Usability of Just-in-Time Training for Treestand Safety Among Age Diverse Populations

A thesis presented to

The faculty of

the Russ College of Engineering and Technology of Ohio University

In partial fulfillment

of the requirements for the degree

Master of Science

Brittany L. L. Crall

August 2016

© 2016 Brittany L.L. Crall. All Rights Reserved.
This thesis titled
Usability of Just-in-Time Training for Treestand Safety Among Age Diverse Populations

by

BRITTANY L. L. CRALL

has been approved for
the Department of Industrial and Systems Engineering
and the Russ College of Engineering and Technology by

Diana Schwerha
Associate Professor of Industrial and Systems Engineering

Dennis Irwin
Dean, Russ College of Engineering and Technology
ABSTRACT

CRALL, BRITTANY L.L., M.S., August 2016, Industrial and Systems Engineering

Usability of Just-in-Time Training for Treestand Safety Among Age Diverse Populations

Director of Thesis: Diana Schwerha

Treestands are the lesser known contributors to hunting related injuries. Falling from a treestand is a life-altering incident that can potentially disable hunters for life. Although the law regulates communication of safety procedures requiring individuals to be trained, several loopholes exist in the system and many hunters do not receive the proper training. The purpose of this research was to develop a useful mobile phone application that would make the information more accessible to hunters and then test this application for usability, effectiveness, and receptiveness. This research analyzed the usability and training effectiveness of the app using a brief pre-and post-testing method, usability questionnaire, and predicted use evaluation when used by two age groups of hunters and non-hunters, ages 21 – 39 and 40 plus. Results indicated that all groups of participants improved their pre and post test scores by 25% on average (p-value of 0.00, T-value of -6.69). All groups of participants indicated that the app was highly usable and hunters reported that they would be very likely to use the app in the future.
I would like to dedicate this work to; my grandfather Gary R. Crall, my uncles Bill Jones and Chris Crall, and my Father Gary D. Crall. If it were not for these men I would not be the hunter I am today.
ACKNOWLEDGMENTS

I would like to express my gratitude to my advisor, Diana Schwerha, for all of her attention and direction in the completion of this work. I would also like to thank my committee for all of their comments and critiques during the development of this study.
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>3</td>
</tr>
<tr>
<td>Dedication</td>
<td>4</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>5</td>
</tr>
<tr>
<td>List of Tables</td>
<td>8</td>
</tr>
<tr>
<td>List of Figures</td>
<td>9</td>
</tr>
<tr>
<td>Chapter 1: Introduction</td>
<td>10</td>
</tr>
<tr>
<td>Chapter 2: Literature Review</td>
<td>14</td>
</tr>
<tr>
<td>2.1. Treestands</td>
<td>14</td>
</tr>
<tr>
<td>2.1.1. Overview</td>
<td>14</td>
</tr>
<tr>
<td>2.1.2. Safety Devices</td>
<td>15</td>
</tr>
<tr>
<td>2.1.3. Best Practices in Utilizing Treestands</td>
<td>16</td>
</tr>
<tr>
<td>2.2. Laws on Hunter Education Courses</td>
<td>18</td>
</tr>
<tr>
<td>2.3. Current Communication of Training Material</td>
<td>19</td>
</tr>
<tr>
<td>2.4. Just-in-Time Training</td>
<td>21</td>
</tr>
<tr>
<td>2.5. Usability</td>
<td>22</td>
</tr>
<tr>
<td>2.6. Assessment Methods</td>
<td>25</td>
</tr>
<tr>
<td>2.7. NIOSH App</td>
<td>26</td>
</tr>
<tr>
<td>Chapter 3: Methodology</td>
<td>27</td>
</tr>
<tr>
<td>3.1. App Design</td>
<td>27</td>
</tr>
<tr>
<td>3.2. App Content</td>
<td>27</td>
</tr>
<tr>
<td>3.3. Hypotheses</td>
<td>28</td>
</tr>
<tr>
<td>3.4. Participants</td>
<td>29</td>
</tr>
<tr>
<td>3.5. Testing Environment and Devices</td>
<td>30</td>
</tr>
<tr>
<td>3.6. Knowledge Testing</td>
<td>30</td>
</tr>
<tr>
<td>3.7. System Usability Scale</td>
<td>31</td>
</tr>
<tr>
<td>3.8. Procedure</td>
<td>32</td>
</tr>
<tr>
<td>Chapter 4: Results</td>
<td>33</td>
</tr>
<tr>
<td>4.1. Demographics</td>
<td>33</td>
</tr>
</tbody>
</table>
LIST OF TABLES

<table>
<thead>
<tr>
<th>Table Number</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>Participant Demographics</td>
<td>33</td>
</tr>
<tr>
<td>Table 2</td>
<td>Hunter Education Background</td>
<td>34</td>
</tr>
<tr>
<td>Table 3</td>
<td>Descriptive Statistics</td>
<td>36</td>
</tr>
<tr>
<td>Table 4</td>
<td>Two-Way ANOVA (hunting status, age)</td>
<td>37</td>
</tr>
<tr>
<td>Table 5</td>
<td>Paired-T Test Pre and Post-Test (ALL Participants)</td>
<td>39</td>
</tr>
<tr>
<td>Table 6</td>
<td>Paired-T Test Pre and Post-Test (Non-Hunters)</td>
<td>39</td>
</tr>
<tr>
<td>Table 7</td>
<td>Paired-T Test Pre and Post-Test (Hunters)</td>
<td>40</td>
</tr>
<tr>
<td>Table 8</td>
<td>Paired-T Test Pre and Post-Test (Young)</td>
<td>40</td>
</tr>
<tr>
<td>Table 9</td>
<td>Paired-T Test Pre and Post-Test (Old)</td>
<td>40</td>
</tr>
<tr>
<td>Table 10</td>
<td>ANOVA (Post-Test versus Age)</td>
<td>41</td>
</tr>
<tr>
<td>Table 11</td>
<td>ANOVA (Two-Way) Hunting Status, Age versus SUS</td>
<td>43</td>
</tr>
<tr>
<td>Table 12</td>
<td>Two Sample T-test on Predicted Use by Age</td>
<td>44</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 1 Main Effect Plot (Pre-Test versus hunting Status) ............................................. 38
Figure 2 Main affects Plot Age on Post-Test .................................................................... 42
Figure 3 Main Effects Plot Hunting Status on SUS.......................................................... 43
CHAPTER 1: INTRODUCTION

The annual hunting market produces approximately $10 billion in revenue (Halanski & Corden, 2008). Furthermore, annual treestand sales are steadily increasing. From 2004 to 2007 sales have increased nearly 15 percent at an annual sale number of 1.5 to 2 million units (Crockett et al., 2010). The US Fish and Wildlife’s estimation states that 10.3 million individuals, nearly 6% of the population currently hunt in The United States (Halanski & Corden, 2008). Given this degree of participation safety concerns are sure to arise. Over 400,000 hunting licenses are sold in Ohio yearly. Most of these hunters utilize treestands for the purpose of deer hunting. Approximately 80 percent of Ohio hunters pursue only deer (Crockett et al., 2010). Treestands are very common among hunters but they are also potentially dangerous. When it comes to hunting injuries, treestands are most likely at fault (Fanter & Gudger, 2011).

Treestand elevation can reach anywhere from 15 to 30 feet high, depending on the hunter’s preference, and at those heights, a falling hunter can reach speeds of 30 miles per hour (Fanter & Gudger, 2011). Treestands are necessary to give the hunter an elevated view of approaching game. Since bow hunting requires close proximity to achieve the desired shot, a bird’s eye view is necessary. Many different types of treestands exist on the market; fixed position, climbing, and ladder treestands. Fixed position stands are stands that are strapped to the tree and accessed by tree steps or a ladder stick. The recommendation is that the hunters use a climbing system that does not screw into the tree or damage it in any way (“Ohio Hunter Safety Course | Study Guide,” n.d.). Climbing stands are stands that the hunter uses to climb up a tree. No climbing
steps or ladder sticks are necessary. Ladder stands are platforms that have a ladder attached and running down the tree at an angle. There are also hand-built treestands but they are not recommended due to the damage they inflict on the tree and increased hazards ("Ohio Hunter Safety Course | Study Guide," n.d.). All elevated treestands have associated risks (Fanter & Gudger, 2011). The National Bow hunter Education Foundation estimates that 90% of hunters use some type of elevated treestand in the field and 10% of those who use them suffer injury (Fanter & Gudger, 2011). Surveys conducted by Glen Mayhew on the use of harnesses report that 55 percent of hunters consistently wear a harness and 15 percent never utilize harnesses ("Treestand accidents avoidable: ArticlesPlus,” n.d.).

Treestand injuries studied in Ohio over a ten year period show the most common types of injuries sustained are spinal, lower extremity fractures, and traumatic brain injury (Crockett et al., 2010). Approximately 80 percent of all falls required some type of operation, and 10 percent of those individuals suffered permanent brain damage as a result of a fall (Crockett et al., 2010). These statistics raise another concern centering on medical cost and disability given the degree of severity of treestand falls. Outcomes for those who fall unprotected by a harness are bleak and the medical treatments are costly.

Given the volume of hunters, the need to communicate knowledge is imperative to increase awareness of treestand safety. Treestand safety training has become paramount in reducing the injuries associated with hunting out of elevated stands. Reducing falls depends largely on the education courses hunters must take. The training is comprised of various procedures to ensure hunters are aware of the hazards present
while utilizing elevated platforms. The material covered spans the entire life cycle of an elevated stand from initial set up to field use (“Ohio Hunter Safety Course | Study Guide,” n.d.).

Understanding the risks and how to properly minimize them using hunter education courses is important but not every hunter is required to take the course. It is required for young hunters now but there are loopholes in the system. Ohio requires all first time hunting license purchases to be validated by passing a hunter education course (“Lawriter - OAC,” n.d.). If the individual can show proof of purchase of a previous hunting license they do not have to pass a hunter education course. As it stands, increasing the awareness in regards to hunter safety can significantly decrease hunting related injuries (Fanter & Gudger, 2011). Since safety procedures for hunters are not mandated by government, this research focuses on demonstrating that a mobile app can increase a hunter’s knowledge by presenting the information adequately and simplistically. Online courses and videos on treestand safety are readily available but not every hunter will voluntarily visit the pages. The app developed during this study can make the material available to the hunter in the field. This will be less cumbersome than other online materials. The purpose of this research is to develop a condensed version of the material already available and compose it in an easy to understand app and then test the apps ability to increase knowledge as well as its usability and predicted use. Such an application has the potential to reach countless hunters with various amounts of knowledge on treestands and their best practices. Both young hunters just getting their
feet wet or older hunters, who may just need a refresher course in treestand safety, will be able to benefit from this training.
CHAPTER 2: LITERATURE REVIEW

2.1. Treestands

2.1.1. Overview

Treestands are popular for many reasons; they give hunters the ability to spot game far before the game spots them, they give time to strategize the shot, they make the hunters’ scent harder to detect, they allow hunters to easily spot other hunters, and they provide a back stop for all shots fired at a downward angle (“HUNTERcourse.com | Treestand Safety,” n.d.). Having the ability to view the area from an elevated platform gives the hunter a better advantage over the prey, much like a bird. The game being hunted does not expect danger to be lurking above their heads. Bow hunters need to carefully place their shot at a substantially close distance in order to take down large game. Shooting a bow accurately and precisely takes skill and discipline. This challenge is perhaps what draws so many hunters into the sport. Treestands are used most commonly in the pursuit of boar, deer, bear, and turkey (Metz et al., 2004). In Ohio, treestands are most likely utilized for whitetail deer hunting. Treestands are one valuable tool in the hunter’s arsenal that allows for close contact between the hunter and the prey.

Many different types and styles of treestands are available on the market. They include ladder stands, climbing stands, fixed position stands, and tripod stands (“Ohio Hunter Safety Course | Study Guide,” n.d.). Ladder type stands are platforms with a ladder attached at an angle with supports strapped to the tree. Climbing treestands are used in two separate pieces, a platform and a seat. These pieces are used to walk the hunter up the tree. Fixed position stands consist of a single structure with a seat and a
platform. The stand requires an independent climbing apparatus. This is referred to as a strap on climbing system. The strap on system is the recommended method over other types that can easily be pulled free and cause damage to the tree (“Ohio Hunter Safety Course | Study Guide,” n.d.). Tripod stands are platforms independent of a tree. They are structures that require sturdy ground to be considered safe but they are not dependent on a tree for support (“Ohio Hunter Safety Course | Study Guide,” n.d.).

2.1.2. Safety Devices

No matter what type of treestand a hunter prefers, they still should be aware of the precautions and procedures associated with safe use of stands. Becoming familiar with the devices manufactured for treestand safety is an essential part of the equation. The proper harness is needed to prevent fall complications. The Treestand Manufacturers Association had previously promoted the use of single strand safety belts but research has since proven them to be hazardous. After the Consumer Product Safety Commission concluded eight deaths attributed to the safety belts, the devices have been removed from the market (Halanski & Corden, 2008). A full body harness with a tether and a tree strap is the recommended defense against falls (“Ohio Hunter Safety Course | Study Guide,” n.d.). The harness should support the hunter and provide a suspension relief system in case of a fall. A suspension relief system is a device build into harnesses that prevents the weight of the hunter’s body from restricting blood flow (“Ohio Hunter Safety Course | Study Guide,” n.d.). When climbing into the stand the hunter should be using a device known as a lineman’s belt. This belt allows for the individual to climb safely in and out of the tree without being detached from a safety device (“Ohio Hunter Safety Course |
Once the treestand is set, a safety line can be installed that attaches the tether to the tree strap from the ground up (“Ohio Hunter Safety Course | Study Guide,” n.d.).

These devices are not unlike the devices seen in various occupations. Some safety equipment can be slightly different in design but they all have the common goal to secure an individual while they are completing tasks. The tasks may vary but the end result is the same. In general industry, the rule of thumb is that an employee should be tied off at heights of six feet or more (Occupational Safety & Health Administration [OSHA], 2012) (OSHA, 2012). The harnesses for general industry are very similar to harnesses utilized by hunters. These harnesses are referred to as personal fall arrest systems; they consist of a full body harness, a sliding back D-ring, and a secure anchorage point (Ellis, 2002). Unlike hunting, industry fall arrest systems are mandatory. Companies must comply with OSHA regulations.

2.1.3. Best Practices in Utilizing Treestands

According to the Hunter Education material, a specific setup procedure should be followed in the field. The first step in utilizing treestands is to set the stand. In order to properly set the stand the hunter should read all the manufacturer’s instructions and make sure that the treestand is designed to meet ASTM standards (“Ohio Hunter Safety Course | Study Guide,” n.d.). Making sure the stand is designed properly and that it has been assembled correctly are two very important factors in ensuring that the stand will maintain structural soundness throughout the season. The hunter should also utilize the buddy system before setting the stand and before setting out into the field they should
communicate to others of where they will be hunting or setting up their treestand (“Ohio Hunter Safety Course | Study Guide,” n.d.). Giving locations, phone numbers, and estimated time of return will let others know where to come looking if the hunter has been in an accident of any type. This can also be compared to work permits and other written safety procedures employees use in their day to day activities.

Once the preliminary work has been done an adequate tree must be selected. The tree should be straight without low branches and bark that is not loose or spiny (“Ohio Hunter Safety Course | Study Guide,” n.d.). A strong straight tree with rough bark suitable for the stand’s claw grip will ensure the treestand is sturdy. After picking a tree that meets all the criteria, depending on the stand, the hunter must choose a climbing system. Before the hunter ever begins climbing they should be secured in a full body harness equipped with a suspension relief system. If the treestand is a ladder stand or a climbing stand this step is not necessary. When utilizing a fixed position treestand the recommendation is to use a strap on climbing system because the alternatives will damage the tree and can potentially pull out while climbing (“Ohio Hunter Safety Course | Study Guide,” n.d.). A strap on system will not damage the tree and cannot be pulled away during climbing. Instructors emphasize the important to use a lineman’s belt while climbing the tree for the first time because it keeps the hunter attached to the tree while they are setting the climbing system (“Ohio Hunter Safety Course | Study Guide,” n.d.).

After installing the climbing system the stand should be hoisted up and placed below the top of the climbing system (“Ohio Hunter Safety Course | Study Guide,” n.d.). If the treestand is a climbing stand the hunter simply would walk up the tree using the
stand. To set a ladder stand it takes about three to five individuals because it must be assembled and positioned before climbing up to secure it. After the stand is secured a gear hoist should be mounted. The gear hoists goal is to prevent the hunter from climbing with their gear. The hoist line should always be placed on the opposite side of the climbing system (“Ohio Hunter Safety Course | Study Guide,” n.d.). This will ensure the hunter maintains a three point contact on the ladder while they climb.

Once everything is in place the stand is ready for the hunt. Several safety practices exist that one should remember when hunting out of a treestand. One should always wear a full body TMA approved harness with a suspension relief system, carry a communication device, and inform friends and family of the location the hunt is taking place and an estimated return time (“Ohio Hunter Safety Course | Study Guide,” n.d.). After climbing into the treestand the tether and tree strap should be adjusted so that there is no slack while in a seated position (“Ohio Hunter Safety Course | Study Guide,” n.d.). In the event of the fall the lack of slack in the tether will increase the likelihood of recovery from the fall. In the event that a fall does take place the hunter should not panic but continue to move the legs and attempt to climb back onto the platform.

2.2. Laws on Hunter Education Courses

All of the safe practices and procedures are covered in more detail in various hunter education courses. These courses are designed to prepare young hunters and older hunters alike to hunt safely. In 1994, forty-six States have required hunter education courses before obtaining a license and the remaining offer the option (Hilaire et al., 1998). Currently about 49 states have some sort of education requirement but there are
still existing loopholes in many states ("Hunter Education Requirements," n.d.). In Ohio all hunters are required to either show proof of purchase of a previous license or proof that they completed a hunter education course ("Lawriter - OAC," n.d.). However, the state also offers the option for young hunters to obtain an Apprentice license that requires them to hunt with a mentor over the age of 21 who has completed a hunter education course but these special licenses can only be purchased for a maximum of three years before the course is required ("Lawriter - OAC," n.d.). This law has received much attention. Some feel that the dangers that arise from allowing children as young as nine years old to carry a weapon without having taken a hunter education course is far too great (Byron, 2013). The law serves as a stepping stone to the young hunting population to acquire a basic field experience before committing to a course. It was implemented to promote the sport of hunting among children but 75% of hunter education instructors hold reservations about the ethics of this law (Byron, 2013).

2.3. Current Communication of Training Material

The hunter education courses offered vary greatly by state and region but they all promote safe practices in the field by improving hunter behavior (Benson & White, 1995). Hunter safety is not mandated by an organization like OSHA; therefore, safety is voluntary. In order to promote safe practices, hunter education courses must concentrate on modifying behavior by increasing the awareness of risks. Since the inception of hunter education courses, hunting related accidents have been reduced by as much as 50% (Hilaire et al., 1998). A study conducted to test the difference between instructor led courses and home study courses looked at performance of students in each category and
found that both methods are comparable but home-study allows for more flexibility to the student (Hilaire et al., 1998). Some states have adopted the method in different ways by utilizing workbooks and other out of class materials. The concept of home study would concentrate the class time on examination and more in depth learning (Hilaire et al., 1998). In conclusion, the method proposed could not be rejected and was found to exhibit benefits to most age groups although it was recommended that the training incorporate hands-on methods in the use of firearms (Hilaire et al., 1998).

Organizations, such as The Treestand Manufacturers Association (TMA), are always working to make the hunting population aware of new developments and safety procedures for treestand safety. They provide standards for harnesses as well promote safety in the forms of tip sheets and other useful materials (“Treestand Safety Guidelines - TMAStands,” n.d.). They also use videos to promote awareness and safe practices in the form of public safety announcements (“Public Safety Announcements - TMAStands,” n.d.). In one of the short videos the speaker highlights the importance of reading all of the manufacturer warnings. The concern is expressed that not all hunters appreciate taking the time to read said instructions and therefore create a risk. The video explains how the TMA has come to combat these bad behavioral practices by requiring product to include video instructions along with the written instructions (“Public Safety Announcements - TMAStands,” n.d.). By doing this, the likelihood of individuals reviewing the methods of proper use is increased.
2.4. Just-in-Time Training

The concept of just-in-time is not a new idea. It derives itself from lean manufacturing principles developed by Toyota (Mincu & Comănescu, 2015). Just-in-Time is a strategy applied to production in which products are produced from resources in such a way that inventory is minimized. Just-in-time training is a concept growing in popularity given that studies have shown 70% of course concepts are forgotten before they can be utilized (Kopp & Burkle, 2010). The concept of applying Just-in-Time to training applied to tutoring focuses less on initial training and more support post tutoring session (Belzer, 2013). Belzer found that the training volunteers received prior to being matched to the tutee was not being utilized to the appropriate degree. Rather than focus the time and energy on pre-match training, Belzer listened in on sessions and supplied the volunteers with feedback (Belzer, 2013). By decreasing the amount of irrelevant information the JIT tutor training model eliminates time spent conveying information that is not well used by volunteers.

Just-in-time training occurs on the job site when needed by the employee. This proximity allows for employees to be on their post at all times while still receiving the training needed to complete their given tasks. This type of training has been further pioneered by the prevalence of computer based programs and simulations (Kopp & Burkle, 2010). Matching the essential training resources to specific needs is the essence of Just-in-Time Training. Applying the method to clinical radiology practice is a well-received instillation of the concept for continuing healthcare education (Kahn et al., 2007). The model created in this study was tested among physicians who indicated that
the modules were user friendly and that they were relevant. Individuals in the medical field must never cease learning with the ever changing technology around them, thus, creating an undeniable need for change in the way the education takes place (Kahn et al., 2007). Just in time training applied to the medical profession can greatly enhance the retention and utilization of new technology at the trainee’s fingertips. Adult learning is much better facilitated by experience than by classroom style training (Belzer, 2013). Just-in-time training modules have the potential to bridge gaps in all areas where training is essential and just like JIT in Lean manufacturing, it can save time and effort.

2.5. Usability

ISO 9241 states that usability is a concept that accesses “…the effectiveness, the efficiency, and satisfaction with which specified users achieve certain goals in determined contexts” (Conti, Collotta, Pau, Vitabile, 2014). In other words, usability of the product is well received by the customer? This definition is broad because usability can be applied to a wide variety of users for different goals. In a study on the usability analysis of a biometric identification feature in android devices, a strategy was proposed to effectively test the effectiveness, efficiency, and satisfaction of the feature (Conti et al., 2014). This was accomplished by usability testing conducted with users to understand the three components of usability as defined by ISO. Effectiveness is defined by how the end result is achieved; efficiency is the component of time in completing the goal, and satisfaction categorized by the user experience and comfort (Conti et al., 2014). The most important aspect of this study was not the results but the concepts proposed for the testing methods in order to implement meaningful changes during the design phase.
Similar work has also been conducted based on the ISO interpretation of usability. David Green of Morehead Kentucky has worked to develop a usability instrument based on the ISO standard (Green & Pearson, 2006). Green’s focus on website usability is driven by the studies revealing the many persistent problems. Furthermore it has been proven that redesign of websites made it possible for Staples to lower dropped sales rates by 25 percent (Green & Pearson, 2006). Green found some merit to the instrument but ultimately derived that the instrument either did not cover all of the bases or usability was not of important influence in customer retention (Green & Pearson, 2006). Given the weight of usability in other areas it can be proven that it does influence customer loyalty, however, catering to every user’s unique interpretation of the ideal usability of a product is difficult. The findings from this study further emphasize the need to fully understand the user in order to analyze usability.

Boopsie is a company that develops library applications. Robin Miller, Brian Vogh, and Eric Jennings conducted a study on usability of the Boopsie app. They identified two areas of concern; issues with built-in features and issues with external links (Miller et al., 2013). The issues that arose were those concerning wording and confusion resulting from the participants not being entirely sure of a particular function (Miller et al., 2013). This study clearly underlines the need to be sure that the information is presented in clear context with appropriate keywords. Keeping in mind the backgrounds of the user population will go a long way in developing a usable feature.

In this day and age anyone can make an app using their phone. Several applications are readily available that do nothing but aid in the development of
applications. The article, “Capitalizing on App Development Tools and Technologies,” lists the available app creating tools available today and the various features they have (Luterbach & Hubbell, 2015). The technology is available to readily develop apps but what makes apps so appealing? The three components of learning applications discussed by Michael Simonson noted as “The 3Rs”. He explains the concepts as Remediation, Reference, and Reminders (Simonson, 2012). Remediation seeks to reinforce knowledge already learned, reference is a tool to use to review definition and other key points, and Reminders aid in the “To do” lists (Simonson, 2012) these concepts are applicable to learning apps and serve as useful components thereof. When developing an application to facilitate learning “The 3 Rs” are a good place to begin the journey.

Usability principals are essential items to understand when developing an app. There are 10 heuristics for interface design that are key to relate in any system’s development (“10 Heuristics for User Interface Design,” n.d.). The system should keep users informed as well as be written in a simplistic, easy to understand way. The system should have methods of backtracking, or undoing a wrongfully entered function without needing to reboot or restart. Consistency of vocabulary is very important as well. If two words are used interchangeably it could create confusion in the system. Another area to consider was promoting of recognition over recall which minimizes the user’s need to memorize information form one section to the other. The system should be flexible enough that it can be useful to both inexperienced and experienced users. The overall design needs to be simple yet inviting thinking about color schemes and pictures that go into the apps overall appearance. There should also be sufficient incorporation of error
messages and mistake proofing as well as help and documentation. (“10 Heuristics for User Interface Design,” n.d.). All of these components make up a usable effective system and should be highly considered when undergoing the task of creating a new system.

2.6. Assessment Methods

Existing scales to analyze perceived usefulness (PU) and perceived ease of use (PEU) have already been developed (Davis, 1989). Davis’s scales focus on assessing how easy a given product is to use and how the user feels the product can be beneficial to them (Davis, 1989). Davis’s work with the PU and PEU scales has been extensively used since its development. His research concluded that PU and PEU correlate to current usage of a given product. The reliabilities of the scales were found to be .98 and .94 respectively (Davis, 1989).

The System Usability Scale is another method of assessing the user’s attitude toward the overall usability of a system. It is devised of ten items that are reverse coded. The scale’s responses range from strongly disagree to strongly agree (Likert 1-5). The scores are derived by grouping the even and odd items together. The score for items 1, 3, 5, 7, and 9 receive a score of the response minus 1. If the participant gave a response of 5 for any of the odd items that score would become a 4 for that particular item. Items 2, 4, 6, 8, and 10 receive a score of 5 minus the response. Therefore all even responses of 1 receive a score of 4. The sum of these individual scores are then multiplied by 2.5 to obtain the percentage. (“How To Use The System Usability Scale (SUS) To Evaluate The Usability Of Your Website,” 2015). Ideally, the participant would rate the system so that it received 40 out of 40 and therefore a 100%. This scale is widely used as a method for
determining accurate usability assessments with small sample sizes (Orfanou et al., 2015). This makes the SUS method ideal when faced with small populations of users. The System Usability is scale is widely used and considered a reliable assessment method (Orfanou et al., 2015).

2.7. NIOSH App

Recently NIOSH has developed a ladder safety application to promote safe practices and awareness of falls in industry (“CDC - Fall Injuries Prevention in the Workplace,” n.d.) The app covers the use of extension ladders from selection to the accessories available (“Ladder Safety on the App Store,” n.d.). The app is very easy to navigate with clear headings and data input areas to aid in selection of the appropriate ladder. The built-in features that allow the user to test the angle of the ladder with a red or green indicator to show the appropriate. Overall the app clearly presents adequate information on ladder safety and is a useful tool to incorporate into industries such as construction (“Ladder Safety on the App Store,” n.d.). This app is one clear example of the research to practice initiative. Research to practice is an initiative pioneered at NIOSH to translate knowledge and technology into workplace interventions. It can be further interpreted as a means of research which ensures relevance to all involved parties (“CDC - r2p,” n.d.).
CHAPTER 3: METHODOLOGY

Knowing that the majority of accidents in the hunting field are comprised of treestand falls, the proposed solution is to present the information to all cohorts of hunters outside of a classroom setting by using the developed treestand safety app. The app highlights the best practices for treestands and presents the hunter with a mobile for safety.

3.1. App Design

When the app was designed several usability principals were considered. It was designed in a way that can be easily understood, the text was short but informative, and many pictures with transposed directions and labels were used. The app menu was easily navigated and the high contrast between background and text made it easy to read while keeping within a natural outdoor color scheme.

3.2. App Content

The content of this application is based on already existing training videos and study guides found online (“Ohio Hunter Safety Course | Study Guide,” n.d.). The app was constructed using an online app making website called appypie to arrange the information from the outline (APPENDIX A). The following learning objectives were addressed in the application.

Learning Objectives:

- The hunter will list the components of a fall arrest system.
- The hunter will list the strap components of a full body harness.
• The hunter will define why the strap components are essential in full body harness.
• The hunter will describe how to properly adjust the harness tether.
• The hunter will define why the tether should be adjusted accordingly.
• The hunter will define a suspension relief system.
• The hunter will describe the purpose of a gear hoist/haul line.
• The hunter will describe how to use a suspension relief system.
• The hunter will list the procedure steps in using a fixed position, climbing, and ladder treestand.
• The hunter will list the 3 r’s and define them.

3.3. Hypotheses

The following hypotheses will be tested using pre-and post-testing concerning their experiences using the app. Usability will be tested using the system usability scales.

1. Question: Do age and hunting status affect baseline scores?
   o H0: Age and hunting status will not significantly affect baseline scores.
   o H1: One group will show higher baseline scores.

2. Question: Does the app increase knowledge in participants?
   o H0: Treestand safety knowledge is not changed in participants by using the app.
   o H1: Treestand safety knowledge is improved in participants after using the app.

3. Research Question 3: Do age and hunting status affect post-test scores?
4. Question: Do age and hunting status affect usability scores?
   o H0: Age and hunting status do not affect usability scores.
   o H1: Age and hunting status do affect usability scores.

5. Question: How likely are old and young hunters to use the app?
   o H0: There is no difference in the likelihood of using the app between young and old hunters
   o H1: One age group of hunters is more likely to use the app than the other.

3.4. Participants

The participants for this study consisted of hunters over the age of 21 divided into two age groups. The study was approved through the Ohio University Institutional Review Board and individuals participated on an informed-consent basis. Ten hunters and non-hunters were tested in each age group. Individuals were recruited by age and divided into groups as follows: ages 21 to 39 and 40 plus. This application was not tested on hunters younger than 21 because in Ohio young hunters are required to take a course. The reason for this age restriction was to eliminate participants who may have taken a course very recently. The hope is that young hunters will use the app in the future. Testing the application by age is important in determining if the older population of hunters is open to the app and able to use it. The use of smartphones is ever increasing in the United States but that does not mean that every person who owns a smartphone is
tech savvy. Technology is a big gap among older individuals and therefore is of concern when developing an application for them.

3.5. Testing Environment and Devices

All tests were conducted in a comfortable indoor environment. No use of any safety equipment was required. The study was concerned with the usability and knowledge retained from using the app. Therefore, this study did not subject the participants to hazards common to treestand use. The vision for just-in-time training is that the user will have mobile access to the content in the field. All participants used the application on a smartphone that they were familiar with. This ensured that the results for usability reflected the likelihood that hunters will use the app on their own device.

3.6. Knowledge Testing

The ability of the app to increase knowledge was determined by the scores of the pre and post-test among the non-hunting and hunting group of participants (APPENDIX C). It was expected that the hunting group would have higher baseline scores on the pre-test, therefore a control group of non-hunters was used to gauge the effectiveness of the app in those with no background in treestand use. It was important that those participants had no prior knowledge of fall safety for treestand use in determining the retention of knowledge facilitated by the app. The scores from the pre-test will give a baseline for comparison. The improvement after using the app determined the ability of the application to teach basic concepts of treestand safety. Scores were determined by the number of correct answers out of 10 questions. They were recorded as percentages.
Participants took a pre-test and a post-test. The questions focused on evaluating how the user’s overall knowledge is improved by using the app (APPENDIX C). In order to minimize confounding results, careful consideration was exercised in examining the participant’s prior knowledge of treestands.

3.7. System Usability Scale

The overall usability of this app was tested using the 10 item system usability scale. Given the small sample size of ten participants per group (Old, Young), it was ideal to use a method that is proven to yield reliable results under the restraint of having few participants (Orfanou et al., 2015). The questionnaire (APPENDIX D) was administered to the participants and scored according to the SUS model. The items were reverse-coded. All odd items desired positive responses and even items desired negative responses. The scores were then converted to percentages. The app was graded using the benchmark average of 68 % (“How To Use The System Usability Scale (SUS) To Evaluate The Usability Of Your Website,” 2015).

The scores are derived by grouping the even and odd items together. The score for items 1, 3, 5, 7, and 9 receive a score of the response minus 1. If the participant gave a response of 5 for any of the odd items that score would become a 4 for that particular item. Items 2, 4, 6, 8, and 10 receive a score of 5 minus the response. Therefore all even responses of 1 receive a score of 4. The sum of these individual scores was then multiplied by 2.5 to obtain the percentage. (“How To Use The System Usability Scale (SUS) To Evaluate The Usability Of Your Website,” 2015). Ideally, the participant would rate the system so that it received 40 out of 40 and therefore a 100%.
3.8. Procedure

Participants were first given a brief background survey (APPENDIX B). This survey gave insight into the hunter’s current use of treestands and prior knowledge. In the same setting, they were given a Pre-Test (10 question quiz) covering content presented in the app (APPENDIX C). The time limit to complete the pre-test was set at 10 minutes. This set baseline scores throughout all groups of participants. The participants then were asked to use the application for approximately 15 minutes or until they felt comfortable using the app. After they had explored the application, they were given the post-test (10 question quiz) which consisted of the same questions as the pre-test (APPENDIX C). They were given a time limit of 15 minutes using the application to complete the post-test. They were allowed to use the app as a reference during this portion of the survey. Once the test is complete, the participants ranked the app using the System Usability Scale (APPENDIX D). The final element of this study was to rate the users’ predicted use of the application using a single item scale (APPENDIX E). After the participants finished with the study, they were paid $10.00. The app was made unavailable after the study to prevent any legal issues should a participant decide to use the app in the field.
CHAPTER 4: RESULTS

All results were analyzed using a combination of paired-t tests, t-tests, ANOVA, and descriptive statistics with Minitab 17 software.

4.1. Demographics

Participants of this study consisted of four groups of people: older hunters, younger hunters, older non-hunters, and younger non-hunters. In the hunting group of people there were 14 males and 6 females. The age ranges were 21 to 35 for the younger group and 42 to 51 in the older. Table 1 shows the breakdown of participants.

<table>
<thead>
<tr>
<th>Hunting Status</th>
<th>N</th>
<th>M/F</th>
<th>Age</th>
<th>Mean</th>
<th>StDev</th>
<th>min</th>
<th>max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunters</td>
<td>10</td>
<td>8,2</td>
<td>O</td>
<td>45.20</td>
<td>2.66</td>
<td>42.00</td>
<td>51.00</td>
<td>9.00</td>
</tr>
<tr>
<td>Hunters</td>
<td>10</td>
<td>6,4</td>
<td>Y</td>
<td>24.20</td>
<td>4.13</td>
<td>21.00</td>
<td>35.00</td>
<td>14.00</td>
</tr>
<tr>
<td>Non-Hunters</td>
<td>10</td>
<td>2,8</td>
<td>O</td>
<td>46.20</td>
<td>7.87</td>
<td>40.00</td>
<td>68.00</td>
<td>28.00</td>
</tr>
<tr>
<td>Non-Hunters</td>
<td>10</td>
<td>2,8</td>
<td>Y</td>
<td>26.60</td>
<td>4.81</td>
<td>21.00</td>
<td>35.00</td>
<td>14.00</td>
</tr>
<tr>
<td>Overall</td>
<td>40</td>
<td>18,22</td>
<td>O,Y</td>
<td>35.55</td>
<td>11.48</td>
<td>21.00</td>
<td>68.00</td>
<td>47.00</td>
</tr>
</tbody>
</table>

4.2. Background Survey

Hunters and non-hunters answered a brief background survey to assess their background in hunting and hunter education. Sixty percent of the younger hunters reported completing the hunter education course. Of those six hunters, 17% said the course did not contain treestand safety. In the older hunting participants, 80% had completed a course. However, 75% of those older hunters reported the course did not contain treestand safety (Table 2). This was to be expected due to recent shift toward the subject. In this survey hunters were asked if they had taken a course and the year(s).
Some had reported multiple courses. In the time that these hunters took the course, treestand safety was considered adequate with equipment such as chest harnesses or belts. Recent studies, as discussed in the literature review, have concluded these methods are extremely hazardous.

Hunting participant ages ranged from 21 to 51 and non-hunter’s age ranged from 21 to 68 (Table 1). The non-hunters had little knowledge of treestand safety or equipment. Many common terms used by hunters completely stumped them. The gear hoist/haul line was one of the most commonly confused along with the suspension relief strap. Even non-hunters who have lived with or been around hunters were confused by the different types of equipment available.

| Table 2 Hunter Education Background |

<table>
<thead>
<tr>
<th></th>
<th>Young Hunters</th>
<th></th>
<th>Older Hunters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Took Course</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>10 %</td>
<td>60</td>
<td>10 %</td>
</tr>
<tr>
<td>Did not contain Treestand safety</td>
<td>1 17</td>
<td></td>
<td>6 75</td>
</tr>
<tr>
<td>DID NOT TAKE COURSE</td>
<td>4 40</td>
<td></td>
<td>2 20</td>
</tr>
</tbody>
</table>

4.3. Descriptive Statistics

Analyses began by looking at the descriptive statistics for both groups of participants. This shows the mean, standard deviation, min, and max for the following
groups: hunters, older hunters, younger hunters, non-hunters, older non-hunters, and younger non-hunters. Table 3 shows the collective results of all participants.

The usability score for hunters as a whole was also very high. The average score was calculated to be about 92.6% with a very low standard deviation of 0.08 (table 3). This shows that hunters generally found the app easy to use and well organized. Many participants indicated that they would be very likely to use this app in the future. The mean predicted use score was 4.4 out of 5 with a minimum score of 2 and maximum of five. Means of the pre and post-tests showed improvement at first glance. Hunters improved roughly 20% and non-hunters averaged 31% improvement.
Table 3 Descriptive Statistics

<table>
<thead>
<tr>
<th>Hunters</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hunters</td>
<td>20</td>
<td>0.58</td>
<td>0.24</td>
<td>0.10</td>
<td>1.00</td>
<td>0.90</td>
</tr>
<tr>
<td>Post</td>
<td>20</td>
<td>0.78</td>
<td>0.18</td>
<td>0.50</td>
<td>1.00</td>
<td>0.50</td>
</tr>
<tr>
<td>SUS</td>
<td>20</td>
<td>0.93</td>
<td>0.08</td>
<td>0.65</td>
<td>1.00</td>
<td>0.35</td>
</tr>
<tr>
<td>Predicted Use</td>
<td>20</td>
<td>4.40</td>
<td>0.82</td>
<td>2.00</td>
<td>5.00</td>
<td>3.00</td>
</tr>
<tr>
<td><strong>Post</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hunters</td>
<td>20</td>
<td>0.42</td>
<td>0.20</td>
<td>0.00</td>
<td>0.70</td>
<td>0.70</td>
</tr>
<tr>
<td>Predicted Use</td>
<td>20</td>
<td>4.20</td>
<td>1.06</td>
<td>2.00</td>
<td>5.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Old</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predicted Use</td>
<td>10</td>
<td>4.00</td>
<td>0.94</td>
<td>2.00</td>
<td>5.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predicted Use</td>
<td>40</td>
<td>4.30</td>
<td>0.94</td>
<td>2.00</td>
<td>5.00</td>
<td>3.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hunters</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>10</td>
<td>0.53</td>
<td>0.26</td>
<td>0.10</td>
<td>1.00</td>
<td>0.90</td>
</tr>
<tr>
<td>Post</td>
<td>10</td>
<td>0.71</td>
<td>0.20</td>
<td>0.50</td>
<td>1.00</td>
<td>0.50</td>
</tr>
<tr>
<td>SUS</td>
<td>10</td>
<td>0.89</td>
<td>0.10</td>
<td>0.65</td>
<td>1.00</td>
<td>0.35</td>
</tr>
<tr>
<td>Predicted Use</td>
<td>10</td>
<td>4.00</td>
<td>0.94</td>
<td>2.00</td>
<td>5.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Old</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predicted Use</td>
<td>10</td>
<td>4.80</td>
<td>0.42</td>
<td>4.00</td>
<td>5.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Non-Hunters</td>
<td>20</td>
<td>0.42</td>
<td>0.20</td>
<td>0.00</td>
<td>0.70</td>
<td>0.70</td>
</tr>
<tr>
<td>Predicted Use</td>
<td>20</td>
<td>4.20</td>
<td>1.06</td>
<td>2.00</td>
<td>5.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Old</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predicted Use</td>
<td>10</td>
<td>4.60</td>
<td>0.38</td>
<td>2.00</td>
<td>5.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predicted Use</td>
<td>40</td>
<td>4.30</td>
<td>0.94</td>
<td>2.00</td>
<td>5.00</td>
<td>3.00</td>
</tr>
</tbody>
</table>

4.4. Statistical Analyses

4.4.1. Research Question 1

Research Question: Do age and hunting status affect baseline scores?

- H0: Age and hunting status will not affect baseline scores
- H1: One group will show higher baseline scores

To understand the relevance of age and hunting status on baseline scores (pre-test), an ANOVA (Two-Way) analysis was run. The response was set to pre-test and the
variables age and hunting status. Results indicated that age was not a significant factor but hunting status was significant.

Table 4 Two-Way ANOVA (hunting status, age)

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunting Status</td>
<td>1</td>
<td>0.29</td>
<td>0.29</td>
<td>5.76</td>
<td>0.02</td>
</tr>
<tr>
<td>Age</td>
<td>1</td>
<td>0.08</td>
<td>0.08</td>
<td>1.61</td>
<td>0.21</td>
</tr>
<tr>
<td>Interaction</td>
<td>1</td>
<td>0.00</td>
<td>0.00</td>
<td>0.08</td>
<td>0.78</td>
</tr>
<tr>
<td>Error</td>
<td>36</td>
<td>1.81</td>
<td>0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>2.18</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

S=0.2240 R-Sq= 17.15% R-Sq(adj)= 10.25%

Table 4 shows the results table for the GLM. The p-values for both variables indicate that hunting status was the only significant factor on the pre-test scores. Therefore the null hypothesis is rejected and H1 is accepted. Figure 1 shows the main effect plot for hunting status on pre-test scores. The analysis indicated that hunters showed higher mean scores on the pre-test than non-hunters.
4.4.2. Research Question 2

Research Question 2: Does the app increase knowledge in participants?

- H0: Treestand safety knowledge is not changed by using the app.
- H1: Treestand safety knowledge is improved after using the app.

This question was analyzed using a paired-t test on pre and post-test scores. Results indicated that the app did increase knowledge across all participants. Descriptive statistics had initially showed signs of improvement. Table 5 shows the results of the paired-t test proving that the null hypothesis is rejected and the alternative is accepted. Treestand knowledge significantly improved after using the app.
After seeing that overall the participants improved it was broken down into the different groups to see how much they improved individually. Table 6 shows the improvement for non-hunters where Table 7 shows hunter improvement. Both show that these two groups of participants improved their scores significantly after using the App. Non-Hunters showed a bigger improvement than hunters. They improved 30% where hunters improved 19%. This can be caused by the hunters’ higher baseline scores.

Table 5 Paired-T Test Pre and Post-Test (ALL Participants)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>40</td>
<td>0.5</td>
<td>0.23</td>
<td>0.03</td>
</tr>
<tr>
<td>Post</td>
<td>40</td>
<td>0.75</td>
<td>0.2</td>
<td>0.03</td>
</tr>
<tr>
<td>Diff</td>
<td>40</td>
<td>-0.25</td>
<td>0.23</td>
<td>0.03</td>
</tr>
</tbody>
</table>

95% upper bound for mean difference: -.1870
T-Test of mean difference =0(vs<0): T-Value = -6.69 P-value= 0.00

Table 6 Paired-T Test Pre and Post-Test (Non-Hunters)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>20</td>
<td>0.41</td>
<td>0.19</td>
<td>0.04</td>
</tr>
<tr>
<td>Post</td>
<td>20</td>
<td>0.72</td>
<td>0.21</td>
<td>0.04</td>
</tr>
<tr>
<td>Diff</td>
<td>20</td>
<td>-0.3</td>
<td>0.26</td>
<td>0.05</td>
</tr>
</tbody>
</table>

95% upper bound for mean difference: -.2027
T-Test of mean difference =0(vs<0): T-Value = -5.16 P-value= 0.00
Both groups of participants showed improvement, however, Table 8 and 9 break down the participants by age to see the improvement. Again both older and younger hunters improved by about 20%.

### Table 7 Paired-T Test Pre and Post-Test (Hunters)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>20</td>
<td>0.58</td>
<td>0.24</td>
<td>0.05</td>
</tr>
<tr>
<td>Post</td>
<td>20</td>
<td>0.78</td>
<td>0.17</td>
<td>0.04</td>
</tr>
<tr>
<td>Diff</td>
<td>20</td>
<td>-0.19</td>
<td>0.19</td>
<td>0.04</td>
</tr>
</tbody>
</table>

95% upper bound for mean difference: -.1192

T-Test of mean difference =0(vs<0): T-Value = -4.45 P-value= 0.00

### Table 8 Paired-T Test Pre and Post-Test (Young)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>20</td>
<td>0.45</td>
<td>0.24</td>
<td>0.05</td>
</tr>
<tr>
<td>Post</td>
<td>20</td>
<td>0.67</td>
<td>0.17</td>
<td>0.03</td>
</tr>
<tr>
<td>Diff</td>
<td>20</td>
<td>-0.22</td>
<td>0.22</td>
<td>0.05</td>
</tr>
</tbody>
</table>

95% upper bound for mean difference: -.1335

T-Test of mean difference =0(vs<0): T-Value = -4.40 P-value= 0.00

### Table 9 Paired-T Test Pre and Post-Test (Old)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>20</td>
<td>0.54</td>
<td>0.22</td>
<td>0.05</td>
</tr>
<tr>
<td>Post</td>
<td>20</td>
<td>0.82</td>
<td>0.19</td>
<td>0.04</td>
</tr>
<tr>
<td>Diff</td>
<td>20</td>
<td>-0.28</td>
<td>0.25</td>
<td>0.05</td>
</tr>
</tbody>
</table>

95% upper bound for mean difference: -.1832

T-Test of mean difference =0(vs<0): T-Value = -5.00 P-value= 0.00
4.4.3. Research Question 3

Research Question 3: Do age and hunting status affect post-test scores?

- H0: Post-test scores are not affected by age and hunting status
- H1: Age and hunting status do affect post-test scores

This research question was analyzed using an ANOVA (Two-Way) on pre-test scores and post-test scores with age as a model. The pre-test results indicated that age was not a significant factor initially, however on the post-test scores, it was. The pre-test p-value showed that age did not affect the score. In other words, the pre-test scores were similar initially. When the analyses were run on the post-test scores the p-value indicated that age significantly impacted the results. Table 6 shows the p-values for each score.

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunting Status</td>
<td>1</td>
<td>0.04</td>
<td>0.03</td>
<td>1</td>
<td>0.32</td>
</tr>
<tr>
<td>Age</td>
<td>1</td>
<td>0.23</td>
<td>0.22</td>
<td>6.24</td>
<td>0.02</td>
</tr>
<tr>
<td>Interaction</td>
<td>1</td>
<td>0.00</td>
<td>0</td>
<td>0.03</td>
<td>0.87</td>
</tr>
<tr>
<td>Error</td>
<td>36</td>
<td>1.30</td>
<td>0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>1.56</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ S = 0.1899 \quad R-Sq = 16.79\% \quad R-Sq(adj) = 9.86\% \]

Figure 2 shows a visual representation of age’s effect on post-test scores. The means for young and old are significantly different. Older participants scored higher on average than the younger participants.
Research Question 4: Do age and hunting status affect usability scores?

- H0: Age and hunting status do not affect usability scores.
- H1: Age or hunting status does affect usability scores.

An ANOVA (Two-Way) of means was used to examine the effect of age and hunting status on usability scores. Descriptive statistics initially showed that usability scores were fairly high across all participants but this app is concerned with the affect that age plays due to the technology involved. The ANOVA indicated that age did not affect the usability scores but once again hunting status did. Age showed a p-value greater than alpha and therefore we failed to reject the null in regards to that factor (Table 7). The p-value for hunting status was 0.04 which meant we rejected the null (Table 7). This result indicated that hunting status did affect usability ratings.
Table 11 ANOVA (Two-Way) Hunting Status, Age versus SUS

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunting Status</td>
<td>1</td>
<td>0.06</td>
<td>0.06</td>
<td>4.34</td>
<td>0.04</td>
</tr>
<tr>
<td>Age</td>
<td>1</td>
<td>0.01</td>
<td>0.01</td>
<td>0.83</td>
<td>0.37</td>
</tr>
<tr>
<td>Interaction</td>
<td>1</td>
<td>0.01</td>
<td>0.01</td>
<td>0.95</td>
<td>0.34</td>
</tr>
<tr>
<td>Error</td>
<td>36</td>
<td>0.53</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>0.62</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

S=0.1214 R-Sq= 14.54% R-Sq(adj)= 7.42%

Figure 3 shows the main effects plot for hunting status on usability scores. Mean usability scores were lower in non-hunters than in hunters. This was to be expected since non-hunters are not going to be invested in the app as much as hunters.

**Figure 3 Main Effects Plot Hunting Status on SUS**

4.4.5. Research Question 5

Research question 5: How likely are old and young hunters to use the app?
- H0: There is no difference in the likelihood of using the app between old and young hunters.

- H1: One group of hunters will be more likely to use the app.

This question was examined using a two sample t-test for predicted use by age. It showed that there was a difference in the predicted use based on age of the participant. The p-value is 0.042 (Table 8) therefore the null hypothesis is rejected in favor of the alternative that one group is more likely to use the app in the future. Results indicated that older hunters were more likely to use the app in the future (Table 8).

### Table 12 Two Sample T-test on Predicted Use by Age

<table>
<thead>
<tr>
<th>Age</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>10</td>
<td>4.8</td>
<td>0.42</td>
<td>0.13</td>
</tr>
<tr>
<td>Y</td>
<td>10</td>
<td>4</td>
<td>0.94</td>
<td>0.3</td>
</tr>
</tbody>
</table>

T-Value = 2.45  P-Value = 0.031  DF = 12
Difference = \( \mu (O) - \mu (Y) \)
Estimate for difference: 0.800
95% CI for difference: (0.088, 1.512)

4.5. Summary of Results

Based on the statistical analyses the app did very well in teaching participants. It also was received as being very easy to use and understand. The goal was to design an app that could be used by both young and old age groups while still being effective. Based on the multiple analyses of research questions it was determined that the app increased knowledge in both hunters and non-hunters. As expected, baseline scores were
affected by the participants hunting status. Hunters scored better initially than non-hunters. Age had no effect on the initial pre-test scores but in post-test score older participants score better. This was not so surprising given the participants experience and patience. Younger participants seemed to merely skim the app instead of reading word for word. Usability scores were very high throughout all participants with only few exceptions; however, hunting status was a significant factor on the participant’s usability appraisals. Hunters rated the app more generously than non-hunters which was completely expected given the individuals investment in the sport of hunting. The predicted use assessment indicated that older hunters were more likely to download the app in the future. This was a surprising result because it was expected that younger hunters would embrace the concept of a mobile training tool more than the older more experienced generation. However, results differed on average by only a small amount. Therefore both older and younger hunters did receive the app well. Both gave high average ratings on usability and predicted use.
CHAPTER 5: DISCUSSION

5.1. Hunter Education Courses

According to the data collected, older hunters had in fact taken a hunter education class. This was not an expected find but majority of those hunters also reported that the hunter education course did not contain treestand safety. Fewer younger hunters reported taking a course but those who did reported it did contain treestand safety. This raises a concern on the structure of the course itself. Previously it was discussed that older hunters could be grandfathered into the system and not be required to take the course. Upon examination of the results it is shown that older hunters who participated had taken a course. This could be attributed to the division of age groups. It is the older hunters, hunters older than those consider older in this study, which have been grandfathered in. This is also dependent on the atmosphere in which these hunters grew up. Instead of concentrating on the fact that hunters may not have to take the course, the gears should shift to creating a stable course. The course should be restructured so that all states teach the same concepts regarding treestand use. The course should also be updated every five years to ensure that new additions to the field are adequately covered.

5.2. Importance of Training

Treestand incidents occur regularly in the hunting world. Many go unnoticed, undocumented, and unpublished but they do happen. The reasons so many fall victim is most likely due to the hunting population’s lack of awareness. Many participants of this study were unfamiliar with the latest technologies in treestand safety. This is due to the products having evolved significantly through the years. Harnesses that consist of a belt
and a strap are still out there despite the danger. Tree steps that screw into the tree are still sold in stores even though they are not recommended. Upon explaining these things to participants, it became clear that it was their first time hearing such a thing. This raises a significant concern about manufacturer’s and the hunting community’s ability to convey information to hunters.

The area of concentration should focus on communication and standardization. Unlike industry, recreational safety is purely voluntary. In order to voluntarily practice safety, the hunter must know how to be safe. The data collected in this study shows just how unaware hunters are despite having taken a course. The terms and equipment were misidentified and many hunters reported not ever using a safety harness. Knowing that one in three hunters will fall from a stand and that many are not practicing safety is a huge problem. These people are not only hunters but also fathers, mothers, and employees. The cost of safety affect more than just checkbook. One fall could spell the end of a life. There is emotional damage, financial damage, and physical damage.

With an app like the one created for this study, there is ample opportunity to reach people. It will get the information out there simplistically and quickly. Classroom learning is a great way for hunters to learn the basics but it is not one on one. An app is used at the hunter’s leisure in the field where it is needed. It should not take the place of required courses but it could enhance them. A hunter education course is a general course. This means that the course is designed to cover a spectrum of hunters. Treestand use is just a small piece of information covered, if it is covered at all. Many older participants reported that there was no section on treestand safety in the course they took.
If course material is presented in the form of an app, students could download the relevant information that they need in their journey to becoming a safe hunter.

5.3. Limitations

After beginning the survey process, it became clear that some of the pre and post-test questions were worded awkwardly. Particularly questions 8 and 9. These questions pertained to information that was not directly present in the app. It was concerned with the procedures practiced among different types of stands. The information was present within the app but the two questions often stumped participants. The wording of the choices should be revised for future testing to obtain a more accurate set of data. Many participants expressed confusion on the meaning of the word “cumbersome”. This word is used in the usability questionnaire. With validated scales it is imperative to stay true to the wording. For future studies there should be a definition given of the word or at least a better wording of the question itself.

The app in its initial stage should be improved upon using the feedback from this study. Not all of the information presented in the app correlated word for word on the tests. The goal was to incorporate the information in a way that was not directly stated so that participants could engage their minds in the subject matter. This affected the responses on 2 of the 10 questions severely. Further research using this method should carefully examine the pre and post-test for consistency in choices and phrasing of questions. There should also be a newsfeed section for the app in which updates could be posted. This could contain testimonials from hunters who had suffered from a fall or even
near misses in which a harness saved their life. It would act as motivation to encourage safe practices.

In this study there was no collection of field data. Participants were not asked to demonstrate any of the concepts taught by the app. Knowledge is essential to increasing safety but without actually gaining hands on experience it cannot be determined the hunter’s capability to practice what was learned. The reasons for not incorporating a field test were primarily based on legality. More extensive consent methods and review would have been needed to go forward with any sort of field experiment but a field test would be a great method to test how well the participants could practice the concepts learned through the mobile app.

5.4. Recommendations for Further Research

Further research on treestand safety should look at the course structure of different states and seek to create a universal outline for all instructors to follow. From this research it is evident that app increased knowledge and was liked by hunters. The reception was very good among both age groups and should be considered in new teaching methods. An online course turned into an app could greatly benefit hunters and prevent deadly injury in the future. A more detailed app structured in the same simplistic manner could teach an entire hunter education course.

Data collection for future research should be more widespread. Hunters are all over the country and this study has only examined a grain of salt in the vast ocean of hunters in the United States. More research and surveys that encompass the entire East Coast could shed more light on the issue of treestand safety. Different states have
different laws regarding hunter education and therefore could hold different results and
trends to examine. Hunter safety is not just a concept for Ohioans. It is a global effort and
hunting is a global sport. Not all hunting activity requires use of treestands but there are
many species where it is essential. Hunters could be bear hunting in Maine out of
treestands or hunting deer out of treestands. In either case there is one commonality and
that is elevation. It would be interesting to examine the methods and courses teaching
treestand safety among various geographical areas.

In this study there was no collection of field data. A field test would be a great
continuation of the assessment of the mobile app. Instead of a written test the hunter
would demonstrate the concepts from the app. They would use the equipment to gauge
how well they can translate knowledge into action. It is one thing to teach safety but
demonstrating safety is completely different. This study only demonstrated the app was
effective in teaching participants to pick correct answers. A field test would take that one
step further in developing a truly effective instructional method to increase awareness and
skill in practicing treestand safety.
REFERENCES


APPENDIX A: APP OUTLINE

FAS – Fall Arrest System

THE HARNESS

1. Full Body Harness
   a. Components
      i. Shoulders
      ii. Waist
      iii. Legs
   b. Distributes the weight over larger area of the body
   c. FALL OUTCOMES
      i. Quick recovery
      ii. Less chance of injury

2. Single strap Harness
   a. Components
      i. Strap
   b. Restricts chest and makes breathing and movement hard
   c. DO NOT USE

3. Chest Harness
   a. Components
      i. Shoulder
      ii. Waist
   b. Restricts chest and makes breathing and movement hard
   c. DO NOT USE

TETHER – Attaches hunter to tree

1. When standing it should be attached at eye level
2. There should be no slack in the line while the hunter is seated
   a. The appropriate tether adjustment prevents the hunter from falling more than a few inches
   b. This makes it easy to recover

SUSPENSION RELIEF SYSTEM - device easily accessible in the event of a fall

1. Pull out device and step into the foot loops
2. Keep legs moving to keep blood flowing
   a. LONG TERM SUSPENSION KILLS
SAFETY PROCEDURES BY TREESTAND TYPE

- **Hand Built Stands:** DO NOT USE!
  1. Structures weaken over time
  2. Slipping hazards
  3. Damage to trees

- **Fixed Position**
  1. Read manufacturer’s instructions before installing
  2. Always use a lineman’s Belt when installing or removing and when ascending or descending the tree
  3. Never support weight on a tree limb
  4. Test and inspect the stand before use
  5. Use a ladder stick or strap on climbing system
     a. Install stand below the top of the climbing system
     b. Never use wooden steps
     c. Avoid Screw in steps

- **Self-Climbing Stands**
  1. Attach FAS to the tree before leaving the ground
  2. Connect both sections together so that if one gives you are not left stranded
  3. Move FAS up the tree as you climb
  4. Take slow steady bites to climb

- **Ladder Stands**
  1. Use at least 3 people to install or remove
  2. Secure each ladder section together using pins
  3. Brace the ladder against the tree
  4. Ladder should be positioned at an angle
  5. Lean forward and use three points of contact while climbing
  6. Attach FAS to the tree as soon as possible

**HAUL LINES**

- Positioned on the opposite the side used to climb
- Used to haul gear into the tree

**IF YOU FALL**

- **3 R’s**
  o RESCUE – if you cannot recover contact help
  o RELIEF – relieve the suspension by using the suspension relief system
  o RECOVER – try to recover from the fall as soon as possible

- **EMERGENCY SIGNALLING DEVICE**
• Radio
• Cell phone
• Personal location device
• Whistle

• SEEK SUSPENTION RELIEF IMMEDIATELY IF YOU MUST HANG FOR A LONG AMOUNT OF TIME

THE DO’s and DON’Ts of TREESTANDS

• DO wear an appropriate HARNESS
• DO READ all manufacturer’s INSTRUCTIONS
• DO INSPECT harness and treestand before use
• DON’T CLIMB with GEAR in HAND
• DON’T EXCEED WEIGHT LIMIT
• DO CARRY A COMMUNICATION DEVICE
APPENDIX B: CONSENT FORM

Ohio University Adult Consent Form With Signature

Title of Research: Usability of Just-in-Time Training for Treestand Safety among Age Diverse Populations
Researchers: Brittany Lashae Lynn Crall

You are being asked to participate in a research project. To be able to decide whether you want to participate in this project, you should understand what the project is about, as well as the possible risks and benefits in order to make an informed decision. This process is known as informed consent. This form describes the purpose, procedures, possible benefits, and risks. It also explains how your personal information will be used and protected. Once you have read this form and your questions about the study are answered, you will be asked to sign it. This will allow your participation in this study. You should receive a copy of this document to take with you.

Explanation of Study
This study is being done because treestand accidents are very common among seasoned hunters. Just-in-Time training is a concept used in occupational settings in which employees are able to check the quality of their work against readily available materials. Treestands should be no different. Development of a mobile app so hunters can be sure they are taking all the right precautions can help prevent fatal falls.

If you agree to participate, you will be asked to: 1) complete a brief background survey, 2) complete a pre-test, 3) download the app, 4) use the app for 15 minutes, 5) take a post-test, and 6) assess the usability of the app and predict your future use should an app similar become widely available.

Your participation in the study will last no more than an hour.

Risks and Discomforts
No risks or discomforts are anticipated

Benefits
This study is important to science/society because it is research that can potentially help to prevent fatal falls and fall-related injuries through Just-in-Time training in the field for hunters all over the country.

You may not benefit, personally by participating in this study.

Confidentiality and Records
Your study information will be kept confidential by not collecting names. We will only collect age and hunting status. No other identifiers are needed.
Additionally, while every effort will be made to keep your study-related information confidential, there may be circumstances where this information must be shared with:
- Federal agencies, for example the Office of Human Research Protections, whose responsibility is to protect human subjects in research;
- Representatives of Ohio University (OU), including the Institutional Review Board, a committee that oversees the research at OU;

**Compensation**
As compensation for your time/effort, you will receive $10.00. If you choose not to complete the study your compensation will be prorated (any partial completion will be equal to 50% compensation). As per Ohio University regulations, you will need to complete a subject payment form. This includes the date, participant name, address, amount and signature. This form will be submitted to the Department of Finance. Additionally, if you are a full or part-time Ohio University employee, your name will be submitted to payroll and taxes on the $10 will be taken out of a future paycheck.

**Contact Information**
If you have any questions regarding this study, please contact the investigator

Brittany Crall, bc857014@ohio.edu, (740) 250-3080
Diana Schwerha, schwerha@ohio.edu, (740) 593-1577

If you have any questions regarding your rights as a research participant, please contact Dr. Chris Hayhow, Director of Research Compliance, Ohio University, (740) 593-0664 or hayhow@ohio.edu.

By signing below, you are agreeing that:
- you have read this consent form (or it has been read to you) and have been given the opportunity to ask questions and have them answered;
- you have been informed of potential risks and they have been explained to your satisfaction;
- you understand Ohio University has no funds set aside for any injuries you might receive as a result of participating in this study;
- you are 18 years of age or older;
- your participation in this research is completely voluntary;
- you may leave the study at any time; if you decide to stop participating in the study, there will be no penalty to you and you will not lose any benefits to which you are otherwise entitled.

Signature ___________________________ Date ________________
Printed Name ________________________

Version Date: 2/15/16
APPENDIX C: PAYMENT FORM

Human Subject Payment

Date: 

Participant Name: 

Social Security Number (Required for payment over $100): 

Address: 


Amount: 

Participant Signature: 

Researcher Signature (optional): 

Payment Compliance Form (Required if payment is $100 or more): Y / N
APPENDIX D: BACKGROUND SURVEY

1. How old are you? ______
2. Do you hunt big game? (Yes| No )
3. Have you ever taken a Hunter Education Course? (Yes| No )
4. If Yes, State? ____ Year? _____
5. Did the hunter safety course contain Treestand safety content? (Yes| No )
APPENDIX E: PRE AND POST-TESTS

1.) What are the components of a Fall Arrest System
   a. Carabiners, straps, safety lines
   b. Harness, Tether, and Suspension Relief System
   c. Lineman's belt, tree strap, and safety lines

2.) What are the components of a full body harness?
   a. Chest and back straps
   b. Waist and chest straps
   c. Shoulders, waist, and leg straps

3.) Why is the strap configuration important in the design of a harness?
   a. The strap arrangement is important because it is secure in the event of a fall
   b. The strap arrangement is important because it allows the hunter to move freely in the event of a fall
   c. The strap arrangement is important because in the event of a fall it distributes the weight evenly over the body

4.) How should the tether be adjusted?
   a. The tether should be secured to the tree with a strap
   b. The tether should have at least 3 feet of slack to catch the hunter before they hit the ground
   c. The tether should be adjusted with no slack while in a seated position

5.) The tether should be adjusted because?
   a. the hunter needs enough room to move around the stand
   b. the hunter's tether is like a seat belt and should secure them to the tree tightly
   c. the lack of slack in the tether prevents the hunter from falling more than a few inches

6.) A Suspension Relief System is?
   a. A device that allows the hunter to hang long amounts of time while minimizing suspension trauma
   b. A device that lowers the hunter to the ground in the event of a fall
   c. A device that makes the hunter more comfortable while hanging out of their stand
7.) The purpose of a Gear Hoist/ Haul Line is?
   a. To lower the treestand from the tree
   b. To lower and raise the hunter’s equipment
   c. To raise or lower rescue equipment in the event of a fall

8.) All of the following are Safe practices for Fixed Position Stands except?
   a. Read instructions
   b. Use a lineman’s belt when climbing
   c. Connect both sections of the stand
   d. Test and inspect before use
   e. Use a climbing system that does not damage the tree

9.) All of the following are Safe practices for Climbing Stands except?
   a. Attach both sections of the stand together
   b. Attach FAS before leaving the ground
   c. Move tether as you climb
   d. Ensure climbing system is strapped onto the tree and pinned together
   e. Take slow steady bites when climbing

10.) The Three R’s are?
    a. Relieve, revisit, restore
    b. Radio, record, restrain
    c. Rescue, relief, recover
APPENDIX F: SYSTEM USABILITY SCALE

1.) I think that I would like to use this APP frequently.
   STRONGLY DISAGREE  1  2  3  4  5  STRONGLY AGREE

2.) I found the APP unnecessarily complex.
   STRONGLY DISAGREE  1  2  3  4  5  STRONGLY AGREE

3.) I thought the APP was easy to use.
   STRONGLY DISAGREE  1  2  3  4  5  STRONGLY AGREE

4.) I think that I would need the support of a technical person to be able to use this APP
   STRONGLY DISAGREE  1  2  3  4  5  STRONGLY AGREE

5.) I found the various functions in this APP were well integrated
   STRONGLY DISAGREE  1  2  3  4  5  STRONGLY AGREE

6.) I thought there was too much inconsistency in this APP
   STRONGLY DISAGREE  1  2  3  4  5  STRONGLY AGREE

7.) I would imagine that most people would learn to use this APP very quickly
   STRONGLY DISAGREE  1  2  3  4  5  STRONGLY AGREE

8.) I found the APP very cumbersome to use
   STRONGLY DISAGREE  1  2  3  4  5  STRONGLY AGREE

9.) I felt very confident using the APP
   STRONGLY DISAGREE  1  2  3  4  5  STRONGLY AGREE

10.) I needed to learn a lot of things before I could get going with this APP
    STRONGLY DISAGREE  1  2  3  4  5  STRONGLY AGREE

APPENDIX G: PREDICTED USE

1.) I would download this app to use in the future if it were available for purchase.
| STRONGLY DISAGREE | 1 | 2 | 3 | 4 | 5 | STRONGLY AGREE |