CATHORALL, MICHELLE L., Dr.P.H. Improving Bicycle Helmet Research: Examining Intervention Studies and Parental Experiences. (2013)
Directed by Dr. Tracy Nichols. 146 pp.

Despite the recognized protection provided by bicycle helmets, estimates indicate that only 25% of people wear one every time they ride. Although much research has focused on identifying determinants of bicycle helmet use, there has been limited success for increasing and sustaining children's bicycle helmet use. One potential reason for this is a limited understanding of how identified determinants of helmet use work together to impact behavior. The goal of this dissertation was to improve research and practice around children's bicycle helmet use to further an aim of ultimately reducing the number of head injuries among children. To accomplish this goal this dissertation is divided into two separate but related products that address critical issues in the field. The first product is a focused literature review on interventions designed to increase children's helmet use and the other is a qualitative study of parental perceptions of and experiences with children's bicycle riding.

The aim of the focused literature review was to gain a better understanding of the bicycle helmet use research by identifying gaps in bicycle helmet intervention methodology and to recommend opportunities to strengthen the field. Identifying gaps in intervention research allows for recommendations that can have a direct impact on future interventions. Inclusion criteria included: articles published in English between 1986-2011 that focus on children under 18 years old, report on an intervention or the evaluation

of an intervention, and have increased helmet use as one of the main outcomes. Thirty-five studies were included in the review.

Findings indicated opportunities for improvement in three broad areas: measurement issues, group differences, and analytic techniques. Recommendations for increasing the accuracy of measurements, examining group differences and differential intervention effects, and the use of sophisticated analytic techniques to account for the data structure and identifying influential contextual variables were provided.

The goal of the qualitative study was to develop a model that described processes associated with children's bicycle helmet use across intrapersonal, interpersonal, community, institutional, and political contexts. The aim was to gain an understanding of how parents assess and manage risks associated with their children's bicycle riding. Using a constructivist grounded theory approach; interviews with parents of children in 3^{rd} – 5^{th} grades were conducted. Interviews covering children's bike riding history and current habits were recorded and transcribed verbatim. Using a constant comparative approach, data were analyzed concurrent with data collection. Initial coding identified critical issues in the data and focused coding was used to further identify specific patterns of behavior. Theoretical sampling was then used to fully develop the categories that emerged. Theoretical coding also described how categories related to one another.

A model emerged from the data that explained the cognitive and behavioral processes parents utilized to balance their anxiety around perceived dangers of bike-riding with their understanding of their children's developmental needs for autonomy. Findings also showed parents' primary concerns focused around more improbable risks

(such as child-snatching) rather than higher probability risks such as falling and head injuries. Implications are discussed in terms of expanding theoretical foundations of intervention design and addressing parental concerns prior to introducing helmet use information. With refinement, findings from this dissertation study may be used to develop interventions to increase sustainable bicycle helmet use and reduce bicycle-related head injuries in children.

IMPROVING BICYCLE HELMET RESEARCH:

EXAMINING INTERVENTION STUDIES

AND PARENTAL EXPERIENCES

by

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A Dissertation Submitted to
The Faculty of The Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Doctor of Public Health

Greensboro
2013

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To my parents, Mom & Sir: thank you for your unconditional love, always believing in me and helping me believe I can do anything I set my mind to. I love you both for your continued support and encouragement.

To my kids, Mason & Taryn: you've been with me through this journey from start to finish. Thank you for playing quietly even before you understood why and sitting through classes on your days off from school. I love you both! You're my inspiration. I hope you will always have the courage to follow your hearts and dare to live your wildest dreams.

A mi mejor amigo: gracias por mucho más de lo que sabes y por quedarte conmigo durante la locura. Con mucho agradecimiento y con todo mi corazón…
te echo de menos y te amo…

APPROVAL PAGE

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ACKNOWLEDGEMENTS

I would like to thank Dr. Dan Bibeau and Dr. Tracy Nichols for their guidance, mentorship and friendship throughout this process and phase of my life. Dan, thank you does not express how grateful I am for your support and protection. Tracy, thank you for your patience and guidance through the writing process.

To my committee members, Dr. Vincent Francisco and Dr. Anne Fletcher, your helpful feedback and guidance added valuable insights to my dissertation and my doctoral studies.

Finally, thank you to the families who shared their time and experiences, without which this dissertation would not have been possible.

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CHAPTER I

INTRODUCTION

Statement of the Problem

Playing is a part of childhood, but it is not without risk of injury. Bicycling remains one of the most popular childhood leisure activities in the United States (Bull, et al., 2001). According to the Bicycle Helmet Safety Institute there are approximately 85 million bicycle riders in the United States (Bicycle Helmet Safety Institute, 2008). Of those, 27.7 million are children age 5-14 (National SAFE KIDS Campaign, 2004; Sacks, Kresnow, Houston & Russell, 1996). Children age 5-14 are seen in hospital emergency departments with injuries sustained during bicycle crashes more often than from any other sport (National SAFE KIDS Campaign, 2007). Head injuries are estimated to occur in as many as 65% of all bicycle crashes (Finnoff, Laskowski, Altman, & Diehl, 2001; Frank, Frankel, Mullins, & Taylor, 1995; VanHouten & Malenfant, 2007). Furthermore, it is probable that non-fatal injuries sustained in bicycle crashes are greatly under estimated due to the number of injuries that do not require medical attention.

Bicycle helmets are an effective countermeasure for reducing the number and severity of head injuries resulting from bicycle crashes (Bull, et al., 2001; Forjuoh, Fiesinger, Schuchmann, & Mason, 2002; National SAFE KIDS Campaign, 2004; Schieber & Sacks, 2001). Studies have shown that when used properly, bicycle helmets

can reduce the number of head injuries by as much as 85% - 88% (Attewell, Glase, & McFadden, 2001; Curnow, 2005; Thompson, Rivara, & Thompson, 1989; VanHouten & Malenfant, 2007) and reduce injury severity by up to 75% (Bull, et al., 2001; Curnow, 2005). Despite their effectiveness at reducing bicycle related head injuries, it is estimated that only 25% of children age 5-14 years always wear a helmet (Sacks, Kresnow, Houston, & Russell, 1996; Schieber & Sacks, 2001).

Although much research has focused on identifying determinants of bicycle helmet use, there has been limited success in making sustainable changes to increase bicycle helmet use. One reason for this is that the processes associated with children's bicycle helmet use are not fully understood (Thompson, Sleet, & Sacks, 2002). Grounded theory is particularly well suited to understanding participant's perspectives and the meaning they have of children's helmet use and can provide an understanding beyond what we already know (Corbin & Strauss, 2008). Studies have examined many factors related to children's helmet use; however these studies have been based on preconceived ideas from existing theories without a full understanding of the meaning that children and parents ascribe to helmet use or how these meanings influence whether a child wears a helmet. Using grounded theory to study parent and child perspectives of helmet use and the associated processes, it may be possible to inform intervention development.

Specific Aims

The goal of this dissertation research is to develop a model to describe processes associated with children's bicycle helmet use across intrapersonal, interpersonal,

community, institutional, and political contexts. The aim of this study is to gain an understanding of the process parents use to assess and manage risks associated with their children's bicycle riding.

Research Questions

Table 1. Original Research Questions

*Research Questions**

Main Questions	What meaning do children and parents ascribe to helmet use? How do children's and parents' attitudes and beliefs about bicycle helmets influence helmet use?

*As new insights emerge from the data during data collection and analysis, research questions will continue to be refined and focused.

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CHAPTER II

REVIEW OF THE LITERATURE

This literature review of bicycle helmet studies is limited to elementary through high school children. Recognizing that children's bicycle helmet use behavior is complex, the review of the literature is divided into five sections. The first section provides an overview of the determinants of helmet use at the various levels of the social-ecological framework. A review of how theories and models have been used in bicycle helmet studies is provided in the next section. Findings from bicycle helmet interventions are summarized in the third section. Findings of surveillance studies are provided next. Finally gaps in bicycle helmet literature are discussed.

Complex Issues Related to Children's Helmet Use

Interventions to increase bicycle helmet use among children have traditionally been school-based programs targeting children directly, with limited success. Although helmet use increases during the intervention period of these programs and may be sustained for the first few months post intervention, long-term helmet use has been shown to return to pre-intervention levels. The majority of traditional bicycle helmet interventions seek to increase helmet use through bicycle helmet safety education, bicycle rodeos, and incentives and free helmet distribution (Hendrickson & Becker, 2000; Kirsch & Pullen, 2003; Logan, Leadbetter, Gibson, Schieber, & al., 1998; Parkin, et al., 1995; Parkin, et al., 1993; Pendergrast, Ashworth, DuRant, & Litaker, 1992; Quine, Rutter, &

Arnold, 2001; VanHouten & Malenfant, 2007). However, children's bicycle helmet use occurs within multiple contexts and little if any consideration is given to how the determinants in multiple contexts influence helmet use (Gielen & Sleet, 1993). One method for accounting for contextual effects on behavior is to use a social ecological framework to identify previously identified determinants of helmet use that can be used as initial concepts and explored more fully through qualitative interviews and focus groups (McLeroy, Bibeau, Steckler, & Glanz, 1988). Below, organized within a social-ecological framework, are factors related to children's bicycle helmet use previously recognized in the literature. A summary of the factors that facilitate helmet use can be found in Appendix A. Although these factors alone have been identified as playing a role in children's helmet use, they have not been interpreted together to gain an understanding of how they may impact children's helmet use behavior.

Intrapersonal factors influencing children's helmet use include knowledge, attitudes, and beliefs of the child (Thompson, Sleet, & Sacks, 2002). Never having thought of wearing a helmet has been cited as a reason why children do not wear helmets (Towner & Marvel, 1992; Hu, Wesson, & Parkin, 1994). Children's negative perceptions about helmets, such as they are ugly or uncomfortable, play a role in whether they wear one (Wasserman, Waller, & Monty, 1988). Also, a lack of perceived susceptibility to injury does not support helmet use (Thompson, Sleet, & Sacks, 2002). The role of intrapersonal factors has been well established in the literature, however what has not been clearly identified is when these factors are established or how they may influence factors at other levels of the social ecological framework.

Interpersonal factors influencing children's helmet use include perceived norms of peers and parents. For example, peer norms that no one else wears a helmet could influence a child not to wear a helmet (DiGuiseppi, Rivara, & Koepsell, 1990). One study reported that peer social norms were more important in determining intention to wear a helmet than attitudes (Macknin & Medendorp, 1994). Parental behavior, attitudes, perceptions, and involvement exert an influence on whether a child wears a helmet (Pendergrast, Ashworth, DuRant, & Litaker, 1992; Hendrickson & Becker, 1998; Miller, Binns, & Christoffel, 1996; Berg & Westerling, 2001). Additionally, parental rules play an important role. In one study examining parental rules about helmet use, 88% of children whose parents had a strict rule (the child is required to wear a helmet every time they ride a bicycle) wore helmets (Miller, Binns, & Christoffel, 1996). The literature has many examples of which parental behaviors impact children's helmet use behaviors, however like the intrapersonal determinants that have been identified, they have not been examined in a holistic context.

Organizational factors influencing children's helmet use include school norms and policies. School based approaches to address children's helmet use have been to try and change perceived norms of helmet use. A study conducted in three Florida schools, with bicycle helmet policies, included a safety assembly, free helmets for those students that did not have one, incentives for students caught wearing a helmet, and citations for students observed not wearing a helmet when riding at or near the schools (VanHouten & Malenfant, 2007). This study found almost near perfect levels of helmet use during the intervention, however, the long-term effects have not been evaluated. It is important to

note however that the highest levels of helmet use were in schools with existing helmet policies.

Community factors influencing children's helmet use include access to and availability of helmets that fit and are safety approved. Two strategies that have been used to increase helmet access include helmet subsidy and give-away programs (Logan, Leadbetter, Gibson, Schieber, & al., 1998; Macknin & Medendorp, 1994; Parkin, et al., 1993; Pendergrast, Ashworth, DuRant, & Litaker, 1992). Logan et al., (1998) found increases in helmet use for children in grade K-6, however they were not sustained and there were no increases seen for grades 7 and 8. A follow-up at nine months post-intervention showed levels of observed helmet use had dropped, returning to pre-intervention levels.

Public policy factors influencing children's helmet use are mandatory helmet laws and their enforcement. Given the effectiveness of bicycle helmets to reduce the number and severity of head injuries states started implementing bicycle helmet use laws in 1987 (Bicycle Helmet Institute, 2007). While there is no federal law, most states have either local or state laws mandating bicycle helmet use. Currently 20 states have statewide helmet laws for children. State laws vary in the ages that they cover, ranging from 12 years old and under in Louisiana and Pennsylvania to 18 years old and younger in California and New Mexico.

In 2001, North Carolina implemented a bicycle helmet law stating that all children, younger than 16 years old are required to wear a helmet when riding a bicycle (Bicycle Helmet Institute, 2007; Carter, Brewer & Garrison, 2007). According to the law

parents or legal guardians can be cited for a child's non-compliance with a fine of $10. In a recent study of the North Carolina law only 19% of parents reported that their child "always" wears a helmet (Carter, Brewer & Garrison, 2007). Bicycle helmet laws have worked to change behavior among some of the population. In a random digit dial telephone survey of bicycle riders, the data suggests that most children who reported always wearing a helmet lived in a state with a helmet law (Rogers, 2002). Helmet use in New York increased after the law was enacted from 4.7% to 13.9% (Abularrage, DeLuca & Bularrage, 1997). Few studies have examined the effect on enforcement of helmet laws on helmet use, but when enforced, helmet laws are even more effective at increasing helmet use among children (Gilchrist, 2000).

Theories and Models Used in Bicycle Helmet Studies

Although the use of theory in injury prevention research has grown in the last ten years, theory based bicycle helmet research is still lacking. There are few studies in the bicycle helmet literature that use behavioral theories and models as a basis for research or developing and evaluating programs (Trifiletti, Gielen, Sleet, & Hopkins, 2005). Individual level theories and models have been applied most commonly. The PRECEDE-PROCEED model, Theory of Planned Behavior (TPB) and Theory of Reasoned Action (TRA), Social Cognitive Theory (SCT) and Health Belief Model (HBM) have been used to guide program development or to identify determinants of helmet use among children. Another theory that has been used to study bicycle helmet use is Diffusion of Innovation Theory (Farley, Haddad, & Brown, 1996). Few studies

have explicitly used theories or models at one or more other levels of the social ecological model.

One of the most frequently used models in surveillance studies and as the basis for intervention development has been PRECEDE. In the Tuscaloosa County Bicycle Helmet Project (TCBHP) PRECEDE was used as the theoretical basis to design and implement the study (Jones & Macrina, 1993). The model was used to describe the problem, including gathering social and epidemiologic data and information on attitudes and behaviors, identify predisposing, enabling, and reinforcing factors, and for program development and evaluation (Green & Kreuter, 2005). PRECEDE is used not only as a theoretical basis for intervention development, but also in nonintervention bicycle helmet research. In one study, predisposing, enabling, and reinforcing factors were used to predict self-reported helmet use. Findings suggested that helmet use is predicted by helmet ownership, participation in an educational intervention, and helmet efficacy beliefs (Hendrickson & Becker, 1998). The PRECEDE model has also been used to develop pre-and post test questionnaires (Hendrickson & Becker, 2000).

The HBM and SCT have been used as a basis for instrument development to identify determinants of children's helmet use. Studies have used beliefs about helmet use and the influence of role models from these two theories to construct survey instruments designed to identify psychosocial factors associated with helmet use (Gielen, et al., 1994). A modified version of the HBM that includes the psychosocial variables of motivation, developmental level and peer group pressures and structural variables of prior injury or exposure to prevention strategies has also been used to design interventions. An

intervention developed by pediatric trauma doctors emphasized the risks and benefits of helmet use, building self-efficacy, addressing barriers, and cues to action (Marsh, Connor, Wesolowski, & Grisoni, 2000). In another study that used constructs from the HBM and SCT, perceptions of injury susceptibility and severity, reduced barriers, self-efficacy, persuasion and skill building were the constructs used as the theoretical basis for the Safety Central program (Kirsch & Pullen, 2003). Results suggest that participation in the program is associated with self-report helmet use at last ride and knowledge retention the year following the intervention. Although not explicitly stated, the Bikes, Blades, and Boards program was designed using constructs of SCT as the theoretical foundation (Blake, Velikonja, Pepper, Jilderda, & Georgiou, 2008).

The TPB and TRA have also been used to develop helmet interventions and to predict intention to wear a helmet. The TRA was used as the basis for a questionnaire designed to increase motivation to wear a bicycle helmet in Quebec (Otis, et al., 1992). The constructs used included intention, behavioral and normative beliefs, and perception of risk. Results indicate that behavioral and normative beliefs were the best predictors of helmet use. In an intervention to predict helmet use social norms, perceptions of control, and intentions were assessed at three time points among middle and high school students (Quine, Rutter, & Arnold, 2001). Significant differences between the intervention and control groups suggest that norms, control and intentions are predictive of helmet use. In a study that measured similar constructs to predict helmet use intention among adolescents, similar results were found (O'Callaghan & Nausbaum, 2006).

Studies that have used theories or models at levels other than the intrapersonal level of the social ecological model are limited. Although most studies have not specifically identified multiple levels of the social ecological framework to target, some studies have implicitly addressed targets at other levels. The Marsh (2000) study explicitly used the HBM. Although cues to action are a construct of the HBM, in this study the doctors actually lobbied for and got passed a city helmet ordinance, which is at the public policy level of the social ecological model, unlike the HBM (McLeroy, Bibeau, Steckler, & Glanz, 1988; Marsh, Connor, Wesolowski, & Grisoni, 2000).

There have been only two comprehensive helmet campaigns that have targeted multiple levels of the social ecological model. The Seattle Children's Helmet Campaign (SCHC) has been the most success bicycle helmet intervention to date (Rivara, et al., 1994). The SCHC was designed to increase parental awareness, reduce financial barriers, and promote awareness in the community. Strategies to target attitudes and values, norms, and legislation included social marketing, posters, brochures, bike rodeos, health fairs, and discount helmet coupons (Rivara, et al., 1994). In this study helmet use among elementary school children increased from 5.5% in 1987 to 40.2% in 1992. Another intervention that used a multilevel approach was the Coalition for Head Injury Prevention (CHIP). Focused on barriers to helmet use, the CHIP intervention employed a variety of strategies at all levels of the social ecological framework (Morris, Trimble, & Fendley, 1994). Some of the strategies employed were education, advertising, discount helmet programs, lobbying for legislation, and social marketing. Results showed that during the two-year intervention helmet use increased from 5.4% to 15.4%.

School Based Bicycle Helmet Interventions

Although interventions to increase children's bicycle helmet use have shown promise, there is more work to be done. The majority of the interventions have been focused at only one level of the social-ecological framework; with little regard for the influence the other levels have on the decision to wear a helmet. Bicycle helmet use interventions for children have traditionally been school-based programs targeting the children with limited success. These interventions seek to increase helmet use through a combination of activities such as bicycle helmet safety education, bicycle rodeos, incentives, and free helmet distribution (Pendergrast, Ashworth, DuRant, & Litaker, 1992; Parkin, et al., 1993; Parkin, et al., 1995; Liller & McDermott, 1996; Hendrikson & Becker, 1998; Logan, Leadbetter, Gibson, Schieber, & al., 1998; Macarthur, Parkin, Sidky, & Wallace, 1998; Kirsch & Pullen, 2003; Hall, Cross, Howat, Stevenson, & Shaw, 2004; VanHouten & Malenfant, 2007; Blake, Velikonja, Pepper, Jilderda, & Georgiou, 2008). One study found increases in helmet use for children in grade K-6, however they were not sustained and there were no increases seen for grades 7 and 8 (Logan, Leadbetter, Gibson, Schieber, & al., 1998). A follow-up at nine months post-intervention showed levels of observed helmet use had dropped, returning to pre intervention levels. A similar study was conducted in three Florida schools that included a safety assembly, free helmets for those students that did not have one, incentives for students caught wearing a helmet, and citations for students observed not wearing a helmet when riding at or near the schools (VanHouten & Malenfant, 2007). The aim of this study was to change social norms of helmet use. While this study found almost near perfect levels of

helmet use during the intervention, there has not been an evaluation of the post-intervention observed prevalence of helmet use.

Another study that aimed to change social norms to increase helmet use utilized peer teachers to lead a 12 session classroom based curriculum, the Helmet Files, and homework activities that corresponded to the classroom material (Hall, Cross, Howat, Stevenson, & Shaw, 2004). Data were collected at three points, pre-intervention and one and 2 years post. Findings for the comparison of helmet use from baseline to 2 years post intervention were not significant, however more intervention students were observed wearing helmets than non-intervention students.

Pendergrast, et al., (1992) conducted a randomized controlled elementary school based trial targeting children in grades 2-4. The control school received a variety of educational materials over the course of a year in the form of letters, activity books, posters, and a coupon for $10.00 off the purchase of a bicycle helmet. In addition to receiving these components, the intervention school also received a bicycle helmet safety demonstration by a bicycle stunt rider. Results found that while the prevalence of reported helmet use increased in the intervention school, they also increased at a comparable rate in the control school with no indication as to why the results were found (Pendergrast, Ashworth, DuRant, & Litaker, 1992). Again, the intervention was not evaluated beyond immediately post-intervention to determine if the increased levels of helmet use were sustained in either location.

One school based study aimed to teach children how to wear a helmet properly and retain the information for a year (Blake, Velikonja, Pepper, Jilderda, & Georgiou,

2008). Students in the intervention group were given a pre-test, a 60 minute multi-media presentation, a bicycle helmet checklist, a demonstration on how to properly fit a helmet, and then a chance to practice what they had learned. At one-year follow-up, results indicate that while there was no difference between the control and intervention groups with regard to helmet fit, students who participated in the BB&B program scored significantly higher on the helmet checklist and retained the knowledge about correct helmet wearing.

The Pendergrast and Logan studies, mentioned above, also assessed parent attitudes and beliefs about bicycle helmet use (Pendergrast, Ashworth, DuRant, & Litaker, 1992; Logan, Leadbetter, Gibson, Schieber, & al., 1998). Results of these assessments demonstrated that parental attitudes are important. However, one of the failings of many interventions has been that this information about parental influence has not been acted upon. Interventions have not targeted parents as a way to change their child's behavior. Parents have untapped potential to influence whether children wear bicycle helmets or not because they are in the best position to supervise, monitor, support, and encourage helmet use.

Bicycle Helmet Surveillance Studies

In the last ten years bicycle helmet research has identified many facilitators and barriers to helmet use. See Appendix A for a complete list of facilitators. In cross sectional surveys, parental helmet use, children riding with adults, and parental involvement have been found to be facilitators of children's helmet use. Studies found a significant difference in helmet use between children who ride their bicycles with their

parents and those who do not (Ehrlich, Helmkamp, Williams, Haque, & Furbee, 2004; Ehrlich, Longhi, Vaughan, & Rockwell, 2001). Of those that rode with parents, 70% reported always wearing a helmet compared to 40% of the children who do not ride with parents. Other studies have found similar results that riding with a helmeted or non-helmeted adult or riding with friends or siblings who wear a helmet increases helmet use (Liller, Morissette, Noland, & McDermott, 1998; Gielen, et al., 1994; Khambalia, MacArthur, & Parkin, 2005).

These findings support similar results related to parental involvement that had been found previously. In addition to riding with a helmeted adult, Finnoff et al (2001) found that children were more likely to wear a helmet if they had a parent who wore one. In a study of high school student's attitudes about helmet use, Berg and Westerling (2001) found that parental rules about wearing a helmet were significantly associated with children's attitudes toward helmet use and reported use. Of the students who reported always using a helmet, 84% had a parental rule about helmet use while almost none of the children among those without a parental rule wore a helmet (Berg & Westerling, 2001). In a study of 5-14 year olds, parental rules about always wearing were significantly associated with reported helmet use, 88% v 19% for no rule (Miller, Binns, & Christoffel, 1996).

In studies aimed at predicting intentions to wear a bicycle helmet, social norms, past behavior, perceived behavioral control, and behavioral and normative beliefs have been found to predict intentions to use a helmet (Otis, et al., 1992; O'Callaghan & Nausbaum, 2006). Beliefs about the outcomes of wearing a helmet and perceived

support from parents and friends were associated with increased intentions to wear a helmet in a study of 4th -6th graders (Otis, et al., 1992). Findings that normative beliefs predict intentions to wear a helmet are supported by more recent findings that parental involvement increase helmet use. Similarly, a study of high school students in Australia examining intentions to use a bicycle helmet found that perceived social pressure to use a helmet, perceived control, and past behavior best predicted intentions (O'Callaghan & Nausbaum, 2006).

Gaps in the Literature

Reviews of the studies from the public health and injury prevention literature suggest that bicycle helmet research has improved in the last decade, however there are three gaps across bicycle helmet studies. How helmet use is measured continues to limit the strength of findings (Schieber & Sacks, 2001). Bicycle helmet research continues to lag behind other areas in injury prevention and public health with regard to examining health disparities and nested samples.

Measurement of bicycle helmet use continues to be an issue. One measurement concern is how helmet use is defined. Many studies only examine the frequency of use, however, use also implies correct use (chin strap fastened, level, and secure) (Schieber & Sacks, 2001). For example, in school-based interventions, observers may only collect whether a helmet was worn, not whether it was worn properly (VanHouten & Malenfant, 2007). Response categories for self-report helmet use further complicate the matter. There is no classification system used resulting in different surveys obtaining different

results. With no standard measurement system obtaining an accurate estimate of correct helmet use prevalence and comparing across studies remains difficult.

Although many studies report descriptive statistics of gender and race or ethnicity, analysis beyond this has not been examined. Gender differences have been reported using prevalence use rates, however none have examined gender as a moderator of helmet use. This is a potentially important new area of study based on descriptive findings that in certain age groups boys are less likely to wear a helmet than girls (Morris, Trimble, & Fendley, 1994; Hall, Cross, Howat, Stevenson, & Shaw, 2004). The evaluation of helmet interventions would benefit from examining the effect of gender on findings. Another area that helmet studies are deficient is in the examination of racial and ethnic disparities. If race/ethnicity is mentioned in a bicycle helmet study it is to describe the sample. Few studies were found that examined race/ethnicity differences in helmet use (Allen, et al., 2007; Chen, Kresnow, Simon, & Dellinger, 2007). Given that in other areas of health and injury prevention, racial and ethnic differences have been identified, specifically studying race/ethnicity differences in helmet use are needed to improve our understanding of helmet use and intervention development.

The third gap is that bicycle helmet studies do not use multilevel modeling (MLM) to analyze the data to account for the influence of the community or school that the study populations are nested in or the violation of non-independence when repeated measures of helmet use are used. Many bicycle helmet studies are conducted in specific counties or schools, however when the data is analyzed, the influence of the particular location is not accounted for. In a study of psychosocial factors associated with

children's helmet use in three separate counties, logistic multiple regression was used to analyze the data (Gielen, et al., 1994). Differences among the counties were tested using multivariate regression. Multilevel modeling would allow for analysis of the influence of the county characteristics on helmet use, thus providing more precise estimates. Hendrickson (1998) examined how well predisposing, enabling, and reinforcing factors predict helmet use in nine schools at multiple time points. The data were analyzed using multiple regression. In the Bikes, Blades & Boards (BB&B) program, a school based program designed to teach children to properly fit their helmet, data were analyzed using ANOVA (Blake, Velikonja, Pepper, Jilderda, & Georgiou, 2008). The analyses in these studies does not account for the hierarchical structure of the data, students nested within schools, or the repeated measures in the Hendrickson study (1998), calling into question the precision of the results. Of the studies examined, only one used MLM to assess the effects of the data structure (Hall, Cross, Howat, Stevenson, & Shaw, 2004). Multilevel modeling would expand the findings to allow for the examination of variation at each level and across levels. Multilevel models could be used in bicycle helmet research to improve precision in estimates at the individual level and explaining the variation within and between locations (e.g., schools or counties) providing a greater understanding of how each factor relates to helmet use (Raudenbush & Bryk, 2002).

To understand how to develop interventions that can create and sustain behavior change, it is necessary to understand the processes and influences involved with learning to wear a bicycle helmet from the child and parent's perspectives.

Study Rationale

Research to date is characterized by intervention studies or surveillance studies designed to identify barriers or factors related to helmet use. Although much research has focused on identifying determinants of bicycle helmet use, there has been limited success in changing and sustaining children's bicycle helmet use. One reason for this is that how the individual determinants of injury prevention related behaviors interact to impact behavior is not fully understood (Gielen & Sleet, 2003). In order for bicycle helmet research to move forward, foundational knowledge of the processes involved in helmet use and how families and contextual factors influence attitudes and behaviors toward helmet use must be developed. To this end, this study will examine the perceptions of parents and children regarding helmet use and how their perceptions are influenced by the larger social, cultural, political, racial, and gender related contexts that their experiences are embedded in. A social-ecological framework will be used to provide insight and a list of initial concepts to be used during analysis. The use of the social ecological framework will allow this study to build on existing bicycle helmet use literature.

Qualitative methodology, using a grounded theory approach, is particularly well suited to understanding participants' perspectives and the meaning they attach to children's helmet use and can provide an understanding beyond what we already know (Corbin & Strauss, 2008). By understanding how participants' perspectives and values are related to helmet use, it may be possible to develop an intervention at multiple levels

of the social-ecological framework that will increase the sustainability of its effect beyond the initial intervention period.

The studies mentioned have examined many factors that relate to children's helmet use, however these factors have been divorced from the contexts in which they occur, making it difficult, if not impossible, to determine how they influence each other. Using grounded theory as a way to analyze the data allows these issues to be identified. This study uses an innovative method for developing an injury prevention model that with refinement will be used to develop an intervention to increase sustainable bicycle helmet use and reduce bicycle related head injuries in children.

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CHAPTER III

STUDY PROPOSAL

Purpose

This dissertation has two parts. The primary purpose of this dissertation research is to develop a model to describe processes associated with children's bicycle helmet use across intrapersonal, interpersonal, community, institutional, and political contexts. The aim of this study is to gain an understanding of children and parent's perceptions of children's bicycle helmet use and how the perceptions influence helmet use. This dissertation will employ a grounded theory approach. Grounded theory is most appropriate to use for this study because of its unique ability to allow the researcher to develop an understanding of behavior and what it means to the various stakeholders (Creswell, 2003; Singleton & Straits, 2005). From this understanding a comprehensive testable model depicting the processes associated with children's bicycle helmet use will be developed. The secondary purpose is to identify and discuss gaps in the existing bicycle helmet literature. The main research questions for this study are:

- What meaning do children and parents ascribe to helmet use?
- How do children's and parents' attitudes and beliefs about bicycle helmets influence helmet use?

As new insights emerge from the data during data collection and analysis, research questions will continue to be refined and focused.

Sampling

Purposive sampling strategies will be used for this study. The initial strategy will be to recruit a homogeneous sample of typical cases, children who ride bikes and their parents of similar socio-economic status, to gain their perspectives on children's helmet use. Starting with a sample that is similar to each other helps focus the data and will facilitate focus groups (Creswell, 2007). As the data is collected and compared, and it becomes evident which categories need to be elaborated on theoretical sampling will be used. Theoretical sampling is a strategy to select participants who can help build the theory by expanding on properties and dimensions of identified categories (Corbin & Strauss, 2008; Creswell, 2007; Draucker, Martsolf, Ross, & Rusk, 2007). It helps ensure that coding is directed by the evolving data and categories are thoroughly developed (Creswell, 2007; Draucker, Martsolf, Ross, & Rusk, 2007). A potential way to achieve theoretical sampling could be through additional purposive sampling or through snowball sampling. Snowball sampling includes asking participants to refer other parents who may be able to offer insight on a particular category.

It is anticipated that between 40 and 60 participants, split equally between parents and children, will be recruited to ensure that the proposed sample size will offer the broadest range of responses and to allow categories to be fully

developed. Data saturation, the point at which all concepts are well defined and explained, will determine the final sample size (Corbin & Strauss, 2008). Including both parents and children is important to obtain both perspectives on why children wear helmets and under what conditions the theory holds (Creswell, 2007).

Target population and Recruitment

Participants include 3rd – 5th grade bike riding children and their parents living in urban and suburban areas. Children in this age group were chosen because they are disproportionately affected by bicycle related head injuries. Additionally, it is around these ages, 8-11 years old, that children gain more independence and may start riding further from home, but are not yet beyond the influence of their parents. Parents are included as a primary stakeholder because they have been found to play an important role in whether a child wears a helmet (Pendergrast, Ashworth, DuRant, & Litaker, 1992; Logan, Leadbetter, Gibson, Schieber, & al., 1998; Hendrickson & Becker, 2000; Forjuoh, Fiesinger, Schuchmann, & Mason, 2002).

Parents and their children will be recruited through local Boy Scout and Girl Scout troops. Children and parents will be recruited from the same households to gain an understanding of the child versus parent perceptions regarding the child's helmet use. Either a presentation will be made to the parents and children during Scout meetings or names and addresses will be obtained from

organization membership records and members will be mailed a recruitment flyer. The flyer will indicate that in order to participate both the parent and the child must agree and that the child must be a bike rider. Parents and children will be asked when scheduling interviews/focus groups whether the child knows how to ride a bike.

Data Collection

The study will consist of interviews with parents and focus groups with children. Background information, including demographic characteristics, will be collected on each participant to summarize the study population. Additional information will be collected from parents about their bike riding and helmet use behaviors and behaviors related to the child's bike riding.

Parents will complete a onetime 1.5-hour semi-structured in-depth interview. The interview guide is in Appendix B. Interviews will be conducted in public meeting facilities that offer private meeting spaces such as local libraries and churches. Up to 30 interviews will be conducted.

Children will participate in a one-time focus group of five to eight children, lasting no more than 1.5 hours. The focus group guide is in Appendix C. Focus groups will be conducted in public meeting facilities that offer private meeting spaces such as local libraries and churches. Groups will be made up of both boys and girls in 3^{rd} – 5^{th} grade, based on their response to the screening question, "How often do you wear a helmet?" Prior to the focus groups, children

will be screened based on how often they wear a helmet in order to examine perceptions and experiences by how often they report wearing a helmet. Children who report "always" wearing a helmet will be placed in focus groups together and children who report "More than half the time," "About half the time," "Less than half the time," or "Never" will be grouped together as non-use. This more conservative method of categorizing self-report helmet use has been recommended by the National Center for Injury Prevention and Control at the Centers for Disease Control and Prevention's (CDC) as no standardized system exists (Schieber & Sacks, 2001). Although self-report helmet use overestimates use, due to recall bias and social desirability bias, it is an acceptable method and the most efficient for determining use for this study. It is possible that children in the focus group will know each other because they are being recruited from the same organization and many will attend the same schools. Efforts will be made to reduce the number of children in any one group from the same troop or who are in the same grade to minimize the influence friendships may have on the conversation. Focus groups were chosen as the preferred data collection method over interviews for the children given their age so that they would not feel intimidated in a one on one interview.

Both interviews and focus groups are necessary to gain a comprehensive understanding of children and parent's perceptions of children's bicycle helmet use. Focus groups and interviews will be audio recorded. Audiotapes will be

used for verbatim transcription. The researcher will conduct the interviews and moderate the focus groups. A note taker will assist with the focus groups.

Data Analysis

Grounded theory data analysis is an iterative process that requires continual comparison of the data and thus will be concurrent with data collection. Interviews and focus groups will be transcribed verbatim. Data analysis will be conducted using Atlas.ti 6.1 ("ATLAS.ti ", 2009). The transcribed data from each interview/focus group will be compared to the previously transcribed data using the constant comparison method of analysis (Glaser & Strauss, 1967; Singelton & Straits, 2005; Charmaz, 2006; Corbin & Strauss, 2008). This method entails a four stage process to search for patterns in the data at each analytic level: 1) identify concepts or themes relevant to the research questions; 2) checking the frequency and distribution of concepts in the data; 3) assembling support for the observations; and then 4) incorporating the identified concepts into a conceptual framework or "grounded theory" (Glaser & Strauss, 1967) of why children use bicycle helmets. This method is most useful for developing and refining interview and focus group questions, examining variation in the data to identify gaps, identifying new categories and re-evaluating existing categories, and moving beyond describing a single case to conceptulaization of a theory.

Data will be coded using initial, focused and theorteical coding (Charmaz, 2006). During initial coding, data will be coded line-by-line to identify concepts

and categories to capture participants' experiences and to provide leads that can be followed up on in new interviews/focus groups. Using the most frequent initial codes, larger segments of data will be coded using focused coding. Focused coding condenses the number of codes by determining which codes categorize the data most accurately and completely across interviews/focus groups, representing recurrent themes. Foscused coding allows for the reevaluation of categories which may result in initial recoding. Then theoretical coding will be used to specify how the categories maybe related and fit together as a theory. Throughout the data collection and analysis process memo-writing will be used to record what is happening in the data, capture the researcher's emerging thoughts and questions about the data, to fill in codes and categories, and as a space to make comparisons. Memo-writing is an essential aspect of the analysis in that it provides a way to reflect on the data and keeping the emerging theory true to the data (Charmaz, 2006).

Data saturation will help ensure that categories are identified and fully developed. When presenting findings only the most general data will be shared. Findings will be used to develop a model of helmet use and tested for accuracy before being refined and pilot tested.

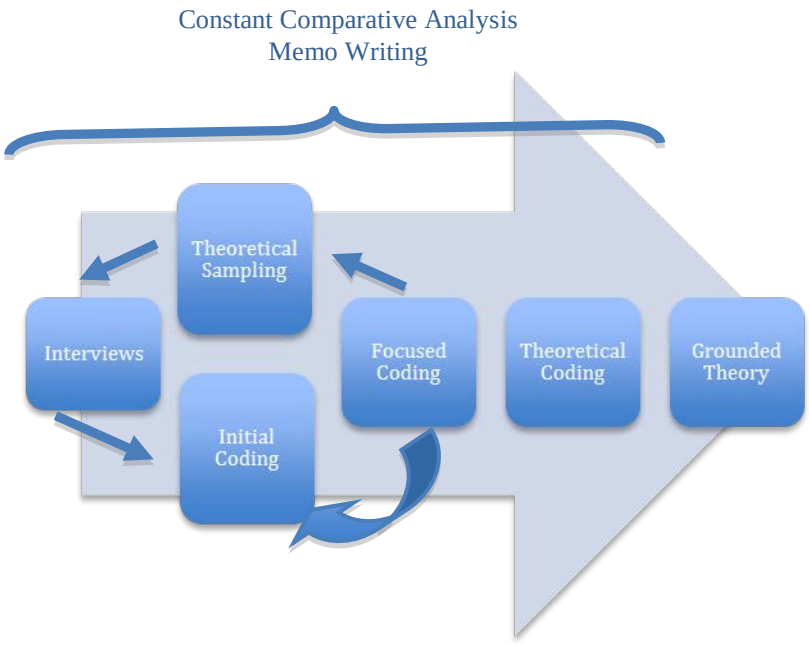

Figure 1. Data Analysis Plan

Focused Review of the Literature

The purpose of the second part of this dissertation research is to expand on the gaps in the bicycle helmet literature identified as part of the literature review and discuss recommendations for future studies. To address this purpose, a systematic review of the literature will be conducted.

Methods

Peer-reviewed publications that are in English, published between 1986-2009, and focused on children under 18 years of age will be reviewed and synthesized. Databases to be searched include Pubmed, CINAHL, and PsychINFO. Search terms include injury prevention, bicycle helmets, barriers to

helmet use, bicycle helmet laws, safety behaviors, trauma, traumatic brain injury (TBI), and theory. A critical analysis of the literature will be conducted and gaps identified. Studies will be examined based on outcome measures, statistical analysis techniques used, and whether group differences related to gender or culture were examined.

Logistics

The projected budget for this dissertation project is presented in Table 2. The researcher time and transcription services will be donated because this is a dissertation project. Although the data analysis software is available at no cost on campus, a student version of Atlas.ti 6.0 was purchased because of the distance between Greensboro and Durham. Site related costs include meeting room rental and refreshments for focus groups. The largest expense is incentives. Participants will receive a $10.00 gift card for their participation. Funding will be requested from the Graduate Student Association for the maximum amount allowable of $400.00 to help offset the costs.

The project is estimated to take 14 months once approved. The timeline includes proposal development, participant recruitment, data collection, transcription and analysis, and report writing. The timeline also includes writing the first manuscript that is intended to be a literature review of the bicycle helmet literature expanding on the gaps identified in the literature review section of this

proposal. The second manuscript will be a data driven paper describing the findings of the study and outlining the proposed theory of children's helmet use.

Table 2. Projected Budget

Budget Item	Cost
Researcher Salary	$ 0
Travel ($0.505 per mile)	$ 0
Transcription Services	$ 0
Software Atlas.ti 6	$ 140
Digital Recording Equipment	$ 0
Site related costs	$ 200
Printing and office supply costs	$ 100
Incentives	$ 900
TOTAL BUDGET	$1340

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CHAPTER IV

MISSED OPPORTUNITIES IN CHILDHOOD BICYCLE HELMET RESEARCH

Abstract

Bicycle helmet use and the effectiveness of helmets have been extensively studied. Although studies from the public health literature suggest that helmet research improved in the last decade, there are several areas of helmet use research that lags behind other areas of unintentional injury prevention. In reviewing the literature, opportunities to advance bicycle helmet use research by improving our understanding of the factors related to and predictors of children's bicycle helmet use were identified. Limiting the focus to intervention studies and children less than 18 years, this article identifies three gaps in the bicycle helmet literature and discusses recommendations for future research to address these gaps by 1) using standard definitions of helmet use and use response categories; 2) placing helmet use in a broader context examining group differences; and 3) using more sophisticated statistical techniques to examine the influence of setting, taking into account nesting and repeat measures.

Keywords: (3) bicycle helmets, missed opportunities, prevention

Introduction

Playing is a part of childhood, but it is not without risk of injury. Bicycling remains a popular childhood leisure activity in the United States (Bull, et al., 2001). Estimates indicate that 27.7 million children ages 5-14 ride bicycles each year (National SAFE KIDS Campaign, 2004). Hospital emergency departments see children with injuries sustained during bicycle crashes more often than from any other sport (National SAFE KIDS Campaign, 2007; U.S. Consumer Product Safety Commission, 2006) and estimates show head injuries occurring in as many as 65% of all bicycle crashes (Finnoff, Laskowski, Altman, & Diehl, 2001; VanHouten and Malenfant, 2007).

When used properly, bicycle helmets can reduce the number of head injuries. Research studies show that helmets can reduce head injuries by 85% - 88% (Attewell, Glase, & McFadden, 2001; Curnow, 2005; Thompson, Rivara, & Thompson, 1989) and injury severity by up to 75% (Bull, et al., 2001; Curnow, 2005), making bicycle helmets an important countermeasure for reducing the number and severity of bicycle crash related head injuries (Bull, et al., 2001; Forjuoh, Fiesinger, Schuchmann, & Mason, 2002; National SAFE KIDS Campaign, 2004; Schieber and Sacks, 2001).

Despite the effectiveness of bicycle helmets, in 2003 only 41% of children, age 5-14 years, were observed wearing a helmet (Cody, Quraishi, &

Mickalide, 2004). Interventions designed to increase helmet use among children have shown short-term success, with effects not sustained long beyond the end of the intervention. For example, a study of children in grades K-6 saw an increase in helmet use during the intervention, however at nine months post-intervention observed helmet use had returned to pre-intervention levels (Logan, Leadbetter, Gibson, Schieber, & al., 1998).

While there is extensive research conducted on children's bicycle helmet use, the majority has focused on intervention and surveillance studies. Research on factors that influence children's helmet use remains understudied. Without this foundational knowledge, our ability to create sustained behavior change lags behind other areas of unintentional injury prevention.

Gaining a better understanding of factors related to unintentional injury has been identified as an important area of study by governmental (NCIPC, 2002) and scientific sources (Gielen and Sleet, 2003; Miller, Romano, & Spicer, 2000). Although bicycle helmet interventions have helped increase national helmet use from 25% to 41% (Cody, et al., 2004) for children, there remain opportunities to increase our understanding of influential factors.

This review focuses on some of these opportunities. It is not an exhaustive review of all bicycle helmet studies, but rather critically examines three areas of research on children's bicycle helmet use where opportunities exist for improvement in research. These three areas of opportunity include issues

pertaining to measurement, attention to group differences, and data analysis. Finally, the paper will explain how attention to these methodological issues could advance our understanding of helmet use, and discuss implications for intervention development and research.

Methods

This review summarizes relevant research on bicycle helmet use in peer-reviewed publications, published in 1986-2011, in English, and focuses on children under 18 years of age. Only those articles that reported the results or evaluations of interventions where one of the main outcomes was an increase in helmet use (including legislative efforts) were reviewed and synthesized (Table 3. Literature Review Table). This review focused exclusively on intervention studies as finding from these studies are most relevant for informing and improving future interventions. Databases searched included Pubmed, CINAHL, and PsychINFO. Search terms include injury prevention, bicycle helmets, bicycle helmet laws, and safety behaviors. Additional studies were identified from reference lists of retrieved articles. A total of 54 studies were gathered from the initial search for articles with helmet use as a main outcome. After determining which articles reported on an intervention or a program or policy evaluation a total of 35 studies were included for this review.

Most of the intervention studies were conducted in the mid-1990s and early 2000s (Table 3. Literature Review Table). Although bicycle helmet use

research has been ongoing for many years, helmet use intervention studies are relatively new, with the first studies appearing in the early 1990s. Over the last 20 years the number of published intervention studies has decreased, with only one study reported in 2011. All the studies reviewed were conducted either in schools or in a larger entity such as a county or a state. School-based interventions included implementation in one or more schools. Community-based interventions included both community-wide, multi-faceted programs and legislative efforts to increase helmet use in a community. Both school and community-based interventions have been successful at increasing helmet use in the study population at posttest.

Measurement Issues

Since the ultimate goal of increasing helmet use is to reduce the number of bicycle crash related head injuries, obtaining accurate estimates of helmet use, while difficult, is critically important. There are many, often over lapping, issues related to helmet use measurement that will be discussed in this section. In particular, issues pertaining to direct observation of helmet use and issues around measuring use by self-report will be identified and discussed.

Measuring Observed Helmet Use

The first issue, which overlaps with so many others, is how helmet use is operationalized. Helmet use can be operationalized as the frequency of use and correct use. Typically researchers define use by measuring its frequency via self-

report. However, the frequency of use may be meaningless if not supported by correct use. Few studies measure correct use. A more useful and meaningful measure of use could include frequency and correctness (Schieber and Sacks, 2001). For a helmet to be worn correctly, it must sit level on the head and the strap must be fastened snug under the chin (Bicycle Helmet Safety Institute, 2010). Correct use offers the best protection for a child's head in a bicycle crash, thus it is essential to reducing bicycle crash related head injuries. Having the chinstrap snugly fastened ensures that the helmet will stay on the child's head in the event of a crash or fall. Having the helmet secure and level on the head keeps the helmet from moving, protecting the child's forehead as well as the back of the head from hitting the ground. While frequency of helmet use is important in preventing head injuries, correct use is essential for optimal head protection. Of the 24 interventions that used observations to assess helmet use, only three also assessed correct use.

Although measuring correct use may not be feasible in all studies, it can be assessed during intervention studies that employ observations to measure helmet use. Intervention studies that include observations at or near schools could assess both frequency and correctness of use. Among the 15 school-based interventions reviewed, only three included both measures (Hall, Cross, Howat, Stevenson, & Shaw, 2004; Ni, Sacks, Curtis, Cieslak, & Hedberg, 1997; VanHouten and Malenfant, 2007).

Observations are typically used to measure correct use while self-report is used to collect frequency of use data. Although observations have limitations due to cost and difficulty defining a sampling frame they offer the most reliable way to assess correct use; remaining the gold standard for measuring helmet use correctness (Schieber and Sacks, 2001). Two issues related to using observations to measure correctness are reliability and inter-rater agreement.

Of the three studies that collected data on correct helmet use, two explained how they trained their data collectors and tested the reliability and inter-observer agreement for the observations. To assess the effectiveness of an intervention aimed at stopping the decline of helmet use post intervention observers were trained to accurately document frequency and correct use using video scenarios. Observer agreement for frequency was 100% and averaged 84% for correct use (Hall, et al., 2004). An intervention at three schools in Florida used similar techniques to train observers to document correct use. Observers, students and research staff, were trained to record correct helmet use using demonstrations, videos of what correct use looks like and inter-observer reliability tests (VanHouten and Malenfant, 2007). The inter-observer reliability for correct use was 93% between adult and student observers. As these studies illustrate documenting correct helmet use is possible by training observers and testing for reliability using inter-observer checks.

Self-Report Response Options

When intervention studies collect self-report data, another measurement issue that arises pertains to the item response options. Although related to how a study operationalizes helmet use, researchers' decisions on the response options provided present a different challenge. This section discusses two issues related to response options, the challenges they present, and opportunities to gain better estimates of the frequency of helmet use. One issue involves the decision to use dichotomous or ordinal scale items to measure frequency of helmet use. Among studies using self (or parent) reported data, eight used dichotomous measures of helmet use frequency. On one hand, dichotomous response options provide a consistent, easy to understand system to categorize helmet use: yes or no. However this option limits the amount of information available to accurately estimate frequency of use and assess intervention effectiveness. By collecting ordinal scale data, researchers can increase the accuracy of helmet use frequency estimates. The second issue is the lack of consistency in response options used across studies. This presents a challenge for synthesizing results and comparing the effectiveness of different intervention approaches. Of the studies reviewed that used ordinal scale response options for helmet use frequency items, nine different response options were identified and three studies failed to report the response categories.

Dichotomous versus ordinal response options. Of the 13 studies that defined helmet use, four used dichotomous (yes/no) items. Dichotomous response categories may lead to inflated estimates of frequency of helmet use by including sporadic use in the estimate. Because helmets offer the most protection when they are worn at every ride and interventions aim to increase helmet use to 100%, the inclusion of sporadic use presents a concern for accurately estimating helmet use and intervention effectiveness. One way to address this issue is to change the options from 'yes' or 'no' to 'always' and 'not always'. This solution allows for more accurate estimates of frequency of helmet use without including sporadic use in the "yes" option. Offering multiple response categories can provide more information and more accurate estimates of frequency of helmet use, however there are concerns with the consistency of response options provided across studies.

Consistency in response options. Six studies reviewed asked questions about helmet use frequency and provided multiple response options. The most common response options were "always," "sometimes," and "never". With no standard classification system, different studies used different response options, thus obtaining different results. For example, one study used the response options "always," "most of the time," "half of the time," "rarely," and "never" while other studies used "always," "sometimes," and "never" or "always or almost always," "more than ½ the time," "less than ½ the time," "never" and "always," "often,"

"sometimes," and "never". Obtaining an accurate estimate of helmet use and comparing findings across studies using multiple response options is difficult. Schieber and Sacks (2001) recommended the following standard helmet use frequency categories: "Always," "More than half the time," "About half the time," "Less than half the time," and "Never." These response options capture true helmet use with the "always" option, a range of sporadic use with three options and nonuse with "never". Having a standard system for responses that captures all levels of use addresses the issue of consistency, allowing comparisons across studies to be made and provides more accurate estimates of use.

Time Period

Another issue in the measurement of helmet use concerns the time period covered in the frequency item. In self-report questionnaires recall bias can be an issue that results in inaccurate estimates of helmet use. Specifying a limited time frame for a question helps reduce recall bias and helps the respondent understand the exact time period that a question refers to, providing a more accurate estimate of helmet use frequency. Studies have addressed this in various ways. Some studies ask very general questions, such as 'do you wear your bike helmet?' (Hendrickson & Becker, 1998; Kendrick and Royal, 2004; Watts, et al., 1997), 'do you wear a helmet at most rides?' (Pendergrast, et al., 1992), or 'when you ride your bicycle, do you ever wear a helmet?' (Lee, et al., 2000; Macknin and

Medendorp, 1994). Another way to phrase the last question is 'do you always wear a helmet when you ride?' (Hall, et al., 2004).

Kirsch and Pullen (2003) addressed this by framing the question on helmet use with a specific time period, 'the last time you rode a bike did you wear a helmet?' Other studies used the same technique of asking about helmet use at the last ride (Dannenberg, Gielen, Beilenson, Wilson, & Joffe, 1993) or in the last month (Bishai, et al., 2003). Other studies address this issue by asking two questions on helmet use with a specific time frame. For example one study asked: 'in the last month did you always use a helmet?' and 'when you rode your bike today, did you wear a helmet?' (Ni, et al., 1997). This issue is related to the issue of dichotomous versus categorical response options because many of these questions use dichotomous response options. To provide even more accuracy in estimates for periods longer than "today's use," questions could be time specific and phrased in a way that allows for categorical response options. To date there are no examples of this in the literature.

Inadequate Attention to Group Differences

Race, ethnicity (Bearinger, Pettingell, Resnick, & Potthoff, 2010; McCoy et al., 2010; Williams, et al., 2007), and sex (Wu, Rose, & Bancroft, 2006) can have a significant influence on health risk behaviors. Group differences, such as sex and race, are important to consider for intervention development, however few studies have done more than report on proportional differences of helmet use

by group. Sex differences are more commonly reported. Most studies do not report differences in helmet use by race, in spite of research indicating that injury risk and safety behaviors vary by race. Likewise there is a dearth of studies that examine the influence of race or ethnicity on helmet use frequency. Group differences as determinants of risk behavior are important factors that need to be studied further to better understand their influence on helmet use as potential leverage points for informing intervention development. To date none of the literature reports on ethnicity, thus it is not included for discussion here. This section will discuss how sex and race are presented in the bicycle helmet use intervention literature and how the data are used in analysis and intervention development, including ways that they can be addressed to advance our understanding of children's bicycle helmet use.

Sex

Research suggests that boys and girls think about (Morrongiello, 1997) and react (Morrongiello, Lasenby-Lessard, & Matheis, 2007) differently to risk, and that parents allow boys and girls to take different risks (Morrongiello and Dawber, 1999). Likewise differences in the frequency with which individuals engage in health behaviors exist by race, ethnicity, and sex for some health outcomes. For example, starting at age 2 there are differences in injury rates between boys and girls for all types of injuries (NCIPC, 2007). Most studies collect data on sex to describe their sample. Although bicycle helmet use studies

sometimes report the proportion of helmet use by sex, to date the bicycle helmet literature has paid little attention to sex related differences and these data have not been examined in detail. Of the 35 studies reviewed, 18 did not collect data on sex, one collected the data but did not report it as part of the study, six studies collected the data using it only to describe the sample, and ten studies reported the percent of helmet use by sex. Only 3 studies examined the relationship of sex on helmet use frequency more closely.

Proportion of helmet use by sex. Findings from several studies suggest that girls wear helmets more often than boys. Rivara et al., (1994) found after a multi-year community-wide intervention that observed helmet use was 47.2% among girls and 38.1% among boys. Similar results were found in other studies. Morris and colleagues, (1994) found that girls were observed wearing helmets more often than boys before and after a four-year helmet use promotion program. Farley and colleagues (1996) found similar results with more girls observed wearing helmets both pre and post intervention than boys. Although there is error in observation measures of helmet use based on the number of observations and the length of time between observations, in general, study results suggest that girls tend to wear helmets more often than boys.

Other studies found that there is little or no difference between the proportion of girls versus boys who wear helmets (Cote, et al., 1992; Dannenberg, et al., 1993). For example, results of an evaluation comparing the effects of

legislation on helmet use in three counties found that use among boys and girls varied by county. One county showed greater helmet use by girls at baseline and follow-up, another county showed greater use by boys at baseline and girls at follow-up, and the third county showed greater use by girls at baseline and among boys at follow-up. These data indicate that helmet use frequency varies by sex, making this variable important to collect and report. However it is critical to move beyond simply reporting helmet use by sex and to test whether statistically significant differences exist.

Most studies only reported the percent of girls and boys wearing helmets, however four tested for statistical significance between the two groups. An evaluation comparing the effects of a helmet promotional campaign on schools in two low-income and two high-income areas, using chi-square analysis, found differences based on sex by income area (Parkin, et al., 1993). In both-income areas boys were observed wearing helmets less often than girls. There was a significant difference in the high-income area with 8% of boys and 21% of girls observed wearing a helmet. A 1995 study examining the effect of an education and helmet subsidy program in high and low income schools, found mixed results (Parkin, et al. 1995). Although girls wore helmets more often than boys (41% versus 37%, respectively) in the high income schools the results were not significant. However, in the low-income areas there was a significant difference between the two groups, with 30% of girls wearing helmets versus 16% of boys.

Evaluation results of a statewide helmet law comparing helmet use in counties with a law and without a law used a chi-square analysis to test whether there was a significant difference in helmet use between girls and boys (Kanny, Schieber, Pryor, & Kresnow, 2001). Although not statistically significant, Kanny and colleagues (2001) found that in counties not covered by the state law girls were observed wearing a helmet more often than boys (37% versus 31%, respectively). LeBlanc and colleagues (2002) found similar results in a pre- post evaluation of the helmet use legislation. Using chi-square analysis, girls were observed wearing helmets significantly more often than boys during two of the three observation periods (LeBlanc, Beattie, & Culligan, 2002). Testing for significant differences is important and more studies could include statistical tests of sex differences. But testing alone is still not enough, it is also critical to examine whether intervention effects differ by sex.

Intervention effects by sex. Only six of the 35 studies reviewed examined whether the intervention effects differed by sex (Karkhaneh, et al., 2011; Hagel, et al., 2006; Hall, et al., 2004; Hendrickson and Becker, 1998; MacPherson, et al., 2006; Morris, Trimble, & Fendley, 1994). Of these, three found significant sex differences. Differences were tested with correlations, odds ratios, prevalence ratios and chi-square analysis.

Using odds ratios, Morris and colleagues (1994), found that girls were twice as likely to be observed wearing a helmet than boys post-intervention.

Results of a school based bicycle safety program evaluation found a statistically significant correlation between the child's sex and reported helmet use at last ride after participating in the program, with more girls reporting helmet use than boys (Kirsch and Pullen, 2003). Findings from two studies compared helmet use pre and post legislation, using relative risk ratios to test for significant sex differences, suggest that girls are more likely to wear a helmet than boys (Parkin, Khambalia, Kmet, & Macarthur, 2003; MacPherson, et al., 2006). Throughout both studies, girls were more likely to be observed wearing a helmet than boys. Hall and colleagues (2004), using odds ratios, found that girls in the intervention group were slightly more likely to report always wearing a helmet at all reporting periods than girls in the control group, with a statistically significant difference at the first posttest. A more recent study examined helmet prevalence pre- and post-law enactment in Alberta, Canada, using prevalence ratios to test for significance, found a statistically significant difference in helmet use between girls and boys. Post legislation, girls were 1.12 times more likely to wear a helmet than boys (Karkhaneh, et al., 2011). Findings from both Kanny and colleagues (2001) and Hagel and colleagues (2006), using chi-square analysis, indicate that although helmet use was higher for girls during all observations, there was not a significant difference between the two groups. From other disciplines we know that girls and boys think about and react differently to risk. Knowing this makes sex an

important demographic variable to examine more closely because interventions may work differently for boys and girls.

Race

In general, injury risk seems to be about the same for Whites, African Americans and Asians (Morrongiello and Schwebel, 2008), however there appear to be group differences for specific injuries (Morrongiello and Schwebel, 2008; Allen, et. al., 2007). Findings suggest that differences in helmet use (Allen, et. al., 2007) and thus head injuries vary by race, but studies have not explored why these differences exist. One reason that race may have an influence on helmet use is culture and level of acculturation (Morrongiello and Schwebel, 2008; Allen, et. al., 2007). Although race is not a measure of culture or acculturation it can be used as a proxy measure.

Even fewer studies report differences in helmet use by race than by sex. Of the 35 studies reviewed, 28 did not collect data on race at all, four studies used the data collected only to describe the sample, two studies reported the percent of helmet use by race, and one study used census tract data to describe the racial profile percentage for the communities the study covered (Macknin and Medendorp, 1994). Two studies simply stated that the majority of helmeted riders were White without providing any additional information (Liller and McDermott, 1996; Liller, et al., 2003).

Proportion of helmet use by race. Of the 35 studies reviewed, only two reported the percentage of helmet use by race. Cote and colleagues (1992) found that in three counties following a mandatory helmet law, White children were observed wearing a helmet more than children of other races. This was true at baseline and follow-up. Helmet use in Howard County for Whites was 5% at baseline and 48% at follow-up, for other races it was 0% at baseline and did not change at follow-up. In Montgomery County baseline use for Whites was 10% and 15% at follow up and 0% for other races at baseline and follow-up. Although one county saw a decline in observed helmet use at follow-up, Whites still wore a helmet more often (Cote, et al., 1992). The Seattle Children's Study, a multi-year community campaign, also found that Whites were observed wearing a helmet more often, 47.8%, compared to 8.2%, 15.5%, and 7.0% for Blacks, Asians, and other races combined respectively (Rivara, et al., 1994).

Only one study tested for statistically significant differences in helmet use proportions by race. In a four county evaluation of a mandatory helmet law, Pearson's chi-square analysis indicated that there is a statistically significant difference in helmet use between White and Black children, regardless of the presence of a law (Kanny, et al., 2001). In counties with a law, 83% of White children and 62% of Black children were observed wearing a helmet. In counties without a law, 38% of White children and 12% of Black children were observed wearing a helmet (Kanny, et al., 2001).

Results of a theory based intervention indicate that being of a race other than White was negatively correlated with self-report helmet use (Hendrickson and Becker, 1998). This study showed that there was a significant negative correlation at baseline and posttest 1. Although only one study was identified that tested whether there was a statistically significant difference in helmet use by race and one examined the association of race and helmet use, the results warrant further investigation. The data on race and helmet use is limited, however given the results of these studies findings suggest that race is related to helmet use.

Intervention effects by race. Studies are needed that examine the relationship between race and helmet use and that examine race as a moderator of helmet use intervention effects. The data are limited; there are not enough studies that test for group differences of intervention effects. Even for studies that examine group differences, the statistical techniques used are inadequate. Using correlation analysis is not an adequate test of moderation and analysis must use techniques appropriate for the data. More studies are needed that examine whether significant differences exist in helmet use by sex and race. Beyond knowing that significant group differences exist, we need to understand how influential group differences are on intervention effects. Studies using appropriate analytic techniques, such as testing interaction effects within logistic regressions (Baron and Kenny, 1986), are needed to examine sex and race as moderators of intervention effects. Study findings suggest that rates of specific

injuries, such as head injuries, vary by race. Although race is not a causal factor for head injuries, it can be used as proxy measure for other variables such as acculturation. Knowing that head injuries vary by race make it an important variable to examine more closely.

Critical Issues in Analysis

The third opportunity for improvement in bicycle helmet studies is the use of sophisticated analytical techniques that could control for the structure of the data and aid in understanding how influential variables are in predicting helmet use. With the recent resurgence of the environment as a factor influencing health, the influence of contextual factors on helmet use could become more important in the formation of research questions and analytic processes used to examine the data. To date most intervention studies have not examined the many contextual variables that influence behavior, such as how characteristics of the setting influence intervention effects. For example, many bicycle helmet studies are conducted in multiple locations to test intervention effectiveness; however they do not examine how contextual factors of the location affect the results. Repeated measures have been used to analyze data collected at multiple time points in some of these studies. Additionally, the design of some of these intervention studies result in nested data where participants are already grouped together, for example in classrooms, schools or counties. Nested data and repeat measures data, with more than two data points per participant, violate the assumption of independence

necessary for traditional regression analysis; however most studies do not use appropriate analytic techniques with these data. One technique that could be used in bicycle helmet use research is multilevel modeling (MLM). Multilevel modeling offers two advantages over traditional regression analysis; 1) it allows researchers to examine contextual differences related to the setting that are largely ignored to date and 2) it accounts for the violation of the assumption of independence in studies where the data are nested or repeated measures are used. Although these are separate issues they can overlap. Researchers in helmet use interventions are not taking full advantage of the methodologies available to them. Multilevel modeling allows us to test for important setting level hypotheses about school or county level characteristics' effects on helmet use as well as individual level variables, thus providing more precise estimates of the intervention effect.

A 4-year helmet use promotion program in Quebec is an example of when multilevel modeling could have been used. As part of the evaluation, census data on community level socioeconomic status of participating municipalities was collected and linked to the individual level measure of helmet use (Farley, et al., 1996). Results from the regression analysis suggest that the socioeconomic status of the municipalities was not associated with helmet use as a main effect at the individual level; however it was associated with use as an interaction term. Although the socioeconomic status of a municipality is not the same as individual level socioeconomic status and is not an individual level variable, the regression

analysis used it as one, potentially leading to erroneous results. Using multilevel modeling, with the municipality as a level-2 variable, could have potentially provided more accurate results, allowing for the influence of the socioeconomic status of the municipality to be examined at the appropriate level. Additionally, using MLM would allow researchers to identify and test other contextual level variables that may influence helmet use. For studies where participants are already grouped, such as in this study, multilevel modeling could be used to account for the fact that the data are not independent from each other as a result of the hierarchical nature of the data.

Multilevel models can also be used to examine the variation in helmet use between settings. Studies have examined the variation of helmet use between settings using relative risk and logistic and multiple logistic regression (MacPherson, et al., 2006; Parkin, et al., 2003; Farley, et al., 1996). However since these techniques do not account for the violation of independence the proportions or the relative risk reported for each setting may not be as precise as they could be. Perhaps more importantly, the techniques do not allow level 2 variables that could influence helmet use to be examined at the appropriate level. One study used MLM to assess the effects of the data structure to examine the variation of helmet use between schools as a secondary question (Hall, et al., 2004). Hall and colleagues (2004) used multilevel modeling to account for school-level clustering. Results of the model indicate that there was a large

variance of helmet use between the schools. These results could have been used to identify school level factors that could be targeted in an intervention.

Multilevel modeling allows the variation of a given variable at each level and across settings to be examined. These sophisticated models could be used in bicycle helmet research to improve precision in estimates at the individual level and explain the variation within and between locations (e.g., schools or counties), providing a greater understanding of factors that may influence helmet use (Raudenbush and Bryk, 2002). The analytic techniques to examine the influence of the community on helmet use were not available when some of the studies in this review were published. However, multilevel modeling techniques will become more important as helmet studies target multiple levels of a socio-ecological model in an effort to understand and influence helmet use behavior.

Discussion

This review of the literature identifies opportunities to better understand children's bicycle helmet use. The first opportunity is to better understand helmet use by operationally defining and measuring it in valid and reliable ways. Practitioners in the field of injury prevention, specifically bicycle helmet use research, could agree on a standard operational definition of helmet use, how to measure use, the response categories provided for self-report data, and how questions about helmet use are framed. Lack of standardization continues to limit the strength of findings (Schieber and Sacks, 2001). Without a standard definition

of helmet use, studies will continue to obtain results that make comparisons across studies difficult. This may also continue to result in frequency counts producing inflated estimates of the protective effects of helmet use among children. Along with a standard definition of use, studies must use standard response categories. The lack of standardization further complicates comparing study results.

Bicycle helmet research continues to lag behind other areas in injury prevention and public health with regard to examining health disparities based on demographic characteristics such as sex, race and ethnicity. A few studies have examined the correlation between sex and helmet use or how likely a child is to wear a helmet based on their sex. Only one study examined significant group differences based on race. Although findings suggest that girls wear helmets more often than boys and that White children wear helmets more often than other races, the existence of these differences is the extent of our knowledge on the subject. None of the intervention studies discussed ethnicity. Questions remain, including:

- How do sex and race influence helmet use?
- Why do these differences exist?

One way to advance the study of children's bicycle helmet use is to use the information from interventions to build the foundation. Knowing that girls and White children are more likely to wear a helmet suggests that interventions may

need to target boys and children of other races differently using tailored messages. However, intervention studies have not used this information. For interventions, we can single out sex, race, or other characteristics to try to understand what types of interventions would work best for each group. Past interventions have ignored these differences. There are no studies examining the effect of sex or race on intervention results either. Two questions that future studies could address are:

- Does sex moderate the intervention effect?
- Does race moderate intervention effects?

Research is needed to understand the influence that group differences may have on children's helmet use and these findings need to be incorporated into interventions.

Understanding how group differences influence helmet use is vital to developing interventions for sustained behavior change. Researchers developing interventions aimed at sustained behavior change must consider that no one intervention approach is going to work for all people, especially when groups think about and approach risk in different ways. With this in mind, future research needs to examine more critically the cognitive and social differences between boys and girls and different races specifically related to helmet use and risk. In intervention studies, examining whether the intervention worked for each group as hypothesized or identifying differential pathways by group, would allow for refining interventions to account for these differences. It should be noted that

it might not be feasible to determine sex, race or ethnicity in all studies. Of the 35 studies examined, only eight reported race and none reported ethnicity. Although it may be difficult to determine sex, race or ethnicity, studies that employ observations for data collection have done so using the observers' best estimate (Karkhaneh, Rowe, Saunders, Voaklander, & Hagel, 2011; LeBlanc, et al., 2002; MacPherson, et al., 2006). Other studies have trained observers using videos and inter-observer comparison checks. In self-report child surveys, where the children may not know or are too young to understand race or ethnicity, it may be helpful for the researcher to assess the child's race or ethnicity after being trained.

Another opportunity to advance the field is to use multilevel modeling techniques to examine the influence of contextual variables on helmet use. Advances in statistical techniques, technology and data linkage have made it possible to create multilevel models that examine individual and environmental level influences as determinants of helmet use. These models allow for the examination of contextual factors that may be related to helmet use and have the potential to provide more accurate estimates of the variation associated with each factor. Research needs to focus on better understanding the influence of contextual factors on helmet use. Using statistical techniques to examine variations in helmet use at multiple levels are important for developing sustainable public health interventions. Research to date has been characterized by intervention studies or surveillance studies designed to identify barriers or

factors related to helmet use. Although much research has focused on identifying determinants of bicycle helmet use, there has been limited success in changing and sustaining children's bicycle helmet use. One reason for this is that we do not fully understand how the individual determinants of injury prevention-related behaviors interact to impact those behaviors (Gielen and Sleet, 2003).

Implications for Helmet Use Interventions

Public health researchers have a unique opportunity to improve helmet use interventions. The data collected, how it is analyzed and presented, and what is done with the findings from studies offer opportunities to expand the helmet use literature. Standardization of the definition and measurement of helmet use is not a new concept (Schieber and Sacks, 2001), although it has not been adopted. If standard definitions and measurements of helmet use were developed and used that would give researchers the data to compare across studies and provide more accurate estimates of children's helmet use.

Another opportunity to improve helmet use research is to use the data collected on groups, such as sex and race, to conduct advanced statistical analysis to examine moderating effects. Knowing whether a group difference moderates an intervention effect and by how much, researchers have the opportunity to use this information to inform interventions tailored to specific groups. For example, if sex was found to moderate an intervention effect, using this knowledge and

knowing that girls and boys think about risk differently, may change the way intervention messages are framed for girls and boys.

Directions for the Future

Several recommendations can be derived from this review. From a public health standpoint, having measures of helmet use that are standardized, gaining a better understanding of how determinants and group differences influence helmet use, and understanding the influence of contextual factors are essential to informing intervention development.

One of the next steps includes incorporating the findings from research in these areas into interventions. This will help researchers and practitioners adjust strategies and activities to create sustainable helmet behavior change and reach groups that may be more resistant to wearing a helmet. To date the bicycle helmet literature has employed predominately quantitative methodology. Overall, an important next step that would be helpful is the use of qualitative methods. Qualitative methods will allow researchers to gain a deeper understanding of the meaning of helmet use for different groups, identify contextual differences between the groups, and identify contextual variables that quantitative methods have not found. This is an important methodological approach to a study that could support the current descriptive findings as well as identify critical variables for future investigations.

Table 3. Literature Review Table

Year	Author(s)	Title	Study	Helmet Use Measures	Analysis	Key Findings
1992	Cote, T. R., Sacks, J. J., Lambert-Huber, D. A., Dannenberg, A. L., Kresnow, M.-j., Lipsitz, C. M., and Schmidt, E.R.	Bicycle helmet use among Maryland children: Effect of legislation and education	Observations	Observed use	Regression	Helmet use increased overall from 4% to 47% post legislation. Helmet use increased in one control county from 8% to 19% and declined in the other, from 19% to 4%. Children over 16 were more likely to wear helmets and kids riding with helmeted adults were more likely to wear a helmet. Sex was not predictive of helmet use. Whites were more likely to wear a helmet at baseline at follow-up than other races.
1992	Pendergrast, R., Ashworth, C., DuRant, R., & Litaker, M.	Correlates of children's bicycle helmet use and short term failure of school level interventions	Questionnaire	Helmet use 'most of the time' *Yes *No *Not sure	Chi-square Logistic Stepwise Regression	Helmet use increased from 4.5% to 16.5% for children at the intervention school and 7.7% to 11.3% at the control school. According to parents 31% of kids who owned helmet did not wear them at posttest. Children in the intervention school more likely to believe that helmets were protective and a good idea. Sibling helmet ownership, parent helmet use, lower parental perceived barriers to use were associated with children's reported helmet use and parental intention to manage child's use. Parental attitudes and behavior play a role in whether children wear a helmet. Parental non-use of helmet was

						associated with parent's lack of intention to manage child's helmet use.
1993	Parkin, P. C., Spence, L. J., Hu, X., Kranz, K. E., Shortt, L. G., & Wesson, D. E.	Evaluation of a promotional strategy to increase bicycle helmet use by children	Observations	Observed use	Chi-square	Overall, observed helmet use went from 3.4% in 1990 to 16% in 1991. Helmet use increased significantly in the high income intervention and control schools, from 4 to 36% for the intervention schools and 4 to 15% for the control schools. Helmet use in the low-income areas also increased. Helmet use in the low-income intervention area went from 1 to 7% and from 3 to 13% posttest for the control area. There was a statistically significant difference in the percentage of boys observed wearing a helmet than girls in the low-income areas (8% vs 21%, p=.001).
1993	Dannenberg, A. L., Gielen, A. C., Beilenson, P. L., Wilson, M. H., & Joffe, A.	Bicycle helmet laws and educational campaigns: An evaluation of strategies to increase children's helmet use	Questionnaire	Wearing a helmet on the most recent ride = 'always' or 'usually' Not wearing on most recent ride = 'Sometimes' or 'Never'	Chi-square Multivariate Logistic Regression	The change in helmet use post legislation was significant in all three counties with the Hayward county having the greatest increase. Students were asked about their helmet use last year and in the last month. In Howard county where the law went into effect, helmet use increased from 11.4% last year to 37.5% in the last month (p<.0001). In Montgomery County use increased from 8.4% to 12.6% (p<.01) and in Baltimore from 6.7% to 11.1% (p<.001). Overall, helmet use increased for both boys and girls, from 12% to 38% and from 11% to 36% respectively.

1994	Cameron, M. H., Vulcan, A.P., Finch, C. F., & Newstead, S. V.	Mandatory bicycle helmet use following a decade of helmet protection on Victoria, Australia - An evaluation	Observations	Observed use	Logistic regression	Helmet use rose from 31% pre-law in 1990 to 75% post-law in 1991. Using logistic regression it was determined that the increase was 1.8 times greater than would have been expected without the law ($p<0.0001$).
1994	Macknin, M. L., & Medendorp, S. V.	Associations between bicycle helmet legislation, bicycle safety education and use of bicycle helmets in children	Observations Questionnaire	*Always *Sometimes *Never *Unknown	Chi-square	Children in communities with a helmet law and education self-reported wearing a helmet more often than children in communities with just a law, 67.6% and 37.2% respectively ($p<0.001$). In control communities without a law or education, self-reported helmet were 17.9% and 21.5% ($p<0.001$). Observed use in the law and education community was 85%.
1994	Rivara, F. P., Thompson, D. C., Thompson, R. S., Rogers, L. W., Alexander, B., Felix, D., & Bergman, A. B.	The Seattle children's bicycle helmet campaign: changes in helmet use and head injury admissions	Observations	Observed use	Descriptive Analysis	Helmet use increased for children from 5.5% to 40.2% between 1987 and 1992. In 1993 helmet use rose to 60%. Helmet use was highest among White children, 47.8% compared to 8.2% for Blacks and 15.5% for Asians. Girls were observed wearing helmets more often than boys, 47.2% and 38.1%, respectively.
1994	Morris, B. A., Trimble, N. E., & Fendley, S. J.	Increasing bicycle helmet use in the community	Observations	Observed use	Chi-square	From 1990 to 1991, there was a significant increase in helmet use from 5.4% to 15.4%. There was a significant increase in helmet use for girls over the study period from 4.4% to 30.9% ($p<0.00001$). The increase for boys was 5.6% to 11% ($p=0.012$). Overall, girls were twice as likely to be observed wearing a helmet, 15.7% compared to 8.1%.

1995	Parkin, P. C., Hu, X., Spence, L. J., Kranz, K. E., Shortt, L. G., & Wesson, D. E.	Evaluation of a Subsidy program to increase bicycle helmet use by children of low-income families	Observations Questionnaire	Observed use	Chi-square	Overall helmet use increased from 3.4% to 28% ($p<.001$) between 1990 and 1992. Observed helmet use increased from 10-47% in the low and high-income areas. There were no differences between observed helmet use in the low-income intervention and control areas, 18% versus 19%. Helmet user in the high-income areas was 48% and 20% in the low-income area. More girls than boys were observed wearing helmets. Use in the high income areas between girls and boys was not significant, 41% and 37% respectively. However in the low-income areas, there was a significant difference in use between girls and boys, 30% versus 16% ($p<.001$).
1996	Liller, K., & McDermott, R.	Increasing children's helmet use through a school based intervention	Observations Questionnaire	Observed use	Descriptive Analysis	Overall helmet use increased from 3.6% in 1993 to 14% in 1996. In the pilot schools, helmet use increased from 6% to 61% over the 3 years. Helmet use in the control schools remained at 10% pre and post study period. The majority of children observed wearing helmets were White.
1996	Farley, C., Haddad, S., & Brown, B.	The effects of a 4-year program promoting bicycle helmet use among children in Quebec	Observations	Observed use	Logistic Regression	Helmet use overall increased from 1.3% pre implementation to 33% at the end of the 4 years in the study group. Use also increased in the control group from about 1.3% in 1991 to 14% in 1993. Results indicate that the study effects were not significantly different for boys and girls ($p=.4$). Helmet use was significantly associated with sex; girls were observed wearing helmets 1.5 times more often than boys (99%

						CI, 1.26 to 1.88).
1997	Ni, H., Sacks, J., Curtis, L., Cieslak, P., & Hedberg, K.	Evaluation of a statewide bicycle helmet law via multiple measures of helmet use	Observations Questionnaire	Observed use Correct use * Always use *Day of survey use	Descriptive Analysis	Observed statewide helmet use increased from 24.5% to 49.3% post-law. Helmet use observations at the middle schools increased from 20.4% to 56.1%. Helmet use increased for both boys and girls. At both observations girls wore a helmet more often than boys, 24.5% and 65.2% for girls pre and post-law and 19.5% and 53.7% for boys pre and post-law. Pre-law, 6.6% of riders were observed with a helmet but not wearing it or wearing a helmet incorrectly and 8.6% were observed post-law. All pre-law and post-law prevalence differences were statistically significant ($p<0.01$).
1997	Watts, D., O'Shea, N., Ile, A., Flynn, E., Trask, A., & Kelleher, D.	Effect of a bicycle safety program and free bicycle helmet distribution on the use of bicycle helmets by elementary school children	Questionnaire	*Always *Sometimes *Never	Chi-square	Self-reported helmet use increased significantly after the safety program from 38% at baseline to 46% post intervention ($p<0.005$).

1998	Britt, J., Silver, I., & Rivara, F. P.	Bicycle helmet promotion among low income preschool children		Observed use	Chi-square	There were increases in observed helmet use in both the intervention and control groups. Helmet use in the intervention increased from 43% to 89% and in the control group from 42% to 60%. The change in the intervention group was statistically significant compared to the change in the control group ($p<0.05$).
1998	Hendrickson, S. G., & Becker, H.	Impact of a theory based intervention to increase bicycle helmet use in low income children	Questionnaire	Do you wear a helmet Yes/No	Correlation 'hierarchical' Multiple Step-Wise Regression	Self-reported helmet use was significantly correlated with being White before the intervention and immediately following the intervention ($r=-0.131$, $p<0.01$ and $r=-0.123$, $p<0.01$, respectively), however it was not correlated at the one month post intervention follow-up. Sex was not significantly correlated with self-report helmet use at any of the data collection periods. Helmet use in the intervention schools increased from 26% to 91%. Helmet use increased in the control schools as well, from 17% to 33%. Results of the hierarchical regression to predict helmet use at time 2 indicate the being in the intervention group versus the control significantly predicts helmet use ($r=0.847$, $p=0.019$). The child's sex was not predictive of helmet use at time two.

1998	Logan, P., Leadbetter, S., Gibson, R., Schieber, R., Branch, C., Bender, P., Zane, D., Humphreys, J., & Anderson, S.	Evaluation of a bicycle helmet giveaway program – Texas, 1995	Observations Questionnaire	Observed use	Chi-square	Observed helmet use pre intervention was 3%. One day post intervention observed use increased to 25%. Use at two weeks and 7 months post intervention increased to 30% and 38% respectively. However at the 9 month follow up, the only 5% of children were observed wearing a helmet.
1999	Borglund, S. T., Hayes, J. S., & Eckes, J. M.	Florida's bicycle helmet law and a bicycle safety educational program: Did they help?	Retrospective record review	None	Chi-square	Post-law there was a significant increase in helmet use, from 5.8% to 20.8% ($p<0.05$). The greatest increase in use was for ages 10-12, from 0% to 26.9% ($p<0.05$).
2000	Floerchinger-Franks, G., Machala, M., Goodale, K., & Gerberding, S.	Evaluation of a pilot program in rural schools to increase bicycle and motor vehicle safety	Observations	Observed use	Regression	In 1997, observed helmet use was 33.9%. This increased to 36.0% in 1998. There was a statistically significant increase in helmet use between the intervention schools compared to the control schools ($p=0.0134$).
2000	Lee, A. J., Mann, N. P., & Takriti, R.	A hospital led promotion campaign aimed to increase bicycle helmet wearing among children aged 11-15 living in West Birkshire 1992-98	Questionnaire	*Always *Sometimes *Never	Mann-Whitney test	After five years of a helmet promotion campaign, there was a statistically significant increase in self-reported helmet use from 11% to 31% for the intervention group ($U=49155$, $p<0.001$). Helmet use in the control group also increased during the study period, although it was not significant, from 9% to 15%. The difference in helmet use between the two groups was statistically significant ($U=68654.5$, $p<0.001$).

2000	Hendrickson, S. G., & Becker, H.	Reducing one source of pediatric head injuries	Questionnaire	None	Descriptive Analysis	Self-reported helmet use at pre-test ranged from 16.7% to 34.5% across the six schools. Helmet use increased in all three conditions and at both follow-up tests. For schools in the classroom and parent intervention helmet use increased from 26.7% to 96.7% and 98.0% at the two follow-up periods. In the classroom only intervention schools helmet use increased from 13.6% to 92.9% at the first follow-up point and then decreased to 82.8% at the second follow-up period. For the control schools, helmet use increased from 16.7% to 33.3% and 62.5% at follow-up.
2000	Wesson, D., Spence, L., Hu, X., & Parkin, P.	Trends in bicycling-related head injuries in children after implementation of a community-based bike helmet campaign	Observations	Observed use	Descriptive Analysis	Results of the community based bicycle helmet campaign show that helmet use increased from 4% to 46% in a five year time period. During the last year of data collection, a mandatory helmet law went into effect increasing observed helmet use from 46% to 67%.

2001	Kanny, D., Schieber, R. A., Pryor, V., & Kresnow, M.-j.	Effectiveness of a state law mandating use of bicycle helmets among children: an observational evaluation	Observations	Observed use	Chi-square and Cochran-Mantel-Haenszel	Overall, observed helmet use was 78%. There was a statistically significant difference in observed helmet use in counties with a law versus counties without a helmet use law. Observed use in counties with a law was 79% compared to 33% in counties without a law (p=0.001). Helmet use for girls and boys in counties with a law was not significantly different, 81% for girls versus 79% for boys. The same was observed in counties without a law, with 37% of girls observed wearing a helmet versus 31% of boys. However, in counties with and without a law race was statistically significant, with more White children observed wearing a helmet than Black children (p=0.001).
2001	Quine, L., Rutter, D., & Arnold, L.	Persuading school-age cyclists to use safety helmets: Effectiveness of an intervention based on the Theory of Planned Behaviour	Questionnaire	Yes/No	Chi-square	In a group of non-helmet users, at the end of the intervention, helmet use increased significantly in the intervention group to 25%, while there was no increase in the control group (p=0.001).
2002	LeBlanc, J. C., Beattie, T. L., & Culligan, C.	Effects of legislation on the use of bicycle helmets	Observations	Observed use	Chi-square	Helmet use in 1995, before the law was enacted was 36% and 38% in 1996. Once the law went into effect, helmet use rose to 75% and continued to increase for the next two years of observations to 84% in 1999. At the 1995/96 and the 1997 observations, there was a statistically significant difference in helmet use by sex, with more girls observed wearing a helmet than boys (p=0.008 and p=0.001,

						respectively).
2003	Kirsch, S. E. D., & Pullen, N.	Evaluation of a school-based education program to promote bicycle safety	Questionnaire	The last time you rode your bike did you wear a helmet? Yes/No	Spearman Rho Correlation	Results indicated that there was a statistically significant correlation between participating in the program and helmet use ($r=.147$, $p<0.05$). The correlation between sex and helmet use was also statistically significant with more girls reporting helmet use ($r=.119$, $p<0.05$).
2003	Delamater, A. M., & Patino, A. M.	Bicycle helmet wearing in children: a seven-year, observational study in Broward County, Florida.	Observations	Observed use	Z-scores	In 1994-1996, pre-law, observed helmet use was 8.3% for elementary school children and 0% for middle school children. Post-law, 2000-2001, helmet use increased to 71.5% and 22.0% for elementary school and middle school children respectively. Results indicate that there was a statistically significant difference in the proportions of children wearing helmets after the law was implemented ($z=29.8$, $p<0.0001$).
2003	Bishai, D., Qureshi, A., Cantu, N., & Parks, C.	Contracting with children and helmet distribution in the emergency department to improve bicycle helmet use	Questionnaire	"Always wore helmet in month after visit." Yes/No	Unadjusted Odds Ratios	Baseline helmet use rose in both intervention groups and the control group. Baseline helmet use in the helmet groups was 25%, 35% in the counseling only group, and 33% in the control group. Post-intervention helmet use rose to 74% in the helmet group, 55% in the counseling group, and 42% in the control group at the 4-week follow-up (OR=2.66; 95% CI, 0.90 to 7.95).

2003	Liller, K. D., Nearns, J., Cabrera, M., Joly, B., Noland, V., & McDermott, R.	Children's bicycle helmet use and injuries in Hillsborough County, Florida before and after helmet legislation	Observations	Observed use	Chi-square Trend analysis	Helmet use rose significantly after the law was implemented, from 3.6% in 1993 to 67.0% in 1998 (OR=55.2; 95% CI, 36.1 to 84.5). Results indicate that there was statistically significant difference in helmet use for Whites and other races, with Whites wearing helmets more often ($p<0.05$). Results of the trend analysis indicated that the increase in helmet use post-law was significantly greater than would normally have been expected without a law ($p=0.0001$).
2003	Parkin, P. C., Khambalia, A., Kmet, L., & Macarthur, C.	Influence of socioeconomic status on the effectiveness of bicycle helmet legislation for children: a prospective observational study	Observations Questionnaire	Observed use	Logistic Regression	Helmet use increased over the 8-year study period, with the largest increases post-legislation. Helmet use at the start of the study, in 1990 was 4% and 44% in 1995. After the legislation was passed helmet use rose to 68% in 1996. Helmet use was greater for girls than boys throughout the study period. Helmet use increased most significantly in the low income (RR=1.86; 95% CI, 1.64 to 2.11) and mid-income areas (RR=1.58; 95% CI, 1.39 to 1.80). Girls wore helmets more often than boys (RR=1.43; 95% CI, 1.66 to 1.50).

2004	Kendrick, D., & Royal, S.	Cycle helmet ownership and use; a cluster randomised controlled trial in primary school children in deprived areas	Observations Questionnaire	Observed use *Always *Sometimes *Never	Logistic Regression	There was no significant difference in helmet use between the intervention groups at baseline. There was a statistically significant increase in helmet use for the educational program with helmet give away at follow-up (difference between means = 6.9; 95% CI, 0.1 to 13.8, p=0.048).
2004	Hall, M., Cross, D., Howat, P., Stevenson, M., & Shaw, T.	Evaluation of a school based peer leader bicycle helmet intervention	Observations Questionnaire	Observed use Correct use *Always *Not always	Odds Ratio ANOVA	Girls were more likely to report always wearing a helmet versus boys (OR=1.3). Additionally, for students who reported that they did not always wear a helmet at baseline, there were increased odds of reporting always wearing a helmet at posttest 1 (OR=1.8) and posttest 2 (OR=1.3) in the intervention schools compared to students in the control schools. There was a statistically significant difference at posttest 1 between the groups (z=2.33, p=0.020). Observer agreement exceeded 94% for correct use. Correct use declined over the study period from 32% at baseline to 24% at post test 2.

2006	MacPherson, A. K., Macarthur, C., To, T. M., Chipman, M. L., Wright, J. G., & Parkin, P. C.	Economic disparity in bicycle helmet use by children six years after the introduction of legislation	Observations	Observed use	Relative Risk	Helmet use increased from 45% in 1995, pre-legislation, to 68% in 1997. In high income areas helmet use in 1995 was 75%, 50% in mid-income areas and 33% in low-income areas. By 2001, six years after the law was enacted, overall helmet use had declined to 46%. However in the high income areas, helmet use in 2001 was 85%. Helmet use in the mid and low-income areas had declined to pre legislation levels of 50% and 33% respectively. Children in the high-income areas were twice as likely to wear a helmet, both in 1995 and 2001, than children in the other areas (RR=2.2; 95% CI, 1.9 to 2.5) and RR=2.6; 95%CI, 2.2 to 3.0) respectively). Girls were more likely to wear a helmet than boys (RR=1.7; 95% CI. 1.5-1.8).
2006	Hagel, B. E., Rizkallah, J. W., Lamy, A., Belton, K. L., Jhangri, G. S., Cherry, N., & Rowe, B. H.	Bicycle helmet prevalence two years after the introduction of mandatory use legislation for under 18 year olds in Alberta, Canada	Observations	Observed use	Poisson regression Prevalence Ratios	Helmet use in children rose significantly post helmet legislation from 28% in 2000 to 83% in 2004 (adjusted prevalence ratio 3.69; 95% CI, 2.65 to 5.14). There was not a significant difference found by sex.

2007	VanHouten, J., & Malenfant, J.	Impact of a comprehensive safety program on bicycle helmet use among middle-school children	Observations	Observed use Correct use	Descriptive Analysis	Helmet use increased at all three schools during the intervention. At Bonita Springs, helmet use rose from 14% to 45%. It rose from 82% at Riviera to 98% and from 52% at Meadowlawn to 95%. Correct helmet use also increased at all the schools. From 9% to 40% at Bonita Springs, 64% to 80% at Riviera, and 30% to 78% at Meadowlawn. Observers were trained to identify and record correct use. At baseline, correct use averaged 9% at Bonita Springs, 64% at Riviera, and 30% at Meadowlawn. During the study period correct use increased to 40% at Bonita Springs, 80% at Riviera, and 78% at Meadowlawn.
2011	Karkhaneh, M., Rowe, B. H., Saunders, L. D., Voaklander, D., & Hagel, B.	Bicycle helmet use after the introduction of all ages helmet legislation in an urban community in Alberta, Canada	Observations	Observed use	Prevalence Ratios	Helmet use increased from 45% to 92% between 2000 and 2006 when the law was enacted (PR=2.03; 95% CI, 1.72 to 2.39). There were significant increases in helmet use for children and adolescents. Helmet use rose from 63% to 100% for children (PR=1.59; 95%CI, 1.38 to 1.82) and 10% to 76% for adolescents (PR=8.00; 95%CI, 1.60 to 39.9). After controlling for other covariates, girls wore a helmet 12% more often than boys, a statistically significant difference (PR=1.12; 95% CI, 1.02-1.22).

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CHAPTER V

HOW PARENTS BALANCE ANXIETY AND PERCEIVED RISKS OF BIKE RIDING WITH THEIR CHILDREN'S NEED FOR AUTONOMY: A GROUNDED THEORY APPROACH

Abstract

For many children bike riding offers a fun form of recreational activity and transportation. However bike riding has inherent dangers. Children between 5-14 years old are disproportionately affected by bike related injuries. Although wearing a bicycle helmet can protect a child's head in a crash, many children do not wear helmets when they ride. Long-term success of interventions to increase children's helmet use has not been realized. Parents play a key role in children's safety. This qualitative study used grounded theory methodology to examine the process parents use to assess and manage risks associated with their children's bicycle riding. Fifteen parents participated in in-depth interviews. From the data a model emerged explaining the cognitive and behavioral processes parents utilized to balance their anxiety around their perceived dangers of bike-riding with their understanding of their children's need for autonomy as they developed. By understanding the process parents use to make safety decisions, effective programming could be implemented to increase children's helmet use. Implications for intervention development are addressed.

Keywords*: risk management, parental anxiety, safety management, bicycle helmet use*

Introduction

Bike riding is a part of childhood for many children and many parents have fond childhood memories of riding their bicycles. It is estimated worldwide 27.7 million kids (aged 5-14) ride bikes each year (National SAFE KIDS Campaign, 2004). Bike riding is not only fun for kids, it is a good form of physical activity and a clean form of transportation. For all the positives, bike riding is not without risk. Bicycles are associated with more childhood injuries than any other product except cars. Head injuries continue to be a major cause of bicycle crash-related deaths. When worn correctly and consistently, helmets can reduce the risk of head injury in a bicycle crash by up to 85% (Attewell, Glase, & McFadden, 2001; Curnow, 2005) and brain injury by up to 88% (Bull, et al., 2001; Curnow, 2005). However, in a 2001 multi-state study only 41% of children between 5-14 were observed wearing a helmet (Cody, Quraishi, & Mickalide, 2004).

Helmet use interventions are a critical component of bike safety programming. These interventions target established factors that influence children's helmet use. The role of parents in children's helmet use and safety behaviors has been established (Pendergast, Ashworth, DuRant, & Litaker, 1992),

however few interventions target parents. Even when interventions include parents, resulting increases in children's helmet use are short-term. Intervention messages for parents focus on increasing knowledge and awareness and changing attitudes. While parents are aware helmets can protect their child's head, this knowledge has not translated into increased helmet wearing by children (Bernstein, Harper, Pardi, & Christopher, 2003).

Although interventions may target parents and parents' role in children's helmet use has been established, studies have not examined how parents' understand bicycle safety and perceive risks associated with their children's bicycle riding. Both theoretical constructs and results from observational studies have identified the importance of parental influence on increasing children's helmet use (Berg & Westerling, 2001; Cody, 2004; Hendrickson & Becker, 1998; Logan, Leadbetter, Gibson, Schieber, & al., 1998; Pendergrast, et al., 1992), however how parents assess and manage risks associated with their children's bicycle riding has not been identified. Understanding this process is critical for developing effective parental components in helmet use interventions. The purpose of this study was to understand how parents assess and manage risks associated with their children's bike riding by developing a model grounded in parental experience.

Methods

Parents were recruited through local Girl Scout and Boy Scout troops. Inclusion criteria included: being the parent of a 3rd to 5th grade child who rides a bicycle and lives in an urban or suburban area. This age group was chosen because not only are they disproportionately affected by bicycle related head injuries, they are also gaining independence from but are not yet beyond parental influence. Thus this period is a critical window of opportunity for increasing parental influence on helmet use and preventing subsequent injury.

Interested parents completed a screening form to make sure they met inclusion criteria. Thirty-two parents completed the screening and were contacted via email. One parent responded by email and the remaining parents were followed-up by telephone. Of these, 18 were reached and 15 agreed to participate.

The final participants were 15 parents who were mostly married (12), white (13), and mothers (11). Two interviews were conducted with both parents present and two with just the father. Parents' average age was 42 years old. Families had between one and four children with an average age of 9.5 years old. Most of the parents (13) lived in houses in middle to upper middle income neighborhoods, one parent lived in a townhouse in an upper middle income neighborhood, and one parent lived in an apartment in a lower income

neighborhood. The Institutional Review Board of the University of North Carolina at Greensboro approved this study.

Semi-structured in-depth interviews were conducted in the family's home from October 2009 – August 2010, lasting between 25 and 50 minutes. All participants provided informed consent and received a gift card for $10 for their participation. The interview guide covered their child's bike riding history, current bike riding behaviors and parental concerns. Parents were also asked demographic questions about themselves and their children. Additional information was collected from parents about their own bike riding and helmet use behaviors and behaviors related to the child's bike riding. Interviews were audio recorded and transcribed verbatim.

Using theoretical sampling to ensure that coding was directed by the data and evolving categories were thoroughly developed (Charmaz, 2006; Draucker, Martsolf, Ross, & Rusk, 2007), follow-up interviews with four parents were conducted in August 2011 and lasted between 15 and 40 minutes. Based on the initial interview data, questions about parents' cycling history were specifically added to subsequent interviews.

Using constant comparative analysis (Glaser & Strauss, 1967), data were analyzed concurrent with data collection. Charmaz' (2006) coding method was used. Data were initially coded line by line to identify concepts that captured participants' experiences and provided leads that were followed up on in

subsequent interviews. Next, initial concepts were used to code larger data segments through focused coding. Focused coding condensed the number of concepts by determining the most accurate and complete data categorization across interviews: 39 focused codes were identified. Recurrent themes emerged from the focused codes, resulting in five categories. In the final stage, theoretical coding, data were reexamined to conceptualize relationships between categories by identifying causes, conditions, responses, and consequences related to parental attitudes, beliefs, and experiences of their children's bicycle riding. Throughout the process memo-writing was used to record the analytic process, data interpretations, fill in categories, and make comparisons. This was an essential aspect of the analysis, providing a way to reflect and keep the emerging theory true to the data (Charmaz, 2006).

Findings

From descriptions provided, a model emerged explaining the cognitive and behavioral processes parents utilized to balance their anxiety around perceived dangers of bike-riding with their understanding of their children's developmental needs for autonomy (see Figure 1). The model depicts a tension that resulted from two competing demands on parents: keeping their children safe and developing their autonomy. This tension drove parents' cognitive (Managing Risk) and behavioral (Mitigating Harm) processes as they attempted to balance these demands. A cyclical loop exists between cognitive and behavioral

processes and perceptions of children's developmental needs. This loop represents parents' reassessments of their children's developing needs. While their anxiety remained constant, their children's increasing needs for autonomy resulted in changes to how they managed risk and mitigated harm.

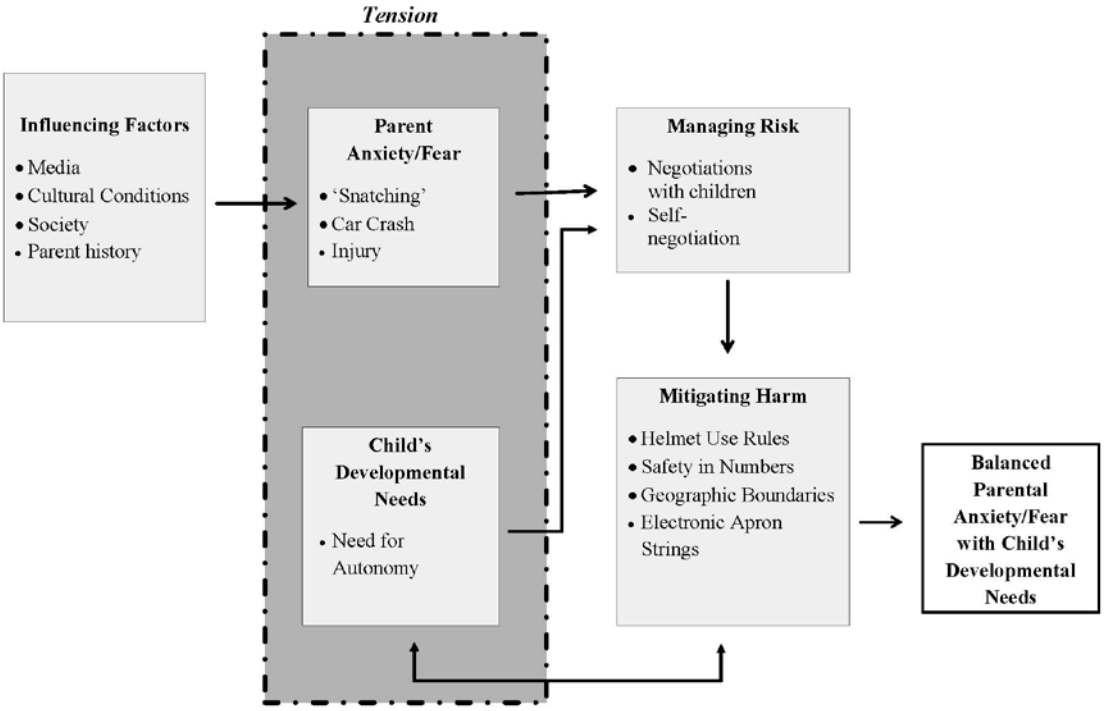

Figure 2. Balancing Parents' Fears with Children's Need for Autonomy

Influencing Factors

Parents' fears were influenced by the media, societal and cultural conditions and their childhood bike riding history (see Figure 1). These factors interacted to help create parental perceptions of the world as a dangerous place for children. Parents reported media depictions as fueling these perceptions. As one mother explained, 'And the media didn't bombard you back then with stories of kids who were snatched out of their very own bedrooms much less off the street when they were miles away from home.' Parents also described a lack of "community" in their neighborhoods, which increased their perception of the risks of bike riding. Parents knew a handful of their neighbors and did not feel their neighbors would help if their children got hurt while riding in the neighborhood. Only one mother said she counted on her neighbors to help with her kids. She felt they would tell her if her children did something wrong and would help them if they got hurt.

Parents' perceptions of current risks were in sharp contrast to their memories of their own childhood. Parents reported great freedom in how and where they rode their bikes. They also reported a lack of helmet-wearing. Parents' recalled growing up in neighborhoods that embodied a sense of community; a community where most kids played outside, parents were out talking, and everyone knew and looked out for each other. Parents also felt the media did not depict dangers such as kidnapping to the extent they do today.

Their memories of the world as a safer and simpler place acted as reminders that the current world is more dangerous and, by increasing their fear and anxiety, affected how they managed these perceived risks and mitigated potential harm to their children.

Fear/Anxiety

While parents responded emotionally to perceptions of the world as dangerous, their responses to bike-riding risks ranged from mild concern to worry and fear. A few parents were mildly concerned that their child would fall off their bike and get hurt. One parent felt that this was part of being a kid so although she thought about it, it didn't worry her. No one mentioned their child falling and hitting her/his head as something that worried them. Almost all parents worried their child would be struck by a vehicle because of increased traffic and lack of attention by drivers. For parents who rode with their children traffic seemed to be the greatest risk. In general however, traffic was not the risk that worried parents the most.

At the forefront of parents' mind was the fear that someone would intentionally harm or kidnap their child. Parents spoke as if the world was more dangerous today than when they were growing up, thus they responded differently from their parents when allowing their children to ride bicycles. As one mother illustrated,

> I just think there are, whether real or imagined there are more dangers out there…we would ride our bikes for miles and miles, I can't even imagine letting my kids go miles away from home on their bicycles. I would be afraid someone would snatch them…we never worried about people snatching kids off the street when I was a kid…Um, it would probably never happen, but it's something that I think about.

Even though parents knew rationally that the likelihood of their child being 'snatched' was low, emotionally it still caused fear.

Child's Developmental Needs

Parents were aware that as their children aged their developmental needs changed, especially their need for autonomy. The perception of this increasing need was a motivating force for changing how they thought about risk and risks they allowed their children to take. The relationship between children's need for autonomy and parental decision-making around risk started when children first learned to ride a bike. One parent, whose child got their first two-wheel bike at age 3, said that she knew her son was a little young but he was 'ready'. Another mother described that her daughter was 'ready' to take her training wheels off because she '…thought she could do it...' In most cases parents assessed perceptions of children's readiness but sometimes children expressed their need for autonomy. As one mother explained: "She came home and said "I want to ride my bike without my training wheels." I was like, "All right, fine." And I took them off..." As children aged, parents' focus on their needs for autonomy shifted to issues of where, how long, and with whom they could ride.

Managing Risk

Managing risk is the cognitive process occurring when parents made decisions about their children's bike-riding habits. It is a dynamic process, changing as children aged and parents perceived their need for autonomy increasing that allowed parents to provide their children with opportunities for independent riding while still maintaining an element of control. However, responding to the increased need for autonomy was difficult for parents because their fears had not changed. When children were young, parents managed the risks without input from the children. As their children developed they might be included in these decisions. Managing risk represents how parents negotiated with themselves or with their children to alter the rules governing their children's bike-riding habits while trying to manage with their own anxiety. As one mother describes it:

> … you just don't let your kid go off and wander around on their bike. But I'm not going to keep them inside, you know…"keep him in a plastic bubble." I mean, you have to let them go out and explore a little bit, and you just make it the safest way you can make it for them to do that and hope for the best.

Central to the model is the tension between parents' implicit recognition of their child's changing developmental needs, specifically for increased autonomy, and their fears about safety. Parents struggled to balance the competing needs of allowing their children to grow and develop into healthy

young adults and coping with their own fear and anxiety around their children's safety. One mother described the delicate balance she maintained between perceptions of danger and her children's age by incorporating new strategies to alleviate her anxiety.

> I feel like it was a lot safer when I grew up. I probably wouldn't let my kids, now, as they're getting a little bit older I would, but only if they had a walkie-talkie or a cell phone with them…, versus that was never an issue, we just took off and went. … I don't know, maybe it's the eyes difference of a parent, hearing like all the media things and stuff I wouldn't probably let them elementary school-wise have been out without me being out there with them.

This was a recurrent theme for parents from the time their child was learning to ride a bike to today. As children developed, parents changed how they managed the risks and the strategies they used to minimize harm, thus creating periods of heightened and lessened states of fear and anxiety.

Mitigating Harm

Mitigating harm represents strategies parents' employed to reduce the risks they perceived when allowing children more autonomy in their bike riding. Parents changed their strategies as their children developed and became more experienced bike riders. When children first learned to ride there was one set of strategies and rules. As children matured new rules and strategies were implemented to try and balance parents' fears with their understanding of their children's growing needs. Parents mentioned several strategies used to mitigate

harm when their children were riding bikes. Some strategies were directly related to reducing the contingency of harm or abduction by a stranger while others reduced the likelihood the child would be injured while riding. Strategies included using a helmet, limiting where the child could ride and for how long without checking in, having to ride with a friend, sibling or parent, and staying connected to the child when out of visual contact.

Instilling helmet use. Parents felt purchasing the helmet with the child's first two-wheel bike would make bike riding synonymous with helmet use. Parents did not have their kids wear helmets with their tricycles, but as one mother explained, 'as soon as they got their two wheelers, I made them wear their helmets so that they could get used to it.' Parents reported that helmet use was nonnegotiable when children were young and first learning to ride, but as kids got older parents weren't as consistent about enforcing use.

Setting geographical boundaries. Parents used boundaries to help alleviate fears around snatching and traffic. As one parent explained, when her child first learned to ride she had to stay on their street. Implicitly and without discussion, as her child got older she was able to ride with her sister or friends a little farther: first to the next cul-de-sac, then around the block, and then the next neighborhood. The exception to this seemed to be when a child asked to ride someplace, such as a friend's house or a park. In these situations the parent and

child negotiated, resulting in new strategies to reduce the parents' anxiety and allow the child the requested freedom.

Safety in numbers. Most of the parents did not allow their children to ride alone. Parents felt that there was safety in numbers and they were less likely to be abducted if they were in a group. Parents talked about their own experiences riding with lots of kids and that there were always kids and parents outside when they were growing up.

Electronic apron strings. As their children got older and started riding farther from home parents needed to feel they still had some control. Electronic apron strings included having the child bring a walkie talkie or a cell phone and calling when they arrived someplace. These strategies ensured parents knew their children were ok, could reach them if they got hurt, and know where they were at any given time. This connection helped reduce parents' anxiety about not being with their child.

Discussion

The data provided by the parents was the foundation for the framework describing how parents balanced their anxiety about their child interacting with the outside world when they rode their bikes and keeping them safe, while at the same time allowing them the autonomy needed to develop into healthy young adults. This framework, describing the cognitive and behavioral processes

involved in children's safe bicycling, fills a gap in the literature that could serve as a new way to frame messages and develop parental intervention components to increase helmet use.

Parental anxiety is not a new construct; however it has not been examined around bicycling or bicycle helmet use. A study of parental anxiety and risk related to parents allowing their children access to outdoor play after an injury is a close comparison (Jenkins, 2006). Parents in that study, similar to the parents in this study, were allowed much more freedom when they were growing up than they allowed their own children. One difference between the findings is that parents in the Jenkins study did not think the world today is any more dangerous than it was when they were growing up. However they still restricted their children's access to outdoor play because emotionally they were anxious about what could happen. In both studies, parents tried to balance their fears of the real or imagined risks with their child's need to grow and experience the world on their own by finding practical solutions to competing emotional and rational thoughts. One way that parents in each study did this was by trying to maintain an electronic connection with their children via walkie-talkies or cell phones. Bauman (2003) describes this as a way to remain close to someone without being in physical contact.

Specific to helmet use and biking safety, managing risk and mitigating harm are concurrent dynamic processes related to the bigger picture of parental

anxiety and child development. How parents manage risks when their children are elementary-school age is based on parents' perception of how 'ready' the child is, with little input from the child. As their children develop the balance between children's need for autonomy and parents' need to keep their children safe and reduce their anxiety over their child's safety results in a reassessment of what strategies they use to mitigate the potential harms. Helmet use appears to be less of a concern relative to traffic crashes and kidnapping.

Research has identified many determinants of children's bicycle helmet use. Although knowing the facilitators or barriers for children wearing a helmet is important, it has not helped practitioners develop interventions for sustained behavior change. For younger children, especially those younger than age 11, parents play a central role in influencing safety behaviors. The field of injury prevention therefore needs to understand and consider parents as targets for interventions. Parents are not worried about head injuries when their children ride their bicycle. Instead they are afraid someone will hurt their children when they are riding, either through abduction or a vehicular crash. Along with these fears, parents are trying to balance their anxiety with allowing their children the autonomy they need to grow and develop. Yet bicycle safety intervention messages focus on awareness and knowledge about protecting the child's head by using a helmet and general safety, thus they are not addressing issues that are salient to parents. Although interventions will not be able to prevent abductions,

they may need to address issues that concern parents before they can engage them to address helmet use.

Most parents know that helmets will protect their child's head if they crash. If parents made decisions based solely on rational thought this might be enough to get them to focus on consistent helmet use. Parents' perception of the risks (whether rational or irrational) and the juxtaposition of current risks with their childhood memories of a "safer time," plays a critical role in parents' decisions making processes related to their children's bike riding. Past interventions used rational and value expectancy theories as frameworks for development. These frameworks assume increasing knowledge and awareness will be enough to motivate behavior change. While these theories may explain the rational decision-making processes (parents desire to keep their children safe), they do not adequately explain the emotional components of the decision-making processes (fear that someone will harm their children). One reason for the low success of sustained behavior change is that these models do not include constructs of the heart or feelings, such as fear and memories (Goodson, 2010). Dual-process theories include both cognitive and affective components to explain how people process information about risk (Goodson, 2010). Risk perception is based on both rational and emotional judgments, thus interventions that neglect the emotional element may not be successful. Studies using dual-process theories

have found that they more thoroughly explain certain types of behaviors or decisions than cognitive based theories (Goodson, 2010).

Limitations

The current study has several limitations. The primary recruitment setting was through the Boy and Girl Scouts. While snowball sampling was used to recruit parents whose children did not participate in scouting, most of the participants represent parents whose children are involved in an extracurricular activity that emphasizes safety. It is also possible that the parents who agreed to participate were different than those that did not participate. Social desirability may have also played a role in whether parents participated in the study or not and in their reports of their children's helmet use habits. Parents whose children do not wear a helmet may not have participated or have discussed non-use because they feared being viewed as a bad parent. In spite of these limitations, this is one of the first studies to directly assess parents' perceptions of risk regarding children's bicycle riding and has yielded unique perspectives that may help improve strategies for engaging parents in bike safety programs.

Conclusions

This grounded theory identifies new contextual factors and theoretical constructs related to children's bicycle helmet use that have not been discussed in the literature, providing additional evidence for the need to include emotions in our intervention design to change decision–making processes. Parents are

struggling to balance the competing demands of keeping their children safe when they ride with allowing them autonomy. Parents do not make decisions based on rational judgments alone, so we must meet parents where they are and account for parents' emotional judgments when framing messages. Before we can interest parents in helmet use, their other fears, such as a vehicle crash or 'snatching' need to be addressed. Although interventions will not be able to prevent abductions, intervention components can be designed that address and may be able to allay their fears of abduction. One way to address this would be by applying 'dual-process theories' that include both cognitive and affective components to explain how people assess and process information about risk. Theories underpinning bicycle helmet interventions rarely, if ever, consider parents' emotions or the larger context of the parenting, risk management, and safety. Applying dual-process theories to helmet use interventions could include messages that acknowledge and respects parents' fears and rational information that addresses the specific fear.

Findings point to the necessity for additional research. Additional qualitative studies could include a larger, more heterogeneous sample of parents to examine the conditions under which the framework holds. Future quantitative studies are then needed to test and refine the framework with larger samples of parents from other backgrounds and areas. One aspect of this could be examining how influential the affective and cognitive components of the model are in

determining helmet use for their children. This information could then be used to inform intervention development.

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CHAPTER VI

EPILOGUE

Summary of Study Goals and Findings

The goals of this dissertation were to 1) gain a better understand of the bicycle helmet use research by identifying opportunities in the literature and 2) gain an understanding of children and parent's perceptions of children's bicycle helmet use and how the perceptions influence helmet use. To accomplish goal one, I conducted a focused literature review to critically examine three areas of research on children's bicycle helmet where opportunities exist for improvement. To accomplish goal two, I conducted a qualitative study, using a grounded theory approach, to elicit experiences related to children's bicycle riding from parents and their children.

Findings from the focused literature review indicate that there are three areas that researchers could address to improve the helmet use research: measurement issues, group differences, and analytic techniques used. Since the ultimate goal of increasing helmet use is to reduce the number of bicycle crash related head injuries, obtaining accurate estimates of helmet use, while difficult, is critically important. There were three, often overlapping, areas of measurement that could be addressed: defining and measuring helmet use in valid and reliable

ways, the use of dichotomous versus ordinal scale response options, and the time period a questions on helmet use refers to. The second area for improvement is the inadequate attention the research gives to group differences. Although some studies report the proportion of helmet use by sex or race, as an example of a demographic group, to date the bicycle helmet literature has paid little attention to sex or race related differences and these data have not been examined in detail. The third area of opportunity is in the analytic techniques used. Using sophisticated analytic techniques such as multilevel modeling could not only control for the structure of the data, but it could aid in our understanding of how influential variables are in predicting helmet use and perhaps more importantly, identify contextual variables as predictors of helmet use.

Based on the findings from this study several recommendations can be made:

1. Careful attention by researchers to measurement issues could result in more accurate estimates of helmet use.
2. Test for sex, race, or other demographic group variable, as moderators of intervention effects and use the results to inform intervention.
3. Use sophisticated analytic techniques to address the hierarchical nature of the data and to examine the influence of contextual variables on helmet use that may be important for future studies.

Findings from the qualitative study suggest that parents have to balance competing demands related to keeping their children safe and giving them the freedom to experience the world on their own so they can grow into health young adults. As children grown and develop their need for autonomy increases. This seems to be implicitly understood by the parents in my study who struggled with meeting their children's need for autonomy and their fears that something bad would happen to then when they rode their bikes. To try and balance these competing needs, parents devised strategies that not only kept their children safe from harm while riding their bicycles but also eased the parents' fears. The following recommendations can be made based on the study findings:

1. Use this information to inform intervention development.
2. Create messages targeting parents to address their concerns around traffic and abduction.
3. Additional research is needed to include additional qualitative studies with different samples of parents and quantitative studies to test the model.

Changes from the Study Proposal

There were two important changes to the original study proposal that need to be addressed. The study I proposed was to develop a comprehensive model of children's bicycle helmet use, including data collected from parent interviews and focus groups with children. Once the project began it became clear that it was too

large an undertaking for a dissertation thus it was decided that just the parent interview data would be included as part of the dissertation. Focus groups with children were conducted and the data will be analyzed at a later date.

In addition, as was anticipated using a grounded theory approach, the research questions addressed by the study were changed based on the interview data. The original research questions were:

- What meaning do children and parents ascribe to helmet use?
- How do children's and parents' attitudes and beliefs about bicycle helmets influence helmet use?

However as parents spoke with me and I analyzed the data, it became evident that they were talking about much more than just their children's bike riding and helmet use, they were describing risk, their children's safety, and their fears. To keep the research questions grounded in the data the question was changed to 'how do parents assess and manage risk when their children ride a bike?'

Future Directions

This dissertation provides directions for future work in bicycle helmet intervention research. The next step will be to analyze the children's focus group data and develop a model that can be used to inform intervention development. The models can then be tested and refined. Refinement could include additional participants with different samples of parents and children. Testing could include developing a survey that could be administered to a large sample of parents and

children using constructs from the models. These findings could be used to further refine the model. Then the models could then be used to inform intervention development and tested for effectiveness.

Personal Reflections

When I started the doctoral program I knew I wanted to do a dissertation on children's bicycle helmet use. Having studied the bicycle helmet literature for the five year prior to starting the doctoral program, I knew something was missing, but I didn't know what. Initially I thought I would develop an intervention to increase helmet use but with much guidance and work over several years my dissertation proposal developed. Although it changed from the initial proposal, it has been a wonderful learning opportunity, but not without some challenges.

The research process proved to be a bigger challenge than I anticipated and I wasn't sure my research would make a valuable contribution to the literature. The first challenge was reaching my target population, parents and their children in 3rd-5th grade and recruitment. After trying unsuccessfully to be allowed to recruit through schools, The Boy and Girl Scouts agreed to let me recruit through local troops. Even then I was not able to meet my recruitment goal. Secondly, I chose to use a methodology that was new to me so I was learning it as I worked. Learning grounded theory by reading books, attending workshops, and working closely with Dr. Tracy Nichols proved to be a

challenging and amazing learning experience. During the early stages of data collection and analysis I doubted that I would finish – I felt overwhelmed, like I had no idea what I was doing. Looking back on the process I can say that it was one of the best learning experiences I have had. My biggest concern was that my research would not yield any new information. Fortunately, this is not the case. To my knowledge, examining bicycle helmet use in the larger context of parenting and their anxiety around their children's safety has not been studied before.

My doctoral studies and this dissertation have provided me with an amazing learning experience, both academically and personally, and a research agenda to keep me busy for several years.

APPENDIX A

FACILITATORS OF CHILDREN'S HELMET USE

Facilitators of children's helmet use previously identified in the literature by social ecological level. Children are more likely to wear a helmet if:

Intrapersonal	• the child knows about helmets and how they can prevent injuries • the child believes that a helmet can prevent head injuries. • the child does not have negative perceptions about helmets being ugly or uncomfortable. • the child believes that they can be hurt as a result of riding a bike and being in a crash. • the child intends to wear a helmet.
Interpersonal	• the child believes that parents and peers have a positive attitude about helmet use • the child rides with kids who wear helmets • the parent uses a helmet • the parent has a positive attitude about using a helmet • the parent rides bikes with the child, regardless of parental helmet use • the parent has a rule about wearing a helmet whenever the child rides a bike
Organizational	• the school has a policy that children must wear a helmet if they ride to school • it is seen as expected and accepted that helmets are used when riding to school
Community	• helmets are available and accessible to everyone
Policy	• the city, town, or state has a mandatory helmet law • helmet laws are enforced

APPENDIX B

INFORMED CONSENT FORMS

UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

Parental Consent Form – Focus Groups

Project Title: Bike Smart

Project Director: Michelle L. Cathorall

Participant's Name:

_____

DESCRIPTION AND EXPLANATION OF PROCEDURES

I am a student at The University of North Carolina at Greensboro [UNCG] interested in learning more about children's bike riding experiences. To help me understand more about kids' and parents' thoughts and opinions about children's bike riding experiences I am conducting a research study with children and their parents or caregivers.

I would like to ask your child to participate in a focus group (guided discussion) with other children. The discussion will cover topics related to learning to ride a bike and riding a bike now. Children will also be asked some questions about rules they have to follow. I would like your child to participate because he/she is in 3rd, 4th or 5th grade, and he/she rides a bike. Up to 45 child/parent pairs will participate in this study. Parents will not see their child's responses and children will not see their parent's responses.

The focus group will be audio taped and conducted at a local school, library, church or community center with 6-8 other children who are about the same age as your child. Two trained discussion facilitators will lead the focus group. The discussion will take approximately 1-1 ½ hours. If your child feels uncomfortable with any of the questions being asked in the focus group he/she may choose not to answer them. All the information gathered will be kept confidential and will be used only for the purpose of learning about parents and children's bike riding experiences, thoughts, and opinions.

RISKS AND DISCOMFITS
If your child participates in the focus groups there is the risk that he/she may feel embarrassed discussing issues pertaining to learning how to ride a bike or how they feel about bike safety when they ride. There is also a slight risk of beach of confidentiality associated with audio taped data because someone might be able to recognize your child's voice. To minimize this potential risk, all data will be stored in a locked cabinet on the UNCG campus accessible only to the researcher. There are no other anticipated risks from participating in the focus group.

POTENTIAL BENEFITS
Your child may find the focus group to be interesting and enjoyable. Results from the study could be used to help improve safe bike riding for children.

COMPENSATION
Your child will be given a $10 gift certificate upon completion of the focus group in appreciation of their help.

Your decision to allow your child to participate or not will not in any way affect your current or future relationship with any part of UNCG or the organization you and your child were recruited through. The organization that you have been recruited through is in no way involved with funding or conducting this study. Your child will not be required to participate if you (or she/he) do not wish to and would be free to withdraw from the research study at any time if you do participate. Either member of the family can refuse to participate or withdraw from the study without affecting the participation of the other member.

The records of this study will be kept private. To protect your child's confidentiality and minimize any risk of breach of confidentiality, children in the focus group will be asked to refer to one another using first names only, and they may use a made-up name if they prefer. In any sort of report I publish, I will not include any information that will make it possible to identify your child or any other child. Written and audio-taped records will be kept in a locked cabinet on the UNCG campus accessible only to UNCG staff, the Institutional Review Board (IRB), the Office of Human Research Protection (OHRP), and me. Electronic data, such as transcripts of the focus groups will not have your child name on them and they will be stored on the UNCG campus on a password-protected computer. All information, written and audio taped data and consent forms will be destroyed three years after the study ends. All consent forms and written documentation will be shredded and the audiotapes will be erased.

UNCG's Institutional Review Board, which insures that research involving people follows federal regulations, has approved the research and this consent form. If you have any questions regarding yours or your child's rights as a study participant, you can call Mr. Eric Allen at (336) 256-1482. Any questions concerning the project itself should be addressed to Michelle Cathorall at (336) 334-9743 or Dr. Daniel Bibeau at (336) 334-5527. Any new information that develops during the project will be provided to you if the information might affect your willingness to continue participation in the project.

You will be given a copy of this form to keep.

You are making a decision as to whether or not to allow your child to participate in a focus group. Your signature indicates that you have read the information provided above and have decided to do so. You may withdraw your consent at any time without prejudice after signing this form should you choose to discontinue your child's participation in this study.

Signature of Parent/Guardian	Date	Time
Signature of Investigator	Date	Time

UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

Consent Form – In-depth Interviews

Project Title: Bike Smart

Project Director: Michelle L. Cathorall

Participant's Name:

_____

DESCRIPTION AND EXPLANATION OF PROCEDURES

I am a student at The University of North Carolina at Greensboro [UNCG] interested in learning more about children's bike riding behaviors. To help me understand more about kids' and parents' thoughts and opinions and children's bike riding experiences I am conducting a research study with children and their parents or caregivers.

I am asking you to participate in an individual interview with a trained interviewer. Interviews will cover when your child learned to ride a bike, your child's bike riding now, bike safety practices, and your bike riding experience. I am asking you to participate because you have a child who is in 3rd, 4th or 5th grade, lives with you, and he/she rides a bike. Up to 45 child/parent pairs will participate in this study. Parents will not see their child's responses and children will not see their parent's responses.

The interview will be audio taped and conducted in your home by a trained interviewer. The interview will take approximately 1-1 ½ hours. If you feel uncomfortable with any of the questions being asked in the interview you may choose not to answer them. All the information gathered will be kept confidential and will be used only for the purpose of learning about parents and children's bike riding experiences, thoughts and opinions.

RISKS AND DISCOMFITS

If you participate in the interviews there is the risk that you may feel embarrassed discussing issues pertaining to your bike riding experience, your child's bike riding practices, or your opinions on bike safety. There is also a slight risk of beach of confidentiality associated with audio taped data because someone might be able to recognize your voice. To minimize this potential risk, all data will be stored in a locked cabinet on the UNCG campus accessible only to the researcher. There are no other anticipated risks from participating in the interview.

POTENTIAL BENEFITS
You may find the interview to be interesting and enjoyable. Results from the study could be used to help improve safe bike riding for children.

COMPENSATION
You will be given a $10 gift certificate upon completion of the interview in appreciation of your help. There are no costs to you for participating in this research.

Your decision to participate or not will not in any way affect your current or future relationship with any part of UNCG or the organization that you were recruited through. The organization that you have been recruited through is in no way involved with funding or conducting. You will not be required to participate if you do not wish to and would be free to withdraw from the research study at any time if you do participate. You can refuse to participate or withdraw from the study without affecting the participation of your child.

The records of this study will be kept private. To protect your confidentiality and minimize any risk of breach of confidentiality, I will only use your first name during the interview or you may use a made-up name if you prefer. In any sort of report I publish, I will not include any information that will make it possible to identify you. Written and audio-taped records will be kept in a locked cabinet on the UNCG campus accessible only to UNCG staff, the Institutional Review Board (IRB), the Office of Human Research Protection (OHRP), and me. Electronic data, such as transcripts of the interview will not have your name on them and they will be stored on the UNCG campus on a password-protected computer. All information, written and audio taped data and consent forms will be destroyed three years after the study ends. All consent forms and written documentation will be shredded and the audiotapes will be erased.

UNCG's Institutional Review Board, which insures that research involving people follows federal regulations, has approved the research and this consent form. If you have any questions regarding your rights as a study participant, you can call Mr. Eric Allen at (336) 256-1482. Any questions concerning the project itself should be addressed to Michelle Cathorall at (336) 334-9743 or Dr. Daniel Bibeau at (336) 334-5527. Any new information that develops during the project will be provided to you if the information might affect your willingness to continue participation in the project.

You will be given a copy of this form to keep.

You are making a decision as to whether or not to participate in the above-described study. Your signature indicates that you have read the information provided above and have decided to do so. You may withdraw at any time without prejudice after signing this form should you choose to discontinue participation.

Signature of Participant	Date	Time

Signature of Investigator	Date	Time

UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

Child Assent Form – Focus Group

My name is Michelle and this project is called Bike Smart

WHAT IS THIS ABOUT? I would like to talk to you about riding your bike. I want to hear about when you first learned to ride a bike and about when you ride your bike now. I will use the information I learn to try and understand bike-riding behavior of kids your age. I will also ask you to answer some questions to see if your mom is like other kids moms.

DID MY PARENTS SAY IT WAS OK? Yes, your parent(s) said it was ok for you to talk with me and the other kids and have signed a form like this one. Your parent(s) will be right outside while we talk.

WHY ME? I would like to hear your thoughts because you are in 3rd, 4th or 5th grade and you ride a bicycle, so you're the expert.

WHAT IF I WANT TO STOP? You do not have to say "yes", if you do not want to be part of the discussion. You will not be punished if you say "no". Even if you say "yes" now and change your mind after later, you can stop and no one will be mad at you.

IS THIS STUDY PART OF THE GIRL OR BOY SCOUTS? No, the Scouts are not involved in paying for or conducting the study.

WHAT WILL I BE ASKED TO DO? If you say yes, you will participate in a 1-hour group discussion with other kids about your age. During the discussion I will ask some questions about bike riding that we'll talk about together. There are no wrong answers.

WILL ANYTHING BAD HAPPEN TO ME? We don't think anything bad will happen to you. I want to hear your opinions and experiences, but you do not have to answer any questions that you don't want to.

WILL ANYTHING GOOD HAPPEN TO ME? No, nothing good will happen directly to you, but your thoughts may help improve bike riding.

DO I GET ANYTHING FOR BEING IN THE STUDY? We will have snacks during the discussion. At the end of the discussion you will receive a $10 gift certificate as a thank you for talking with me.

WHAT IF I HAVE QUESTIONS? You are free to ask questions at any time.

If you understand what has been read to you and want to be part of the discussion, please write your name below.

_____

(Please write your name and today's date)

Thank you!

APPENDIX C

INTERVIEW GUIDE

Interview Guide

(NOTE: replace child with appropriate word, either son/daughter/grandson/granddaughter, etc.)

Once recruitment script has been read to the interviewee and consent form is signed, turn on the tape recorder.

Children's Bike Riding

1. I'd like to start by hearing about when your child first learned to ride a bike, can you tell me about that?

   Potential areas to probe: age, who taught the child, use of training wheels or helmet, safety concerns, parents' feelings, perception of how child felt

2. Can you tell me about when your child rides his/her bike now?

   Potential areas to probe: where the child rides, who the child rides with, supervision, rules, how often, why the child rides, parent fears/feelings

Bike Safety

3. When your child rides their bike, what, if any, concerns do you have?

   Potential areas to probe: source of concern, previous experience with injury, areas of confidence they have in child's bike riding, safety precautions they already take, child's helmet use, child's ability, child's temperament and/or personality

Helmet use

4. What type of things do you think encourages children to wear helmets?

   Potential areas to probe: *why they feel that way, their experience, use of media and role models*

5. What type of things do you think discourages kids from wearing helmets?

Potential areas to probe: *why they feel that way, their experience, what their kids say*

6. What haven't I asked that I should be asking about children's bike riding experience?
7. Are there other people I should speak with to learn more about children's bike riding experiences?
8. May I contact you again if I need clarification or to follow-up on some of our conversation?

Background Information
(Ask or complete without asking as appropriate)

1. Relationship to the child

_____

2. Do you live with the child?

_____

3. Sex
   - o Male
   - o Female

4. Age _____

5. Race/Ethnicity (Check all that apply)
   - o American Indian or Alaska Native
   - o Asian
   - o Black or African American
   - o Hispanic/Latino/a
   - o Native Hawaiian or Other Pacific Islander
   - o White
   - o Other _____

6. Marital Status
   - o Single
   - o Married
   - o Divorced or Separated Widow/Widower

9. Do you ride a bike?
   - o No
   - o Yes
   - o Don't know

IF YES:

a. Do you wear a helmet when you ride?
   - o No
   - o Yes
   - o Don't know

b. How often do you wear it?
   - o Always
   - o More than half the time
   - o About half the time
   - o Less than half the time
   - o Never

c. Do you ever ride with your child?
   - o Yes
   - o No

10. Does North Carolina have a bicycle helmet law?
    - o No
    - o Yes
    - o Don't know

7. How many other children live in the home with the child? _____

    a. Ages:
    _____

8. With whom does the child live (Check all that apply)
    - o Mother
    - o Father
    - o Step-Mother
    - o Step-Father
    - o Grand-Mother
    - o Grand-Father
    - o Aunt
    - o Uncle
    - o Other
    _____

Regarding your child

1. Sex
    - o Boy
    - o Girl

2. How old is your son/daughter?
    _____

3. What grade is he/she in?
    - o 3rd
    - o 4th
    - o 5th

4. Race/Ethnicity: (Check All That Apply)
    - o American Indian or Alaska Native
    - o Asian
    - o Black or African American
    - o Hispanic/Latino/a
    - o Native Hawaiian or Other Pacific Islander
    - o White

- o Other
  _____

5. Does your child own a bike?
   - o Yes
   - o No
   - o Don't know

6. Does your child own a bike helmet?
   - o Yes
   - o No
   - o Don't know

7. On average, how often does your child ride a bike?
   - o Once a week
   - o More than once a week
   - o Once a month
   - o More than once a month

8. How often does your child wear a helmet when he/she rides a bike?
   - o Always
   - o More than half the time
   - o Less than half the time
   - o Never

9. When your child wears a helmet, does he/she fasten the chinstrap?
   - o Yes
   - o No
   - o Don't know
   - o He/She does not wear a helmet

10. Is your child supervised when he/she rides?
    - o Yes
    - o No

    If yes, by who?

_____

11. Do you have any rules for your child about wearing a helmet when they ride a bike?
    - o Yes

o No

If yes, what is it?

_____

We're almost finished. I just have a few more brief questions.

Closing

That was my last question. Do you have any questions? Is there anything you may have thought of during our discussion that you'd like to share? Thank you again for taking the time to talk with me, your insights have been very helpful.

APPENDIX D

FOCUS GROUP GUIDE

Focus Group Guide: Child

(NOTE: *Prior to the focus groups participants will be screened based on whether they report "always" wearing a helmet when they ride or not. Separate focus groups will be conducted for kids who "always" wear a helmet and kids who do not. The assent form will be read aloud to the children and then they will be collected prior to the start of the focus group. The questions each include potential areas to probe on. Background information will be gathered at the in the middle of the focus group in order to summarize the participants. Because the children will be separated into focus groups based on whether they "always" wear a helmet or not the children will be asked to complete the authoritative parenting index to explore whether there is a relationship between reported helmet use and whether the child perceives their primary female caregiver as authoritative or not. These sections will be read a loud to the participants for them to complete. Start questions after consent form has been read aloud and signed.)*

Brief icebreaker
So, you know my name – what is it? But I don't know yours, so, before we start I want to know your name. In front of you there is a card and a marker. Please write a name on the card. You don't have to write your name. You can write any name you want to be called today. Then we'll introduce ourselves.

(Once introductions are finished, we will start with the focus group questions)

Now that we know each other's names, the first thing I would like to do is talk about bike riding.

Focus Group Questions

1. Can you tell me about when you learned to ride a bike?
   Potential areas to probe on: age, who taught them, the process, where they learned, how they felt riding for the first time, safety precautions

2. Now, tell me about when you ride a bike now?
   Potential areas to probe on: frequency, riding companions, locations, safety precautions, why they ride,

Visual aid – Show kids picture of kids on their bikes with and without a helmet (See Appendix E)

3. Now I'm going to show you a picture and I want you to tell me about it.
   Potential areas to probe on: describing certain kids, reasons for the description, reasons kids wear helmets, reasons they don't wear helmets
4. What do you think other people think about wearing a bicycle helmet?
   Potential areas to probe on: friend's perceptions, family perceptions, media and role models

5. Are there other people you think I should to talk to about kid's bike riding?
   Potential areas to probe on: reasons why a person is chosen as important

6. What else should I know about kids' bike riding that I haven't asked you about?

Ok, now that you've had a snack, I want to do a couple more things. Each of you should have a sheet of paper with some questions on it. I'm going to read each question and I would like each of you to write the answer on your paper. The first questions are about you. I'm going to read the questions out loud, please answer the questions the best you can. If you do not understand something you can ask me.

12. Are you a
    - o Boy
    - o Girl

13. How old are you? _____

14. What grade are you in?

    - o 3rd
    - o 4th
    - o 5th

15. Who do you live with? (Check all that apply)
    - o Mother
    - o Father
    - o Step-Mother
    - o Step-Father
    - o Grand-Mother
    - o Grand-Father
    - o Aunt
    - o Uncle
    - o Other _____

16. Do you own a bike?
    - o Yes
    - o No
    - o Don't know

17. Do you own a bike helmet?
    - o Yes
    - o No
    - o Don't know

18. When you wear your helmet, do you fasten the chinstrap?
    - o Yes
    - o No
    - o Don't know
    - o I don't wear a helmet

19. Does someone watch you when you ride your bike?
    - o Yes
    - o No

    If yes, who? _____

20. When you ride your bike do you have to follow any rules?
    - o Yes
    - o No

    If yes, what rules? _____

APPENDIX E

VISUAL AID PHOTO FOR FOCUS GROUPS