.2270	0.2046	0.1019	0.0452
Modeled=0 (not modeled)	0.0564	-2.8754	0.3029	<.0001
Type= Prototype	0.0533	-2.9309	0.3043	<.0001
Order=0 (Standard first)	0.5216	-0.6509	0.2731	0.0176
StandHeight	1.0244	0.0241	0.0197	0.2218
Weight	1.0015	0.0015	0.0151	0.9212
ATV_Experience=0 (no experience)	0.5778	-0.5485	0.2753	0.0470

4.2.2.2 Adult Participants

Overall Success

Overall, when collapsing across all trials (un-modeled and modeled), 98 percent of adults were able start the CR prototype ignition and 96 percent were able to start the standard (see Table 4-8). The difference in success between the two ignition types was not significant ($p=1.0$).

Table 4-8. Overall Success Rates for Adult Participants

		Failed	Success	Total
Standard	# of participants	2	48	50
	percentage	4%	96%	
CR Prototype	# of participants	1	49	50
	percentage	2%	98%	
Total	# of participants	3	97	100
p=1.0				

Effect of Modeling on Success

Prior to modeling, 72 percent of adults were able start the standard ATV ignition. Of the 14 adults who were unable to start the Standard ignition during the un-modeled initial trial, 92.3 percent were successful after the procedure was modeled by the experimenter. This difference was not statistically significant (p=0.1622).

When attempting to start the CR ignition prototype, 42 percent of adults were successful during the un-modeled trial. Of the 29 adults who were unable to start the ATV with the CR ignition prototype, 96.6 percent were able to start the ATV after the procedure was modeled (p<0.0001) (see Table 4-9).

Table 4-9. Comparison of Modeled versus Un-modeled Success Rates

			Failed	Success	Total
Standard	Before Modeling	# of participants	14	36	50
		percentage	28%	72%	
	After Modeling	# of participants	1	12	13[2]
		percentage	7.7%	92.3%	
CR Prototype	Before Modeling	# of participants	29	21	50
		percentage	58%	42%	
	After Modeling	# of participants	1	28	29
		percentage	3. 4%	96.6%	
Standard Ignition : The difference is not significant (p=0.1622)					
CR Prototype Ignition: The difference is significant (p<0.0001)					

When comparing the post modeling standard ignition trial to the naïve standard ignition trial, modeling significantly decreased the mean time to success for adult participants (9.5 seconds for modeled vs. 42.3 seconds for naive; p=0.0002). Similarly, the average time to success for the post-model CR prototype was significantly reduced relative to the time to success for the naïve CR ignition prototype trial (21.1 seconds for modeled vs. 47.9 seconds for naive; p = 0.0004). There was no significant difference between mean time to success for the standard vs. CR prototype ignitions, either with (p=0.18) or without modeling (p=0.42).

[2] One participant's data was lost for the modeled standard ignition trial.

Prior to modeling, 53 percent of women were successful at starting the standard ATV. Of the 8 women who failed to start the standard ignition in the naïve condition, 100 percent of women were able to start the ATV in the modeled trial (see Table 4-10). The modeling seemed to have a significant effect on the women's performance for the standard ignition (p=0.0194). In addition, 82.9 percent of men could start the standard ignition in the naïve trial. Eighty percent of the 6 men who failed the naïve trial were successful after the procedures were modeled. However, there was not a significant effect of modeling on the men's performance (p=0.99) (Table 4-10).

Table 4-10. Impact of Modeling and Gender with Ability to Start the Standard Ignition

Standard Ignition Type			Failed	Success	Total
Females	Before Modeling	# of participants	8	7	15
		percentage	53.3%	46.7%	
	After Modeling	# of participants	0	8	8
		percentage	0%	100%	
Males	Before Modeling	# of participants	6	29	35
		percentage	17.1%	82.9%	
	After Modeling	# of participants	1	4	5[3]
		percentage	20%	80%	
Females: The difference is statistically significant for women (p=0.0194)					
Males: The difference is not statistically significant for men (p=0.99)					

When comparing the success rates post modeling CR ignition prototype trial to the naïve CR ignition prototype trial, 6.7 percent of women were successful at starting the CR prototype prior to modeling. Approximately, 93 percent of the 14 women who failed to start the CR ignition prototype in the naïve trial were successful after the procedure was modeled (Table 4-11) (p<0.0001). Prior to modeling, 57.1 percent of men started the CR prototype; and after modeling, 100 percent of men who were unsuccessful at starting the ATV in the naïve trial were successful (p=0.0019). For both genders modeling significantly increased the likelihood of successfully starting the CR ignition prototype.

[3] One participant's data was lost for the modeled standard ignition trial.

Table 4-11. Impact of Modeling and Gender with Ability to Start the CR Prototype Ignition

CR Prototype Ignition Type			Failed	Success	Total
Females	Before Modeling	# of participants	14	1	15
		percentage	93.3%	6.7%	
	After Modeling	# of participants	1	13	14
		percentage	7.1%	92.9%	
Males	Before Modeling	# of participants	15	20	35
		percentage	42.9%	57.1%	
	After Modeling	# of participants	0	15	15
		percentage	0%	100%	
Females: The difference is statistically significant for women (p<0.0001)					
Males: The difference is statistically significant for men (p=0.0019)					

Impact of 15th Percentile on Success

Overall, the height and weight of the adult participants did not significantly impact success rates for either ignition type. While 97.6 percent of adults above the 15th percentile could start the CR ignition prototype, 100 percent of adults below the 15th percentile could start it (p=0.99). Similarly, 95.1 percent of adults above the 15th percentile could start the standard ignition, 100 percent of adults below the 15th percentile could start it (p=0.99) (see Table 4-12).

Table 4-12. Impact of Height & Weight on Ability to Start the ATV

			Failed	Success	Total
Standard	Not Below 15th Percentile	# of participants	2	39	41
		percentage	4.9%	95.1%	
	Below 15th Percentile	# of participants	0	9	9
		percentage	0%	100%	
CR Prototype	Not Below 15th Percentile	# of participants	1	40	41
		percentage	2.4%	97.6%	
	Below 15th Percentile	# of participants	0	9	9
		percentage	0%	100%	
Standard Ignition : The difference is not significant (p=0.99)					
CR Prototype Ignition: This difference is not significant (p=0.99)					

4.2.3 Coded Video Findings

Video data for a sample of participants were coded to examine behavior and determine what controls (buttons and switches) were used most frequently by participants for a given trial. Because there were several controls on the ATV that were not recorded by the software, the video coding gave a more complete picture of what participants were drawn to and what controls they most frequently tried when attempting to start the ATV.

For both experienced and novice children, a random sample of 20 session videos were coded, with equal number of males and females (see Table 4-13). For the experienced group, the location of the session was also evenly divided, with 10 of the coded sessions taking place in the DC Metropolitan area and 10 of the coded session taking place at Altoona, PA. However, due to constraints with regard to the age of recruited participants from Altoona, PA, there were a greater number of older participants included in the experienced coding sample.

Since only a sample of videos were coded, the below findings represent observed trends in behaviors.

Table 4-13. Demographic Make-Up of Child Participant Videos

Number of Experienced Participants included in coding sample		
	Male	**Female**
DC Metropolitan Area (7-10 years old)	2	3
DC Metropolitan Area (11-15 years old)	3	2
Altoona, PA (7-10 years old)	3	1
Altoona, PA (11-15 years old)	2	4
Number of Novice Participants included in coding sample		
	Male	**Female**
Younger (7-10 years old)	5	5
Older (11-15 years old)	5	5

Analysis of the video coding included noting the number of controls a participant attempted to manipulate in any given trial. Anytime a participant would press a button or turn a switch (or key) in an attempt to "start" the ATV the coder would flag the event. However, for consistency, flags were only inserted once for every time the participant manipulated a given control. To illustrate, if the participant tried to turn the engine switch four times (without attempting any other control), a single flag would be inserted for the engine switch.

The average number of controls attempted for each trial was calculated for each of the child participant groups (children with ATV experience, and children without ATV experience). This was calculated by dividing the total number of flagged controls by the total number of trials for a given group. When video coding was complete for the subset of participants, the absolute number of

controls tried in a trial was tallied as a potential indicator of participant persistence, or as an indication of the child understanding what the researcher did and quickly repeated the actions . Paired t-tests were used to test for differences in the children's behaviors across the different trials.

Overall, for experienced children the average number of controls manipulated in both the unmodeled standard method (15.05) and unmodeled CR prototype method (17.40) were similar (p=.28). However, when comparing across unmodeled and modeled trials within method (standard, CR prototype), the number of controls manipulated is higher for the un-modeled standard method (15.05) than for the modeled standard method (5.00; p<. 0001). That is, once the experienced children observed the researcher's behavior using the standard method, they tried fewer controls when attempting to start the ignition. Conversely, there was no statistically significant difference in the average number of controls manipulated by experienced children when trying to start the CR prototype before or after modeling (17.40 vs. 15.95) (p=.60). The experienced children seemed to test a similar number of controls, even after the researcher modeled the CR prototype ignition. Finally, after the researcher modeled both standard and CR prototype ignition for the experienced children, the children tested fewer controls on average in the standard modeled trial (5.00 vs. 15.95) (p=.005).

Table 4-14. Average Number of Controls Tested

	Average Number of Controls Tested per Trial			
	Standard Un-modeled	Standard Modeled	CR Prototype Un-modeled	CR Prototype Modeled
Experienced	15.05	5.00	17.40	15.95
Novice	14.95	8.20	19.60	15.40

Similar comparisons were made with novice children. For novice children, the average number of controls manipulated for the unmodeled standard method (14.95) was less than the number of controls attempted in the unmodeled CR prototype method (19.60) (p=.03). However, when comparing unmodeled and modeled trials within method, the number of controls manipulated was higher for the un-modeled standard method (14.95) than for the modeled standard method (8.20; p=.004). As with the experienced children, once the novice children observed the researcher model the behavior using the standard method, they focused on fewer controls when attempting to start the ignition. Interestingly, relative to the unmodeled CR prototype condition (19.60), the average number of controls manipulated by the novice children decreased significantly after the researcher modeled the CR ignition prototype (15.40; p=.03). The novice children seemed to test fewer controls in both of the modeled trials (standard and CR prototype). Finally, after the researcher

modeled both standard and CR prototype ignition for the novice children, they tested fewer controls on average in the standard modeled condition (8.20 vs. 15.40) (p=.006).

Within each trial type (unmodeled standard (p=.95); modeled standard (p=.13); unmodeled CR prototype (p=.38); unmodeled CR prototype (p=.84)) there was no significant difference in the average number of controls used by novice and experienced children. Two sample t-tests were employed for this comparison.

For each of the two modeled trials, the amount of extraneous controls tested was tallied (see Table 4-15). An extraneous control is anything that the participant tested that was not explicitly modeled for them; and therefore, not a relevant step to starting the ATV. For example, if the participant tried to turn the key after the CR ignition prototype was modeled, that action would be considered an "extraneous control" because the experimenter did not use the key when modeling the CR ignition prototype. This is an indication of how much the participants were able to retain.

Table 4-15. Average number of extraneous controls tested per trial

Average Number of Extraneous Controls per Trial				
	Standard Un-modeled	Standard Modeled	CR Prototype Un-modeled	CR Prototype Modeled
Experienced	-	1.35	-	4.85
Novice	-	1.73	-	6.85

When comparing the number of interactions with extraneous controls for the modeled standard trial and the modeled CR prototype trial, both the novice children (p=.0005) and the experienced children (p=.009) had more interactions with extraneous controls, on average, in the modeled CR prototype trial than in the modeled standard trial. However, there was no significant difference in the number of extraneous controls tested by novice and experienced children in either the modeled standard trial (p=.95) or the modeled CR prototype trial (p= .26). Again, paired t-tests were used for tests of the same group (experienced or novice) across trials, while two-sample t-tests were used when comparing experienced and novice children within a trial.

When the Run switch was excluded, across the board, the Key was the most common control tested for both un-modeled trials and the modeled standard trial (see Table 4-16). For the modeled CR prototype, the children favored the start button and the foot brake.

Table 4-16. Most common control tested aside from the Run Switch

	Most Common Control Tested			
	Standard Un-modeled	Standard Modeled	CR Prototype Un-modeled	CR Prototype Modeled
Experienced	Key (63)	Key (23)	Key (80)	Start button (72)
Novice	Key (61)	Key (41)	Key (68)	Foot brake (76)

Proportion of Controls Used by Child Participants

Figures 4-1 to 4-2 illustrate the proportion of each control used when trying to start the ATV in relation to the total number of controls interacted with for each un-modeled trial. The proportions should be thought of as descriptive and qualitative in nature. No tests for significance were performed. Overall, the distribution of proportions for novice and experienced children are very similar. For the un-modeled Standard trial (see Figure 4-1), both experienced and novice groups interacted with the key frequently (approximately 21% of the time.). In addition, children seemed to interact frequently with "Other" controls (18 percent and 22 percent, respectively). These "other" controls are defined as any button or action that is not normally involved in starting an ATV, and would include turning on the light switch, twisting the gas cap or turning the ATV to all-wheel drive.

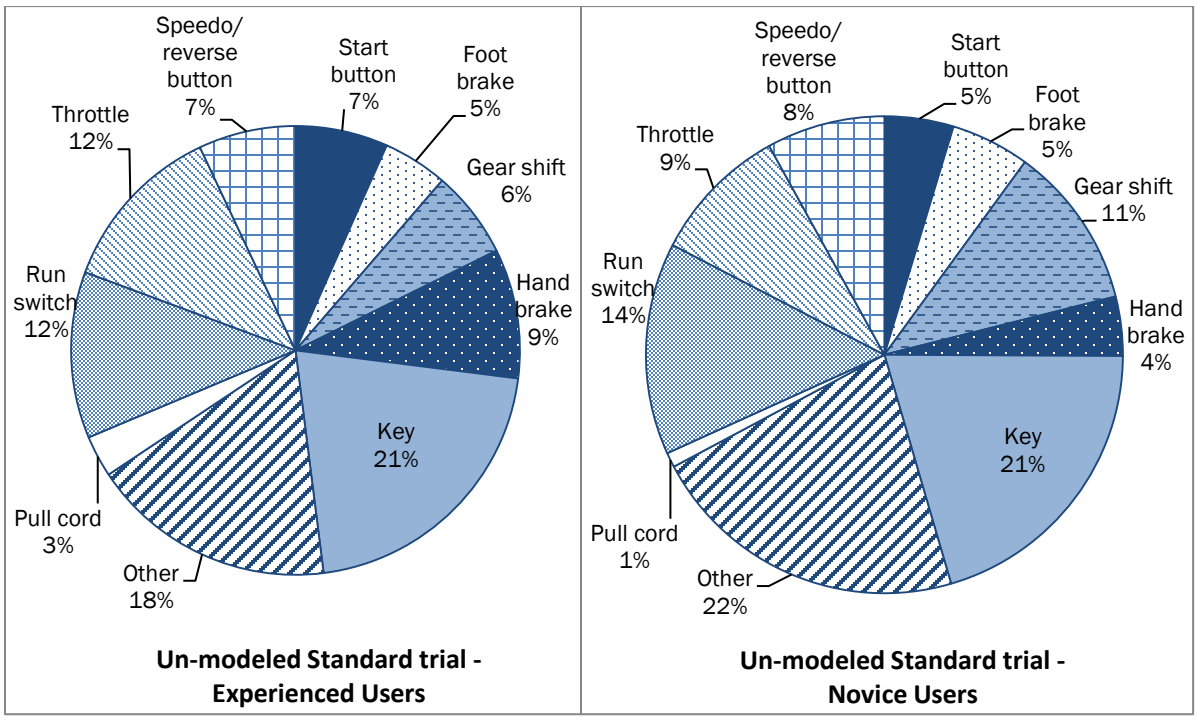

Figure 4-1. Proportion of Controls used for Un-modeled Standard trial

Similarities between the experienced and novice child participants are found in the un-modeled CR Ignition Prototype trial as well (Figure 4-2). For this trial, the discrepancy between "Other" controls is pronounced, with "Other" consisting of 12 percent of total interactions with controls for the experienced group, but 23 percent of controls for novice participants. Experienced users also used the hand brake at a greater proportion than novice children (12 percent vs. 7 percent), perhaps as a safety consideration; a common reason given for holding the hand brake was that experienced users did not want the ATV to move.

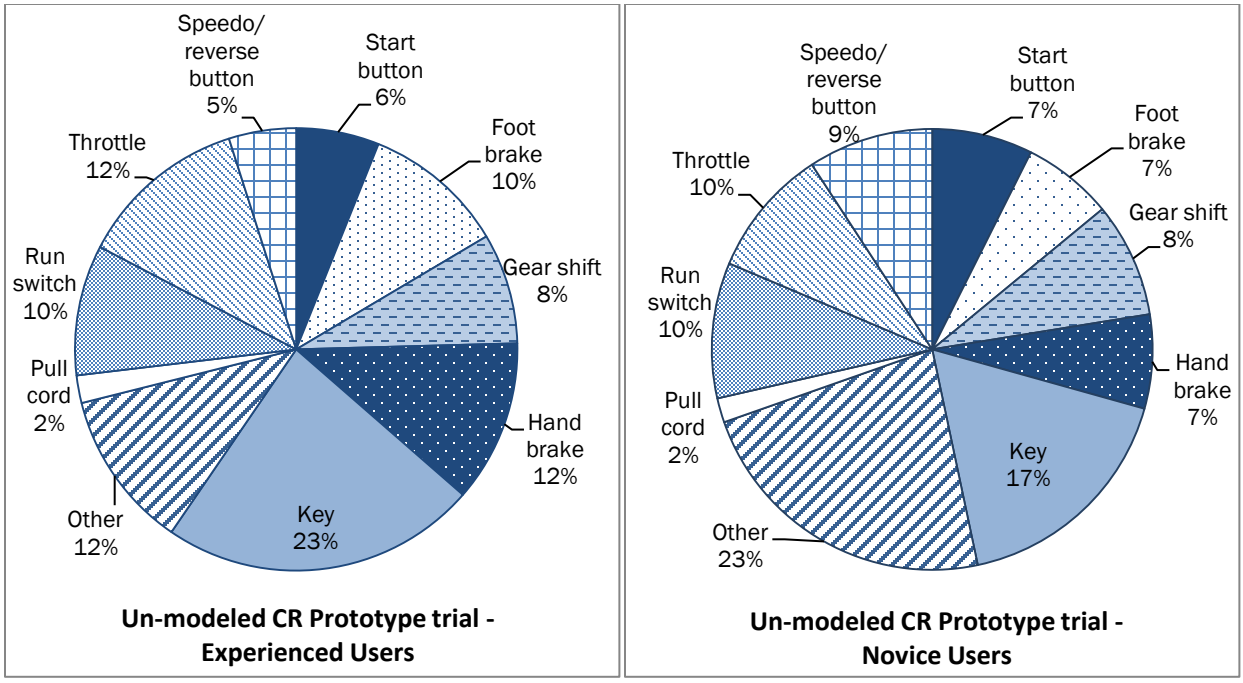

Figure 4-2. Proportion of Controls used for Un-modeled CR Prototype trial

Child Participants Observed Moving Back

Video coders looked for indicators of triggering or attempting to trigger the child-resistant weight device during the modeled CR ignition prototype trial (Table 4-17). A notation was made every time a participant (1) moved or sat back, either inadvertently or on purpose, and triggered the weight sensor, or (2) when a participant visibly moved back in the seat, even if they did not trigger the weight sensor.

Table 4-17. Proportion of children that moved back on seat after modeled

Proportion of children that moved back on seat after modeled	
Experienced (7-10)	67%
Experienced (11-15)	73%
Novice (7-10)	40%
Novice (11-15)	60%

Only 20 percent of the children were able to successfully start the ATV using the CR ignition prototype. Many of the children were not heavy enough or did not move back far enough to trigger the weight sensor. However, any attempt was still noted. Overall, 50 percent of the novice children attempted to move back in the seat after the researcher modeled the CR ignition prototype. Seventy percent of the experienced children attempted to move back in the seat. It is possible that experienced children were more sensitive to body placement (a factor for controlling/steering ATVs) than novice participants. Additionally, the younger novice participants were the least likely to move back in the seat after the method was modeled (40 percent).

Gender differences among children

In general, there were few differences between male and female child participants with regard to the number of controls attempted for each trial. Two-sample t-tests were used to test for differences in average number of controls by gender and experience within each trial; none of the differences were statistically significant. This is partly a consequence of the small sample sizes.

Table 4-18. Average number of controls tested by gender

Average Number of Controls Tested per trial by Gender				
	Standard Un-modeled	Standard Modeled	CR Prototype Un-modeled	CR Prototype Modeled
Experienced Girls	13.50	5.50	17.70	15.80
Experienced Boys	16.60	4.56	17.10	16.10
Novice Girls	15.30	5.50	20.90	14.20
Novice Boys	14.60	11.29	18.30	16.60

When experienced children were broken out by gender, all female participants, regardless of age, in the coded sample moved back in their seat after the procedure was modeled in the CR ignition prototype trial (Table 4-19). In contrast, only 40 percent of experienced males did the same (p=.011). It appears that the experienced girls are more likely to observe the behavior and attribute it to starting the ATV.

Table 4-19. Proportion of experienced children and novice children that moved back on seat after modeled by Age

Age & Gender	Participants with ATV Experience	Novice Participants
Girls (7-10)	100%	60%
Girls (11-15)	100%	80%
Boys (7-10)	40%	20%
Boys (11-15)	40%	60%

Girls still attempted to move back in the seat more often than their male counterparts during the modeled CR Prototype trial, but this difference was not statistically significant (p=.63) (Table 4-19).

4.3 Follow-Up Discussion

The following sections summarize the discussions that took place once the participants had an opportunity to work with the ATV. Both child and adult participants were asked to elaborate on

their experience. Adult participants were asked to discuss the effectiveness of the prototype design, that is, whether or not the prototype is a practical solution, and any suggestions for design improvements that might improve their overall acceptance of the device.

4.3.1 Child Participants

When asked about their experience, some of the most common controls that all child participants (those with ATV experience and those without) recalled trying were the Run Switch and the Key. In addition, several children stated that they always turned the key because they equated the key with starting the engine of a car. When asked about strategy or methods for starting the ATV, many children in the novice sessions recalled that they "tried everything." After returning to the discussion table, no single child participant in the novice sessions was able to clearly recall the steps used when trying to start the ATV using either ignition type. While most novice children were able to recall at least some of the steps the experimenter performed when modeling the two methods, they frequently mixed up the two methods or combined steps. Similarly, children with ATV experience struggled, but some were more successful at recalling the sequences.

About half of the novice children and most of the experienced children indicated that they observed the experimenter move towards the back of the seat when modeling the CR ignition prototype. However, several participants who noticed the experimenter move back, chose not move back themselves, saying that they did not think it was important. They thought the experimenter was simply adjusting the position for comfort or moving further away from the engine for safety reasons. Those who did move back said it was because they were just copying the experimenter's movements. Overall, only three or four children (all of whom were older) speculated there might be a sensor in the seat that may need to be activated to start the ATV. Only one of these children thought that it might be related to child safety.

Most of the participants were confident that they were able to start the ATV at least one time during the four trials, even when they failed. Similarly, most children were confident they knew how to start a passenger vehicle, even when they failed to recall key components, such as stepping on the brake. Interestingly, some of the experienced children were able to recall all the components of starting a passenger vehicle and some reported actually "warming up" the car or driving the car down the driveway for their parents. When asked how they "learned" to start a passenger vehicle, most of the children said they learned from observing their parents, and in some cases, their parents actually showed them.

When asked what they might do differently at home to try and start the ATV, younger participants (7-10) were usually less vocal about other strategies they might employ, but older children suggested they would look for the manual, search online, or ask an adult for help. Since most children were not aware of the weight-based sensor in the seat, very few offered suggestions of how to defeat it. Those who were aware of the sensor mentioned placing a heavy object on it or enlisting a friend to assist them.

4.3.2 Adult Participants

Effectiveness of the CR ignition prototype

Adult participants were of mixed opinions with respect to the effectiveness of the design. Most adults felt that the CR ignition prototype would prevent younger children (ages 7-8 years) from starting the ATV, but it would be less likely to deter older children from activating the ignition. Most participants felt that children ages 9 – 11 would figure out the sequence of steps to start the ignition prototype, and all participants felt that it was extremely likely a child ages 12 - 15 years old would be able to start the ATV without hesitation.

One adult suggested that maybe it was not an issue if children ages 12 – 15 were able to start it, as many of them are the size of adults; and therefore, can maneuver an adult-sized ATV. Several participants suggested that children ages 9 and older, if motivated, would be likely to "Google", "You-tube" or use the internet to figure out how to start the ATV. Additionally, others felt that if a child frequently observed an adult starting the ATV, they would eventually know how to start it. These same participants alluded to the fact that most children learn by observing, and starting an ATV would be no different. Some participants also felt that ATV experience may impact ability to start the prototype, and that children with ATV experience would be more likely to defeat the child-resistant feature as it is currently designed.

Participants suggested several ways that children might defeat the CR prototype ignition. Common strategies included: use of cinder blocks or other heavy objects on the seat, or asking a friend or sibling to assist to help override the seat sensor. The overall opinion of most participants was that kids are resourceful and they will be able to find a way to defeat the system.

Acceptability

Many participants felt the CR ignition prototype may prevent younger and smaller children from starting the ATV and thereby prevent accidents. A few participants mentioned the unintended benefit of the CR ignition prototype is that it may serve as a theft deterrent, because a thief may not be familiar with the sequence to start it.

Conversely, participants associated several negatives with the CR prototype. Participants were concerned about adding an additional electrical feature to the ATV. This is another feature that could short circuit or fail, which would be hazardous if a person was riding on a trail or somewhere that was far from home or help. Additionally, participants were dissatisfied with the placement of the Start button, indicating it was too flimsy and could easily brake off, especially considering that ATVs are intended for rough use.

Participants were also confused about the function of the ignition prototype. There were questions related to whether or not the seat sensor needed to be activated when riding or just when starting the ATV. Participants were concerned that the design was similar to a riding lawn mower, such that the engines shut off when the occupant leaves the seat. The lawn mower design would not be applicable for an ATV because the rider frequently oscillates between sitting and standing. Others questioned why the key was not an additional step in the CR ignition prototype, there was concern that this could leave the vehicle vulnerable to theft.

In general most participants did not think the number of steps required for the CR ignition prototype was too onerous, but many indicated that they would prefer not to have this feature on their own ATV. Most felt that it was not "applicable" to their situation. Some of the participants with children living in the home said, "My kids are too old", while others said, "My kids would never take my ATV without permission." It is notable that many of the participants had young children, but perceived their children to be experienced or knowledgeable enough about the ATV. Therefore, in their opinion, there was no need for this ignition type.

While participants did not necessarily think the CR ignition prototype was applicable for their situation, it did not seem to deter them from purchasing an ATV if it had this feature. However, all participants were adamant about not paying extra for the feature. When asked to further explain their preference, many felt that the feature should be a no-cost option. Therefore, those who want the CR feature can purchase an ATV with it and those that don't can purchase an ATV without this technology. Only a few participants indicated that they would try to disable or override the system by deactivating the weight sensor. However, most were concerned that disabling the system would void a manufacturer's warranty; and therefore, would be more inclined to leave the system in, even if it was annoying at times.

Possible Design Improvements

Participants suggested several design improvements related to the CR ignition prototype. One of the more common suggestions was to replace the Start button with one that is more durable. Others suggested moving the Start button because at its current location it draws too much attention and may attract children. Additionally, rather than a sequence of steps that must be completed, a lot of participants suggested that a key pad could be added, and the user could develop their own passcode. Participants felt that this would be much tougher for a child to override. Other improvements include: increasing the weight trigger for the seat sensor to over 100 lbs., moving the switch from the foot brake to the hand brake because it would be more durable, and develop a solution or override in case the system fails. Some participants suggested installing a switch on the ATV that would activate the weight sensor. If the adult did not have children, they do not need to use it, but if the presence of children was an issue, they could turn on the sensor which would require a specified weight to activate the ignition.

4.3.2.1 Questionnaire Responses

As previously mentioned, adult participants were asked to complete a brief questionnaire regarding their opinion of the two ATV ignitions once they completed the hands-on portion of the session. When asked whether they found the ignition types to be frustrating, most participants indicated that they did not find the Standard ignition frustrating (Figure 4-3) or challenging to work with (Figure 4-4). Relative to the Standard ignition, more participants found the CR ignition prototype frustrating (Figure 4-3) and challenging to start (Figure 4-4).

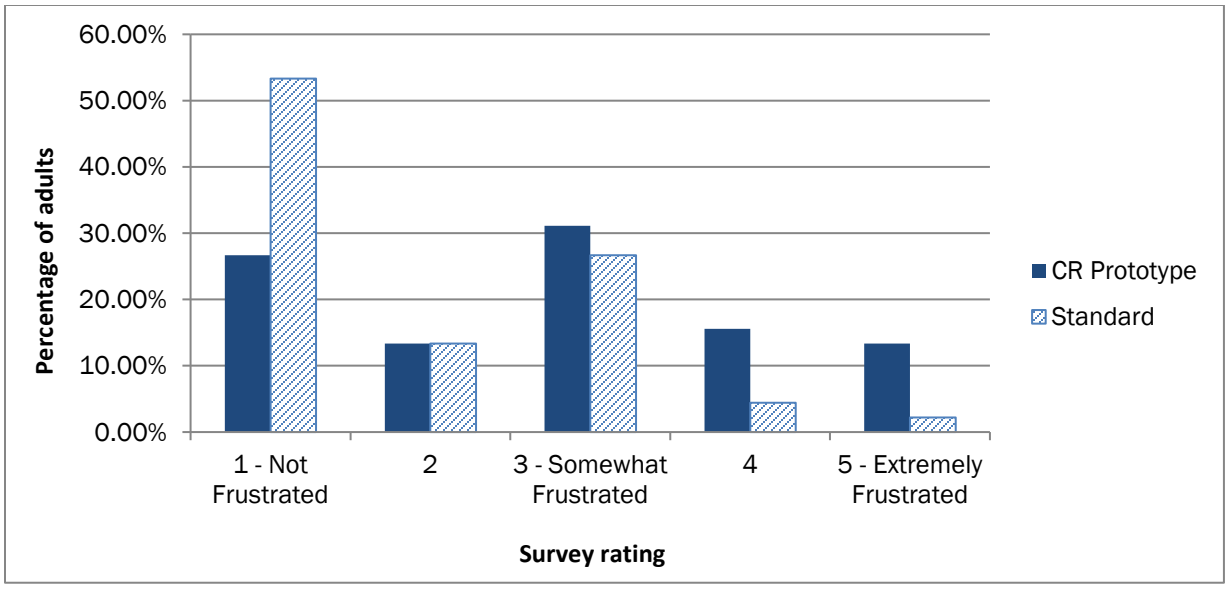

Figure 4-3. Adult Participant Rankings of "Frustration" by Ignition Type

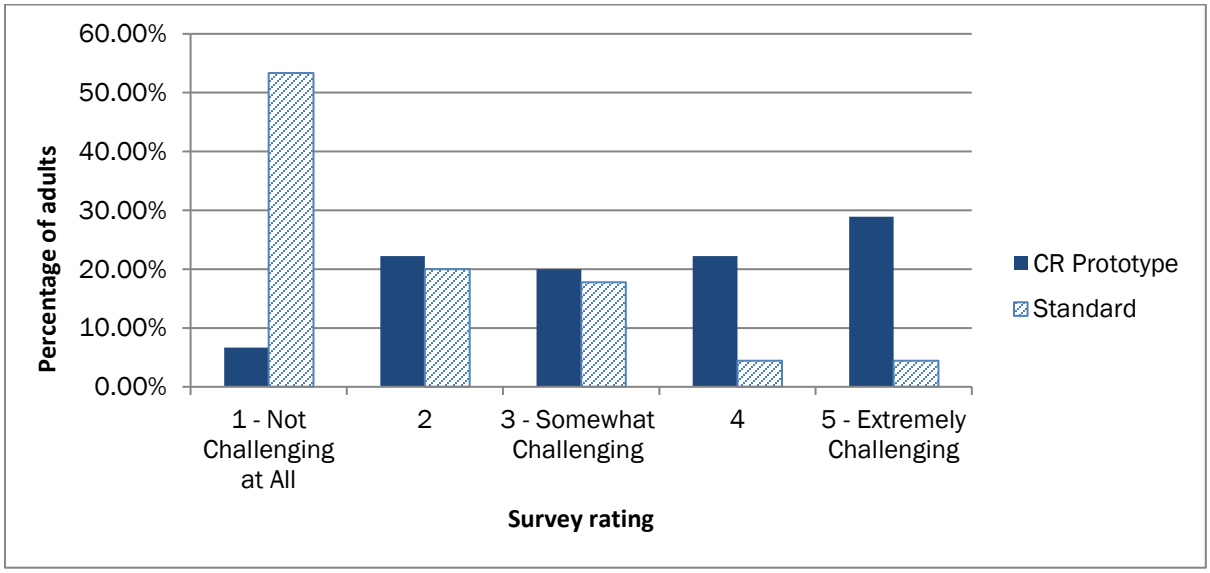

Figure 4-4. Adult Participant Rankings of "How Challenging" by Ignition Type

Similarly, participants seemed to have mixed opinions on how effective the CR ignition prototype would be at preventing a child from starting the ATV, whether or not they disliked the ignition, and whether the presence of the child-resistant feature on an ATV would impact their decision to purchase (see Table 4-24). Approximately, 86.6 percent of participants felt the ATV would be "Somewhat effective" to "Extremely Effective," at preventing a child from starting an ATV. Additionally, most participants (75.6 percent) either "Somewhat liked" to "Extremely liked" the CR ignition prototype.

Approximately, 37.8 percent of the adults indicated that, if an ATV were equipped with a child-resistant feature, "It might impact their decision" to purchase the ATV. Thirty-three percent indicated it would not impact their decision at all. Please note, the questionnaire did not indicate if the decision would be impacted negatively or positively.

Table 4-20. Participant Responses to Questionnaire

Rating of how effective the participant thought the child-resistant prototype ignition would be against children's attempts to start the ATV.		
Category	**Frequency**	**Percent**
Missing	5	
1 - Not Effective at All	2	4.4%
2	4	8.9%
3 - Somewhat Effective	15	33.3%
4	10	22.2%
5 - Extremely Effective	14	31.1%
Rating of how much the participant liked the child-resistant prototype ignition.		
Category	**Frequency**	**Percent**
Missing	5	
1 - Extremely Dislike	2	4.4%
2	9	20.0%
3 - Somewhat Like	15	33.3%
4	14	31.1%
5 - Extremely Like	5	11.1%
Rating of the extent which the presence of such a child-resistant prototype would impact their decision to purchase a particular ATV.		
Category	**Frequency**	**Percent**
Missing	5	
1 - It would not impact my decision at all	15	33.3%
2	6	13.3%
3 - It might impact my decision	17	37.8%
4	4	8.9%
5 - It would very much impact my decision	3	6.7%

5 Conclusions and Discussions

5.1 Child Participants

In summary, when compared to the standard ignition, the CR ignition was more effective in preventing children from starting the ATV. While approximately 76 percent of the children were ultimately successful at using the standard ignition, only 20 percent were capable of starting the ATV using the CR ignition prototype. While experience with an ATV had no significant effect on the success rate of children when working with the standard ignition (80 percent for experienced children vs. 71 percent for children without experience), children with experience driving or riding an ATV were more successful starting the ATV using the CR prototype than children without experience (35 percent vs. 5 percent, respectively). This may be the result of having experience actually starting or observing adults start ATVs with different ignition mechanisms, or exposure to other off-road vehicles (lawn mowers, tractors), which have a weight sensor on the seat in order to prevent injury to the rider. Many of the experienced children lived in more rural areas. Having this exposure to alternative types of ignitions, may have given the experienced children an advantage when working with the CR ignition prototype.

It is common knowledge that children learn through observation and repetition. In fact when asked if they know how to drive a car, most children in the study indicated that they did, and that the behavior was learned from watching their parents. Thus as part of the protocol, the experimenter modeled the procedure for starting the ATV ignition if the child failed at the initial attempt to start either of the ignition systems. While modeling the procedures appears to have a positive effect on the child's ability to activate either of the ignition types, the positive effect seems to be age related and greater for the standard the ignition.

None of the children between 7-11 years old were able to activate the CR ignition prototype prior to the experimenter modeling the procedures. Once they observed the experimenter turn on the CR ignition, only 15 percent of the 9-11 year olds were capable of successfully performing the procedures (none of the children 7-8 were successful). Overall, older children (12-15 years old) were more successful in their initial attempts to start the ATV with the CR ignition (4 percent). Once modeled, approximately 29 percent of the oldest children were able to start the ATV using the CR ignition.

It is important to note, that while the CR ignition prototype prevented most of the younger children from starting the ATV, 6 percent of the youngest children started the ATV using the standard ignition prior to modeling and 46 percent were successful after the standard procedures were modeled. A similar success rate was observed for the children between the ages of 9-11 years old when interacting with the standard ignition (10 percent vs. 68 percent). Finally, 32 percent of the oldest children (12-15 years old) were successful prior to having the standard procedure modeled, and 83 percent were successful after modeling. Interestingly, significantly more children in each of the three age conditions were able to activate the standard ignition after modeling when compared to the CR ignition prototype.

While age appears to be a contributing fact in the success rate for either ignition type, it is probably related to the child's cognitive maturity and ability to observe and recall all of the components of activating the ignition. Overall weight and height did not seem to be predictive factors for success.

As noted in the body of the report, children were only given 2 minutes to successfully activate either ignition type before and after procedures were modeled. It is understood that in a less controlled environment, children will have extended periods of time to make attempts and will in-turn receive feedback from the sound of the engine if successful. Most children indicated that they would access the internet in order to learn how to activate the ATV or simply learn how to override the CR components.

5.2 Adult Participants

Overall, 96 percent of the adults were successful at starting the ATV using the standard ignition while 98 percent were successful at starting the CR ignition. Similar to the children, observing the experimenter start the ATV using either ignition type increased the likelihood that the adult was successful in their second attempt at starting it. The increase was significant for both genders when working with the CR ignition.

There was some concern that smaller statured adults might experience the same challenges as children do when trying to activate the CR ignition. However, the data indicated the success rates for the 15th percentile adults for either ignition type was not significantly different than their counterparts.

In general, most adults did not have a strong positive or negative opinion of the CR ignition prototype. This may have been due to the fact that most adults felt that this prototype was not applicable to their situation. That is, some did not have children living in the home or as regular visitors, others felt that they had provided their children with enough safety information related to riding the ATV that they would trust them, still others indicated that their children would never ride unsupervised, or try to use the ATV without asking first.

While most adults felt that the number of steps required to start the CR ignition was not too onerous for an adult to use. They did believe that the CR ignition would probably be successful at preventing all of the children between 7-8 years old from starting the ATV. Conversely, they felt that some of the 9-11 and most of the 12-15 year olds would be successful at overriding the system. Accordng to the adults participants, children in the older age group had the physical capabilities to override the system, and if motivated enough would seek out other sources when trying to learn how to start the ATV (Google, YouTube, etc). Note that these opinions are consistent with what is shown in the data.

Finally, while most of the adults were indifferent to the addition of the feature, some did express concerns related to adding an additional electrical component that will eventually break, the lack of requiring a key that may leave the ATV open to increased theft opportunities, and the possible increase in purchase cost that the feature might introduce. Some adults suggested the integration of a key pad or alternate key that would activate the CR ignition. When necessary, the adult can activate the CR ignition, otherwise it would be in the standard mode.

5.3 Study Limitations

It is important to note that this study did present certain limitations that should be considered when interpreting the findings. In the real-world children will receive feedback in the form of the engine turning over that would enable them to recognize if a strategy or trial was successful. In addition, children would have more time to work with the ATV and may have had more opportunities to observe an adult starting the ATV. Finally, the child might call on friends for assistance. All of these factors may contribute to a greater success rate outside of the controlled environment. It is important to note that, as with any study that uses a volunteer sample in order to explore behavior, the findings from the study may not be generalizable to the overall population.

5.4 Other Notable Findings and Recommendations

Many adult users took the "not my child" approach and did not think their child would ever try to start their ATV without asking for permission or without supervision. In addition, supervision seems to represent different things to different people. Supervision can mean riding with the child (on the same ATV or alongside), watching the child from a stationary point, or just being aware that the child is outside on the ATV. Additionally, most of the adult riders store their key with the ATV. Many of the adults keep the ATV in the ignition or on the ATV seat, while others simply hang it on a hook in the garage. All of these locations represent easy access points for curious children. Very few adults kept the key out of sight or locked away.

These findings imply that the statistics related to ATV injuries and fatalities related to under-age children operating an adult ATV are not widely known or understood among all ATV users, or that ATV users may be misinformed. This suggests a need for better public information and educational (PI&E) disseminated by industry as well as CPSC aimed at providing accurate information related to risks associated with riding and crash severity.

While there is a delicate balance between testing the CR prototype capabilities and effectiveness, and educating children on how to override a CR system that is meant to safeguard against misuse, a more naturalistic study might provide feedback similar to what was done for adults. This design might better help to determine the effectiveness of the feature in preventing children from starting an ATV in a more naturalistic setting.

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