2008

A pilot study evaluating the effectiveness of a computer-based gaming strategy in educating school-age children about vehicle safety

Amanda S. Bechberger
University of Windsor

A PILOT STUDY EVALUATING THE EFFECTIVENESS OF A COMPUTER-BASED GAMING STRATEGY IN EDUCATING SCHOOL-AGE CHILDREN ABOUT VEHICLE SAFETY

by

Amanda S. Bechberger

A Thesis
Submitted to the Faculty of Graduate Studies
through the Faculty of Nursing
in Partial Fulfillment of the requirements for
the Degree of Master of Science at the
University of Windsor.

Windsor, Ontario, Canada

2008

Your file Votre référence
ISBN: 978-0-494-47026-8
Our file Notre référence
ISBN: 978-0-494-47026-8

Author's Declaration of Originality

I hereby certify that I am the sole author of this thesis and that no part of this thesis has been published or submitted for publication.

I certify that, to the best of my knowledge, my thesis does not infringe upon anyone's copyright nor violate any proprietary rights and that any ideas, techniques, quotations, or any other material from the work of other people included in my thesis, published or otherwise, are fully acknowledged in accordance with the standard referencing practices. Furthermore, to the extent that I have included copyrighted material that surpasses the bounds of fair dealing within the meaning of the Canada Copyright Act, I certify that I have obtained a written permission from the copyright owner(s) to include such material(s) in my thesis and have included copies of such copyright clearances to my appendix.

I declare that this is a true copy of my thesis, including any final revisions, as approved by my thesis committee and the Graduate Studies office, and that this thesis has not been submitted for a higher degree to any other University or Institution.

Abstract

Road-related crashes are a serious public health issue that continue to kill and injure thousands of children and young adults every year (World Health Organization, 2007). Elevated fatality and injury rates coupled with the low rates of booster seat use among 4- to 8-year old children illustrate the critical need for strategies to improve the rate of booster seat use in this population. The increasing popularity of gaming among children offers an opportunity to use computer games to teach injury prevention to this age group. This pilot study investigated the effectiveness of a computer-based gaming strategy for educating school-aged children about strategies to stay safe in vehicles. Pre- and post-intervention questionnaires were administered to inner-city preschool and elementary students between the ages of 4 and 11 years at the St. Alban's Boys' and Girls' Club in Toronto, Ontario. Changes in children's perceptions about booster seat safety, and their preferences for booster seats were investigated after playing the Booster Buddies Clek Adventure Game. Databases embedded into the game served to evaluate children's performance within the game, their preferences for booster seat styles and their knowledge about correct booster seat use and safe conduct while travelling in a vehicle. This study also examined the utility of gaming software in educating children about safety seat practices, as well as children's attitude towards this type of educative tool.

Dedication

This thesis is dedicated to my husband, Joe, who has been a great source of motivation and inspiration, and always helped me find clarity during my times of writing and frustration. And to my parents, who have provided me with continuous support and encouragement since the beginning of my studies.

Acknowledgements

From the formative stages of this thesis, to the final draft, I owe an immense debt of gratitude to my principal supervisor, Dr. Anne W. Snowdon. Her sound advice and guidance were invaluable throughout my thesis and graduate program. Furthermore, I would like to thank my advisory committee members, Dr. Christine Thrasher, Dr. Sharon McMahon and Dr. Ziad Kobti for their encouragement and valuable feedback.

I would also like to extend a special thanks to the staff and students at the George Brown College School of Computer Technology; especially Sean Guadron, Priam Givord, and Craig Alguire for their knowledge of game art and design and their assistance in producing the game.

In addition, I would like to thank the staff and children of St. Alban's Boys' and Girls' Club who participated in this study.

Finally, I would like to take this opportunity to acknowledge the AUTO 21 Network Centres of Excellence and MAGNA Aftermarket Inc. for their support and contributions throughout this research.

To each of the above, I extend my deepest appreciation.

TABLE OF CONTENTS

List of Figures

List of Tables

Chapter 1

A Pilot Study Evaluating the Effectiveness of a Computer-based Gaming Strategy in Educating School-Age Children about Vehicle Safety

Introduction

Motor vehicle crashes (MVC) are a leading cause of injury-related death and hospitalization for Canadian children and youth (Leitch, 2008). Worldwide, nearly 400,000 young people under the age of 25 are killed in road traffic crashes annually leaving millions more injured or disabled (World Health Organization, 2007). Despite the elevated risk in youth, children aged 4 to 8 years are especially important since they are more likely to die as passengers in motor vehicle crashes than from any other form of unintentional injury (Centers for Disease Control, 2007; National Highway Traffic Safety Administration, 2007). Recent statistical data has shown that approximately 68 Canadian children aged 14 and under are killed in car crashes in each year, and another 880 are seriously injured (Safe Kids Canada, 2008). Unfortunately, misuse of child restraint devices and the incidences of children failing to be properly restrained remain widespread. Data reported from Safe Kids Canada (2008) indicates that an estimated 44% to 81% of children are correctly restrained. In spite of numerous preventative efforts to promote seat belt use and appropriate child restraint systems, the rates of death and injury associated with traffic collisions remains unacceptably high. In recent literature examining road safety education, the focus of much of the research has been traditional and in the context of pedestrian safety and public transportation (Bailey et al., 2008; Glang, Noell, Ary & Swartz, 2005; Tabibi & Pfeffer, 2003; WHO, 2007). Within this literature, the findings related to the application of computers and interactive multimedia

programs have been both positive and promising. This particular study not only serves as a preliminary examination of the utility of gaming software as a tool for educating children about safety seat practices, but also demonstrates the efficiency of an embedded database as a strategy for investigating children's knowledge about booster seat safety.

Study Purpose

Despite increased efforts to provide public information and education about the importance of restraint use, vehicle occupant safety continues to remain at the forefront of health promotion efforts (Safe Kids Canada, 2008, WHO, 2007). Elevated fatality and injury rates coupled with a decrease in restraint use, particularly among school-aged children, illustrate the critical need to devise strategies to promote awareness among parents and children about the significance of vehicle restraint devices. Current evidence suggests that several types of interventions, either singly or in combination (i.e. incentives, distribution, enforcement of law, and/or education) have been effective in increasing the use of booster seats for children aged 4 to 8 years (Ehiri, Magnussen, Emusu, King, & Osberg, 2008). Unfortunately, "finding ways to translate available knowledge into greater age-appropriate booster seat use remains a challenge..." (Ehiri et al., 2008). Some of the current recommendations for future research focus on the individual effects of the various types of interventions, on those studies targeting high-risk populations, and on increased public awareness (Ehiri, King, Ejere & Mouzon, 2007; World Health Organization, 2007). However, a recent review from The Cochrane Database of Systematic Reviews (Ehiri et al., 2008), indicated that the majority of intervention efforts intended to increase the use of booster seats in motor vehicles among 4- to 8-year olds targeted adults such as parents or caregivers (Ebel, Koepsell, Bennett,

Rivara, 2003; O'Neil, 2005; Stevens, 2000), and families (Johnston, Britt, D'Ambrosio, Mueller, Rivara, 2000), leaving very few education strategies focused exclusively on children (Bowman, Sanson-Fisher, Webb, 1987).

In many of the recent studies examining road safety among youth, the focus of the research is often in the context of pedestrian safety and public transportation (Glang et al., 2005; Tabibi & Pfeffer, 2003; WHO, 2007). Within this literature, safety education is the most common type of approach evaluated. Moreover, non-traditional injury-prevention educational efforts such as the use of computers and interactive multimedia programs have supported that children are learning more than imparting information or knowledge, but also skills (i.e. safe street-crossing) (Glang et al., 2005). "Computer-based, interactive interventions are feasible, and have been effective in promoting behaviour change in people with chronic diseases such as diabetes or heart disease, leading to improved knowledge, social support, health behaviours and clinical outcomes" (Murray, 2005 & Wantland, 2004 as cited in Bailey et al., 2008). Computer-based interventions have also proven to be effective in health promotion contexts such as problem drinking (Linke, Brown, & Wallace, 2004), smoking cessation (Strecher, 1999), nutrition and physical activity (Patrick et al., 2001) (as cited in Bailey, et al., 2008). Interactive computer-based interventions can be tailored to meet individual needs and can promote active learning through interactive learning strategies (Kanuga & Rosenfeld, 2004 as cited in Bailey et al., 2008). The use of computerized education strategies to teach children about vehicle safety may be the promising individualized approach that helps reduce the high child death and injury rates reported in motor vehicle crash data.

The purpose of this preliminary study was to explore the effectiveness of a computer-based gaming strategy in educating children about the importance and use of vehicle restraint devices.

Chapter 2

Review of the Literature

Introduction

Canadian children 14 years and under, are a special group of vehicle occupants who are at a much greater risk of death and injury from car crashes, than any other age group (Safe Kids Canada, 2007). Despite numerous advances in research and preventative efforts, motor vehicle collisions (17%) are the number one cause of child injury-related death, followed closely by drowning (15%), and threats to breathing (11%), such as suffocation, choking, and strangulation (Safe Kids Canada, 2007). Risk of injury among this age group is elevated not only because of a lack of age-appropriate and/or incorrect use of child restraint systems, but also because their small, immature and growing structures make them highly vulnerable when prematurely placed in adult seat belts (Safe Kids Canada, 2007; Santschi, Echave, Laflamme, McFadden, & Cyr, 2005; Shepherd, Hamill, & Segedin, 2006; Weber, 2000; Weinstein, Sweeney, Garber, Eastwood, Osterman, & Roberts, 1997).

Injury Outcomes

Childhood injuries caused by motor vehicle crashes are real. Most often they are serious in nature and have even resulted in death. "Each year, Canadian children have an approximate 1 in 86,000 risk of dying and a 1 in 6,600 risk of being seriously injured as a passenger in a motor vehicle" (Safe Kids Canada, 2007, p. 9). Of the injuries sustained by child victims of road traffic crashes, head injuries (i.e. traumatic brain injury) are the most frequent (Davies, 2004; Safe Kids Canada, 2007; WHO, 2004). A common misconception among nearly a quarter of Canadian parents surveyed in 2006 was that the

leading health risks to their children were obesity, inactivity, nutrition, cancer, diabetes, smoke, and second-hand smoke, with no references made to vehicular-associated risks (Safe Kids Canada, 2007). Unfortunately, many parents are not aware of the risks and serious injuries linked to vehicle crashes (Safe Kids Canada, 2007); with even fewer realizing the range of life-threatening injuries or permanent disabilities caused by early lap-belt use (Safe Kids Canada, 2004).

In a study by Winston, Durbin, Kallan, and Moll (2000), examining the danger of premature graduation to seat belts for children 2 to 5 years, 58% of all significant injuries were primarily to the head. Other injuries requiring hospital admission highlighted in a recent publication by Safe Kids Canada (2007) were to the upper (34%) and lower (18%) extremities, the face and neck (7%), the torso (6%), and the spinal cord/vertebral column (1%). Abdominal injuries are another type of significant life-threatening childhood injury that often presents much more subtly, and when undetected or missed, can have a grave impact on the morbidity of the pediatric motor-related trauma patient (Davies, 2004).

The term 'seat belt syndrome' was first coined by Garrett and Braunstein in 1962 and refers to "...injuries to the intestinal viscera and to the lumbar spine associated with [two-point] seat-belt restraints" (Public Health Agency of Canada, 2005, para 2). Since the original design and intent of the seat belt was for adults, they cross over the harder and more durable bones of the shoulder, chest, and hips. However, when used by a small child, the belt tends to ride up onto their soft abdomen, increasing their potential for injury to vital internal organs (Safe Kids Canada, 2004). When placed behind the back or under the arm, children can be propelled forward over the lap belt, causing severe injury

to their spinal cord with even further damage to their internal organs (Safe Kids Canada, 2004). In a recent study examining the injury patterns in rear-seated, seat-belt-restrained children aged 5 to 15 years, the abdomen/spine cluster was associated with 4- to 8-year old children wearing lap-only belt restraints (Elliott, Arbogast, & Durbin, 2006). However when optimally restrained, children in this age group "...are at a significantly lower risk of abdominal injury than children suboptimally restrained for age" (Nance et al., 2004). To date, there have been an increasing number of pediatric studies examining the risks of injury to children prematurely graduated to child restraint systems, each deriving very similar conclusions (Nance et al., 2004; Santschi et al., 2005; Shepherd et al., 2006; Vessentini, 2007; Winston, Durbin, Kallan, & Moll, 2000). Specifically, lap belts and age-inappropriate child restraint systems will continue to raise the incidences of child morbidity and mortality unless resources are directed towards the increasing use of three-point, age-*appropriate* restraint devices (Nance et al., 2004; Santschi et al., 2005; Shepherd et al., 2006; Vessentini, 2007; Winston et al., 2000).

Patterns of Booster Seat Use, Misuse and Failure to Restrain

In spite of numerous efforts to promote and increase age-appropriate child restraint use, the misuse of child restraint devices and the incidences of failing to restrain them, continue to soar and induce serious child injuries (Bennett, Kaufman, Schiff, Mock, & Quan, 2006; Brown, McCaskill, Henderson, & Bliston, 2006; WHO, 2004). For example, in the U.S. half of the 350 children, age 4 to 7, who die in traffic crashes each year, are not using any type of restraint device (i.e. child safety seats, booster seats, or seat belts) (NHTSA, 2007). Moreover, findings from the National Highway Traffic Safety Administration (2007), state that "less than 20 percent of kids who should be in

booster seats are actually in them when they are riding in cars" (p. 34). In Canada, only 28% of children in this age group were observed to be using booster seats in a national observational study (Snowdon, Hussein, High, Stamler, & Polgar, 2008). In recent years, the booster seat use data has demonstrated that the usage of adult seat belts have become the most popular substitution for age-appropriate child restraint devices (Brown et al., 2006; NHTSA, 2006; NHTSA, 2005; Ramsey et al., 2000; Winston et al., 2000). In 2005, the overall shoulder belt use rate was 82% with consecutively lower rates in each preceding year as far back as 1994, with the rate at that time as low as 58% (NHTSA, 2005). This significant decrease in the use of car or booster seats has also been noted with increasing age and number of child occupants in a vehicle (Brown et al., 2006; Ramsey et al., 2000). For instance, the restraint status results reported by Brown and colleagues (2006) demonstrated adult seat belt use to be as high as 44%, 68%, and 94% among children aged 2 to 4 years, 5 to 6 years and 7 to 8 years respectively.

Early published results have also shown that "improperly restrained children in an age-appropriate restraint system [can sustain] a greater proportion of moderate or worse injuries than properly restrained children who were in the wrong restraint for their size" (Tingvall, 1987; Weinstein et al., 1997). Though one cannot dispute that the use of safety belts has saved the lives of many children (NHTSA, 2005), injury severity between optimally and suboptimally restrained children has also been proven to differ significantly. Data collected for 152 child occupants aged 2 to 8 years showed that of all of the children injured, it was those that were suboptimally restrained that were more likely to receive an injury score of moderate or greater (Brown et al., 2006).

To be effective, child restraint devices must be used and installed correctly every time. According to Elliot and colleagues (2006), "Compared with seat belts, child restraints, when not seriously misused (e.g. unattached restraint, child restraint harness not used, 2 children restrained with 1 seat belt) were associated with a 28% reduction in risk for death..." (p. 617). In 2005, The National Highway Traffic Safety Administration (NHTSA) (2005) served to update current levels of child restraint system misuse among the public. After collecting data on restraint use by 5,527 children under 80lbs in 4,126 vehicles, 3,442 (73%) were found to display one or more critical misuses (NHTSA, 2005). During the course of the misuse study, the most common forms detected were loose vehicle safety belt attachments and harness straps securing the child to the child restraint device (NHTSA, 2005). Other observed behaviours or situations that occurred with less frequency included: misrouted harness straps on high-back boosters, vehicle safety belt use in place of the child restraint harness, parent customized and added accessories to the seats, self-created child restraint systems from parts of more than one used restraint system, and premature graduation to forward-facing seats (NHTSA, 2005). Additionally, forms of misuse concerning children and their behaviour increased when the child buckled themselves or when done by older siblings, when traveling to recreational sports and wearing equipment, when the size of the vehicle increased as well as the distance between the child and the driver in the vehicle, and when traveling in the afternoon versus in the morning (NHTSA, 2005).

Although the benefits of booster seat use are clear, it is equally important to determine reasons for its non-use. Parental misconception was among the most commonly cited causes for lack of booster seat use (Ramsey et al., 2000; Safe Kids Canada, 2004).

That is, a large majority of parents reported that children 3 to 8 years were too large for booster seat use and therefore no longer needed such forms of restraint for this age group (Ramsey et al., 2000). Other barriers to booster seat use that were noted when comparing parents of children in booster seats with those whose children wore seat belts, showed differences in risk perception, awareness/knowledge, and parenting style (Simpson, Moll, Kassam-Adams, Miller, & Winston, 2002). Finally, non-use was attributed to other problems with the seat itself, particularly, installation and/or function of the seat as well as space taken in the vehicle when transporting 3 or more passengers in the vehicle (Ramsey et al., 2000). Along with parental reasons for booster seat non-use, only two studies were found to examine the attitudes and perceptions of the children mandated to use them (Ramsey et al., 2000; Simpson et al., 2002). Research in this area demonstrated that "among parents who used a seat belt for their child, the child's resistance reportedly played a major role in the decision to transition the child to a seat belt" (Simpson et al., 2002, p. 733). Unfortunately, little work has been done on children's perceptions and acceptability of child restraint systems and it is from this premise that future programs and initiatives should consider expanding their efforts for increased use.

Booster Seat Legislation

The rate of booster seat use has remained unchanged among Canadian children despite three provinces (i.e. Nova Scotia, Newfoundland and Labrador, & British Columbia) having booster seat laws between 2004 and 2007 (Safe Kids Canada, 2008; Snowdon et al., 2008). Although it is strongly encouraged that children start using booster seats when they have outgrown their child safety seats (i.e. more than 40 pounds), they should continue to ride in a booster seat, in the rear of the vehicle, until the lap belt lies

low across the child's upper thighs and the shoulder belt crosses the middle of the child's chest and shoulder (i.e. age 8 or 145cm tall) (American Academy of Pediatrics, 2007; CDC, 2007; NHTSA, 2007; Safe Kids Canada, 2008). Booster seats in motor vehicles are designed to elevate 4- to 8-year-olds off of the vehicle seat, allowing them to use adult seat belts more safely and comfortably (Ehiri et al., 2008). In a review of best practice guidelines, Weber (2000) states "boosters are not restraint systems by themselves, but rather positioning devices that depend entirely on the vehicle belts to hold the child and booster in place. Thus [facilitating] the transition between a child restraint and seatbelts" (p. 15). While optimal restraint has been shown to reduce the risk of child morbidity and mortality overall (Durbin, Chen, Smith, Elliott, & Winston, 2005; Durbin, Elliott, & Winston, 2003; Elliott et al., 2006; Nance et al., 2004; Shepard et al., 2006), child vehicle restraint use (i.e. booster seats) is not likely to increase due to the variability of existing child restraint laws and their enforcement, both within and among countries (Insurance Institute for Highway Safety, 2007; Ministry of Transportation, 2005, Safe Kids Canada, 2008). Findings of a preliminary 2006 study showed that after enacting, encouraging, and enforcing a new law in the state of Wisconsin, the results indicated a significant change in the direction of safer practices from pre- to post- booster seat law change (NHTSA, 2007). Thus, evidence from venues in which booster seat legislation is enacted demonstrates the power of policy and law to effect adult (i.e. parental) behaviour change, thereby reducing child injury and death through age-appropriate restraint use.

According to Canadian law, all drivers are responsible for ensuring passengers under the age of 16 are safely secured in some form of child restraint device when traveling in a motor vehicle (Ministry of Transportation, 2005). At present, the following

five provinces mandate age-appropriate booster seat use: Newfoundland and Labrador, British Columbia, Nova Scotia, Quebec, and Ontario (Safe Kids Canada, 2008). In addition, children in each of these provinces must ride in a booster seat until they are a minimum of 8 or 9 years or at least 80 pounds or 145cm tall (Safe Kids Canada, 2008). Failure to comply with these regulations in any of the aforementioned provinces can result in a ninety dollar fine, plus two demerit points and a victim surcharge (Ministry of Transportation, 2005).

In 1978, the first mandatory child restraint use law was implemented in the State of Tennessee (NHTSA, 2005). Unfortunately, nearly 30 years later, child restraint laws are still inconsistent and/or are not clearly defined, especially among children 5 to 9 years (Angulo-Vazquez & De Santis, 2005). In the United States, only 29 states plus Washington, D.C., require booster seat use (Ministry of Transportation, 2005). Although all 50 U.S. states and the District of Columbia have child restraint laws, the age at which seat belts can be used instead of child restraints differs significantly in each state. In the latest published document on U.S. child restraint laws, only 11 out of 50 states, including the District of Columbia, mandated that adult safety belts were not permissible for children up to 15 years (Insurance Institute for Highway Safety, 2007). Amongst the other states, it is legal for children between the ages of 4 and 15, to travel with a seat-belt in a motor vehicle (Insurance Institute for Highway Safety, 2007). The legal consequences for violators in various states also vary with fines for a first offence ranging from ten to one-hundred dollars in the majority of states. Only in the states of Nevada (effective October 1st, 2007), Texas and South Carolina are fines greater than or equal to one-hundred dollars

enforced, with violators in these states having to pay fines of five hundred, two hundred, and one-hundred dollars respectively (IIHS, 2007).

In recognition of the need for reliable data on booster seat use among 4- to 7-year old children, the NHTSA (2007) were pioneers in conducting the first-ever probability-based survey of booster seat use in the United States. Data from this 2006 survey found that "...41 percent of children in this age group were using booster seats (whether high-backed or backless), 17 percent were restrained in child safety seats, 33 percent were in seat belts, and 9 percent were unrestrained" (NHTSA, 2007). These results demonstrate that there are still a substantial number of children (42%) who are not properly protected (NHTSA, 2007). In Canada, this rate is significantly higher, with over 70% of children traveling in motor vehicles at high risk (Safe Kids Canada, 2007).

Booster Seat Intervention Research

Paediatricians and family practice physicians are two of the most common sources of information for parents of young children. In recognizing this, researchers have placed a heavy emphasis on their roles in promoting current recommendations on child safety and restraint systems within the literature (Durbin et al., 2003; NHTSA, 2005; Pierce, Mundt, Peterson, & Katcher, 2005; Ramsey et al., 2000; Simpson et al., 2002). Although there may have once been a time in which these professionals were instrumental in promoting car seat safety, child injury risks remain high. Recent efforts have expanded to include community-based models (Greenberg-Seth, Hemenway, Gallagher, Ross, Lissy, 2004; Turner, McClure, Nixon, & Spinks, 2005; Zaza et al., 2001) as well as a number of group interventions to promote child restraint systems and their use (Bruce & McGrath, 2005). In a review by Turner and colleagues (2005), community-based programs were

proven successful in increasing child booster seat use in 4- to 8-year old children by up to 13%. Among other community-based efforts, incentives and increased exposure to the program have had the greatest impact on increasing child rear seating from 33% to 49% (Greenberg-Seth et al., 2004). However, the most common problem noted in many of these programs is their short-term rather than long-term effects (Greenberg-Seth et al., 2004; Grossman & Garcia, 1999; Pierce et al., 2005; Williams, Whitlock, Edgerton, Smith, & Bell, 2007).

In addition to group and community-focused initiatives, there have also been a number of other strategies recommended within the literature to increase booster seat use (Ehiri et al., 2008; Elliott et al., 2006; Gittelman, Pomerantz & Laurence, 2006; Pierce et al., 2005; Simpson et al., 2002). Some of the strategies suggested by surveyed parents included media and school campaigns, improved laws, and extending the use of child restraints to older ages (Durbin et al., 2005; Simpson et al., 2002; Snowdon et al., 2008; Zaza et al., 2001). The development of educational programs and legislation, the tightening of current child passenger restraint laws, and continued education for parents, nurses, health educators, and physicians have also been explored (Davies, 2004). The suggestions provided by Decina, Lococo, and Block (2005) are unique within this scope of literature in that they discuss educating persons other than parents, particularly booster seat age children, by way of public service announcements on regularly viewed television programs (e.g. Saturday morning cartoons). Regrettably, there have been only a few trials to date that have exclusively evaluated the effectiveness of booster seat interventions with children (Ehiri et al., 2008; Gittelman et al., 2006; Zaza et al., 2001), with even fewer conducted in Canada.

In a recent review of evidence on the effectiveness of booster seat promotion interventions, Ehiri and colleagues (2008) found that all of the interventions tested demonstrated a positive effect. Namely, providing incentives or distributing free booster seats in combination with education, along with education only interventions, were effective in promoting the use of booster seats for 4- to 8-year olds (Ehiri et al., 2008). Moreover, of the studies included for review, there was only one in which the participants were exclusively children (Bowman, Sanson-Fisher, & Webb, 1987).

Computer Game Types & Characteristics

While there are numerous classifications of 'games', the focus and application of this particular study is on personal computer games. A personal computer game (also known as a computer game or simply a PC game) is a game in which people interact with a system (i.e. computer interface devices such as the keyboard and mouse, or a joystick or game pad) to generate visual and/or auditory feedback through a computer screen, and/or speakers/headphones (Smed & Hakonen, 2006). In his first book devoted to the theory of computer and video games, Crawford (1984) explores 'gaming' and the fundamentals of computer game design. According to Crawford (1984), "a game is a closed formal system that subjectively represents a subset of reality" (Representation, para 1). Although the popularity and knowledge of computer games have significantly evolved over the last few decades, the first graphical computer game (a version of Tic-Tac-Toe) created by A.S. Douglass, has only been in existence since 1952 (as cited in Beliss, 2008).

Today, thousands of computer games are commercially available, with many of them often divided into one of two broad categories: skill-and-action games (i.e. focusing on perceptual and motor skills) and strategy games (i.e. concentrating on cognitive effort)

(Crawford, 1984). According to Crawford (1984), skill-and-action (S&A) games are the largest, most popular group of computer games, and are defined as "...real-time play, [with] heavy emphasis on graphics and sound, and [the] use of joysticks or paddles rather than a keyboard. The primary skills demanded of the player are hand-eye coordination and fast reaction time" (Skill-and-Action Games, para 1). In addition, he groups these game types into the following six categories: combat games, maze games, sports games, paddle games, race games, and miscellaneous games (Crawford, 1984). Strategy games comprise the second broad class of computer games, with this classification of gaming emphasizing cognition rather than manipulation (Crawford, 1984). According to Crawford (1984), "the major distinguishing factor between strategy games and S&A games is the emphasis on motor skills. All skill-and-action games require some motor skills; strategy games do not" (Strategy Games, para 1). Moreover, strategy games often require much more play time than S&A games and are almost always restricted to personal computers. This classification of gaming is also divided into various sub-categories: adventure games, dungeon and dragon games, war games, games of chance, educational games, and interpersonal games (Crawford, 1984).

Within his book, Crawford (1984) also discussed the advantages of computer technology and the importance of maximizing them with game design. The following six features of computer technology were described: 1) game responsiveness; 2) the ability to act as a game referee; 3) real-time play; 4) the ability to provide an intelligent opponent; 5) the ability to limit the information given to the player in a purposeful way; and 6) the ability to utilize data transfer over telephone lines for game play. While there are many reasons why people engage in game playing (representation, interaction, conflict, and

safety), Crawford (1984) postulates that learning is the most fundamental motivation for all game-playing, followed closely by fantasy/exploration, nose-thumbing, proving oneself, social lubrication, exercise, and need for acknowledgement. Moreover he states that although game designers "...will never fully understand all of the human motivations to play games.... [they must] appreciate the importance of these motivations and at least try to understand them in order to master the art of computer game design" (Crawford, 1984, Individual Tastes, para 6).

Applications of Technology in Health Promotion

With the increased popularity and access to computers and internet in school and home environments, computer games and other forms of electronic technologies are now being examined and evaluated as educational and skill training tools in the fields of safety education, health promotion and illness and injury prevention. For example, virtual reality (McComas, Mackay, & Pivik, 2002) and interactive multimedia (Glang et al., 2005) programs have proven successful in teaching safe pedestrian street crossing among children. The role of interactive computer-based interventions have also proven to be unique and promising in areas of health education related to the management of chronic disease (Lewis, 1999), asthma (Bartholomew et al., 2000; Krishna et al., 2003), smoking cessation (Carpenter, Watson, Raffety, & Chabal, 2003), HIV/AIDS (Thomas, Cahill, & Santilli, 1997) and nutrition (Campbell, Honess-Morreale, Farrell, Carbone' & Brasure, 1999). A new protocol for sexual health promotion among teens is now under current review (Bailey et al., 2008). While there has been much debate and hesitation in previous literature related to the influence of computer games and other forms of technology over today's youth, current findings have been both positive and promising in teaching

children about safety (Glang et al., 2005; McComas, Mackay, & Pivik, 2002). A recent study reportedly "suggests that early computer exposure before or during the preschool years is associated with the development of preschool concepts and cognition among young children" (Li & Atkins, 2004, p. 1715). Other key advantages of computers as an educational tool is the ability to engage the user, to tailor material based on user performance, to provide immediate corrective feedback when a concept has not been mastered, to review content as needed (Glang et al., 2005), and to "provide practice opportunities that are very hard to accomplish by other means" (Thomas et al., 1997, p. 84). The application of computer technology in child vehicle occupant safety would not only satisfy the recommendations to individualize educative interventions, but also provide opportunities to evaluate cost-effectiveness, long-term effects of a safe simulation activity, and the randomization needed in this area of study.

Clinical Significance

In spite of numerous preventative efforts to promote appropriate child restraint systems, lack of child occupant vehicle safety has become an important global obstacle to health (WHO, 2007). Reviews of booster seat intervention research show that few studies have tested the effect of injury prevention strategies targeted directly towards children, in particular, school-aged Canadian children 4- to 8-years of age (Bruce & McGrath, 2005; Ehiri et al., 2008; Turner et al., 2005; Zaza et al., 2001). Interventions with children often focus on the parents or caregivers who transport them in motor vehicles. While child behaviour has been investigated in an attempt to understand facilitators and barriers to booster seat use (Ramsey et al., 2000; Simpson et al., 2002; Snowdon et al., 2008), researchers have neglected to explore children's direct influential power in swaying

parental decisions towards undertaking unsafe vehicle safety practices (Simpson et al., 2002). Although various interventions have been implemented to increase booster seat use, the education intervention has been the sole strategy evaluated among children (Bruce & McGrath, 2005; Ehiri et al., 2008; Turner et al., 2005; Zaza et al., 2001).

Despite the important place technology has in the lives of today's children and youth, vehicular and road safety education interventions for primary school groups remain traditional. Even the most recent child restraint system interventions were conducted in the classroom, with instruction characterized by reinforcing messages (e.g. insist on using a restraint when traveling in the car), games, songs, drawings featuring cartoon characters, and coloring activities (Bruce & McGrath, 2005; Ehiri et al., 2008). Even though the provision of information about booster seats and the relevant skills provided to children has shown a beneficial outcome in favour of traditional education (Ehiri et al., 2008), prospective researchers interested in gaming-education strategies and child-centered learning may want to consider the incorporation of computer-based approaches into child road safety education.

Chapter 3

Theoretical Framework

Social Learning Theory (SLT) proposed by Albert Bandura (1977) is the "unified theoretical framework for analyzing thought and behavior" that will guide this study and support our understanding of how children can learn age-appropriate vehicle safety using a computer-based gaming tool such as the Booster Buddies Clek Adventure Game (p. vi). Unlike traditional psychological theorists, Bandura believes that all learning results from either direct experience or observationally through modeling (Bandura, 1974). In the famous "Bobo doll" experiment, Bandura and colleagues (1961) wanted to demonstrate that people could learn information and behaviors by watching other people. Children were studied because they were found to generally have less social conditioning (Bandura, Ross, & Ross, 1961). This phenomenon, more commonly known as observational learning (also known as vicarious learning, social learning or modeling), occurs when people learn through modeling (Bandura, 1976). Namely, they are able to form their own conclusions of how new behaviors are performed, and store this coded information which later serve as guides for appropriate conduct (Bandura, 1976). Additionally, Bandura (1977) states, "The capacity to learn by observation enables people to acquire large, integrated patterns of behavior without having to form them gradually by tedious trial and error" (p. 12). For instance, just like parents or guardians would not teach their children to touch a hot stove or to ride their bicycles in a busy street by having them learn the most appropriate behavior through the consequences of trial and error, young children cannot also be expected to learn the importance of age-appropriate vehicle restraints by way of victimization in motor vehicle crashes. According to Bandura (1977),

"...people are not equipped with inborn repertoires of behavior... [and] the more costly and hazardous the possible mistakes, the heavier is the reliance on observational learning from competent examples" (p. 12-16).

Within the framework of the social learning theory, the process of modeling and the successful achievement of a newly desired behavior are governed by the following: (1) Attentional processes, (2) Retention processes, (3) Motor Reproduction processes, and (4) Motivational processes (Bandura, 1965). These four component processes are summarized schematically in Appendix A (Bandura, 1977). Attentional processes are the first step, as they determine what will be observed in terms of modeling influences and what will be learned from the exposure (Bandura, 1965). According to Bandura (1977), "people cannot learn much by observation unless they attend to, and perceive accurately, the significant features of the modeled behavior" (p. 15). In the Booster Buddies Clek Adventure Game, two animated, humorous booster seat characters Olli and Otto, serve as the modeling influences used to capture the attention of the target population. Other engaging game design components incorporated include a colourful, interactive, cartoon town that ties together four different mini games, energetic and developmentally fitting characters, and a radio system that lets players choose their preferred background music. The intent of the game was for school-aged children to observe and learn vehicle safety messages and appropriate behaviours when traveling as occupants in motor vehicles.

The second major process involved in observational learning involves retaining the compelling behavior that was modeled. Bandura (1977) emphasizes that "through the medium of symbols, transitory modeling experiences can be maintained in permanent memory. It is the advanced capacity for symbolization that enables humans to learn much

of their behavior by observation" (p. 25). According to Piaget's preoperational period of cognitive development, it is between the ages of 2 and 7 that children acquire this ability for inner, symbolic manipulations of reality and the emergence of the symbolic function or behavior (i.e. imitation & symbolic play) (Huitt & Hummel, 2003). Moreover, mental images appear late in this period because of the child's dependence on internalized imitation (Boeree, 2003). Language also appears during this period, and according to Bandura (1977), "As linguistic skills are developed, verbal modeling is gradually substituted for behavioural modeling as the preferred mode of response guidance" (p. 39). Throughout the game, the designers incorporated several visual and verbal cues as well as continued exposure to Olli and Otto to engage players while in the town and within each mini game. For instance, in the Back Seat Bash mini game, the designers emphasized the importance of safe vehicle conduct by having Olli and Otto demonstrate a series of unsafe behaviours while traveling in the back seat of a car (e.g. throwing objects). Vocal messages were also used to draw attention to players about the danger of the unsafe actions when the player correctly prevents an inappropriate action from taking place. By allowing the players to observe Olli and Otto performing unsafe behaviours in the game, the social learning theory suggests that they are more likely to remember them (Bandura, 1971). In addition, the repetition of making correct behaviour choices in the game increases player proficiency as well as retention.

Motor reproduction processes, the third component of modeling, involves translating the images or descriptions into actual behavior (Bandura, 1965). Bandura (1977) believes that "skills are not perfected through observation alone, nor are they developed solely by trial-and-error fumbling" (p. 46). The seriousness of child occupant

vehicle safety and the interactive component of the game, allows players a fun opportunity to achieve a close approximation of the desired modeled behavior without any life-threatening risks. Additionally, through informative feedback and the ability to exit and return to previous screens, the designers allow the new modeled behaviors to be refined through self-corrective adjustments (Bandura, 1977).

Motivation is the last necessary component of observational modeling described by Bandura (1971). He theorizes that not all observational learning leads to a change in behaviour, and that the observer must be motivated to carry out the action they have observed and remembered (Bandura, 1977). Moreover, he also suggests that what may be self-satisfying for some people may not necessarily induce a change in behaviour for someone else (Bandura, 1977). Within the booster buddies game, the designers incorporated the following motivational factors: problem-solving, mini-game level progression, time constraints, a coin-score system for successful progress, the ability to visualize the player's accumulation of coins in the coin deck and the current status of their car customization.

The utilization of positive reinforcement incentives such coins to purchase booster seat accessories is another important tenet of Bandura's social learning theory. He believes that by way of observing the outcomes of others and the occasions on which they are punished or rewarded, a person's behavior can be altered (Bandura, 1976). For instance, "seeing behavior succeed for others increases the tendency to behave in similar ways, while seeing behavior punished deceases the tendency" (Bandura, 1977, p. 117). In addition, he also states that "most human behavior is maintained by anticipated rather than by immediate consequences" (Bandura, 1977, p. 109). In applying this theory, it is

foreseen that by observing and internalizing the positive or negative actions of complying with vehicle occupant safety in the game, children will learn to anticipate the consequences of unsafe motor vehicle behaviour and model the newly learned vehicle safety behaviour(s) in a real-life setting.

Chapter 4

Methodology

Research Design

This preliminary study evaluated the impact of a computer-based gaming strategy in child vehicle safety education. Pre- and post-intervention questionnaires were administered to test for changes in children's perceptions about booster seat safety, and their preferences for booster seats after playing the Booster Buddies Clek Adventure Game. The satisfaction portion of the post-survey served to examine the utility of gaming software in educating children about safety seat practices, as well as children's attitude towards this type of learning strategy. The purpose of the single group pre- post-test design was to determine if the game was effective as an educative tool. This design served to determine the efficiency of the gaming strategy, and was not intended to measure whether or not the game increased vehicle safety seat use among its participants.

Population and Setting

The population for this study consisted of inner city preschool and elementary students between the ages of 4 and 11 years who were active members of the St. Albans Boys' & Girls' Club in Toronto, Ontario. The choice of children in the 4- to 8-year age range was based upon best practice guidelines for age-appropriate restraints for this group. The age criteria was extended during the second data collection phase to include children up to 11 years of age, for the purpose of increasing sample size. All data collection took place at the club over the course of two days, with a two week time span between the first and second data collection phases.

This type of club was chosen based on the premise that they are safe and supportive environments that provide children and youth, ranging in age from pre-school to young adulthood, with programs in health, physical recreation, technology, personal growth and more, with thousands of clubs located in numerous community service locations across Canada. Preference for the St. Alban's Toronto site was based on the convenience and diversity of its geographical location, high-volume of children, presence of a computer lab for children, and previously established collegial relationships with George Brown University.

Sample & Eligibility Criteria

Convenience samples were obtained from the preschool and After 4 programs. Children were eligible for the study if they were between the ages of 4 and 11, if they were English speaking, and were active members of St. Alban's Boys' & Girls' Club. All children meeting the eligibility criteria were invited to participate using three strategies: 1) posters were displayed throughout the preschool and After 4 programs advertising the study and inviting children in the targeted age group to participate (Appendix C); 2) information (Appendix E) and consent letters (Appendix F) were sent home to parents or caregivers with each eligible child explaining the research study and encouraging parents or caregivers to allow their child to participate; and 3) the staff approached each parent or caregiver to inform them of the study and seek their child's participation in the study.

Children Demographics

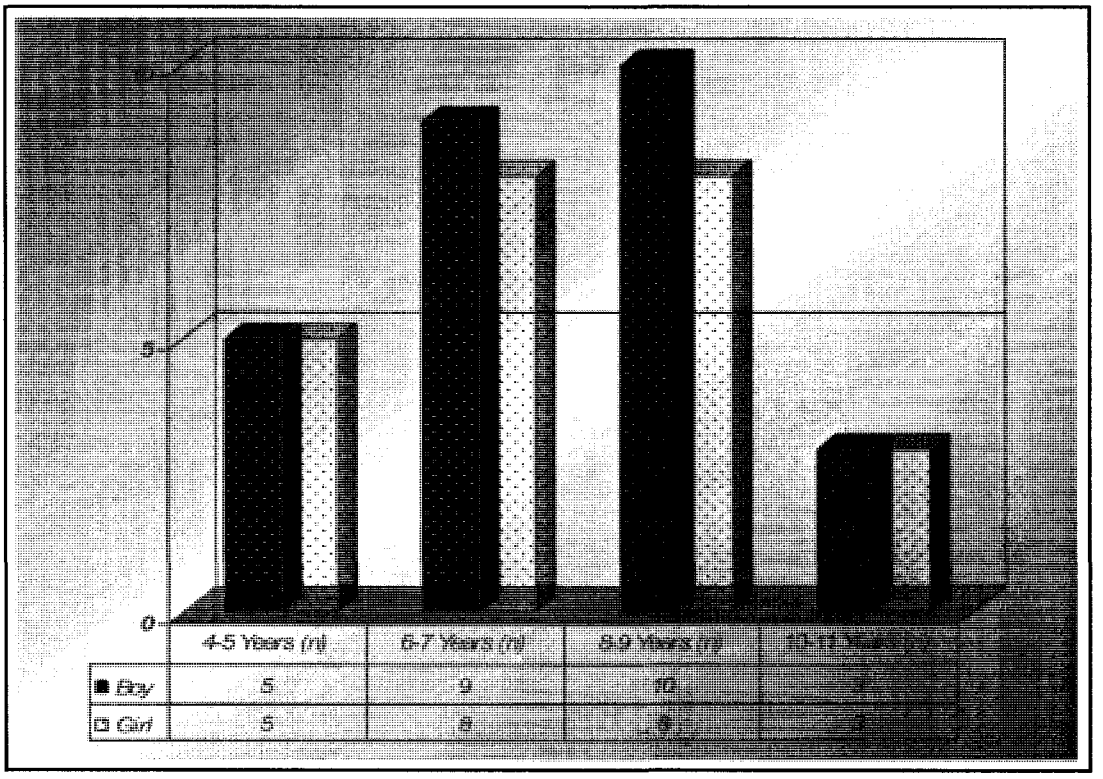
Complete data was collected on a total of n=51 eligible children who were in attendance at either the preschool or After 4 program on the data collection dates. Of the

89 children enrolled in the programs, 37 were excluded because they either were not in attendance or did not have completed consent from their parents or caregivers to participate in the study. An additional child was excluded from the analysis as a result of an inability to provide feedback or to participate in game play without the aid of a counsellor. The remaining 51 children were interviewed and observed while grouped into one of four age categories: 4 to 5 years, 6 to 7 years, 8 to 9 years of age, and 10 to 11 years. The age range of the children reported on was 4 to 11 years. Seventeen of the participants in the study were 6 to 7 years, 18 children were 8 to 9 years, while 10 children were aged 4 to 5 years. Only 6 children were between 10 and 11 years of age. There was only a slight marked difference in the sexual orientation of the participants: 27 children were male and 24 of them were female (Table 1). Forty of the children that participated in the study were enrolled in St. Alban's After 4 program, while 11 of them were from the preschool program.

Non-specific family demographics for these children is summarized as follows: 1) mean age of parents - 37; 2) range of parental incomes (i.e. combined household income) - $96,000 - $152,000; 3) educational level of parents - College or University; 4) ethnic diversity of students - Caucasian, Asian, and Black; and 5) religious orientation - Jewish and Catholic.

Table 1

Children Demographics



Note: Total Cases = 51; n = number.

Instrumentation and Materials

Pre-Intervention Questionnaire

A pre-intervention questionnaire was administered to every child enrolled in the study. Baseline demographic data such as gender and age, as well as current booster seat use was collected by way of a pictorial survey prior to the implementation of the gaming strategy. The purpose of the pre-intervention questionnaire was to elicit descriptive baseline data of each child's current restraint use, booster seat preferences, and insight related to which restraint device they thought was safest to travel with in a vehicle. The

questionnaire used diagrams, descriptive words, and drawings, to ask a series of three questions, each averaging a minute in length (Appendix B).

Post-Intervention Questionnaire

A post-test questionnaire was also given to every child immediately following the gaming experience. The purpose of the post-intervention questionnaire was to explore any changes in children's booster seat preferences or insight related to which restraint device they thought was safest to travel in after playing the game. This questionnaire used the same diagrams, descriptive words, and drawings as did the pre-survey, but instead only asked them to answer two of the three questions: "circle the way you think is *safest* to sit in your family car" and "if you could make your own booster seat, what would it look like?".

The satisfaction component of the post-survey served to examine the preferences of different age groups for this type of education strategy. The satisfaction questionnaire asked each child the following questions: (1) a) How did you like the game? b) What didn't you like? (2) a) How easy was it to play the game? b) What did you learn from this game? (3) Would you tell your sister/brother/friend to play a game like this? (4) Would you play a game like this at home if you had it? (5) Would you play a game like this at school if your teacher let you? Participants were asked to respond to each question using a Likert-type 4 point scale of faces ranging from very much or very easy (e.g. happy face/smile) to not at all or not at all easy (e.g. unhappy face/frown) (Appendix C). Children's comments about the game and nonverbal behaviour during game play were recorded as field notes immediately after the gaming experience, as no tape recording took place.

Booster Buddies Clek Adventure Game

The Booster Buddies Clek Adventure Game is an interactive computer-based educational game targeting 4- to 8-year old children in Ontario that was designed and produced by AUTO21 researchers from the University of Windsor and George Brown College in collaboration with MAGNA Aftermarket Inc. Both its design and intent are unique as this is the first computer-based game for children with a focus on child vehicle safety.

The program begins with the safety town introduction presented by two booster seat narrators Olli and Otto. Within this introduction, the booster seat characters describe the layout of the safety town and the objective of the game (i.e. to earn coins to build and drive their customized car). The design of the main screen gives players the illusion that they are passengers in a motor vehicle by displaying a dashboard on the bottom of the screen and the safety town as the backdrop (Figure 1A). After the safety town introduction, players are prompted by Olli and Otto to enter their gender and age and then visit each unique location within the town to earn coins which can be redeemed to help build their customized car. Once the player has accumulated a minimum of seven coins, they can purchase a ticket to take part in the driving challenge course known as the "Clek Arena Rampage". Each location within the game represents four diverse mini games (i.e. Back Seat Bash, Factory Dazs, Clek's Custom Shop, and Clek's Arena Rampage) varying in objectives, game design, mechanisms and important vehicle safety messages. Databases were embedded within each mini game and designed for the purpose of gathering data without intruding on the learner's experience. The embedded databases recorded data on children's performance within the game, their preferences for booster

seat styles and accessories and their knowledge about correct booster seat use and safe conduct while travelling in a vehicle. The learning concepts for each mini game as well as the type of data collected from each of them was based upon booster seat best practice guidelines for this age group (Safe Kids Canada, 2008).

Game Embedded Database

Data generated during the introductory segment of the game included information on the user id, age, and gender of every player. Each participant's user id was created by way of the IP address of the computer in addition to the player's login time. Age and gender data was gathered by prompting the players to enter this information following the safety town introduction. Data was also collected related to the type of mini game played, whether or not it was repeated, the highest level completed, the number of attempts made to complete the level(s), and the number of wins and/or losses for each mini game. Additional data was recorded specific to each mini game. For instance, in the Factory Dazs mini game, data was gathered on the type and number of dolls launched, as well as the type of seat the doll was launched into. The collection of this type of data allowed the researcher to analyze the number of correctly matched dolls to seats. Within Back Seat Bash, the database captured information on the type and number of incorrect behaviour(s) displayed to the players. The time stamps in the database represented whether or not the player was able to identify the unsafe behaviour, attempted to correct it, or was successful at completing either or both tasks. Clek's Custom Shop was the only other mini game with a separate database designed to examine children's vehicle and booster seat preferences. Specific data collected in this database mini game included: 1) car type

(i.e. truck or buggy); 2) booster seat style (i.e. high-back or low-back); 3) car colour; 4) car decals; 5) booster seat accessories; and 6) car accessories.

Factory Dazs Mini Game Overview

This mini game features an array of automobile safety equipment and offers players the opportunity to familiarize themselves with seat belts as well as booster, child, and infant seats. The game mechanism employed in this mini game is an amusing combination of the famous Rube Goldberg device and classic arcade pinball. The design of this game allows players to be engaged for approximately five to ten minute intervals, while providing an open-ended reward system for particularly eager players. Trial and error is encouraged, correct estimations are rewarded, and a rich feedback loop is designed to hold the player's attention. The learning concept for this mini game centers on teaching children the correct seat for the relative size and weight of each doll character. By virtue of playing this mini game, it is anticipated that child safety seat recommendations will be built into the player's symbolic repertoire and internalized in their minds.

Game Play Process

In this particular mini game scenario, the player is working in a doll factory to earn coins by moving doll characters of various sizes (i.e. teen, child, infant and baby) from a conveyor belt into the age-appropriate safety seat so that they can be shipped out to the toy store (Figure 1B). After a brief real-time animation demonstrating one sequence of game play, the player is invited to begin. Dolls of varying sizes then begin to roll down the conveyer belt and onto the launch pad, where it waits until the player clicks on the launch device. Below this delivery system are safety seats of various sizes (i.e. seat belt,

booster seat, child seat and baby seat) waiting to receive a doll character of the most appropriate size. Once the doll launch device is clicked and released, the player must manipulate various levers and springs in order to get the doll character into the correct safety seat. The player earns coins each time they match the doll to the correct seat. Visual and audio feedback is provided to the player when the doll is sent to the right or wrong safety seat to support their learning. With the completion of each level, both the rate at which the dolls are distributed and the number of springs used to manipulate the dolls into the correct seat increases up to a maximum level of ten. The game ends when the launch device fills up with five dolls.

Back Seat Bash Mini Game Overview

This game tests players' knowledge of in-car safety by engaging them in prevention strategies to keep Olli and Otto from performing unsafe actions in the back seat of a car. The objectives of this game require the player to identify an unsafe action and then perform a displayed keypad sequence to prevent the behaviour from occurring. This mini game educates players by allowing them to take an active role in enforcing safe behaviour in the car.

Game Play Process

The introduction to this game features Olli and Otto getting into the back seat of their car, securing their seatbelts, and then removing blankets from under the child passenger's seat (Figure 2A). Once game play begins, Olli and Otto begin performing unsafe actions in the back seat, with the intent of the player spotting the unsafe behaviour and preventing it from occurring. The reward of a coin and positive feedback from the booster seat characters (e.g. "great job") are given after each unsafe action that is

prevented. Safety messages presented in the game include: (1) never put your hand or body outside the window and never throw anything out, (2) do not block the driver's view in the back mirror, (3) only open the door or window when the vehicle is parked, (4) keep hands away from the door handles while the car is moving, (5) only get out of the car after you have looked and made sure it is safe, (6) the safest place for you is in the backseat, (6) you should never be left alone in the car, (7) never unlatch the seat belt, and (8) never put the shoulder belt behind you. An "X" appears on the screen each time the player does not prevent the unsafe action from taking place. Players lose the level after the attainment of three "X"s.

Clek's Custom Shop Mini Game Overview

Clek's Custom Shop is a customization game that allows players the freedom to design cars and booster seats to their liking. The main purpose of this mini game is to fill the gap in literature regarding child booster seat preferences and the types of booster seat features that may increase their desirability to travel in them. The goal of the player in this game is to redeem accumulated coins for various car and/or booster seat upgrades. This mini game allows the player the opportunity to decide on the paint colour, decals, and upgrade accessories for their car and/or booster seat without any time constraints. Players are also given the choice between two styles of vehicles (i.e. truck or buggy) and booster seats (i.e. high-back or low-back). Some of the customization items include: wheels, lights, a fire hose, a ladder, speakers, ribbon, a mirror, and a crown. Once the player adds an upgrade to their car, a quick safety message from Olli and Otto is played as a result of adding the upgrade. For example, "Not enough children in Canada are using their booster seats". Each time a player clicks on an upgrade that they have added, the

safety message is replayed. Quick tips about general safety are also provided to players upon exiting this mini game.

Game Play Process

Once the introduction and demonstrations are completed, the player is given the opportunity to choose the type of vehicle and booster seat that they would like to customize. The game then begins with the player's selected style of car and booster seat displayed in the shop (Figure 2B). While navigating through the shop, the car accessories are presented to the left of the main screen, while the booster seat, paint colours, decals and accessories are located to the right. Available upgrades for the car and booster seat are highlighted each time the player scrolls over the item, while alerting them about the number of coins required to purchase the upgrade in an odometer located at the bottom left of the screen. Safety messages are given to players each time they choose an accessory for their car or booster seat, scroll over an item they previously purchased, or exit the mini game. Once players are satisfied with their car and booster seat choices and exit the mini game, they are returned to the main safety town screen where Olli and Otto provide another safety message.

Clek's Arena Rampage Mini Game Overview

Once players have earned enough coins in the safety town, they have the ability to purchase a ticket to take part in a driving challenge course known as the "Clek Arena Rampage", or CAR. The "Clek Arena Rampage" is an animated cartoon land adventure, with a series of arena-style driving challenges in the spirit of "MXC-Most Extreme Elimination Challenge". The learning concept for this mini game centers on teaching

children the importance of road hazards, street signs and safe driving awareness. For instance, the young driver must keep on the look out at all times in order to overcome several road obstacles such as slippery roadways and unexpected and unforeseen objects such large boulders and loops/curves in the roadway. With each lap completed, the player's ability to depict and avoid road hazards is challenged as the number of obstacles and the speed at which they are presented increases. Players are rewarded in this mini game with ribbons of first, second, or third place, based on time and successful completion of the course.

Game Play Process

This mini game takes place in a sporting arena in which the player uses the vehicle that they personalized in Clek's Custom Shop to drive on the course. The track can be looped up to a maximum of three times, with the difficulty level of the challenges increasing with each lap. Obstacles are laid out along a winding track that begins on a straight-away and enters a series of sharp turns. The players must proceed through the following obstacles in order to complete the track and reach the finish line: 1) a shaky bridge haunted by jumping fish; 2) a speed boost power-up followed by a track that loops through the air; 3) an ice-cream shop that throws ice cream cones onto the track; 4) a construction zone cluttered with barricades and orange road cones; 5) a rotating block bridge in which sections of the bridge rotate independently of one another; 6) an oversized magnet that is lowered from overhead; 7) a mountain side winding path with an avalanche of dinosaur eggs; 8) a thunderstorm producing lightening and slippery roadway puddles; 9) a railroad crossing; 10) a cave with tumbling boulders;

11) a jump ramp; 12) a volcano; and 13) a hairpin turn. A graphical representation of the track and the obstacles is provided in Figures 3A and 3B respectively.

Procedure

The study took place at the Boys' & Girls' Club during preschool and After 4 program hours. All eligible children present at the club on the dates of the study with consent to participate took part in the investigation. Children were divided and examined by age categories predetermined by the Boys' and Girls' Club program in which they were enrolled: Children enrolled in the full-time preschool program were examined during day-time program hours, as opposed to children in the After 4 program, who participated in the study during after school hours. For the students unwilling or unable to participate in the study, they were escorted to another area of the club without access to the study area or participants, in which they participated in program activities as usual. Research assistants worked with each child to familiarize them with the game; however only served as sources of assistance during the game play process. Each research assistant that participated in the study was trained by the author using a written protocol to ensure consistent fidelity of procedures. Parents who accompanied their children to the study were welcomed to stay in a waiting area until their children completed the study.

Upon entering their regularly scheduled classroom, all eligible participants were directed to a second classroom where all pre- and post-testing took place. Once settled at individual desks, each student was asked to complete the pre-intervention survey. After 5 to 10 minutes, the group of students was escorted to the computer lab and seated in front of computer monitors. Each child received instructions on how to use the game prior to receiving the intervention to ensure that differences in outcome were not due to

unfamiliarity with the equipment used. During the gaming experience, children were observed by the research assistants and the author to ascertain that no specific cues were given with game tasks. If a child had difficulty with a task or requested guidance, the research assistants provided encouragement and/or redirected the child to focus on the game play instructions provided by Olli and Otto without intervening in the child's progress. Field notes were recorded on children's comments and behaviors during game play. Following 30 minutes of game play or the child's expressed desire to resign from the game play experience, all children were administered a post-intervention survey at their computer station, in the same order in which the pre-intervention survey was given. Upon completion of the post-intervention survey, all participants were taken back to their scheduled programs for activities as usual.

Data Analysis

Descriptive data analysis was undertaken using the Statistical Package for Social Sciences computer program (Version 16.0.1). Descriptive statistics were used to summarize the data collected from the surveys as well as the embedded databases. Since the demographic data of the participating children was categorical, ordinal and interval in nature, the findings are presented descriptively via frequency tables to describe patterns and trends in the study data. Qualitative data was subjected to simple content analysis.

Validity and Reliability

Content validity addresses the appropriateness of the instrument items as they relate to the particular constructs under investigation (Polit & Beck, 2004). The pre-intervention survey utilized for this study had been previously used in a much larger study in which the construct of vehicle restraint use was thoroughly examined and supported (Snowdon

et al., 2008; Snowdon, Polgar, Patrick, & Stamler, 2006). Content validity was supported in a series of pilot studies of the survey instrument for this study.

Initially, the instrument was administered to ten 4- to 8-year-old children who were asked to identify questions they felt were difficult to understand. On the basis of that pilot test, changes to the survey were made and it was administered a second time to ten different children within the same age range. Any diagram or wording that was unclear or difficult to understand was re-drawn and/or re-written and clarified.

History threat is a threat to internal validity in which changes in the environment outside of the project could produce changes in the variable under study (Polit & Beck, 2004). For example, if the child participants involved in the first data collection had disclosed information to the study participants in the second session, this may have altered the children's opinions and affected the latter group's results. Moreover, due to the fact that participants were re-tested at their computer stations and in-close proximity to other interviewers and participants (i.e. as opposed to the same location in which the pre-testing took place), this event had the potential of changing participants' insight and attitude and must therefore be considered as an alternative explanation for the changes in participants' post-test responses.

The instrumentation threat is another type of single-group threat to the internal validity of a study, and is caused by inconsistencies with the testing instrument (i.e. interviewer, grader, or the test itself) (Polit & Beck, 2004). This type of threat is plausible in this study due to a lack of consistency in the pre- and post-survey interviewers. For instance, participants may not have had the same interviewer for both pre- and post-test measures. Thus, the participants' responses may not be due to the

intervention, but rather the changes made to the interviewers used to examine their perceptions about booster seat safety and their preferences for booster seats after playing the game.

Testing could also be a threat to the internal validity of the findings. Taking a test generally affects subsequent testing; thus, participants' performance on a measure at the end of the study may differ from an initial testing, not because of the intervention, but because they are familiar with the measure (Polit & Beck, 2004). In this particular study, the post-test survey was identical to the pre-test.

Ethical Considerations

Approval of the study was obtained from the Research Ethics Board of the University of Windsor as well as the Preschool Manager and Computer Coordinator at St. Alban's Boys' and Girls' Club. Permission to send information letters to parents or caregivers of the eligible children in the study was also requested through the aforementioned St. Alban's staff members. Prior to any student becoming a subject of research, a letter of consent seeking parental or guardian approval in addition to an information letter was sent home to parents and caregivers notifying them of the following: (1) the aims, methods, anticipated benefits and potential hazards of the research; (2) their child's right to abstain from participation in the research and his/her right to terminate his/her participation at any time; (3) the confidential nature of their child's replies and actions. Assents were also provided to each study participant prior to the commencement of the study (Appendix G). The identity of individuals from whom information was obtained in the course of the study is kept strictly confidential, with no

identifying information on any study data. No pressure or inducement of any kind was applied to encourage parents/caregivers or their children to become participants of this research. Participation in the study was strictly voluntary and parents or guardians had the right to withdraw their children from the study at any time without consequence. The study data will be kept confidential and information is accessible by the researcher of this study and the multidisciplinary research team of a larger study. All information collected for this research study will be kept in a locked drawer accessible only by the researcher and the multidisciplinary team.

Chapter 5

Results

Child Accounts of Booster Seat Use

Thirty-four children between the ages of 4 and 11 years described using a booster seat by way of a pictorial survey prior to the gaming experience. Among the 51 children enrolled in the study, 14 reported using a seat belt, two explained interchanging between the use of a booster seat and a seat belt, and one child disclosed traveling unrestrained. A 6-year-old boy elaborated on his combined restraint use by stating, "My dad says I have to use my booster seat only if we are riding on the 401. I can wear my seat belt when we are riding around the neighbourhood". Tables 2 and 3 demonstrate the rates of booster seat use according to gender and age respectively. Overall, low-back booster seats were the most frequently used child restraint device (n=23). More boys confirmed using low-back booster seats (n=15) compared to girls who more commonly reported the use of high-back booster seats (n=9). No significant gender differences were noted among the other types of restraint devices. Other patterns among the data demonstrated a strong linear relationship between age and reported booster seat use. Specifically, as age increased, the likelihood of children riding in booster seats decreased.

Table 2

Frequency of Child Reported Booster Seat Use According to Gender

Child Accounts of Current Restraint Use	Gender (n=51)		
	Boy	Girl	Total
Low-back booster seat	15	8	23
High-back booster seat	2	9	11
Seat belt	8	6	14
No Restraint	1	0	1
Booster seat & Seat belt	1	1	2

Table 3

Frequency of Child Reported Booster Seat Use According to Age

Child Accounts of Current Restraint Use	Age (n=51)			
	4-5 years	6-7 years	8-9 years	10-11 years
Low-back booster seat	6	10	6	1
High-back booster seat	3	4	4	0
Seat belt	0	2	7	5
No Restraint	1	0	0	0
Booster seat & Seat belt	0	1	1	0

Child Perception of Safest Restraint Device

Pre- and post-surveys were used to assess for changes in child perception of the safest way to sit in a vehicle. Each participant was asked to indicate the safest restraint device for their age by circling one of four pictorial diagrams (i.e. child in a low-back booster seat, a high-back booster seat, a seat belt, or no restraint) both before and after their gaming experience. Tables 4 and 5 demonstrate the changes in the participant's perception of the safest restraint device after playing the Booster Buddies game. While

high-back booster seats (n=20) were perceived as the safest form of restraint before exposure to the game, child perceptions changed slightly and low-back booster seats (n=18) were considered safest after the gaming experience. There was also minimal change in the number of children who identified seat belts as the safest form of restraint after the gaming intervention. Three children (4- to 5-years of age) changed their post-survey responses after playing the game, indicating that the game did not help them understand that seat belts are not the safest way to travel in a vehicle. Though boys thought that low-back booster seats were a lot safer than girls both before and after the gaming experience, no gender patterns were noted among the pre or post results for seat belts.

Table 4

Child Perception of Safest Restraint Device - Pretest

Child Perceptions of Safest Restraint Devices	Age (n=51)				
	4-5 years	6-7 years	8-9 years	10-11 years	Total
Low-back booster seat	5	6	4	2	17
High-back booster seat	3	10	7	0	20
Seat belt	1	1	6	4	12
Booster seat & Seat belt	0	0	1	0	1
Both Boosters	1	0	0	0	1

Table 5

Child Perception of Safest Restraint Device - Posttest

Child Perceptions of Safest Restraint Devices	Age (n=51)				
	4-5 years	6-7 years	8-9 years	10-11 years	Total
Low-back booster seat	3	6	7	2	18
High-back booster seat	3	7	5	0	15
Seat belt	4	1	6	4	15
Booster seat & Seat belt	0	0	0	0	0
Both Boosters	0	0	0	0	0

Satisfaction with the Gaming Experience

The satisfaction component of the post-survey examined the respondent's preferences for gaming as a type of educative tool. Using a 4-point Likert scale, the children were asked to rate how much they liked the game. The majority of children (n=43) indicated that they liked the game 'very much' or 'okay'. Only 8 children were not satisfied with their gaming experience. Tables 6 and 7 summarize children's satisfaction with the gaming intervention by age and gender respectively. A strong linear relationship was found between age and game satisfaction. That is, as age increased, the children's satisfaction with the game decreased. Slightly more girls (n=22) described liking the game compared to boys (n=21).

Table 6

Satisfaction with Gaming Experience According to Age

How did you like the game?	Age (n=51)			
	4-5 years	6-7 years	8-9 years	10-11 years
Very Much	6	9	7	1
Okay	1	7	8	4
Not Quite	2	1	2	1
Not At All	1	0	1	0

Table 7

Satisfaction with Gaming Experience According to Gender

How did you like the game?	Gender (n=51)		
	Boy	Girl	Total
Very Much	10	13	23
Okay	11	9	20
Not Quite	4	2	6
Not At All	2	0	2

Another measure of satisfaction in the post-survey examined whether or not children would recommend the game to others and play it at home or at school if they had access to it. Forty-three percent of the sample (n=22) confirmed that they would recommend the game to others, 55% (n=28) agreed that they would play the game at school if their teacher let them, while 63% (n=32) affirmed that they would play the game at home if they had access to it. The results further indicated that more children between the ages of 6 and 9 (n=14) would recommend the game to others and use it at school if they had it (n=20), compared to 6- to 7-year olds (n=13) who would play the game at

home if they had it. No gender patterns were noted with respect to the children's likelihood of recommending the game or using it within home or school settings.

Ease of the Gaming Experience

The level of difficulty of the Booster Buddies game was another method incorporated into the post-survey to assess the effectiveness of the gaming tool. By way of a 4-point Likert scale, children were also asked to rate how easy or difficult it was to play the game. The results indicated that 26 children reported the game to be easy, while another 25 described it as difficult to play. There were no significant correlations between age and gender and children's perceived level of difficulty of the game.

A Qualitative Perspective of the Gaming Experience

The effectiveness of the Booster Buddies game was further explored by way of open-ended questioning. Following the gaming intervention, children were asked to discuss what they did not like about the game. Although the responses varied, four common themes emerged: 1) game control, 2) technical glitches, 3) inadequate instructions, and 4) satisfaction with the gaming experience.

Game control was the most popular theme that emerged from the qualitative data and refers to the children's difficulty with controlling certain aspects of the mini games. Of all the mini games played, children primarily discussed game control issues with Clek's Arena Rampage. Specifically, children shared that "well in this game it's kind of hard to control the car", "the curves are hard when racing", "hard to drive", "this is really hard! This is really hard! Why is this so hard? Do you have more than one life?" and "can't do this. I can't drive this thing at all! I want to go to another game". When playing this mini game, a number of children were observed to have difficulty keeping control of

their car on the winding track or while completing a series of sharp turns. Moreover, many of the children were also observed to have difficulty maneuvering their vehicles through the barriers (e.g. tumbling boulders) or returning their car to the track once diverted from it. Game control issues within Factory Dazs were also discussed, with some children explaining that it was "hard to control where the dolls came up or out" and that "it's too hard to put the dolls where they need to go". Within this mini game, dolls of varying sizes begin to roll down the conveyer belt and onto the launch pad, where it waits until the player clicks on the launch device. Once the doll launch device is clicked and released, the player must manipulate various levers and springs in order to get the doll into the correct safety seat. Observers noted that many children had difficulty both keeping up with the pace at which the dolls were released onto the launch pad (i.e. accumulation of dolls on the launch pad), and controlling the distance and landing location of the dolls launched. Some of the older participants even suggested improvements for future designs such as, "It would be good if you could hold the doll to see it better".

Technical glitches were the second theme that arose in the children's discussion of their dislikes of the game and is defined as any malfunction or technical problem with the game. After playing the Booster Buddies game, many children felt that "it didn't work very well" and that "it had some bugs". Technical glitches were also discussed by the children in accordance with certain mini games. Within Clek's Rampage Arena, numerous children shared that they "couldn't get to race" and that the "race game takes too long to load". There were numerous instances during data collection, in which children were delayed in playing the mini game as a result of exceptionally slow

downloading times, spontaneous shut down of the game or the game coming to a standstill and the computer having to be restarted. Similar comments related to discontent with the Back Seat Bash mini game were also expressed by child statements such as "seems to freeze a lot". Many of the game malfunctions experienced within this mini game were associated with the arrows coming to halt on the screen or the game failing to respond to the player's actions. For example, there were instances in which the game proceeded on its own, failing to respond to children touching the spacebar or completing correct arrow keypad sequences.

A third theme that transpired from the children's discussion was the inadequacy of the game's instructions. Much of the children's qualitative discussion on this topic focused on the quality and pace at which the game instructions were provided. In response to the gaming experience, many children stated that "they didn't explain as easily as they could", that it was "hard to figure out what to do sometimes", that they "don't get the instructions" and that the "instructions were way too fast". Though game instructions and demonstrations of the correct sequence of game play were presented by the booster seat characters (i.e. Olli and Otto) at the beginning of each mini game, the children indicated that the demonstrations were brief and that the booster seat characters spoke too quickly. Moreover, many children were observed during data collection to cuff their hands over their headphones while attentively staring at the monitor to improve hearing quality. Lastly, numerous children sought game clarification from research assistants and guidance on how to proceed with their games despite the instructions and game play demonstrations provided at the beginning of each mini game. Specifically,

children stated "I don't know what to do. How do I get out of here?", and "I don't know how to get the dolls to the spots".

Finally, satisfaction with the gaming experience was the last theme that evolved upon eliciting feedback about what children did not like about the game. This theme centers on the positive qualitative responses about the game. For some children, the entire gaming experience was enjoyable as they affirmed that "it was all fun", "liked it all", and "good game for learning. I would recommend this game as a safety game". In developing the game, the designers incorporated technology such as computer animation and player interaction to increase the desirability of the game for school-aged children. During the data collection phase, numerous children expressed a strong desirability to test a "new computer game" prior to their game play experience. In addition, the same enthusiasm was demonstrated by several children not enrolled in study. For example, many non-participants requested to play the game and attempted to get feedback from their peers about the gaming experience. In addition, motivational components of the game such as the ability to earn coins to redeem them in a driving challenge course or to customize a booster seat were also well received by the sample, with every child taking the opportunity to play the Rampage Arena and Custom Shop mini games.

Evidence of Learning

Children's responses to the qualitative question, "What did you learn from this game?" demonstrated evidence of learning. The majority of children expressed that the game helped them to learn that they "need to be safe in the car" and "what not to do in a car". Numerous children were also able to both remember and clearly articulate several of the safety messages presented in the game. A few of the more commonly repeated

messages included, "don't throw things in the car", "don't take off your seatbelt", "don't stand up in the car", and "do not put your seatbelt behind you". In other cases, especially among the younger respondents, children not only repeated the safety messages from the game, but also associated the unsafe actions with harmful consequences. For example, two 5- and 6-year-olds stated, "should not unstrap yourself or you could get hit in the face" and "should never undo your seatbelt or things like that or you can really hurt yourself". Other safety comments articulated by the children were in reference to parents and drivers, and included, "don't distract the driver" and "no fooling around in the back seat when parents are driving". Finally, playing the Booster Buddies game also taught children that "different ages of kids go in different seats", as a number of respondents stated that children should "be in the back seat until 12 years old" and that they should "have a booster seat if under 8 years old". Only a small number of children (n=7) claimed that they "already knew all the safety rules" or that they "didn't learn anything" from the game.

Factory Dazs Mini Game

Thirty-six children took the opportunity to play the Factory Dazs mini game. Of the 36 participants, 28 completed level 1, seven conquered level 2, with only one child achieving level 3. Success within a level was attained if the player correctly matched the dolls with the predetermined number of safety seats. The minimum number of correct matches to achieve success in level 1 was two. With each successive level, the time between each doll and the number of correct matches required for completion increased by 20%. Moreover, a player was considered unsuccessful and 'lost' the level when the launch device filled up with five dolls. Out of 113 dolls launched, 36 were correctly

matched to their seat. Despite the low success rates, 30 participants made as many as three attempts to complete one or more levels. Only five players made four to six efforts to surpass a level(s), while one child attempted success on seven or more occasions for successful level completion.

Back Seat Bash Mini Game

Thirty-three participants within the sample played Back Seat Bash, with two from the eldest age category taking a second opportunity to play the mini game. In contrast to the Factory Dazs results, the participants in this mini game were a lot more successful at progressing through sequential levels. A player was considered to have "lost" a level either after one minute of game play or if the player failed to identify the unsafe behaviour and incorrectly performed the keypad sequence on five occasions. While five participants were unsuccessful within their levels, 17 players "won" at least twice, and 11 were victorious on three or more occasions. Figure 4 uses an algorithm to illustrate the flow from the initial occurrence of an unsafe behaviour to the onset of the next unsafe behaviour.

Figure 4

Back Seat Bash Safety Behaviour Algorithm

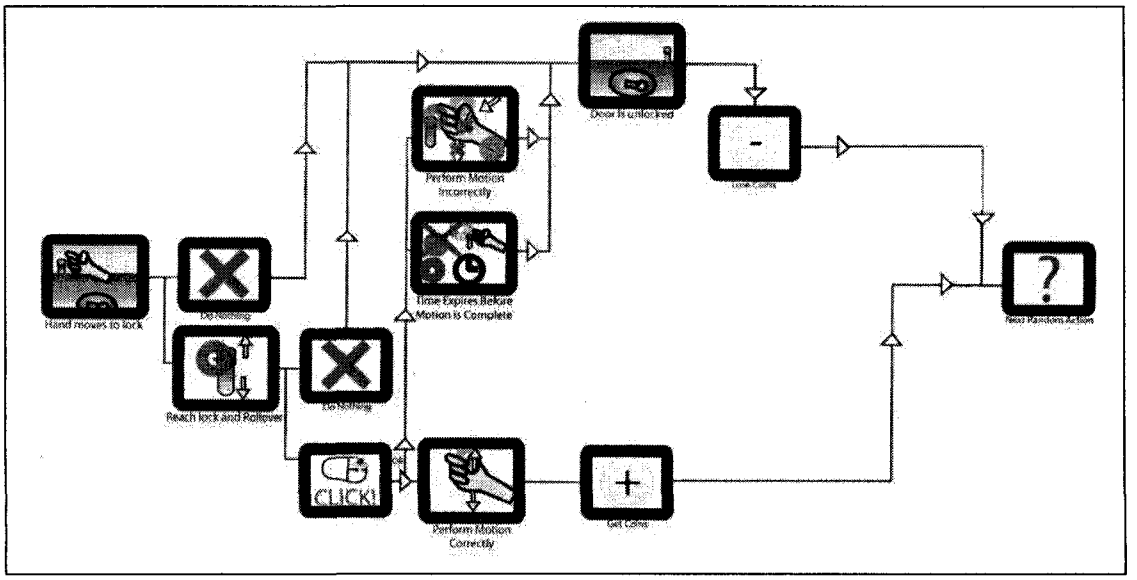


Table 8 itemizes each of the unsafe actions presented in the mini game, as well as the number of times the player was exposed to the behaviour, identified the behaviour, and attempted to prevent it from occurring. The study sample was exposed to a total 493 unsafe behaviours in the mini game. Of those unsafe behaviours, the participants correctly identified 367 of them, with 164 successful attempts made to prevent Olli and Otto from performing unsafe actions in the back seat of the car.

Table 8

Back Seat Bash Safety Behaviour Results

Unsafe Behaviour	Number Times Child Exposed to Behaviour n	Number Times Child Identified Behaviour n	Number Times Child Corrected Behaviour n
Roll Down Window	56	52	9
Slouch	61	51	10
Stand	60	49	37
Throw Object	76	50	29
Unlock Door	30	27	11
Open Door	32	28	4
Remove Seat Belt	102	72	33
Put Seat Belt Behind Shoulder	56	39	31
Total	493	367	164

The number of attempts made to complete one or more levels were much more widely distributed in this mini game, with 17 participants making at least three attempts to complete level(s). Another eleven players made four to six attempts to be victorious within the game, while five children made more than seven attempts to achieve success

within their game play experience. Children 8 to 9 years (n=13) demonstrated the most success within this mini game by having the majority of wins (n=13), reaching the highest levels (i.e. greater than level 2) (n=8), and having the greatest number of attempts to complete one or more levels (n=14) than any other age category.

Clek's Custom Shop Mini Game

The entire study sample (n=51) participated in the Clek's Custom Shop mini game. Eighteen participants selected high-back booster seats, while 11 chose low-back booster seats. More girls (n=11) demonstrated preference for a high-back booster seat than boys (n=7), while children 8- to 9-years (n=9) showed greater preference for high-back booster seats compared to any other age category. Booster seat accessory choices also demonstrated that the sample preferred seats that were both comfortable and equipped technologically. For example, 17 participants chose to accessorize their booster seats with a fan and DVD/Mp3 players, while another 12 players demonstrated desirability for cup holders and a lamp. Tables 9 and 10 demonstrate booster seat accessory choices according to age and gender respectively. Esthetics such as colour and decals were also shown to be widely desired in the design of a booster seat. The esthetic selections within the mini game demonstrated that children preferred colours such as red (n=25), blue (n=11), and pink (n=10), as well as flame (n=16), lightening rod (n=15), and heart (n=12) decals. Tables 11 and 12 respectfully illustrate children's colour and decal preferences according to age and gender.

Table 9

Booster Seat Accessory Choices According to Age

Age		Booster Seat Accessories					
		Cup Holder	DVD Player	Fan	Lamp	Mp3 Player	Pillow
4-5 years	n	3	4	5	5	4	4
6-7 years	n	3	3	2	1	3	2
8-9 years	n	5	7	7	3	8	3
10-11 years	n	1	3	3	3	2	1

Table 10

Booster Seat Accessory Choices According to Gender

Gender		Booster Seat Accessories					
		Cup Holder	DVD Player	Fan	Lamp	Mp3 Player	Pillow
Boy	n	5	6	10	6	6	6
Girl	n	7	11	7	6	11	4

Table 11

Colour and Decal Preferences According to Age

		Colours					Decals					
Age		Red	Orange	Blue	Pink	Green	Lightning Rod	Stars	Hearts	Stripe	Flower	Flames
4-5 years	n	3	0	4	3	0	6	0	3	0	0	1
6-7 years	n	12	1	1	3	0	4	0	5	0	1	4
8-9 years	n	7	1	4	3	3	3	1	3	1	1	8
10-11 years	n	3	0	2	1	0	2	0	1	0	0	3

Table 12

Colour and Decal Preferences According to Gender

		Colours					Decals					
Gender		Red	Orange	Blue	Pink	Green	Lightning Rod	Stars	Hearts	Stripe	Flower	Flames
Boy	n	17	2	7	0	1	11	0	0	0	0	14
Girl	n	8	0	4	10	2	4	1	12	1	2	2

Clek's Rampage Arena Mini Game

Although every study participant (n=51) was observed playing the Rampage Arena mini game, the results of only three participants were captured via the embedded database. Several children expressed a strong desirability to participate in the arena-style

driving challenges prior to their game play experience. However, much disappointment was expressed after exposure to the mini game, as several children stated that they "couldn't get to do the race", "couldn't control the car", "[found it] hard to drive" and/or "got stuck on the road and the rocks". Much frustration was also shared among the participants with respect to the game's design and the instructions provided within the game. For instance, one child explained, "When I went to race the first time too slow and the second time too fast". Another child indicated that he was not at all in favour of the mini game by stating, "I didn't like the race. It is bad because it is hard to control. I didn't like the dragon because it is dumb. I would not play this game at home".

Summary

The results of this study demonstrated support for the use of gaming as an education strategy. School-aged children were very receptive to the Booster Buddies Adventure Game and felt especially favourable about its application in home and school settings. The results suggest a number of design features which need to be reconsidered before undertaking future studies. Game design issues related to control, technical glitches, and the quality and pace of the mini game instructions were identified by the children and widely contributed to their discontent with the gaming experience. This study showed that children were highly motivated by mini games such as Clek's Custom Shop and Clek's Rampage Arena. Many children were very enthusiastic and receptive to creating their own car and booster seat and then using them to participate in the driving challenges featured in the Rampage Arena. Other mini games such as Factory Dazs and Back Seat Bash promoted correct restraint use and safe conduct in vehicles. Finally, this study showed that children desired high-back booster seats that were esthetically

appealing, comfortable, and technologically savvy. Specifically, today's generation of children want to travel in a booster seat that is colourful, graphically pleasing, contains cup holders and supports DVD players.

Chapter 6

Discussion

The results of this study demonstrated preliminary evidence that children learned about vehicle safety from 30-minutes of computer game play. After the gaming experience, children showed the ability to discuss safety messages from the game, booster seat recommendations, and the consequences associated with unsafe vehicle conduct. Though there is limited research that has examined the use of computer games in child health education, a similar study explored the application of an interactive multimedia program, *Walk Smart* (Glang et al., 2005). The results of the study showed that children who participated in the 40-minute CD-ROM program significantly improved their ability to discriminate dangerous vehicles in a variety of types of mock traffic intersections. Clearly, technology such as computer-based games, have assumed a prominent role in the culture of today's children and have shown to have the potential to provide important health information to them. Given that, more studies are needed to examine the effectiveness of computer games and other forms of technology on child health education.

The findings of this study are also consistent with social learning and child development theories. According to Bandura's social learning theory (1974), all learning results from either direct experience or observationally through modeling. He further states that modeling, and therefore learning, can only take place in the presence of four conditions: Attention, retention, motor reproduction, and motivation (Bandura, 1971). Observational learning is supported in this study mainly by the children's ability to articulate the majority of safety messages presented in the game. The game results also

showed evidence of meeting the four component processes of learning as outlined in the theory.

Attention is the first element of the modeling process, in which Bandura (1977) postulates that observers cannot learn unless they pay attention to the object or behaviour modeled. The results of the study indicated that the majority of children in the sample (n=43) felt very favorably about the game, while observational notes demonstrated that many of them stared intently at the computer monitor during game play. Observers also noted that several children continued with game play despite announcements that the 30-minutes of game play had expired. Furthermore, several computer monitors were reported to be turned off in order to encourage children to participate in the post-survey. Qualitative findings further support the fact that some children were adamant about continuing game play, as indicated by expressions such as "I want to get back to my game! Can I get back to my game?". Game features that gathered the most interest among the sample included the driving course and the custom shop. One 6-year-old boy stated, "Racing is the best!", while another 10-year-old girl expressed, "I like how I could design my car". The gaming strategy also collected a lot of attention from the children's parents, with a number of them asking questions about the objectives of the tool and requesting to see a sample of the game. One father in particular, demonstrated much interest in the game, as a result of having had previous research experience investigating the effects of computer education games, and offered suggestions for future game design ideas.

Retention, the second component process, is described by Bandura (1965) as occurring if the observer is able to code or structure the information in an easily remembered form or if they can mentally or physically rehearse the model's actions. The

designs of both the Back Seat Bash and Factory Dazs mini games offered children the opportunity to practice the actions modeled at the beginning of each game. The Back Seat Bash data suggests that retention occurred given that a large majority of the sample was able to both remember and articulate several of the safety messages presented in the game. Retention may have been further supported by the gaming strategy by allowing children to progress through multiple levels within the games. Data from both the Factory Dazs and Back Seat Bash mini games indicate that children made numerous attempts to complete one or more levels in the games. For example, five children made more than seven attempts to prevent the occurrence of unsafe actions within one or more levels of the Back Seat Bash mini game.

In addition to improving retention, computer-based education games may also be a useful tool to improve children's self-confidence towards learning. Within the social learning view, self-efficacy occurs when one believes that they can "...successfully execute the behaviour required to produce the outcomes" (Bandura, 1977, p. 79). By incorporating multiple levels into a computer learning tool, children are given the opportunity to increase skill mastery while progressing through the various levels. The ability to play multiple levels also provides numerous opportunities for success, which builds self-confidence. For instance, in the Back Seat Bash mini game, it is likely that the children's ability to recognize and prevent the behaviours may have increased had they been given more time to play the game. In addition, with more repetitive exposure, the children's success rates may have also increased, causing them to feel a greater sense of accomplishment and that they had gained knowledge about unsafe vehicle practices from the game. By incorporating measurements of self-efficacy into the pre-and post-surveys

of future studies, more conclusive evidence may be provided about the effects of computer-based learning tools on child self-efficacy.

Motor skills play another significant role when modeling a specific behaviour or object, and are the third component in the process of modeling. According to Bandura (1977), motor reproduction processes involve translating the modeled images or descriptions into actual behaviour. Within the Factory Dazs and Back Seat Bash mini games, children were provided with the objectives of the mini games and then demonstrated the sequence of game play by the booster seat characters prior to the gaming experience. In the Factory Dazs mini game, the game objective was to correctly match the dolls of varying sizes and weight to their restraint devices. The results showed evidence of motor reproduction in that 36 dolls were correctly matched to their seats. Results from the Back Seat Bash mini game serve as further evidence of children's ability to reproduce what was modeled, in that the participants were able to successfully identify 367 out of 493 unsafe behaviours, while preventing 164 of them from taking place. Future research needs to examine whether this modelling results in actual use of booster seats.

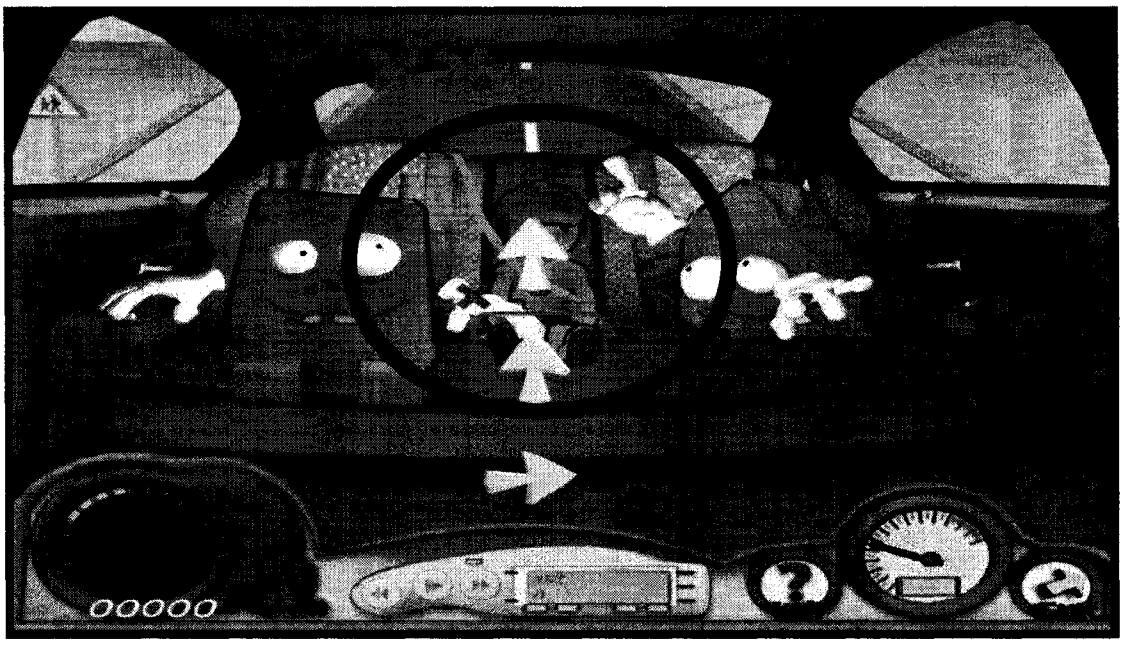
Motivation is the last modeling process outlined in Bandura's (1971) social learning theory. In his theory, Bandura (1977) postulates that observers will only perform the desired act if they have some motivation or reason to do so. In the design of the Booster Buddies game, a number of factors (e.g. a coin-score system, level progression, and time constraints) were incorporated into the game for the purpose of motivating game play. The results showed evidence that the children were motivated to play the game as indicated by the sample's high mini game participation rates and by children taking the opportunity to play certain games more than once. Specifically, nearly two-thirds of the

sample played the Factory Dazs (n=36) and Back Seat Bash (n=33) mini games, while all 51 children played Clek's Custom Shop and Rampage Arena. The results from the latter two mini games suggest that children were more motivated by games that focused on customization and driving challenges. Though some research will argue that video and computer games that involve action, driving, sports, and combat increase aggressiveness and other negative behaviours in children (Dorman, 2004), they have grown significantly popular in recent years. More research is needed to explore the effects of skill-and-action games on child behaviour and learning, but wherein the game objectives and messages are positive such as injury prevention.

Although the results of this exploratory study were encouraging, its effects were not all positive. By virtue of playing the game, three children changed their pre-survey responses in support of seat belts as the safest form of vehicle restraint for their age category. This result further supports Bandura's (1971) social learning theory by suggesting that child perceptions about safety restraint knowledge may have changed from observing the restraint device modeled in the game. For example, Figure 5 illustrates the main screen in the Back Seat Bash mini game in which the child is demonstrated wearing a seat belt while riding in the car.

Figure 5

Illustration of Seat Belt Use in Back Seat Bash Mini Game



Furthermore, being that the three children that changed their safety knowledge responses to indicate that seat belts are safe were only 4-and 5-years of age, suggests that Piaget's theory of cognitive development may have also played a significant role in children's learning about vehicle safety. Within this theory, Inhelder and Piaget (1964) explain how learning is provoked by situations or people, and that it occurs as a function of total development. They also distinguish child development by four main stages: sensory-motor, pre-operational, concrete operational, and formal operational (Inhelder & Piaget, 1964). Since the children in this study were between 4 and 11 years, Piagetian theory would describe them as being in the pre-operational (2-7 years) and concrete operational (7-11 years) periods (Inhelder & Piaget, 1964). According to Piaget's Stages of Cognitive Development, the preoperational period can be divided into two stages, the pre-conceptual stage (ages 2 to 4) and the intuitive stage (ages 4 to 7) (Inhelder & Piaget,

1964). In the pre-conceptual stage of thinking children reason transductively (i.e. making inferences from one specific to another) as opposed to either deductively or inductively (Carlson & Buskist, 1997). Another important characteristic of this stage is the development of symbolic representation (Inhelder & Piaget, 1964). In a summary of Piaget's theory, Hutchison (2003) explains that "through play, children learn to use symbols and actively engage in what Piaget labelled deferred imitation. Deferred imitation refers to the child's ability to view an image and then, significantly later, recall and imitate the image" (p. 165). Intuitive thinking is a concept applicable to the last half of the preoperational stage, from 4 to 7 years, in which children are thinking more logically than they were beforehand although the logic they follow, is a little faulty (Inhelder & Piaget, 1964). Although the results indicated that the three children that changed their responses to seatbelts were 4 and 5 years, this finding suggests that these children may have still been in the pre-conceptual stage, and that the change in their response may have been based solely on transductive reasoning and imitation. Consequently, future research needs to examine the design of the game relative to children's cognitive and development stages.

Finally, based on the evidence that children enrolled in the study were examined in close proximity to one another, the changes in the children's safety knowledge responses may also be consistent with a second child development theory known as Vygotsky's Social Development Theory. In contrast to Piaget's understanding of child development (in which development necessarily precedes learning), Vygotsky felt that social learning precedes development (Vygotsky, 1978). According to Vygotsky (1978), children learn by internalizing the activities, habits, vocabulary, and ideas of the members

of the community in which they grow up. During the data collection phase of the study, observational notes indicated that children often consulted with one another while playing the game and before replying to post survey questions. Therefore, these findings suggest that social collaboration may have also played an important role in children's learning about vehicle safety. Future investigators may want to consider providing children with a more isolated gaming and survey testing environment in order to provide more conclusive evidence of this finding.

Other significant findings of the study were related to the game's design. Observational notes suggested that several children lacked the skill and cognitive level required to fulfill the objectives of certain mini games. For example, many of the children that played the Back Seat Bash mini game were observed lacking the eye-hand coordination required to look at the computer monitor while hitting the space bar (i.e. to indicate that they recognized the unsafe behaviour), and then quickly completing the presented arrow keypad sequence to prevent unsafe actions from taking place. As a result, children compensated by focusing their eyes on the screen, while using both hands simultaneously to engage in game play. That is, one hand remained on the space bar, while the other hand hovered over the arrow pad. Moreover, observers also noted that the children that played the Factory Dazs mini game did know how to engage in game play despite the instructions and demonstrations provided at the beginning of the game. Specifically, children were witnessed aimlessly clicking their mouse on the screen or attempting to use the keyboard to activate the doll launch and manoeuvre the springs/levers needed to match the dolls to their correct seats. The same remained true for Clek's Rampage Arena, in which some children were observed trying to use the mouse,

rather than the keyboard, to drive their car. These findings are once again consistent with Piaget's stages of cognitive development. According to Piagetian theory (1964), the pre-operational child primarily uses simple strategies to solve problems (Inhelder & Piaget, 1964). However, once the child reaches the concrete operational stage, they possess a completely new set of strategies, allowing problem-solving using logical rules. The findings of the study suggest that the game mechanisms and game objectives were likely to be too cognitively advanced for children less than seven years of age. Further investigations should consider adding a design feature to the game that categorizes players according to age, and adjusts the mini game messages and skill levels to support the cognitive and developmental needs of the children.

In addition to the findings that suggested that there may have been drawbacks to the design elements of certain mini games, the findings of the study also suggest the possibility of programming errors in the game's embedded databases. Findings from the databases indicated that the data was often skewed or missing, signifying a technological flaw in the sensitivity of the database in recording children's gaming activities. Consequently, children had to proceed with game play in a predetermined sequence outlined by the researcher. Although there was much merit in incorporating the databases into the game, these preliminary findings suggest that more research is needed to increase the reliability of the databases and further examination of the effects of gaming software on child learning is warranted.

The child preference data was another unique aspect of the study in that very limited research currently exists related to child preferences and vehicle safety. Namely, since children are the primary users of booster seats and have been shown to have a direct

influential power in swaying parental decisions towards undertaking unsafe vehicle safety practices (Simpson et al., 2002), it was felt that one should target their specific preferences towards this type of child restraint device. Although the results of the study demonstrated evidence that child booster seat preferences vary by age and gender, they suggested that school-aged children want to travel in high-back booster seats that are not only colourful and graphically appealing, but also comfortable and convenient. Clearly, with more research conducted on child booster seat preferences, manufacturers will be able to produce booster seats that better meet the needs of children, therefore, increasing the likelihood of their use.

Booster seat use rates within this study were somewhat higher than what has been previously reported in the literature. Specifically, the results indicated that 67% of children 4- to 11-years (n=34) in the sample used a booster seat. This finding significantly contrasts national studies which show that less than one out of every five children between the ages of 4 and 8 is riding in a booster seat (NHTSA, 2007). In Canada, only 28% of children in this age group were observed to be using booster seats in a national observational study (Snowdon et al., 2008). Moreover, the findings of children's perception of the safest restraint device also demonstrated evidence that 37 out of 51 children had accurate knowledge of the safest child restraint device prior to the gaming experience. Non-specific family demographics for these children indicated that parental incomes (i.e. combined household income) range from $96,000 to $152,000, and that their educational backgrounds support College diplomas and University degrees. Given these parental demographics and that the sample was selected by their families, the findings suggest that children in the study may have been from families that could afford

a booster seat, that had knowledge of current booster seat recommendations, and that already practiced booster seat use. Since this study was only a preliminary examination, further examination of these outcomes is warranted.

Limitations

Though this pilot study was only a preliminary investigation of the effectiveness of a computer-based learning tool in educating children about vehicle safety, the data gathered was limited as a result of a small sample size. While the age range of the participants was increased to include children up to 11 years, the results of the study were based on a sample of 51 children. Future investigations may want to consider the participation of children from elementary schools, other non-profit child organizations, and additional Boys' and Girls' club locations.

Given that there was a two week time span between the first and second data collection dates, this posed an additional threat to the internal validity of the study. Specifically, as a result of the large gap between the dates, there was a greater chance that the participants involved in the first data collection disclosed information to the study participants in the second session. Thus, this limitation may have altered the children's attitudes and perceptions and affected the latter group's results. Future studies may want to consider minimizing the timeframe between the dates to avoid this type of threat.

Another limitation of this study was related to its use of a convenience sample. Selection bias may have occurred in this study as a result of parents having the choice to allow their child to participate in the study. Specifically, the children that participated in the study may have had a significant amount of knowledge of the importance of vehicle safety, in comparison to a randomly selected group of children. In addition, despite the

sample coming from an inner-city program, it under represented children of lower socioeconomic status, children whose parent's did not receive secondary or post-secondary education and children with Hispanic and Inuit backgrounds. Forthcoming research may want to consider other sampling methods that reduce selection bias, in order to have a better representation of the target population as a whole.

The next limitation of this study concerns its setting. Since the study took place during regularly scheduled preschool and After 4 program hours, there was limited space for the participants to engage in game play and complete pre- and post-surveys. Therefore, pre- and post-surveys were conducted by interviewers in-close proximity to other study participants. In addition, participants had to be re-tested at their computer stations after completing the gaming experience since the room in which the pre-testing took place was no longer available. This finding suggests that children's survey responses may be biased as a result of the influences of other participants. Further studies may want to consider providing a more controlled environment (i.e. conducting the study at an alternative location or time of day) in order to improve the accuracy of the results.

The lack of consistency in the pre- and post-survey interviewers was also a limiting factor within this study. Since the study participants may not have had the same interviewer for both pre- and post-test measures, their responses may have varied as a result of the change in their interviewer rather than the actual intervention. Future researchers may want to consider increasing the ratio of interviewers to participants (e.g. one interviewer for every two children) in order to reduce this type instrumentation threat to the internal validity of the study.

Lastly, the study findings were also limited given that the timeframes allotted for survey questioning and game testing were too short. Specifically, as a result of allocating approximately 60-minutes to complete both surveys and the gaming experience, participants did not have the opportunity to play all of the mini games and were rushed through the post-survey. Therefore, by having restricted the playtime of the mini games or permitted more than 60 minutes to complete the study, more conclusive data may have been gathered.

Implications for Nursing Practice

Though numerous advances have been made to minimize their impact and increased incidences, motor vehicle crashes remain a leading cause of injury death and hospitalization in Canadian children and youth (Leitch, 2008). Child road-related crashes are a serious global health issue that necessitates immediate action to improve the rate of booster seat use in this population. As the analysis indicates, a computer-based learning tool has demonstrated preliminary evidence as being effective in educating children about vehicle safety. Given that health promotion and injury prevention is an essential component of nursing, and that nurses have access to this population, they are in a unique position to use this type of learning tool to teach children about safe vehicle practices.

The results also have implications for the use of computer-based learning tools that may offer a new avenue for nurses to make crucial connections with children on health related education that may not have been previously demonstrated. Traditionally, nurses may have used dolls, drawings, creative arts, and videotapes to teach children about health promotion topics. Based on the fact that the study was a preliminary examination of the use of a computer-based learning tool in teaching children about

vehicle safety, this suggests that nurses have had very limited experience with this type of intervention strategy. The results of the study demonstrated important evidence that children felt very favorably about a computer-assisted gaming strategy that motivated learning. Therefore the results of this study suggest that computer-based gaming methods offer nurses the ability to expedite child learning about vehicle safety by providing them with important health information in a manner that they can relate to and understand.

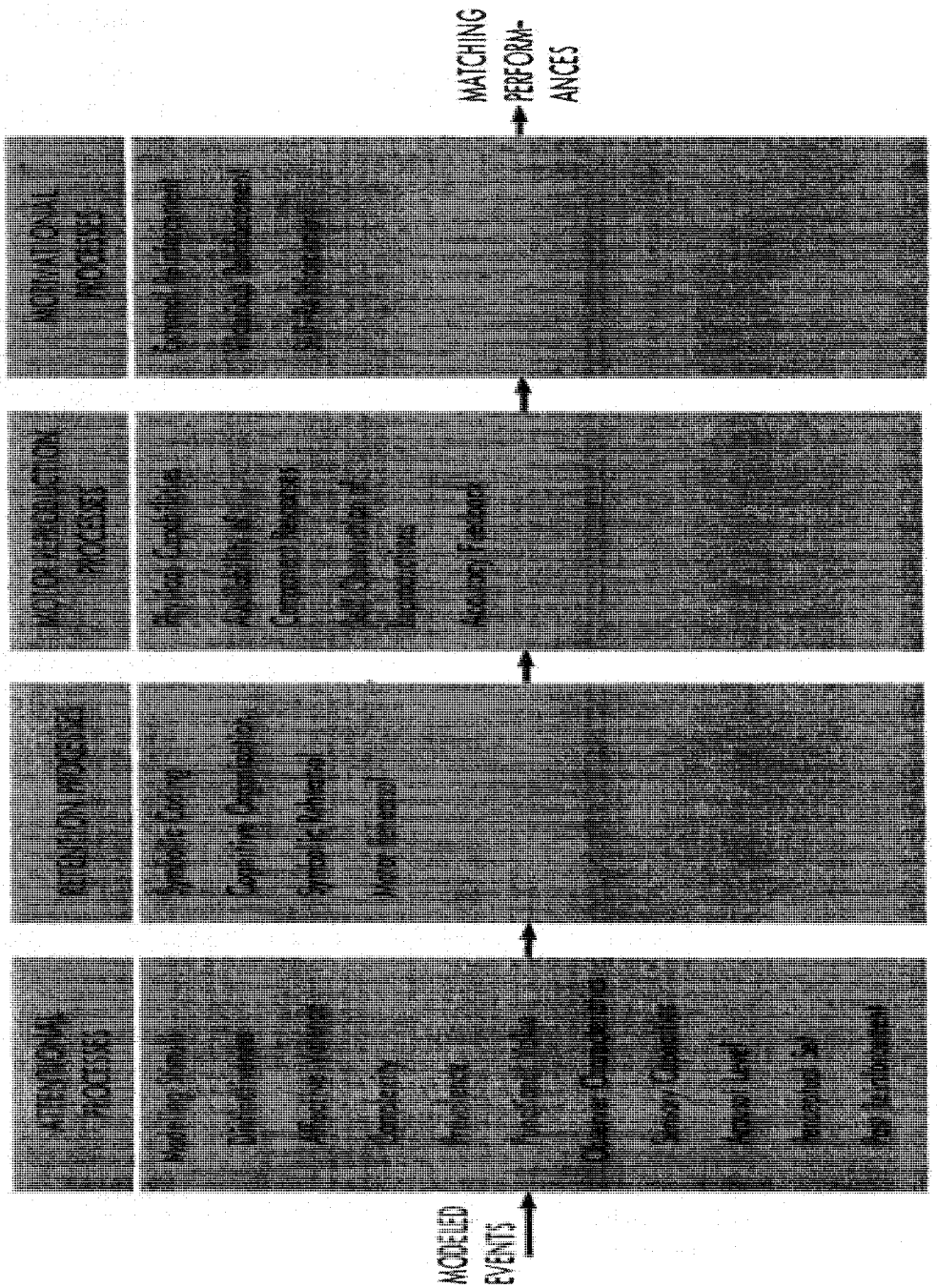
Finally, as the analysis indicated, the gaming learning tool was very appealing to children with many of them advocating for its use as an educative strategy within their homes. Thus, these finding suggests that computer-based games may be a viable nursing intervention that engages all family members. Though the majority of booster seat intervention research to date has targeted parents (Ehiri et al., 2008; Elliott et al., 2006; Gittelman et al., 2006; Pierce et al., 2005; Simpson et al., 2002; Zaza et al., 2001), the results indicate that the interactivity of gaming learning tools may offer nurses an opportunity to teach families about the importance of vehicle safety.

Summary

Motor vehicle crashes will remain a challenge until more creative ways are found to translate current safety knowledge into greater age-appropriate booster seat use. Although much merit was gained from this preliminary examination, a great deal of work is needed. Maximizing the recruitment efforts of the students and addressing programming and redesign issues are some of the major issues that must first be addressed before conducting further trials. Based on the game's strong appeal and child recommendations for its use as an educative strategy at home and in school settings, computer-based interventions prove promising in teaching children about vehicle safety.

When optimized to its fullest potential, the Booster Buddies Clek Adventure Game will not only help establish the reliability and validity of the gaming approach for measuring children's learning, but also demonstrate the efficiency of an embedded database as a strategy for measuring child knowledge outcomes.

Appendix A: Processes of Observational Learning



Appendix B: Pre-Intervention Questionnaire

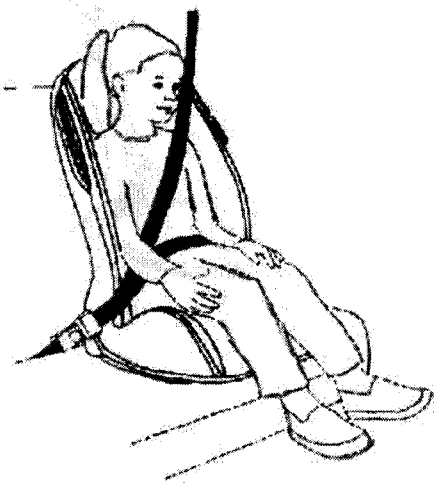
Subject ID: _____

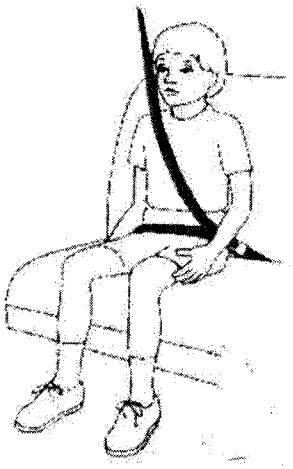
Age: 4 5 6 7 8 Gender: Boy Girl

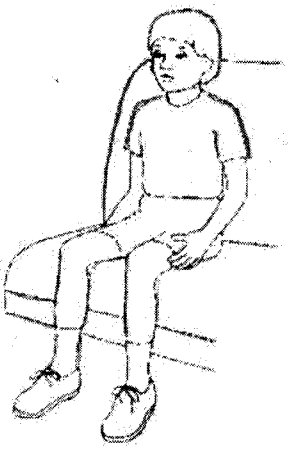
Weight: _____ Height: _____

Date: _____ Time: _____

Circle the way you sit in your family car:

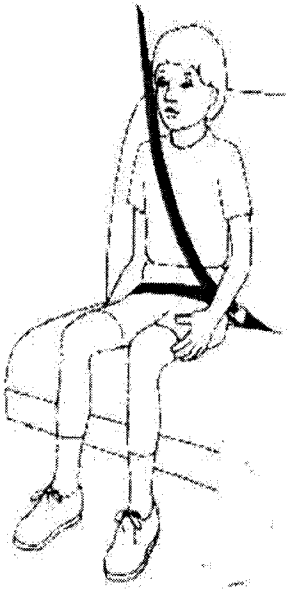


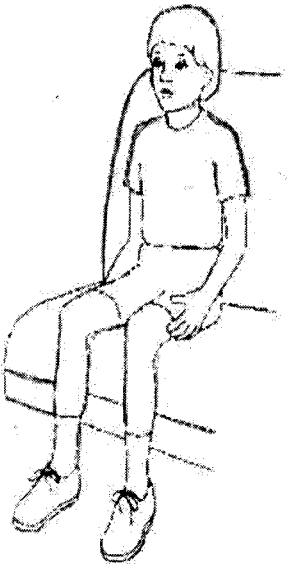




Subject ID: _____

Circle the way you think is ***safest*** to sit in your family car:

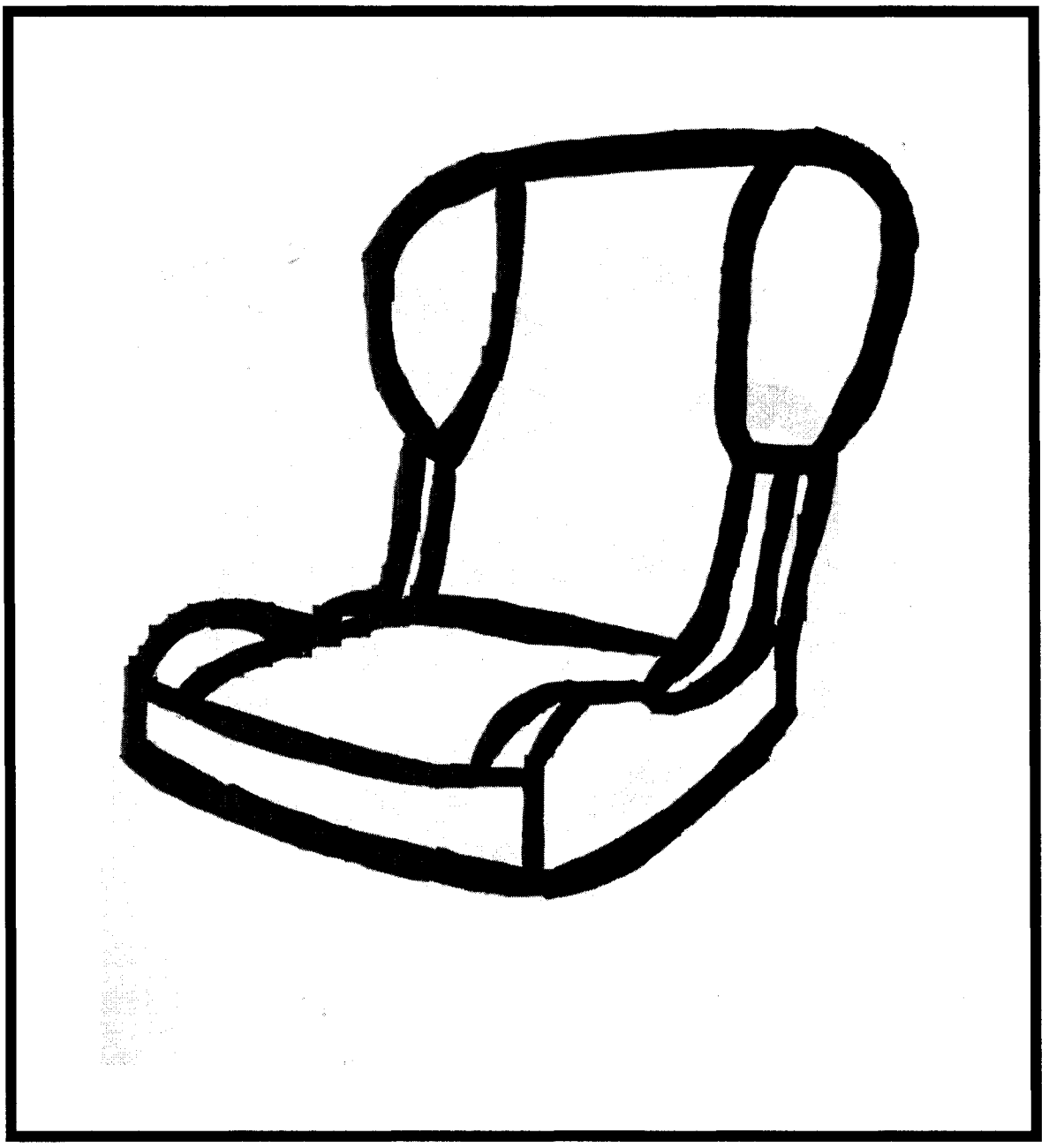




Subject ID: _____

If you could make your own booster seat, what would it look like?

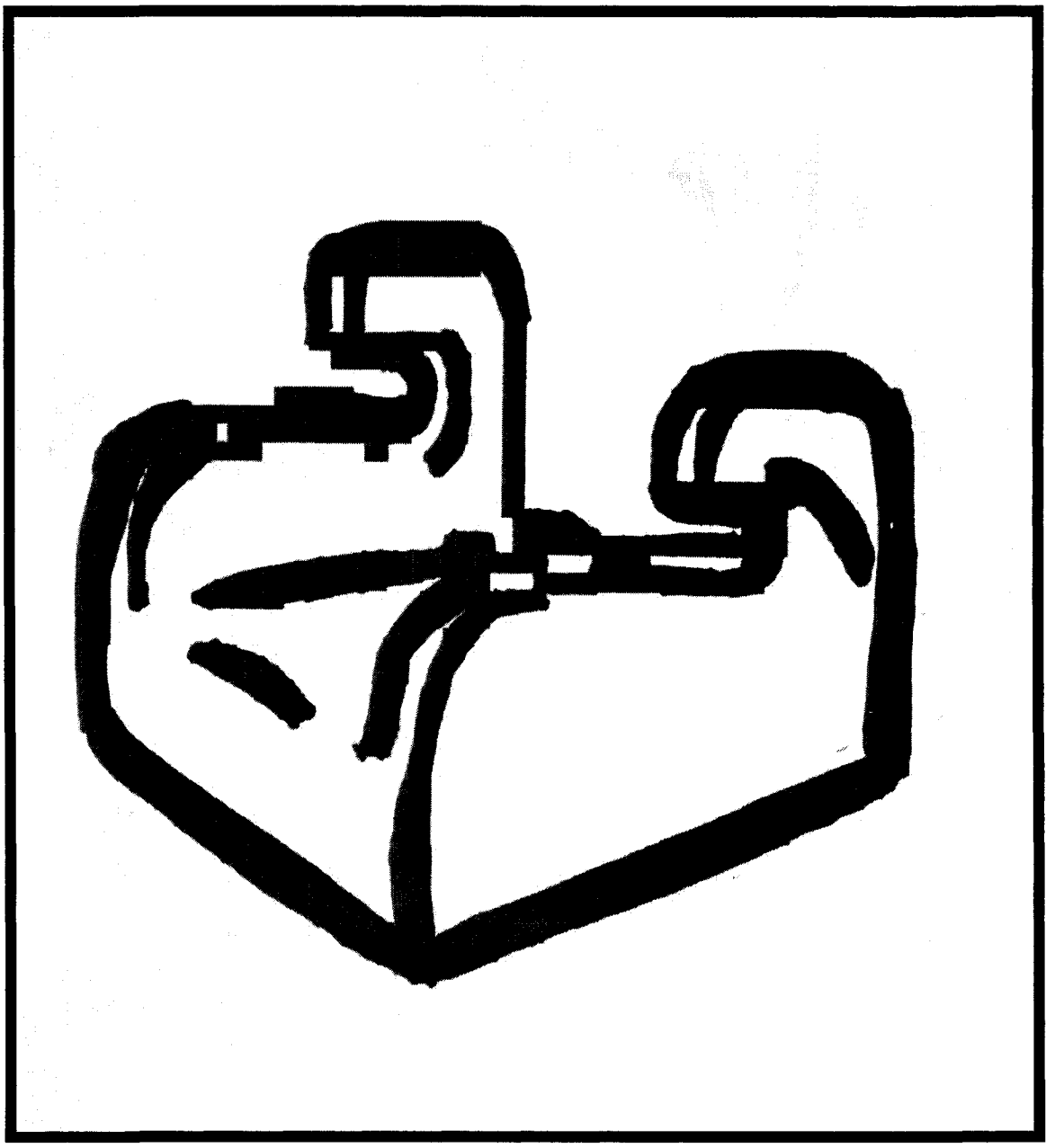
Please draw and/or describe in words.



Subject ID: _____

If you could make your own booster seat, what would it look like?

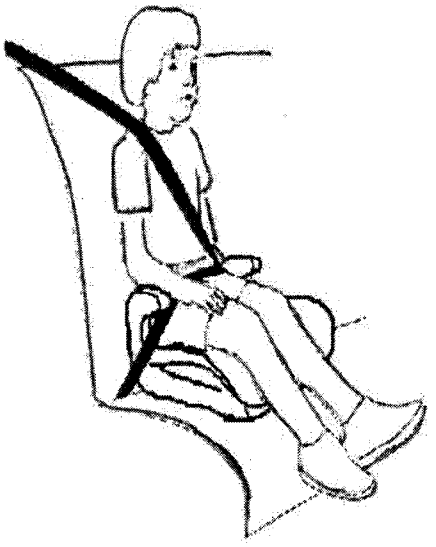
Please draw and/or describe in words.

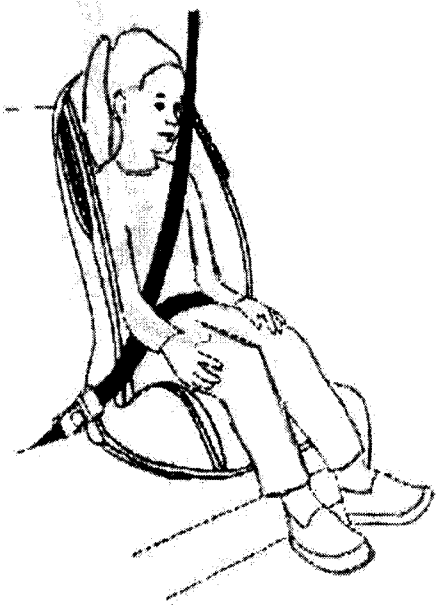


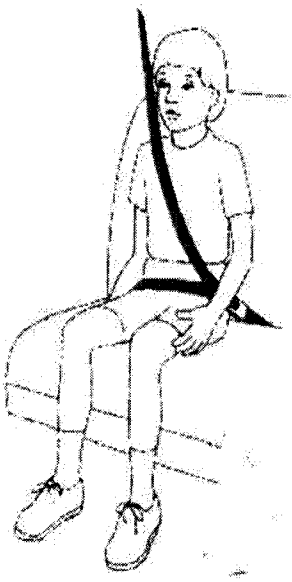
Appendix C: Post-Intervention Questionnaire

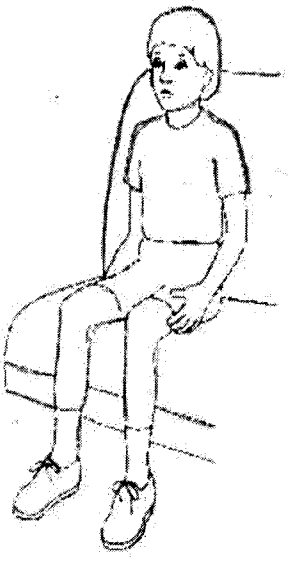
Subject ID: _____

Circle the way you think is ***safest*** to sit in your family car:





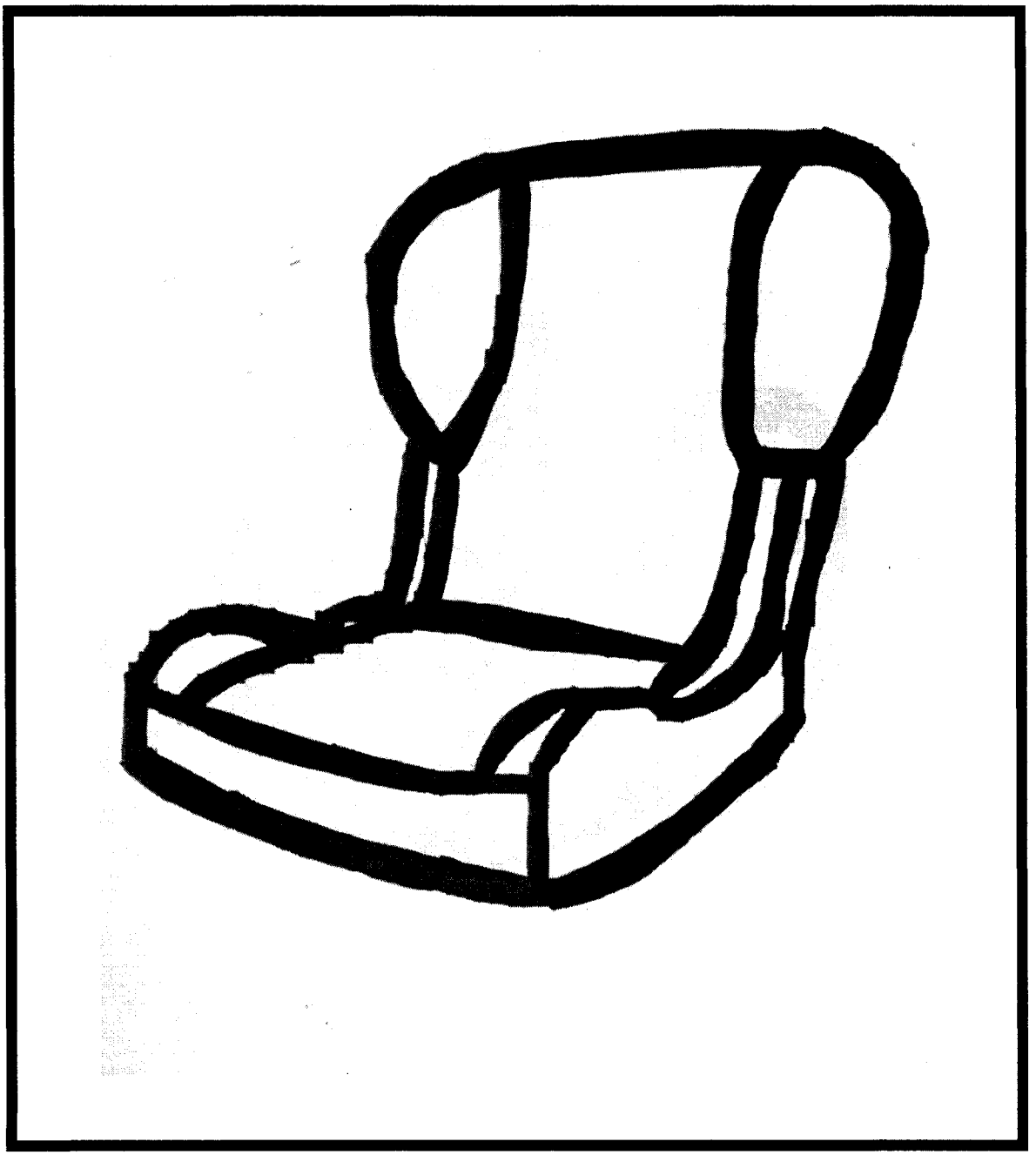




Subject ID: _____

If you could make your own booster seat, what would it look like?

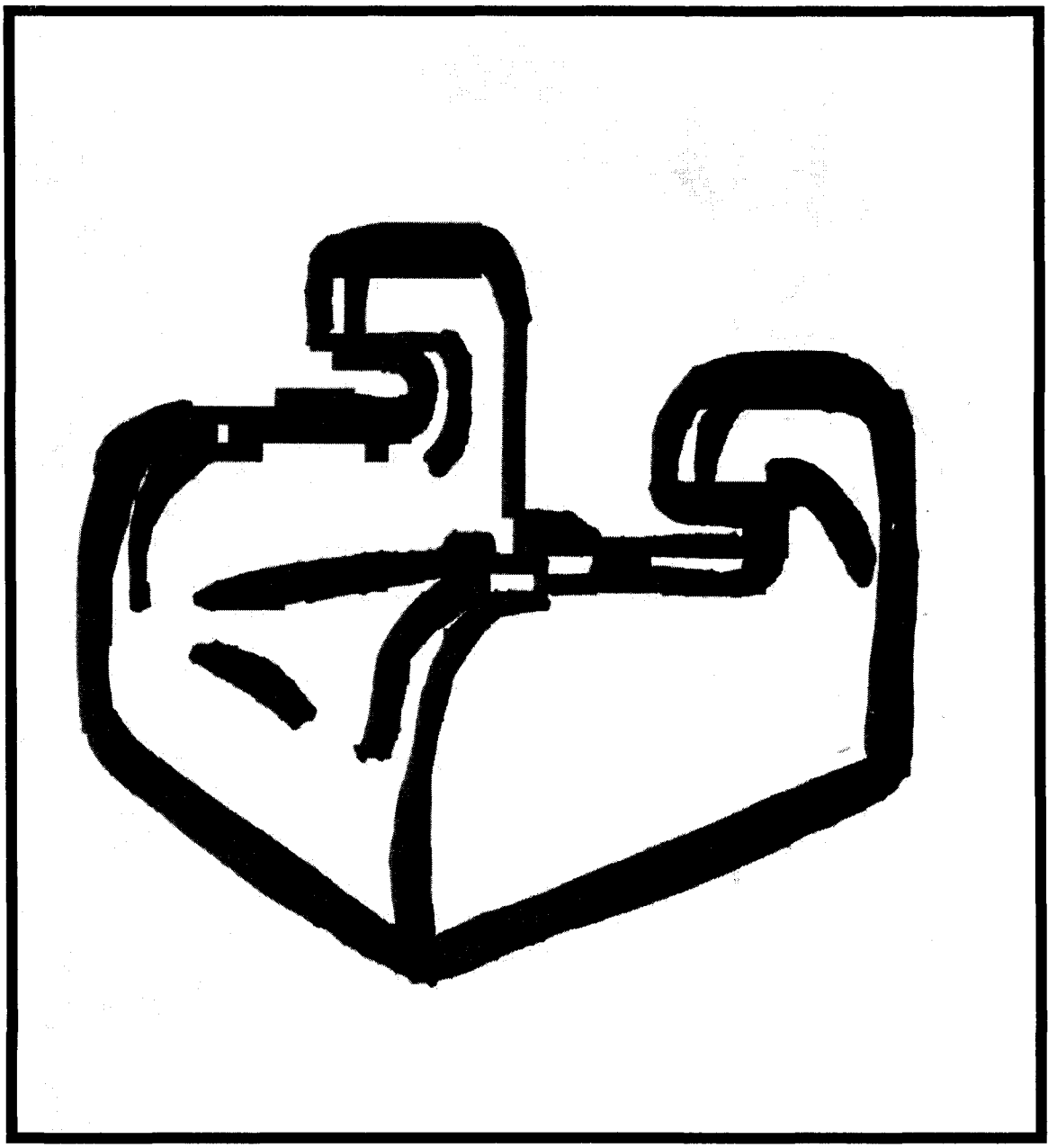
Please draw and/or describe in words.



Subject ID: _____

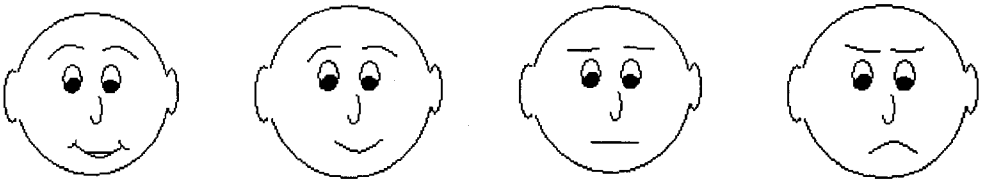
If you could make your own booster seat, what would it look like?

Please draw and/or describe in words.



Subject ID: _____

1. a) How did you like the game?

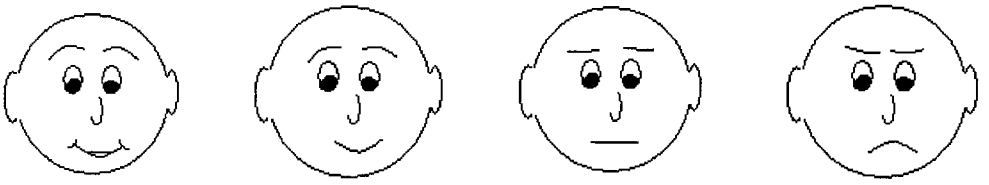


Very Much Okay Not Quite Not At All

1. b) What didn't you like?

_____
_____
_____
_____

2. a) How easy was it to play the game?



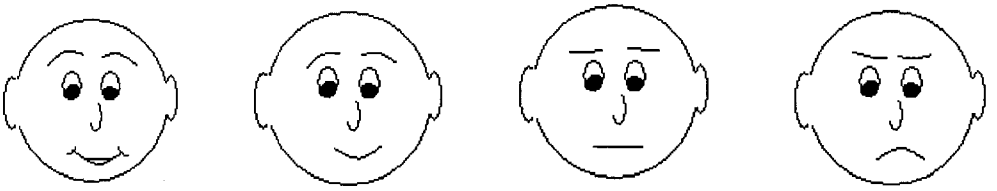
Very Much Okay Not Quite Not At All

2. b) What did you learn from this game?

_____
_____
_____
_____

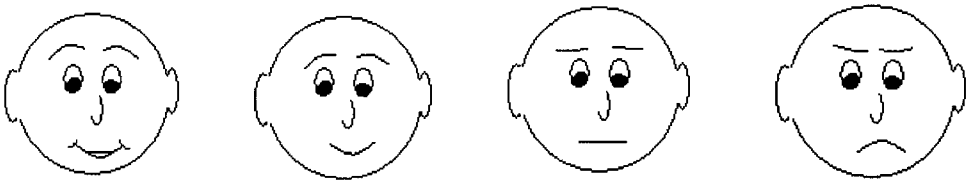
Subject ID: _____

3. Would you tell your sister/brother/friend to play a game like this?



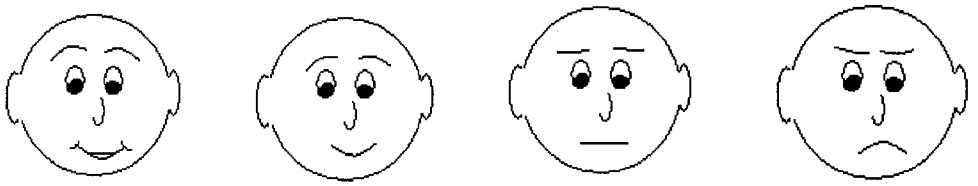
Very Much Okay Not Quite Not At All

4. Would you play a game like this at home if you had it?



Very Much Okay Not Quite Not At All

5. Would you play a game like this at school if your teacher had it?

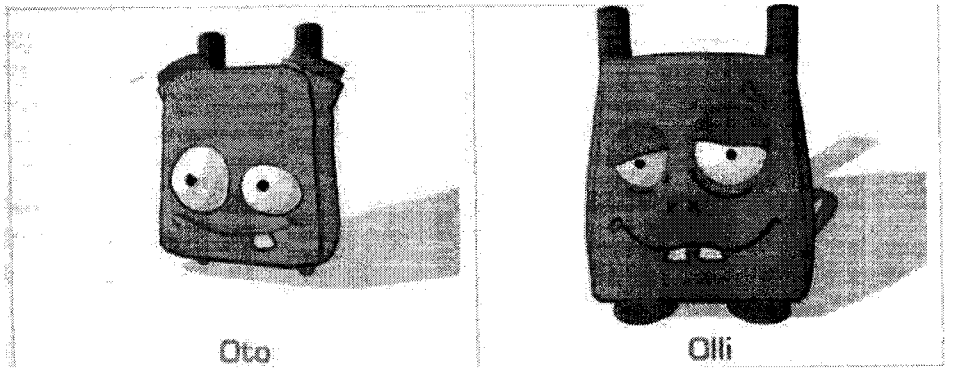


Very Much Okay Not Quite Not At All

Appendix D: Poster Display

BOOSTER BUDDIES CLEK ADVENTURE GAME

"Looking for boys and girls to participate in a research study"



VEHICLE SAFETY FOR CHILDREN

Date:

Location:

Please take a few minutes to stop by the computer lab and participate - **THANK-YOU**

Appendix E: Letter of Information

LETTER OF INFORMATION FOR CONSENT TO PARTICIPATE IN RESEARCH

Title of Study: **A Pilot Study Evaluating the Effectiveness of a Computer-Based Gaming Strategy in Educating School-Aged Children about Vehicle Safety - A Consent Form for Parents**

Your child will be asked to participate in a research study conducted by **Amanda Sue Bechberger – Graduate Student Investigator from the School of Nursing, Dr. Anne W. Snowdon – Faculty Investigator from the Odette School of Business, and Dr. Christine Thrasher - Faculty Supervisor from the School of Nursing,** at the University of Windsor. **The results of this research will contribute to a Master's Thesis** and is funded by AUTO21 Centres of Excellence and Magna Aftermarket Incorporated.

If you have any questions or concerns about the research, please feel to contact **Amanda S. Bechberger – Graduate Student Investigator from the School of Nursing at dipasqu@uwindsor.ca, or Dr. Anne W. Snowdon – Faculty Investigator from the Odette School of Business at 519-253-3000, ext. 4255 or snowdon@uwindsor.ca.**

PURPOSE OF THE STUDY

The purpose of this pilot study is to investigate the effectiveness of a computer-based gaming strategy in educating school aged children about vehicle safety.

PROCEDURES

If your child volunteers to participate in this study, s(he) will be asked to do the following:

a) **The study will take place at St. Alban's Boys' & Girls' Club during preschool and After 4 program hours. If your child is present at the club on the day of the study with consent to participate s(he) will take part in the investigation.**
b) **On the day of the study, your child will participate in organized activities divided into age groups. If your child is enrolled in the full-time preschool program s(he) will be provided the opportunity to play the game during day-time program hours. If your child attends the After 4 program, s(he) will participate in the study by going to the computer classroom with her/his own age cohort during the after school program.**
c) **If your child is unwilling or unable to participate in the study, s(he) will be escorted to another area of the club without access to the study area or participants, in which s(he) will participate in program activities which is usual practice at this club for all planned activities.**
d) **Upon entering her/his regularly scheduled classroom, your child will be directed to a second classroom where the survey testing will take place.**
e) **Once settled at individual desks, your child will be asked to complete the pre-intervention survey. After five to 10 minutes, s(he) will be escorted to the computer lab and seated in front of a computer monitor.**
f) **Your child will receive instructions on how to use the game prior to the intervention to ensure that differences in outcome will not be due to unfamiliarity with the testing equipment to be used.**
g) **Research assistants (RAs) will work with your child to support them getting familiarized**

with the game; and will serve as sources of assistance during the game play process when asked to by the child. Each RA participating with the study will be trained by the first author in the research protocol to ensure consistent fidelity of procedures. RA's will observe your child at play with the game and record field notes describing her/his comments, interactions with the game to identify preferences or attitudes towards the game.

h) **If you chose to accompany your child to the study you will be welcomed to stay with your child or in a waiting area until s(he) completes the study, which will take approximately 30 minutes.**
i) **During the gaming experience, your child will be observed by the RAs as well as the first author to ensure that no specific cues are given with game tasks.**
j) **If your child is having difficulty with a task, the RA will provide encouragement but will not intervene with her/his progress.**
k) **Following 20 minutes of game play, your child will be taken back to the pre-testing area, in which a post-intervention survey will be administered in the same location and order in which the pre-intervention survey was given.**
l) **Upon completion of the post-intervention survey, your child will be taken back to his/her scheduled programs for activities as usual.**

POTENTIAL RISKS AND DISCOMFORTS

There are no foreseeable risks, discomforts, inconveniences or significant physical or psychological risks to subjects that participate in this study.

POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

Potential direct benefits to your child would include an increased awareness of safety while travelling in vehicles, as well as skills related to safe behaviour while traveling in vehicles.

PAYMENT FOR PARTICIPATION

Subjects involved in the study will not receive payment for their participation.

CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission.

The identity of the children participating in this study will remain anonymous; parents' identity from whom information is obtained in the course of the study shall be kept strictly confidential, with no identifying information on any study data.
The study data will be kept confidential and information will be accessible by the researcher of this study and those persons affiliated with AUTO21 research team only. All information collected for this research study will be kept in a locked drawer accessible only by the researcher and the AUTO21 research team.

PARTICIPATION AND WITHDRAWAL

You can choose whether your child can be in this study or not. If consent for him/her to volunteer to be in this study, he/she may withdraw at any time without consequences of any kind. He/she may also refuse to answer any questions they don't want to answer and still remain in the study. The investigator may withdraw he/she from this research if circumstances arise which warrant doing so.

FEEDBACK OF THE RESULTS OF THIS STUDY TO THE SUBJECTS

At the time of completion of the study, results will be shared with the Administrators of St. Alban's Boys' and Girls' Club. Copies of the study results will also be posted in the St. Alban's preschool and After 4 program classrooms for you to view in addition to the copies of the research findings that will be made available for you to take for your perusal. If you would like a copy of the results, a copy will be provided to you.

SUBSEQUENT USE OF DATA

This data may be used in future studies in order to document and describe the effectiveness of how children learn using educational video games.

RIGHTS OF RESEARCH SUBJECTS

Your child may withdraw his/her consent at any time and discontinue participation without penalty. If you have questions regarding his/her rights as a research subject, contact: Research Ethics Coordinator, University of Windsor, Windsor, Ontario, N9B 3P4; Telephone: 519-253-3000, ext. 3948; e-mail: ethics@uwindsor.ca

SIGNATURE OF INVESTIGATOR

These are the terms under which I will conduct research.

_____ _____

Signature of Investigator Date

Appendix F: Consent Letter

University of Windsor
thinking forward

CONSENT TO PARTICIPATE IN RESEARCH

Title of Study: **A Pilot Study Evaluating the Effectiveness of a Computer-Based Gaming Strategy in Educating School-Aged Children about Vehicle Safety - A Consent Form for Parents**

Your child will be asked to participate in a research study conducted by **Amanda S. Bechberger – Graduate Student Investigator from the School of Nursing, Dr. Anne W. Snowdon – Faculty Investigator from the Odette School of Business, and Dr. Christine Thrasher - Faculty Supervisor from the School of Nursing,** at the University of Windsor. **The results of this research will contribute to a Master's Thesis** and is funded by AUTO21 Centres of Excellence and Magna Aftermarket Incorporated.

If you have any questions or concerns about the research, please feel to contact **Amanda S. Bechberger – Graduate Student Investigator from the School of Nursing at dipasqu@uwindsor.ca, or Dr. Anne W. Snowdon – Faculty Investigator from the Odette School of Business at 519-253-3000, ext. 4255 or snowdon@uwindsor.ca.**

PURPOSE OF THE STUDY

The purpose of this pilot study is to investigate the effectiveness of a computer-based gaming strategy in educating school aged children about vehicle safety.

PROCEDURES

If your child volunteers to participate in this study, s(he) will be asked to do the following:

a) **The study will take place at St. Alban's Boys' & Girls' Club during preschool and After 4 program hours. If your child is present at the club on the day of the study with consent to participate s(he) will take part in the investigation.**
b) **On the day of the study, your child will participate in organized activities divided into age groups. If your child is enrolled in the full-time preschool program s(he) will be provided the opportunity to play the game during day-time program hours. If your child attends the After 4 program, s(he) will participate in the study by going to the computer classroom with her/his own age cohort during the after school program.**
c) **If your child is unwilling or unable to participate in the study, s(he) will be escorted to another area of the club without access to the study area or participants, in which s(he) will participate in program activities which is usual practice at this club for all planned activities.**
d) **Upon entering her/his regularly scheduled classroom, your child will be directed to a second classroom where the survey testing will take place.**
e) **Once settled at individual desks, your child will be asked to complete the pre-intervention survey. After five to 10 minutes, s(he) will be escorted to the computer lab and seated in front of a computer monitor.**
f) **Your child will receive instructions on how to use the game prior to the intervention to ensure that differences in outcome will not be due to unfamiliarity with the testing equipment to be used.**
g) **Research assistants (RAs) will work with your child to support them getting familiarized with the game; and will serve as sources of assistance during the game play process**

when asked to by the child. Each RA participating with the study will be trained by the first author in the research protocol to ensure consistent fidelity of procedures. RA's will observe your child at play with the game and record field notes describing her/his comments, interactions with the game to identify preferences or attitudes towards the game.

h) **If you chose to accompany your child to the study you will be welcomed to stay with your child or in a waiting area until s(he) completes the study, which will take approximately 30 minutes.**
i) **During the gaming experience, your child will be observed by the RAs as well as the first author to ensure that no specific cues are given with game tasks.**
j) **If your child is having difficulty with a task, the RA will provide encouragement but will not intervene with her/his progress.**
k) **Following 20 minutes of game play, your child will be taken back to the pre-testing area, in which a post-intervention survey will be administered in the same location and order in which the pre-intervention survey was given.**
l) **Upon completion of the post-intervention survey, your child will be taken back to his/her scheduled programs for activities as usual.**

POTENTIAL RISKS AND DISCOMFORTS

There are no foreseeable risks, discomforts, inconveniences or significant physical or psychological risks to subjects that participate in this study.

POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

Potential direct benefits to your child would include an increased awareness of safety while travelling in vehicles, as well as skills related to safe behaviour while traveling in vehicles.

PAYMENT FOR PARTICIPATION

Subjects involved in the study will not receive payment for their participation.

CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission.

The identity of the children participating in this study will remain anonymous; parents' identity from whom information is obtained in the course of the study shall be kept strictly confidential, with no identifying information on any study data.
The study data will be kept confidential and information will be accessible by the researcher of this study and those persons affiliated with AUTO21 research team only. All information collected for this research study will be kept in a locked drawer accessible only by the researcher and the AUTO21 research team.

PARTICIPATION AND WITHDRAWAL

You can choose whether your child can be in this study or not. If consent for him/her to volunteer to be in this study, he/she may withdraw at any time without consequences of any kind. He/she may also refuse to answer any questions they don't want to answer and still remain in the study. The investigator may withdraw he/she from this research if circumstances arise which warrant doing so.

FEEDBACK OF THE RESULTS OF THIS STUDY TO THE SUBJECTS

At the time of completion of the study, results will be shared with the Administrators of St. Alban's Boys' and Girls' Club. Copies of the study results will also be posted in the St. Alban's preschool and After 4 program classrooms for you to view in addition to the copies of the research findings that will be made available for you to take for your perusal. If you would like a copy of the results, a copy will be provided to you.

SUBSEQUENT USE OF DATA

This data may be used in future studies in order to document and describe the effectiveness of how children learn using educational video games.

RIGHTS OF RESEARCH SUBJECTS

Your child may withdraw his/her consent at any time and discontinue participation without penalty. If you have questions regarding his/her rights as a research subject, contact: Research Ethics Coordinator, University of Windsor, Windsor, Ontario, N9B 3P4; Telephone: 519-253-3000, ext. 3948; e-mail: ethics@uwindsor.ca

SIGNATURE OF RESEARCH SUBJECT/LEGAL REPRESENTATIVE

I understand the information provided for the study **A Pilot Study Evaluating the Effectiveness of a Computer-Based Gaming Strategy in Educating School-Aged Children about Vehicle Safety** as described herein. My questions have been answered to my satisfaction, and I agree to allow my child to participate in this study. I have been given a copy of this form.

_____
Name of Subject

_____ _____
Signature of Subject Date

SIGNATURE OF INVESTIGATOR

These are the terms under which I will conduct research.

_____ _____
Signature of Investigator Date

Appendix G: Assent for St. Alban's Boys' and Girls' Club Students

University of Windsor
thinking forward

Assent for St. Alban's Boys' and Girls' Club Students

I am a student researcher, and I am doing a study on a new computer game. I would like to ask you to play the game and tell me what you think about it. Then, I would like you answer some questions about yourself such as how old you are, and how much you weigh. I would also like you to look at some pictures and tell me how you ride in your car.

When I am finished talking with all the kids who agree to be in my study, I will write a report on what I have learned. My teachers will read it, and it might be put in a book, but no one will know who the kids are that answered my questions.

I want you to know that I will not be telling your teachers or parents or any other kids what you answer. The only exception is if you tell me that someone has been hurting you. If I think that you are being hurt or abused I will need to tell your parents or someone else who can help you. Otherwise, I promise to keep everything that you tell me private.

Your mom and/or dad have said it is okay for you to play my computer game and answer my questions about the game and how you ride in the car. Do you think that you would like to answer them? You won't get into any trouble if you say no. If you decide to answer the questions you can stop answering them at any time, and you don't have to answer any question you do not want to answer. It's entirely up to you. Would you like to try answering the questions?

I understand what I am being asked to be in this study, and I agree to be in this study.

_____ _____

Signature **Date**

_____

Witness

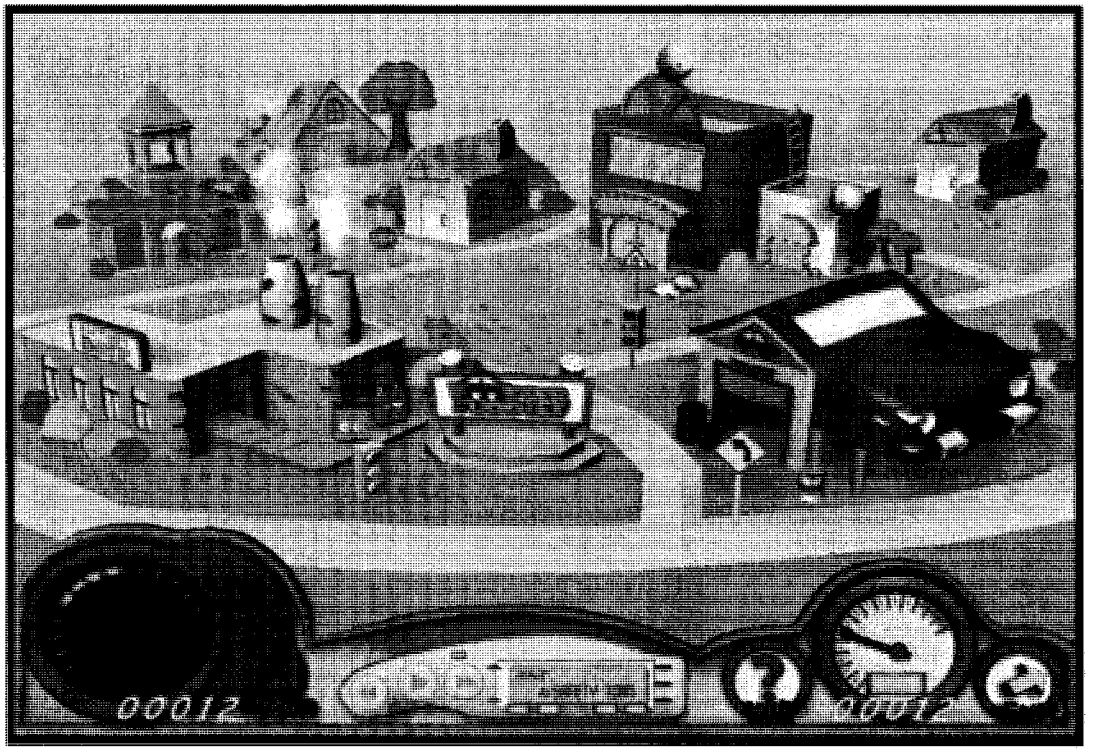


Figure 1A. Booster Buddies Safety Town.

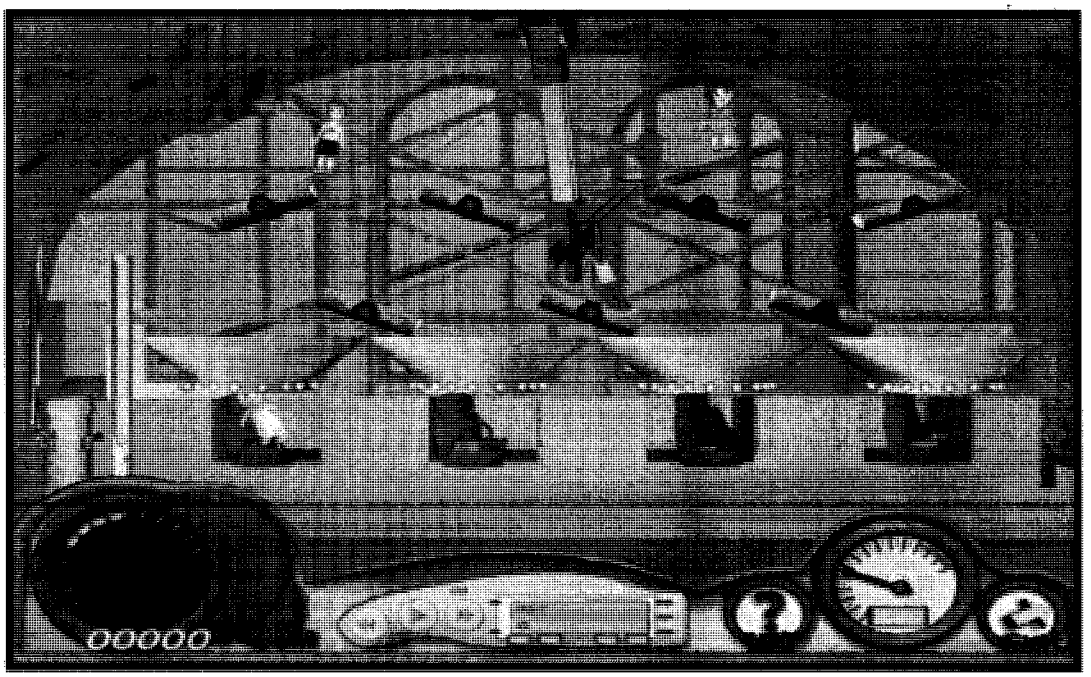


Figure 1B. Factory Dazs Mini Game.

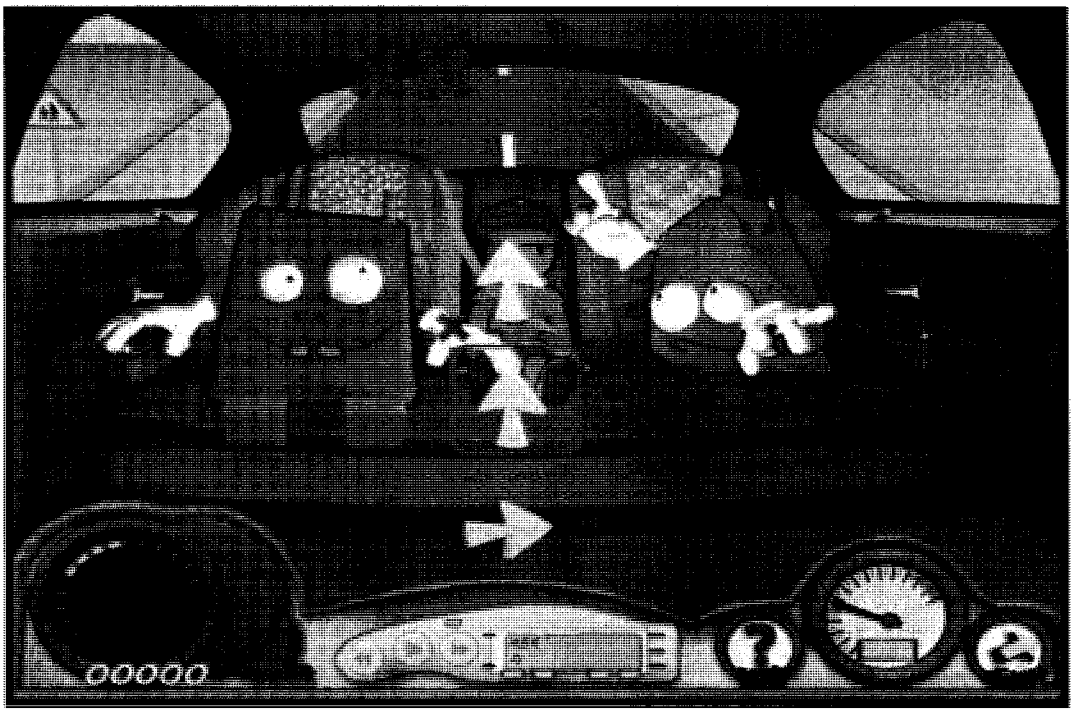


Figure 2A. Back Seat Bash Mini Game.

Figure 2B. Clek's Custom Shop Mini Game.

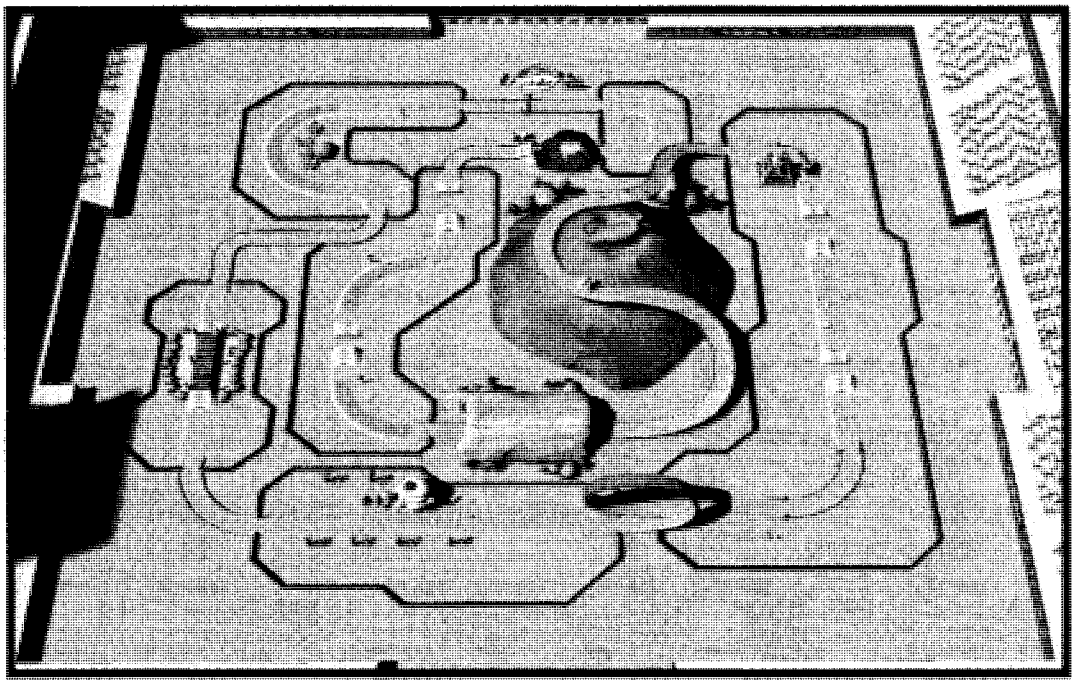


Figure 3A. Clek Arena Rampage Track.

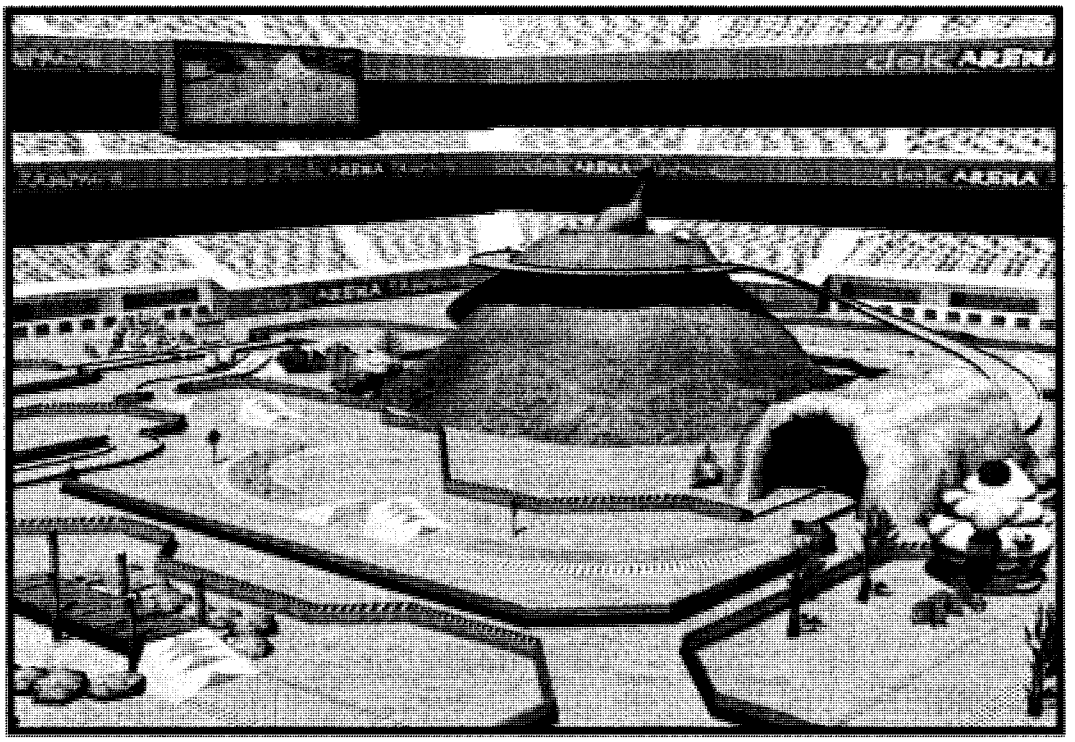


Figure 3B. Clek Arena Rampage Obstacles

References

American Academy of Pediatrics. (2007). Car safety seats: A guide for families 2007. Retrieved from http://www.aap.org/family/carseatguide.htm

Angulo-Vazquez, V., & De Santis, J. P. (2005). Booster seat or seat belt? Motor vehicle injuries and child restraint laws in early preschool and early school-age children. [Electronic version]. *Journal for Specialists in Pediatric Nursing, 10*(4), 183-190.

Arbogast, K. B., Ghati, Y., Menon, R. A., Tylko, S., Tamborra, N., & Morgan, R. M. (2005). Field investigation of child restraints in side impact crashes. [Electronic version]. *Traffic Injury Prevention, 6*(4), 351-360.

Bandura, A. (1965). Behavioural modification through modeling procedures. In L. Krasner & L. P. Ullman (eds.), *Research in behaviour modification.* New York: Holt, Rinehart & Winston.

Bandura, A. (1974). Behaviour theory and the models of man. *American Psychologist, 29,* 859-869.

Bandura, A. (1976). Effecting change through participant modeling. In J. D. Krumboltz & C. E. Thoresen (Eds.), *Counseling methods.* New York: Holt, Rinehart & Winston.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioural change. *Psychological Review, 84,* 191-215.

Bandura, A. (1971). *Social learning theory.* New York: General Learning Press.

Bandura, A. (1977). *Social learning theory.* New Jersey: Prentice-Hall.

Bandura, A., Dorothea, R., & Ross, S. A. (1961). Transmission of aggression through imitation of aggressive models. Journal of Abnormal and Social Psychology, 63, 575-582.

Bailey, J. V., Murray, E., Rait, G., Mercer, C. H., Morris, R. W., Peacock, R., Cassell, J. A., & Nazareth, I. (2008). Interactive computer-based interventions for sexual health promotion. *The Cochrane Database of Systematic Reviews, 4*. Retrieved from http://gateway.tx.ovid.com.ezproxy.uwindsor.ca/gw2/ovidweb.cgi

Bartholomew, L. K., Gold, R. S., Parcel, G. S., Czyzewski, D. I., Sockrider, M. M., Fernandez, M., Shegog, R., & Swank, P. (2000). Watch, discover, think, and act: Evaluation of computer-assisted instruction to improve asthma self-management in inner-city children. *Patient Education and Counseling., 39*(2-3), 269-280. Retrieved from PubMed database.

Beliss, M. (2008). *Computer and video game history: Early arcade machines, the history of home consoles, and the history of the video game.* Retrieved from http://inventors.about.com/library/inventors/blcomputer_videogames.htm

Bennett, T. D., Kaufman, R., Schiff, M., Mock, C., & Quan, L. (2006). Crash analysis of lower extremity injuries in children restrained in forward-facing car seats during front and rear impacts. [Electronic version]. *The Journal of Trauma: Injury, Infection, and Critical Care, 61*(3), 592-597.

Boeree, C. G. (2003). *Jean Piaget and cognitive development.* Retrieved November 1, 2007, from http://webspace.ship.edu/cgboer/genpsypiaget.html

Bowman, J. A., Sanson-Fisher, R. W., & Webb, G. R. (1987). Interventions in preschools to increase the use of safety restraints by preschool children. *Pediatrics, 79*(1), 103-108. Retrieved from http://pediatrics.aappublications.org/cgi/content/abstract/79/1/103

Brown, J., McCaskill, M. E., Henderson, M., & Bilston, L. E. (2006). Serious injury is associated with suboptimal restraint use in child motor vehicle occupants. [Electronic version]. *Journal of Paediatrics and Child Health, 42,* 345-349.

Bruce, B., & McGrath, P. (2005). Group interventions for the prevention of injuries in young children: A systematic review. [Electronic version]. *Injury Prevention, 11,* 143-147.

Campbell, M. K., Honess-Morreale, L., Farrell, D., Carbone, E., & Brasure, M. (1999). **A** tailored multimedia nutrition education pilot program for low-income women receiving food assistance. [Electronic version]. *Health Education Research, 14*(2), 257-267.

Carlson, N. R., Buskist, W., Enzie, M. E., & Heth, C. D. (1997). *Psychology: The science of behaviour.* Toronto, Ontario: Pearson Education Canada, Ltd.

Carpenter, K. M., Watson, J. M., Raffety, B., & Chabal, C. (2003). Teaching brief interventions for smoking cessation via an interactive computer-based tutorial. [Electronic version]. *Journal of Health Psychology, 8*(1), 149-160.

Centers for Disease Control and Prevention. (2007). *National child passenger safety Week, September 16-22, 2007.* Retrieved from http://www.cdc.gov/ncipc/duip/spotlite/chldseat.htm

Crawford, C. (1984). *The art of computer game design.* New York: McGraw-Hill.

Davies, K. L. (2004). Buckled-up children: Understanding the mechanism, injuries, management, and prevention of seat belt related injuries. *Journal of Trauma Nursing, 11*(1), 16-24. Retrieved from CINAHL database

Decina, L. E., Lococo, K. H., & Block, A. W. (2005). Misuse of child restraints: Results of a workshop to review field data results. *Traffic Safety Facts: Research Note.* Retrieved from http://www.nhtsa.dot.gov/people/injury/research/TSF_MisuseChildRetraints/809851.html

Durbin, D. R., Chen, I., Smith, R., Elliott, M. R., & Winston, F. K. (2005). Effects of seating position and appropriate restraint use on the risk of injury to children in motor vehicle crashes. [Electronic version]. *Pediatrics, 115*(3), e305-e309.

Durbin, D. R., Elliott, M. R., & Winston, F. K. (2003). Belt-positioning booster seats and reduction in risk of injury among children in vehicle crashes. [Electronic version]. *The Journal of the American Medical Association, 289*(21), 2835-2840.

Ebel, B. E., Koepsell, T. D., Bennett, E. E., & Rivara, F. P. (2003). Use of child booster seats in motor vehicles following a community campaign: A controlled trial. *Journal of American Medical Association, 289*(7), 879-884.

Ehiri, J. E., Ejere, H. O., Hazen, A. E., Emusu, D., King, W. D., & Osberg, S. J. (2006). Interventions to increase children's booster seat use: A review. [Electronic version]. *American Journal of Preventive Medicine, 31*(2), 185-192.

Ehiri, J. E., Magnussen, L., Emusu, D., King, W., & Osberg, J. S. (2008). Interventions for promoting booster seat use in four to eight year olds in motor vehicles. *The Cochrane Database of Systematic Reviews, 4*(1). Retrieved from http://gateway.tx.ovid.com.ezproxy.uwindsor.ca/gw2/ovidweb.cgi

Ehiri, J., King, W., Ejere, H. O., & Mouzon, P. (2007). Effects of interventions to increase use of booster seats in motor vehicles for 4-8 year olds. *AAA Foundation for Traffic Safety.* Retrieved from http://www.aaapublicaffairs.com/Assets/Files/200621499200.BoosterReport.pdf

Elliott, M. R., Arbogast, K. A., & Durbin, D. R. (2006). A latent class analysis of injury patterns among rear-seated, seat-belted children. [Electronic version]. *The Journal of Trauma: Injury, Infection, and Critical Care, 61*(5), 1244-1248.

Elliott, M. R., Kallan, M. J., Durbin, D. R., & Winston, F. K. (2006). Effectiveness of child safety seats vs seat belts in reducing risk for death in children in passenger vehicle crashes. [Electronic version]. *Archives of Pediatrics and Adolescent Medicine, 160*(6), 617-621.

Gittelman, M. A., Pomerantz, W. J., & Laurence, S. (2006). An emergency department intervention to increase booster seat use for lower socioeconomic families. [Electronic version]. *Academic Emergency Medicine, 13*(4), 396-400.

Glang, A., Noell, J., Ary, D., & Swartz, L. (2005). Using interactive multimedia to teach pedestrian safety: An exploratory study. *American Journal of Health Behavior, 29*(5), 435-442. Retrieved from ProQuest Nursing & Allied Health Source.

Glassbrenner, D., & Ye, J. (2007). Booster seat use in 2006. *Traffic Safety Facts: Research Note.* Retrieved from www.nhtsa.dot.gov/portal/nhtsa_static_file_downloader.jsp?file=/staticfiles/DOT/NHTSA/NCSA/Content/RNotes/2007/810796.pdf

Glassbrenner, D., & Ye, T. J. (2007). Child restraint use in 2006 – Use of correct restraint types. *Traffic Safety Facts: Research Note.* Retrieved from www.nhtsa.dot.gov/portal/nhtsa_static_file_downloader.jsp?file=/staticfiles/DOT/NHTSA/NCSA/Content/RNotes/2007/810798.pdf

Greenberg-Seth, J., Hemenway, D., Gallagher, S. S., Ross, J. B., & Lissy, K. S. (2004). Evaluation of a community-based intervention to promote rear seating for children. *American Journal of Public Health, 94*(6), 1009-1013. Retrieved from CINAHL database

Grossman, D. C., & Garcia, C. C. (1999). Effectiveness of health promotion programs to increase motor vehicle occupant restraint use among young children. *American Journal of Preventive Medicine, 16*(1), 12-22. Retrieved from MEDLINE database.

Hamilton, J. (2007). Canada and the world. *Canadian Road Safety Youth Conference.* Retrieved from *http://www.tc.gc.ca/hookedonroadsafety/presentations/presentation4.pdf*

Huitt, W., & Hummel, J. (2003). Piaget's theory of cognitive development. *Educational Psychology Interactive.* Retrieved from http://chiron.valdosta.edu/whuitt/col/cogsys/piaget.html

Hutchison, E. D. (2003). *Dimensions of human behaviour: The changing life course.* Sage Publications Inc.

Inhelder, B. & Piaget, J. (1964). *The early growth of logic in the child: Classification and seriation.* New York: Harper & Row.

Insurance Institute for Highway Safety. (2007). *Child restraint laws.* Retrieved from http://www.iihs.org/laws/ChildRestraint.aspx

Johnston, B. D., Britt, J., D'Ambrosio, L., Mueller, B. A., & Rivara, F. P. (2000). A preschool program for safety and injury prevention delivered by home visitors. *Injury Prevention, 6,* 305-309.

Kanuga, M., Rosenfeld, W. D. (2004). Adolescent sexuality and the internet: the good, the bad, and the URL. *Journal of Pediatric & Adolescent Gynecology, 17*(2), 117-124.

Krishna, S., Francisco, B. D., Balas, A., Konig, P., Graff, G. R., & Madsen, R. W. (2003). Internet-enabled interactive multimedia asthma education program: A randomized trial. [Electronic version]. *Pediatrics, 111*(3), 503-510.

Leitch, K. K. (2008). Reach for the Top: A Report by the Advisor on Healthy Children & Youth, *Health Canada.*

Lewis, D. (1999). Computer-based approaches to patient education: A review of the literature. *Journal of the American Medical Informatics Association, 6*(4), 272-282. Retrieved from CINAHL database.

Li, X., & Atkins, M. S. (2004). Early childhood computer experience and cognitive and motor development. [Electronic version]. *Pediatrics, 113*(6), 1715-1722.

Linke, S., Brown, A., & Wallace, P. (2004). Down your drink: a web-based intervention for people with excessive alcohol consumption. *Alcohol & Alcoholism, 39*(1), 29-32.

McComas, J., MacKay, M., & Pivik, J. (2002). Effectiveness of virtual reality for teaching pedestrian safety. *Cyberpsychology & Behavior: The Impact of the Internet, Multimedia and Virtual Reality on Behavior and Society, 5*(3), 185-190. Retrieved from MEDLINE database

Ministry of Transportation. (2005). *Bill 73 – An act to enhance the safety of children and youth on Ontario's roads.* Retrieved from http://www.mto.gov.on.ca/english/about/bill73.htm

Ministry of Transportation. (2007). *Safe & secure – Choosing the right car seat for your child.* Retrieved from http://www.mto.gov.on.ca/english/safety/carseat/choose.htm

Nance, M. L., Lutz, N., Arbogast, K. B., Cornejo, R. A., Kallan, M. J., Winston, F. K., & Durbin, D. R. (2004). Optimal restraint reduces risk of abdominal injury in children involved in motor vehicle crashes. [Electronic version]. *Annals of Surgery, 239*(1), 127-131.

National Highway Traffic Safety Administration. (2002). *Motor vehicle occupant protection facts: Facts about children and youth.* Retrieved from http://www.nhtsa.dot.gov/people/injury/airbags/OccupantProtectionFacts/children_youth.htm

National Highway Traffic Safety Administration. (2002). *Motor vehicle occupant protection facts: The need to promote occupant restraint use for children, youth, and 16- to 20-year olds.* Retrieved from http://www.nhtsa.dot.gov/people/injury/airbags/OccupantProtectionFacts/restraint.htm

National Highway Traffic Safety Administration. (2005). *Occupant protection.* Retrieved from http://www-nrd.nhtsa.dot.gov/Pubs/810621.PDF

National Highway Traffic Safety Administration. (2007). *Traffic safety facts: Traffic tech – Technology transfer series.* Retrieved from www.nhtsa.dot.gov/portal/nhtsa_static_file_downloader.jsp?file=/staticfiles/DOT/NHTSA/Communication%20&%20Consumer%20Information/Traffic%20Tech%20Publications/Associated%20Files/tt331.pdf

O'Neil, J. (2005). Methods to increase booster seat use in 4 to 6 year old children. *The 49th AAAM Annual Conference,* September 11-14.

Organization for Economic Co-Operation and Development. (2004). *Keeping children safe in traffic.* Retrieved from http://www.oecd.org/dataoecd/14/58/31950392.pdf

Patrick, K., Sallis, J. F., Prochaska, J. J., Lydston, D. D., Calfas, K. J., Zabinski, M. F., et al. (2001). A multicomponent program for nutrition and physical activity change in primary care: PACE+ for adolescents. *Archives of Pediatrics & Adolescent Medicine, 155*(8), 940-946.

Pierce, S. E., Mundt, M. P., Peterson, N. M., & Murray, L. K. (2005). Improving awareness and use of booster seats in head start families. *Wisconsin Medical Journal, 104*(1), 46-51. Retrieved from http://www.wisconsinmedicalsociety.org/_WMS/publications/wmj/issues/wmj_v104n1/Pierce.pdf

Polit, D. F. & Beck, C. T. (2004). *Nursing research: Principles and methods.* (7th ed.). Philadelphia: Lippincott, Williams & Wilkins.

Public Health Agency of Canada. (2005). *Canadian paediatric surveillance program – 2003 results.* Retrieved from http://www.phac-aspc.gc.ca/publicat/cpsp-pcsp03/page7_e.html

Ramsey, A., Simpson, E., & Rivara, F. P. (2000). Booster seat use and reasons for nonuse. [Electronic version]. *Pediatrics, 106*(2), e20.

Safe Kids Canada. (2008). *Child passenger safety.* Retrieved from http://www.sickkids.ca/SKCPublicPolicyAdvocacy/section.asp?s=Child+Passenger+Safety&sID=15073 http://www.sickkids.ca/SKCForParents/section.asp?s=Safety+Information+by+Topic&sID=10774&ss=Child+Passenger+Safety&ssID=11330&sss=Booster+Seat&sssID=11570

Safe Kids Canada. (2004). *Booster seat use in Canada: A national challenge.* Retrieved from http://www.sickkids.ca/SKCPublicPolicyAdvocacy/custom/EnglishReport_BoosterSeats.pdf

Safe Kids Canada. (2007). *Child & youth unintentional injury: 1994-2003 10 years in review.* Retrieved from http://www.ccsd.ca/pccy/2006/pdf/skc_injuries.pdf

Santschi, M., Echave, V., Laflamme, S., McFadden, N., & Cyr, C. (2005). Seat-belt injuries in children involved in motor vehicle crashes. *Canadian Journal of Surgery, 48*(5): 373-376. Retrieved from CINAHL database

Shepherd, M., Hamill, J., & Segedin, E. (2006). Paediatric lap-belt injury: A 7 year experience. [Electronic version]. *Paediatric Emergency Medicine, 18*(1), 57-63.

Simpson, E. M., Moll, E. K., Kassam-Adams, N., Miller, G. J., & Winston, F. K. (2002). Barriers to booster seat use and strategies to increase their use. [Electronic version]. *Pediatrics, 110*(4), 729-736.

Smed, J. & Hakonen, H. (2006). *Algorithms and networking for computer games.* England: Wiley & Sons, Ltd.

Snowdon, A. W., Hussein, A., High, L., Stamler, L. L., Polgar, J. M., & Follo, G. (2008). The effectiveness of a multi-media intervention for parents on knowledge of safety seat use for children. *Journal of Pediatric Nursing, 23*(2), 126-139.

Snowdon, A., Polgar, J., Patrick, L., & Stamler, L. (2006). Parents' Knowledge and Use of Safety Systems for Children in Ontario. *Canadian Journal of Nursing Research, 38(2),* 98-114.

Statistics Canada. (2007). *Age-standardized mortality rates by selected causes, by sex* Retrieved from http://www40.statcan.ca/l01/cst01/health30a.htm

Stevens, S. L. (2000). *Effects of intervention on booster seat purchase: a field study.* Thesis, Virginia Polytechnic Institute and State University.

Strecher, V. J. (1999). Computer-tailored smoking cessation materials: A review and discussion. *Patient Education & Counseling, 36*(2), 107-117.

Subramanian, R. (2007). Motor vehicle traffic crashes as a leading cause of death in the United States, 2004. *Traffic Safety Facts: Research Note.* Retrieved from www.nhtsa.dot.gov/portal/nhtsa_static_file_downloader.jsp?file=/staticfiles/DOT/NHTSA/NCSA/Content/RNotes/2007/810742.pdf

Tabibi, Z., & Pfeffer, K. (2003). Choosing a safe place to cross the road: The relationship between attention and identification of safe and dangerous road-crossing sites. [Electronic version]. *Child: Care, Health & Development, 29*(4), 237-244.

The Children's Hospital of Philadelphia. (2006). *Child passenger safety.* Retrieved from http://209.85.207.104/search?q=cache:AnYP6yMWWR4J:www.chop.edu/consumer/your_child/wellness_index.jsp%3Fid%3D-8852+Misuse+of+child+safety+seats+is+also+widespread+with+nearly+4+out+of+5+children+improperly+restrained&hl=en&ct=clnk&cd=1&gl=ca

Thomas, R., Cahill, J., & Santilli, L. (1997). Using an interactive computer game to increase skill and self-efficacy regarding safer sex negotiation: Field test results. Health *Education & Behavior, 24*(1), 71-86. doi: 10.1177/109019819702400108

Tingvall, C. (1987). Children in cars: Some aspects of the safety of children as car passengers in road traffic accidents. *Acta Paediatrica Scandinavica Supplement,* 76(339), 1-35. Retrieved from MEDLINE database.

Transport Canada. (2005). *Canadian motor vehicle traffic collision statistics – Fatalities and injuries by age group.* Retrieved from http://www.tc.gc.ca/roadsafety/tp/tp3322/2005/page2.htm

Transport Canada. (2005). *Canadian motor vehicle traffic collision statistics – Percentage of driver and passenger fatalities and serious injuries where victims were not using seat belts, 2001-2005.* Retrieved from http://www.tc.gc.ca/roadsafety/tp/tp3322/2005/page7.htm

Transport Canada. (2004). *Road safety in Canada: An overview.* Retrieved from http://www.tc.gc.ca/roadsafety/stats/overview/2004/menu.htm

Turner, C., McClure, R., Nixon, J., & Spinks, A. (2005). Community-based programs to promote car seat restraints in children 0-16 years – A systematic review. [Electronic version]. *Accident Analysis & Prevention, 37*(1), 77-83.

Vesentini, L., & Williems, B. (2007). Premature graduation of children in child restraint systems: An observational study. [Electronic version]. *Accident Analysis and Prevention, 39*(5), 867-872.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Weber, K. (2000). Crash protection for child passengers: A review of best practice. *UMTRI Research Review, 31*(3), 1-27. Retrieved from http://www.carseat.org/Resources/Weber_CPCP.pdf

Weinstein, E., Sweeney, M. M., Garber, M. A., Eastwood, M., Osterman, J. G., & Roberts, J. V. (1997). The effect of size appropriate and proper restraint use on injury severity of children. *Child Occupant 2nd Symposium, Society of Automotive Engineers.* Retrieved from http://206.160.145.240/technical/papers/973310.

Williams, S. B., Whitlock, E. P., Edgerton, E. A., Smith, P. R., & Bell, T. L. (2007). Counselling about proper use of motor vehicle occupant restraints and avoidance of alcohol use while driving: A systematic review for the U.S. Preventive Service Task Force. *Annals of Internal Medicine, 147*(3), 194-206. Retrieved from http://www.annals.org/cgi/content/abstract/147/3/194

Winston, F. K., Durbin, D. R., Kallan, M. J., & Moll, E. K. (2000). The danger of premature graduation to seat belts for young children. [Electronic version]. *Pediatrics, 105*(6), 1179-1183.

World Health Organization. (2007). *Youth and road safety.* Retrieved from http://whqlibdoc.who.int/publications/2007/9241595116_eng.pdf

World Health Organization. (2004). *Road safety – Safety restraints.* Retrieved from http://www.ops-oms.org/English/DD/PUB/safety_restraints_en.pdf

Zaza, S., Sleet, D. A., Thompson, R. S., Sosin, D. M., Bolen, J. C., and the Task Force on Community Preventive Services. (2001). Reviews of evidence regarding interventions to increase use of child safety seats. [Electronic version]. *American Journal of Preventive Medicine, 21,* 31-47.

VITA AUCTORIS

NAME:	Amanda S. Bechberger
PLACE OF BIRTH:	Windsor, Ontario
YEAR OF BIRTH:	1981
EDUCATION:	St. Thomas of Villanova Secondary School, LaSalle, Ontario 1995 – 2000
	University of Windsor, Windsor, Ontario 2000 – 2004 B.Sc.N
	University of Windsor, Windsor, Ontario 2005 – 2008 M.Sc.