# The Development of a Conceptual Framework for Identifying Functional, Expressive, Aesthetic, and Regulatory Needs for Snowboarding Helmets

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## ABSTRACT

The purpose of this research was to identify the design characteristics and attitudes that impact the use of snowboarding helmets and to test statistically a proposed conceptual framework for identifying perceived importance of functional, expressive, aesthetic, and regulatory (FEAR) needs of snowboarding helmets for current snowboarders.

Data for this study was collected online. The final sample was composed of 391 participants, which represented a 13.67% response rate. Multiple comparisons were used to examine mean differences among the FEAR variables, as well as attitudes toward helmet use. A multiple linear regression was used to test four proposed hypotheses.

The results of hypotheses revealed that there was an impact between attitudes toward helmet use and perceived importance of functional needs, but this relationship depended on the level of expressive needs, aesthetic needs, and helmet usage. The typical impact of functional needs on attitudes toward helmet use was positive (slope = .013) when all variables were at their respective means (Hypothesis 1). Hypothesis 2 tested to see if there was an impact between

attitudes toward helmet use and perceived importance of expressive needs, but again, this relationship depended on the level of functional needs and helmet usage. The typical impact of expressive needs on attitudes toward helmet use was positive (slope = .014) when all variables were at their respective means. Similarly, the impact between attitudes toward helmet use and the perceived importance of aesthetic needs was dependent on the level of functional needs and helmet usage. The impact of aesthetic needs on attitudes toward helmet use was typically negative (slope = -.012) when all variables were at their respective means (Hypothesis 3). Finally, Hypothesis 4 looked at the impact between attitudes toward helmet use and the perceived importance of regulatory needs. Unlike the other three hypotheses, this relationship did not depend on any other variables. The impact of regulatory needs on attitudes toward helmet use was positive, and the strength of association was .010. Although hypothesis 1-3 were substantially supported, and hypothesis 4 was fully supported, from a statistical point of view, the interaction effects between the independent variables (i.e., FEA needs) and the covariate (i.e., helmet usage) limit the findings, so we can not really state that the hypotheses were supported.

However, based on information obtained from the respondents in this study, the application of a FEAR needs assessment of snowboarding helmets could help to enhance the overall performance of snowboarders. In other words, the improvement of helmet functionality, expressive qualities, aesthetic attributes and regulatory needs would provide a more enjoyable snow activity to participants. Thus, the conceptual framework of the perceived importance of FEAR needs would be acceptable to understand the attitudes toward helmet use among snowboarders.

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# CHAPTER 1

# INTRODUCTION

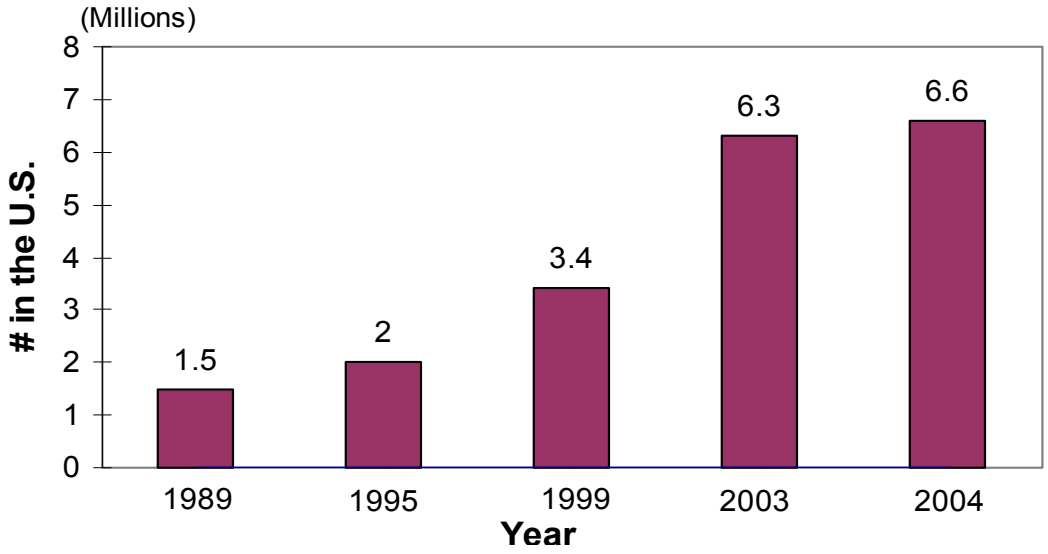
Today, participation in snowboarding has been dramatically increasing. For many, snowboarding is an intense winter sport, requiring protective equipment for those who actively participate in this sport. However, poorly designed protective equipment and dissatisfaction with overall protective equipment performance, maybe offer many snowboarders not to use protective gear due to uncomfortable reasons. Snowboarding helmets may be one of the most important protective devices for snowboarders; protecting their heads as well as reducing the risk of brain injury. Young male participants, since they dominate the snowboarding population, experience a greater risk of injuries. However, this young population seems not to be knowledgeable on helmet safety, or they may not be wearing helmets due to dissatisfaction with helmets available in the current market in a basis of the previous study that mentioned uncommon helmet usage among snowboarders (Aslam & Thomas, 2004). Therefore, this study attempts to examine the helmet needs of snowboarders in relation to design criteria. Developed design criteria may be an effective method to increase overall helmet usage affected by positive attitudes among snowboarders; thereby decreasing injury risks. This introductory chapter provides the background.

## Background

Snowboarding started in the United States in the early 1970s, and since then the popularity of snowboarding has dramatically increased (Corra, Conci, Conforti, Sacco, & Giorgi,

2004). In 1989, there were some 1.5 million snowboarders worldwide, with 40% of those snowboarders living in North America (Abu-Laban, 1991). By January 1995, there were an estimated 2 million snowboarders in the U.S. alone (McDonah, 2000). Young and Niedfeldt (1999) reported that there were more than 3.4 million participants in the U.S., and snowboard riding appeared to be the fastest growing and most popular winter sport across the nation. The population of snowboarding on ski slopes reached approximately 25% to 37% in 1995 (McDonah, 2000). From 1996 to 1998, it was estimated that snowboarders made up 44 % of the population on U.S. ski resort slopes ("Snowboarding Facts," n.d.). Torjussen and Bahj (2005) estimated that by 2002, there were 4 to 7 million participants worldwide. Similarly, the National Sporting Goods Association estimated that during the 2004-2005 season, there were 6.6 million snowboarders ("Grays on Trays: Snowboarding for Adults," n.d.) (Figure1).

*Figure 1.* Population of Snowboarding Participants in the United States



Furthermore, due to the competitive nature of snowboarding, it was declared as an Olympic Sport in 1994 and debuted as a medal sport in the 1998 Winter Olympic Games in Nagano, Japan (Idzikowski, Janes, and Abbott, 2000; Nakaguichi, Fujimaki, Ueki, Takahashi, Yoshida, & Kirino, 1999).

With the popularity of snowboarding on the rise, the number of injured snowboarders is also increasing (Matsumoto, Miyamoto, Sumi, Sumi, & Shimizu, 2002). Falls and jumps represented the leading cause of snowboarding injuries; particularly among beginning snowboarders (Young & Niedffldt, 1999; McDonah, 2000; Uzura, Matsuzawa, Watanade, & Chiba, 2003; Idzikowski et al., 2000). At the same time, findings by Made and Elmqvist (2004) discussed that advanced riders have a greater risk for head/neck injuries in their study, because more advanced snowboarders demonstrate higher risk behaviors. Therefore, both beginners and advanced participants are at risk for injuries.

The Colorado Snowboard Injury Survey, conducted from 1988 to 1999, revealed that there were 7430 snowboarding-related injuries (e.g., shoulder, elbow, wrist, etc) reported to 47 medical facilities near Colorado Ski resorts (Idzikowski et al., 2000). Another study, conducted by Pigozzi, Santori, Salvo, Parisi, and Luigi (1997) from 1989 to 1994, found 106 snowboarding-related injury cases in Italy. Pigozzi et al. considered that the number of injuries were likely to be higher than the number reported in Italy during those seasons, because many snowboarders had a tendency not to report their injuries. However, both studies found that the majority of the injuries occurred in male participants. Fukuda, Takaba, Saito, and Endo (2001) found that there were 634 snowboarding-related head injuries between 1994 and 1999 in Japan. They indicated that snowboarders suffered head injuries approximately 6.1 times more often than skiers; estimating that the incidence of snowboarder head injuries was 6.33 per 100,000

snowboarder days, while there were only 1.03 head injuries per 100, 000 skier days. In spite of the reports of head injuries, helmet use among snowboarders was relatively low (Macnab, Smith, Gagnon, & Macnab, 2002; Shorter, Jensen, Harmon, & Mooney, 1996). In addition, protective gear, such as helmets, is not required for snowboarders except for those who participate in official snowboard competitions.

## The Problem Statement

In the snowboarding community, helmet use is infrequent, even though helmet usage reduces the incidence of head injuries (Aslam, & Thomas, 2004; Corra et al., 2004; Ferrera, Mckenna, & Gliman, 1999; Finch & Kelsall, 1999; Hentschel, Hader, & Boyd, 2001; Levy, Hawkes, Hemminger, & Knight, 2002; Machold, Kwasny, Gabler, Kolonja, Reddy, Bauer, & Lehr, 2000; Macnab et al., 2002; US Consumer Product Safety Review, 1999; Young & Niedfeldt, 1999). As a result of this phenomenon, snowboarders may be at higher risks for serious head injuries. Because of the relative youth of the participants and intense activity of the sport, there is a higher risk for head injuries from both novice and advanced snowboarders. Although the number of snowboarders continues to grow, very little research has been conducted to assess the special needs of snowboarding helmets. Much of the research has focused on identifying the pattern of snowboarding-related injuries for snowboarders, but has not specifically investigated protective equipment in terms of functional design. Consequently, there are no studies directly related to examining design criteria of snowboarding helmets, and very little research has dealt with attitudes towards helmet use among snowboarders.

Protective equipment is a basic need for very intense and aggressive sports such as downhill skiing, football, ice hockey, road / mountain biking, and in-line skating; snowboarding is no exception, also requiring protective equipment. However, protective equipment in this sport, specifically helmets, is rarely used, even though the use of helmets has been shown to significantly reduce head injuries in the event of an accident (DiGuiseppi, Rivara, & Koepsell, 1990; Dorsch, Woodward, & Somers, 1987; Fullerton & Becker, 1991; Runyan, Earp, & Reese, 1991; Thompson, Rivara, & Thompson, 1996). In addition, there are no regulations on snowboard helmet use for snowboarders (Consumer Product Safety Commission, 1999; Hagel et al., 1999). This lack of regulatory needs maybe cause many snowboarding participants to have negative attitudes or ignorance of the importance of helmet usage. Therefore, determining snowboarder's attitudes towards helmet use in relation to design criteria, as well as regulatory needs, may shed light on why snowboarders resist helmet use.

Therefore, the purpose of this research was to identify the design characteristics and attitudes that impact the use of snowboarding helmets and to test statistically a proposed conceptual framework for snowboarders' helmets to increase helmet use.

The specific objectives of this research were as follows:

## Objectives

1. To compare the perceived importance of elements in design characteristics (functional-expressive-aesthetic requirements) for snowboarding helmets as defined by user needs;
2. To examine the perceptions and acceptance that snowboarders have concerning regulatory needs;

3. To determine the perceived importance of attitudes towards snowboarding helmet use; and
4. To test statistically the relationships in the proposed conceptual framework, adopted from the FEA model with the additional components of regulatory needs (R) for determining the impacts of the FEAR needs on attitudes towards snowboarding helmet use.

## Research Questions

1. What are the user needs in design characteristics for snowboarders' helmets as measured by perceived importance?
2. What are the regulatory needs towards helmet use for snowboarders as measured by perceived importance?
3. What benefits would affect wearing a helmet for snowboarders?
4. What relationships do FEAR needs have with attitudes towards helmet use for snowboarders?

This study was designed to provide insight into preventing snowboarders' head injuries and improving design criteria for snowboarding helmets. In addition to design characteristics of helmets, this study would look at regulatory needs that might be effective towards helmet usage among snowboarders. Therefore, hypotheses would examine the relationships and perceptions of needs regarding protective snowboarding helmets among snowboarding participants.

## Hypotheses

Hypothesis 1: Perceived importance of functional needs for snowboarders would have an impact on attitudes towards snowboarding helmets, controlling for other needs (i.e., expressive, aesthetic, and regulatory needs).

Hypothesis 2: Perceived importance of expressive needs for snowboarders would have an impact on attitudes towards snowboarding helmets, controlling for other needs (i.e., functional, aesthetic, and regulatory needs).

Hypothesis 3: Perceived importance of aesthetic needs for snowboarders would have an impact on attitudes towards snowboarding helmets, controlling for other needs (i.e., functional, expressive, and regulatory needs).

Hypothesis 4: Perceived importance of regulatory needs for snowboarders would have an impact on attitudes towards snowboarding helmets, controlling for other needs (i.e., functional, expressive, and aesthetic needs).

The information of the current study is summarized and tabulated in Table 1.

Table 1

Information of the Current Study

| | I | II | III | IV |
|---|---|---|---|---|
| Objectives | Level of importance of design characteristics (FEA user needs) | Perceptions and acceptance for regulatory (R) needs | Level of importance of attitudes towards helmet use | Statistical testing for the relationships in the proposed model |
| Research Questions | How important | How important | Benefits affecting helmet use | Statistically effective in understanding snowboarders' attitudes towards helmet use, influenced by FEAR needs |
| Hypotheses | | | | Hypotheses 1-4 |
| Analysis | Multiple Comparisons | Multiple Comparisons | Descriptive Statistics (Frequencies) | Multiple Linear Regression |
| Questionnaire Parts | FEA needs (II, III, IV) | Regulatory Needs (V) | Attitudes towards helmet use (I) | Total scores of sets; I & II I & III I & IV I & V |

## Assumptions

1. The subjects would be able to perceive and identify their needs of protective helmets.
2. Snowboarding participants would want specific needs for snowboarding helmets.
3. The subjects would understand the instrument questions.
4. The subjects would respond honestly and accurately.
5. The subjects would not participate in this survey more than only one time.

## Operational Definitions of Terms

Snowboarding: The youth-oriented and intense winter sport in which the participant slaloms down a slope while standing sideways on a board that resembles a cross between a skateboard and a ski (Ganong, Heneveld, Beranek, & Fry, 1992; Bladin, McCrory, & Pogorzelski, 2004).

Protective gear: Equipment being worn for the protection of the wearer in a number of contact / intense / aggressive sports not only to reduce the severity or likelihood of injury to the body, but also to prevent reinjury to an athlete (Wilson, 1998; Marshall, Loomis, Waller, Chalmers, Bird, Quarrie, & Freehan, 2004).

Functional needs: The utility of items that to provide the wearer components of comfort, fit, protection, safety, thermal balance, mobility, and donning/doffing (Lamb & Kallal, 1992; Bye & Hakala, 2005).

| | |
|---|---|
| Expressive needs: | Elements that convey particular messages about the wearer in terms of identity, roles, status, and self-esteem to enhance the communicative and symbolic aspects of clothing/equipment (Lamb & Kallal, 1992). |
| Aesthetic needs: | The desire for beauty of clothing/equipment by use of elements such as line, form, color, texture, and pattern to create a pleasing design (Lamb & Kallal, 1992). |
| Needs Assessment: | A developmental process for determining and measuring gaps between actual objects and the ideal of objects (Mullet, 1984). |
| Design Process: | A systematic problem-solving process applied to many fields to achieve the goal to meet the special needs of the end users (Kober & Bagnall, 1981; Yu, 2000; Labat & Sokolowski, 1999). |
| Snowboarder's Role Identity: | One's imaginative view of themselves in the snowboarding role, based on the reaction of other people (Synder, 1983). |
| Snowboarding Commitment: | A psychological construct reflecting the desire and resolve to continue participation in a snowboarding sport over time at various levels of specificity, including sport enjoyment, involvement opportunities, involvement alternatives, personal investments, and social constructs (Scanlan, Russell, Wilson, & Scanlan, 2003). |

# CHAPTER 2

# REVIEW OF LITERATURE

The objective of the literature review is to explore studies linked to the important aspects of snowboarding helmets. Initially, the review of literature will discuss previous research relevant to information on snowboarding and perspectives on protective devices, including snowboarding helmets. This chapter will highlight issues of snowboarding trends, attitudes towards the use of protective devices/equipment, injury patterns, head injuries, helmets, needs assessment, the design process, the functional-expressive-aesthetic (FEA) consumer needs model, studies on expressive needs, and theories in predicting and understanding behavioral factors to evaluate snowboarders' attitude towards helmet use.

## Snowboarding Trends

Snowboarding has become one of the fastest growing and most successful trends worldwide (Chow, Corbett, & Farstad, 1996; "Snowboarding Facts," n.d.; Geddes & Irish, 2005; Machold et al., 2000). The worldwide snowboarding population dramatically increased during the last two decades, from an estimated 1.5 million in 1989, to 4 to 7 million in 2002 (Abu-Laban, 1991; Torjussen & Bahr, 2005). Snowboarding was officially recognized at the Winter Olympic Games in Nagano, Japan in 1998, due to the increase in participation and enthusiasm for the sport (Made & Elmqvist, 2004). Today, snowboarding tends to be not only leisure, but also a competitive sport.

In North America, it has been estimated that snowboarding accounts for as much as 40% of the participants on the slopes (Made & Elmqivst, 2004). With the increase in snowboarders,

the percent of skiers has fallen, based on information released from the National Sporting Goods Association in 1988 (Young and Niedfeldt, 1999). McLennan and McLennan (1991) estimated more than 290,000 participants in snowboarding in the U.S. in the early 90's. Approximately, 2 million snowboarders in the U.S. were reached by 1995 (McDonah, 2000). The National Ski Areas Association (2005) estimated 56.4 million snowboarding visits during 2004 and 2005. An Internet website reported 6.6 million estimated snowboarders in 2004 and 2005 ("Grays on Trays: Snowboarding for Adults," n.d.).

With the rapid growth of this sport, snowboarding has been increasingly investigated. Researchers from countries such as America, Canada, Italy, Norway, Sweden, Scotland, Australia, Japan, Korea, and the Czech Republic have investigated the sport (Hagel, Meeuwisse, Mohtadi & Fick, 1999; Idzikowski et al., 2000; Machold et al., 2000; Made & Elmqvist, 2004; Langran, 2003; Pigozzi, et al., 1997; "Ski Korea This Winter." n.d.; Johnston, 2005; Torjussen & Bahr, 2005; Yamakawa, Murase, Sakai, Iwama, Katada, Niikawa, Sume, Nishimura, & Sakai, 2001). It is expected that the number of participants in snowboarding will continue to rise. As the popularity of snowboarding increases, so will snowboarding related injuries (Geddes & Irish, 2005; Hackam, Kreller, & Pearl, 1999; Pino & Colville, 1989). As such, it is important to investigate whether the expectations and needs of snowboarders are being met.

### *The Characteristics of Snowboarding Participants*

This contemporary winter sport seems to have unique participant characteristics, with the populations being predominately young males, (Heino, 2000). Heino stated, "Youth were immediately attracted to the snowboard" (p. 178). Anderson (1999) characterized participants in

this sport as young, white, and male. She further explained that 86% of snowboarding participants were white males, while only 9% were white women. Chow et al. (1996) also pointed out the relative youth of snowboarding participants. Due to the energetic nature of young male participants, this activity tends to be an aggressive winter sport with associated risks for participation. Similarly, Idzikowski et al. (2000) indicated that advanced male snowboarders seem to have more aggressive riding styles than other groups, including female participants at all levels of ability, according to their ten-year results from the Colorado snowboard injury survey.

Anderson viewed snowboarding culture as "the diversity of sporting masculinities through exploration of the construction of gender in an emerging sport" (p. 56). She described snowboarding as not only sporting masculinity, but as a means of masculinity construction for young male participants. Images of snowboarders include wild, tough, aggressive, strong, competitive, and contemporary participants in a sport full of enthusiasm. Heino (2000) addressed that young snowboarders differentiated themselves from skiers to offer resistance to the dominant culture of skiers, creating a unique style of clothing; loose and baggy fashions and equipment, representing the individual's personality and expressions.

## Attitudes toward the Use of Protective Devices/Equipment

Prevention may be the first step in reducing the risk of sport injuries. Wearing a helmet and facial protection among ice hockey players is associated with reducing the risk of injury, but many players reported disliking wearing facial protection because wearing no facial protection is perceived as the sign of a tough aggressor (Stuart, Smith, Malo-Ortiguera, Fischer, & Larson, 2002). Previous investigations of injuries in snowboarding have showed that less than 10 % of

injured snowboarders wore wrist protection devices, despite the availability of protective equipment, (Chow et al., 1996). Likewise, Young and Niedfeldt (1999) discussed that although most snowboarders in their study did not wear protective devices, those who wore wrist guards showed that the protective equipment was very effective in preventing wrist injuries. Similarly, U.S. Consumer Product Safety Commission (CPSC) reported that the number of head injuries among skiing and snowboarding in 1988 was estimated to be more than 16,000 cases. Also, CPSC estimated that each year more than 7,000 head injuries could be prevented or reduced in severe head damages with helmet use. According to Liotta (2004), no one among participants in snow sports wore a helmet five years ago. Contrastingly, in 2004, it was estimated that 10 percent of skiers and snowboarders wore a helmet. He addressed that a helmet should be a necessary but not a fashion accessory because a helmet has been accepted as a piece of protective gear for skiers and snowboarders.

Langran (2003) assessed snowboarders' attitudes towards the use of protective equipment. He cited several reasons for not wearing a helmet and/or wrist guards from his study. The main reason for not wearing either protective device was that snowboarder's felt they were unnecessary; no need for helmet 39%, and no need for wrist guards 32.8%. Secondary reasons for not wearing protective equipment included helmets being too expensive (28%), and wrist devices being uncomfortable (27%).

A study conducted by Takriti, Lee, and Mann (2001) aimed to show factors that were considered important for teenagers to wear a bicycle helmet. They found that differences in gender, age, and helmet ownership led to varying attitudes related to wearing bicycle helmets. Neither an obligatory school rule nor comfort influenced boys to decide whether to wear a helmet or not. With regard to age differences in this study, the younger age group of teenagers

placed a greater deal of importance on whether wearing a helmet was enforced by law or a school regulation than the older age group of teenagers. In addition, teenagers who owned helmets placed more importance on legislation as a reason to wear a helmet, than those who did not own helmets. The authors suggested that young helmet owners would prefer helmet wearing to be compulsory. Furthermore, DiGuiseppi, Rivara, and Koepsell (1990) identified attitudes toward bicycle helmet ownership among school-aged children, with the mean age of a third-grade child. They found that bicycle helmet ownership was positively associated with attitudes and knowledge related to health and safety. In addition, they noted reasons for the children not wearing bicycle helmets: lack of awareness of importance in wearing helmets, high cost to purchase, peer pressure (friends do no wear helmets), discomfort, and unattractiveness.

The U.S. Consumer Product Safety Commission reported, in the National Bike Helmet Use Survey (1999), that 44% of respondents wore a helmet all or some of the time because they lived where legislations requires bike helmet use. In contrast, the U.S Consumer Product Safety Commission states that there are no state laws requiring the use of skiing helmets for any age group, that it is a matter of personal choice. The absence of state laws requiring skiing helmets may affect snowboarders' attitudes towards helmet use, negating the benefit.

### *The Benefit of Using Protective Devices/Equipment*

Marshall, Loomis, Waller, Chalmers, Bird, Quarrie, and Feeban (2004) conducted an evaluation of protective equipment for prevention of rugby injuries. They found that the use of mouth guards tended to protect players from teeth, mouth, and jaw injuries. Also, they reported that the use of headgear appeared to be effective in reducing the risk of any scalp, ear, or

concussive injury. They expected that the "increased use of protective equipment may afford a significant opportunity for injury prevention in this rugby sport" (p.114). Results showed that although mouth guards were the most used protective gear among the players during team practices or past games (65%), the use of other protective devices were relatively low; headgear (14%), shin guards (8%), and support sleeves (8%).

Idzikowski et al. (2000) viewed that although wrist guards had a significant protective effect on wrist injuries among snowboarders, the majority of wrist injuries (94%) occurred when not wearing protective wrist guards. In addition, Chow et al. (1996) indicated that individuals in their study who used protective wrist devices showed no pains or injuries to the wrist, because wrist guards provide protection to the distal forearm. Furthermore, Aslam and Thomas (2004) found that the use of wrist protectors among snowboarders has been shown to decrease the numbers of bone injuries.

According to the U.S. Consumer Product Safety Commission (1999), a nationwide study of ski injuries in Sweden during the 1985-1986 ski season, reported that head injuries among skiers wearing helmets was 50% lower than for those not wearing helmets. Geddes and Irish (2005) noticed that the injury rate of skiers and snowboarders has been decreased by the use of protective devices. Shorter, Jensen, Harmon, and Mooney (1996) found that a decrease in lower extremity injuries among snowboarders was a result of improvements in equipment. In addition, Hackam, Kreller, and Pearl (1999) proposed that the severity and impact of snow-related injuries would be significantly reduced by appropriate prevention strategies, including an increased emphasis on proper equipment use, especially helmet use for children. Hogg (2003) reported that equipment failure among skiers and snowboarders contributed to increased injuries. Ski binding malfunction commonly contributes to injury; for example, when the binding is set too

high to release quickly, it is difficult for skiers to avoid injury. The research suggests that proper maintenance and selection of equipment should be recommended to snowboarders to decrease injuries (US Consumer Product Safety Preview, 1999; Yamakawa, Murase, Sakai, Iwama, Katada, Niikawa, Sumi, Nishimura, & Sakai, 2001). Furthermore, Machold et al., (2000) mentioned that continual development of better protective devices for snowboard riders should lead to a decrease in the rate of injury.

## Injury Patterns

Snowboarding is considered a dangerous and uncontrolled sport, so researchers have completed various investigations on snowboarding injuries (Bladin, McCrory, & Pogorzelski, 2004). Table 2 summarizes the research completed on snowboarders with regard to injuries and skill levels.

A number of studies have completed surveys and profiled snowboarding injuries (Bladin et al., 2004; Hagel et al, 1999; Pigozzi et al., 1997; Fukuda et al., 2001; Torjussen & Bahr, 2005). Hagel et al. (1999) found that approximately 40% of total injuries in snow-related recreational events were reported by snowboarders. In addition to the rate of snowboarding injuries, Abu-Laban (1991) discussed that snowboarding injuries frequently involve young and healthy males. Hentschel, Hader, and Boyd (2001) indicated that the snowboarding population is younger, more likely to be male, adventurous, and engaging in potentially hazardous activities, resulting in snowboarders having a higher number of serious brain injuries than skiers. The following sections describe the patterns of snowboarding injuries categorized by body locations and collision-related injuries.

Table 2

*Summary of Injury Sites in Snowboarding by Skill Levels*

| Researcher(s) | Place | Injury Sites (# of the most reported injuries in each study) | Skill Level | | |
|---|---|---|---|---|---|
| | | | Beginner | Intermediate | Advanced |
| Torjussen & Bahr (2005) | Norway (Oslo) | Knee (13)<br>Back (11) / Head (11) | | | X |
| Made & Elmqvist (2004) | Sweden (Lapland) | Lower Arm and Wrist (197) for beginners<br>Head and Neck (83) for experts | X | | X |
| Machold, Kwasny, Eisenhardt, Kolonja, Bauer, Lehr, Mayr, & Fuchs (2002) *** | Australia | Wrist (no indicated # but mentioned 50% of wrist injuries) | X | | |
| Yamakawa, Murase, Sakai, Iwama, Katada, Niikawa, Sumi, Nishimura, & Sakai (2001) ** | Japan (Okumino) | Spinal Injuries (238) | X | X | X |
| Idzikowski, Janes, & Abbott (2000) | U.S. (Colorado) | Wrist (1570) for beginners<br>Shoulder (666) for intermediates and experts | X | X | X |
| Machold, Kwasny, Gabler, Kolonja, Reddy, Bauer, & Lehr (2000) | Australia | Lower arm and wrist (49)<br>Hand (30) | X | | |
| Hackam, Kreller, & Pearl (1999) | Canada (Toronto) | Head (no indicated #) | X | | |
| Hagel, Meeuwisse, Mohtadi, & Fick (1999) | Canada (Southern Alberta) | Wrist (173) Head (112) | X | | |
| Pigozzi, Santori, Salvo, Parisi, & Luigi (1997) | Italy | Upper Limb (48): Shoulder (17)<br>Lower Limb (41): Knee (18) | X | | |
| Shorter, Jensen, Harmon, & Mooney (1996) | U.S. (New Hampshire) | Head (27)<br>Long Bone (13)<br>(Extremity Fractures) | X | | |
| Bladin, Giddings, & Robinson (1993) | Australia (Northern Hemisphere) | Ankle (64)<br>Knee (62) | X | | |
| Ganong, Heneveld, Beranek, & Fry (1992) | U.S. (California) | Wrist (99)<br>Knee (75) | X | | |
| Abu-Laban (1991) | Canada (Banff) | Ankle sprain (27)<br>Spinal Injury (16) | X | | |

*Note.* * Emphasis on head injuries
** Emphasis on spinal injuries
*** Emphasis on wrist injuries

*Upper Extremity Injuries*

Chow et al., (1996) stated that the upper extremity was the most common injury area for snowboarders. In particular in their study, wrist fractures occurred more frequently for inexperienced riders than for riders with more than 1 year of experience. Pigozzi et al. (1997) indicated that upper limbs were the most frequent injuries among their snowboarding patients (48%), lower limbs second (38.5%), followed by other parts of the body (16%, e.g., cranium, abdomen, and spinal column).

Idzikowski et al. (2000) looked at reported snowboarding injuries in Colorado from 1988 to 1998. A total of 7430 snowboarding-related injuries were reviewed. The majority of all snowboarding injuries were the result of falls (81%), most frequently with shoulder and wrist injuries. Similarly, a study conducted by Bladin et al. (2004) found that the most common injury site in snowboarders was the wrist. Furthermore, Aslam and Thomas (2004) said that frequently wrist injuries occurred from backward falls. In addition, they stated that since the snowboarder stretches his arm backwards to weaken the impact of the collapse, backward falls may increase the incidence of radial head fractures, anterior dislocations of the shoulder, and clavicular fractures.

Prall, Winston, and Brennan (1995) attempted to identify patterns of severe snowboarding-related injuries. They found that snowboarders were likely to be at greater risk for minor spine injuries. The spinal cord is defined as "a part of the vertebrate nervous system that is enclosed in and protected by the vertebral column" ("Spinal cord." September 13). Yamakawa et al. (2001) reviewed the occurrence rate and characteristics of spinal injuries received by snowboarders in Japan from 1988 to 2000. They found that patients who suffered

impact to the head or back suffered from concussions, back pain, motor weakness, sensory disorders, or lumbago, and these patients were treated as potential cases of spinal injury. In addition, these spinal injuries were primarily seen in the intermediate and expert snowboarders; Yamakawa et al. suggested that this is due to the high rate of jumping failure in those groups. Among competitive male snowboarders at the National Elite Level, shoulder dislocations were the most severe injuries (Torjussen & Bahr, 2005). Similarly, Idzikowski et al. (2000) indicated that certain shoulder injuries were more frequent with intermediate and expert snowboarders than with beginners.

### *Lower Extremity Injuries*

Lower extremity injuries in snowboarders include leg/ankle fractures, foot fractures, hip dislocations, knee sprains, and ankle sprains (Corra et al., 2004). Machold et al. (2000) indicated that the lower extremities represented 21% of injuries in their study. Torjuseen and Bahr (2005) found that hip dislocations were the most severe injury seen in their study on competitive female snowboarders. Pigozzi et al. (1997) reported that the most frequent injuries to the lower extremities were to the knee (16.9%) and ankle (14.1%). McDonah (2000) mentioned that the incidence of severe knee injuries is associated with snowboarders using stiff or hard boots rather than soft or hybrid boots. McDonah indicated that non-release bindings on snowboarders has an additional benefit of preventing rotational injuries to the lower extremities; however, these bindings may increase the risk of suffocation for snowboarders because snowboarders' heads are immersed into deep power.

*Collision Injuries and Falls*

Many investigators indicated that collision injuries among snowboarders were caused by the frequency of falling and jumping (catching air) during snowboarding maneuvers (Fukuda et al., 2001; Haruki et al., 2001; Hegel et al., 1999; Hiroshi et al., 1999; Machold et al., 2000; Matsumoto et al., 2002). A very popular practice in snowboarding is jumping or "catching air" (Beranek, & Fry, 1992; Ganong, Heneveld, McDonah, 2000; Hiroshi et al., 1999). Catching air is defined as "intentionally or unintentionally performing an aerial maneuver or otherwise leaving the ground during transit" (Boon, Smith, Edward, & Laskowski, 1999, p.7.) Hiroshi et al. (1999) commented that the risk of injury was associated with the loss of balance while jumping. Aerial maneuvers have increased risk of injuries to the head, face, spine, and abdomen when a snowboarder lands incorrectly from a jump, and the resulting collisions leads to severe injuries (Chow et al., 1996). Similarly, Shorter et al. (1996) mentioned that head injuries were seen equally in fall and collision groups of snowboarders. A study conducted by Ganong et al. (1992) mentioned "catching air" as "hospital air" since competitive snowboarders seeking elevated speeds while jumping appear to be at higher risk for head, spine, and torso trauma. The failure of "catching air" leads them to be hospitalized; thus, it is called as "hospital air". Due to the high rate of jumping, the intermediate and expert snowboarding groups appear to suffer from a larger number of spinal injuries (Haruki et al., 2001). On the other hand, Matsumoto et al. (2002) pointed out that beginners faced similar injury risk to intermediates because entry-level snowboarders have increased landing failures.

Prall, Winston, and Brennan (1995) reported that snowboarders had increased numbers of head and abdominal injuries as compared to skiers. In addition, they reported that injured

snowboarders are commonly young males, with a higher proportion of head, neck, back, and trunk injuries (Fukuda et al., 2001; Hagel et al., 1999). Ganong, Heneveld, Beranek, and Fry (1992) addressed that 74% of injuries resulted from a fall. Collisions are also frequent snowboarding accidents; including colliding with another person, natural obstacles, such as trees, or other obstacles, such as fence posts or ski lift posts (Hegel et al., 2004; Shorter et al., 1996).

## Head Injury

Despite advances in technology of sports equipment for skiers and snowboarders, the incidence of head injuries seems to have increased (Levy et al., 2002). Head injuries are the leading cause of death and critical injury in sports (Fullerton & Becker, 1991; Levy et al., 2002). Among sports, Fullerton and Becker (1991) indicated that bicyclists experienced greater risk for head injuries than any other sport participants. Weiss (1994) investigated the epidemiology and nature of bicycle-related head injuries, and found that approximately half of all bicycle-related deaths occurred to children and adolescents, and the majority of bicycle-related accidents deaths were due to head (brain) trauma.

Among snow sports, snowboarding has not been analyzed as well as the other snow sports (Nakaguchi, Fujimaki, Ueki, Takahashi, Yoshida, & Kirino, 1999). However, with the growing popularity of snowboarding, and because this snow sport is more dangerous than skiing and tobogganing, there is an increased need for understanding the occurrence and injuries caused by this activity (Hackam et al., 1999). Levy et al., (2002) investigated the types of head injuries among skiers and snowboarders and found that the cause of death in 72% of fatalities among skiers and snowboarders within Colorado ski resorts from 1996 to 2000, were related to head

injuries. In their study, head injury was the cause of death in 14 (87.5%) of the 16 deaths among the 350 head injury patients. In addition, Levy et al. found that approximately 78% of head-related injuries reported in the study were male patients.

In a study conducted in Japan from 1995 to 1997, Nakaguichi et al. (1999) evaluated 559 snowboarding related injury patients. They found that 26% of these patients sustained head injuries. In addition, they indicated that falls from jumping contributed to a large number of these injuries. Other studies have noted that falls were the most frequent cause of injuries to snowboarders; however, injuries caused from jumping significantly impacted the incidence of head injuries among snowboarders (Fukuda et al., 2001; Torjussen & Bahr, 2005; Nakaguchi et al., 1999). Stuart et al. (2002) identified that skiers showed more severe injuries, but snowboarders had a significantly greater risk of sustaining head injuries.

McDonah (2000) reported that 25% of falls occurred from inappropriate jumping due to inexperience, and that the snowboarders who reported head injuries did not wear a helmet. Stewart et al. (2000) discussed that although the advances in technology associated with manufacturing protective devices has had an effect on the decrease of snow-related injuries from skiers and snowboarders, the incidence of head injuries is still increasing. In addition, since younger people enthusiastically accept snowboarding, protection from head injuries should be a primary safety concern.

## Helmets

Sport injuries have negative impacts on participation; thus, the prevention of sport-related injuries is a significant element in promoting physical activity (Eime, Finch, Owen, Gifford, &

Vear, 2004). Aggressive or intense sport participants should be aware of wearing protective equipment. Since the snowboarding population continues to grow, as does the rate of snowboard-related injuries, researchers should pay a particular attention to their needs, especially helmets as protective equipment.

### *Helmets and Headgear Use in Sports*

Research conducted by Hennessey, Morgan, Elliot, Offner, & Ferrari (2002) found that helmets significantly reduced head and brain injuries resulting from bicycling, climbing, skiing, and snowboarding. Similarly, McDonah (2000) found that brain injuries were significantly reduced among skiers and snowboarders when suitable helmets were worn. Finch and Kelsall (1999) stated that the use of helmets and padding within helmets would be useful in preventing injuries and reducing the impact associated with falls, but there has been published a very few assessment of the effectiveness related to those devices in preventing injuries. Similarly, Macnab et al. (2002) indicated that historically, there has been no mention of helmet use in reports of injuries to skiers and snowboarders. Both of these studies stressed the lack of helmet use in general. On the other hand, Cantu (1996) addressed that improved protective headgear could prevent athletic head injuries. According to the Consumer Product Safety Review (1999), helmet use by skiers and snowboarders could prevent or reduce 44% of serious head injuries. In addition, Machold et al. (2000) indicated in their research on risk of injury through snowboarding, that the use of helmets would reduce the incidence of head injuries.

Although many researchers have indicated that helmet use will prevent injuries, (Ferrera, McKenna, & Gilman, 1999; Geddes & Kevin, 2005; Made & Elmqvist, 2004; McDonah, 2000;

McLennan & McLennan, 1991; O'Neill & McGlone, 1999; Uzura et al., 2003). Macnab et al, (2002) found among snowboarders, only 28% used helmets, as compared to 54% of skiers. Usage of protective equipment (e.g., helmets or headgears) appears to be low among intense sport participants (e.g., skiers, snowboarders, ice hockey players, etc).

Researchers have investigated negative reasons for not using helmets and headgear in aggressive or intense sports. Finch (1996) identified factors associated with bicycle helmet use among teenagers. He indicated that the most common reason for not wearing a bicycle helmet among teenagers was discomfort. In addition, not being fashionable contributed to them not wearing a helmet while riding a bicycle. Due to their perceived negative factors, the need to wear a helmet among young bicyclists seems to be low. At the same time, Finch identified the major reasons for wearing helmets as follows: a) safety, b) forced to wear by parents, c) law / policy enforcement, and d) not wanting to pay a fine.

In addition to bicycle helmet use, Finch, Mclntosh, and McCrory (2001) determined the attitudes of school age rugby players towards protective headgear. The respondents said that they played more confidently while wearing protective headgear, but 63% of the respondents reported poor ventilation. Other negative comments associated with protective headgear included uncomfortable to wear (15%), and difficult to communicate while wearing (3%). Furthermore, negative design features of headgear included: being uncomfortable (61%), and too hot (57%). Pettersen (2002) also examined the attitudes of players and coaches to the use of protective rugby headgear. He indicated that wearing headgear among players was low even though the players believed the headgear offered protection against concussion. The common reasons for not wearing headgear in his investigation were that mandatory headgear was not required, they were uncomfortable to wear, and the cost was too high.

Hagel et al. (2003) pointed out similar findings for face-shield use in ice hockey, motorcycle helmet use, and motor-vehicle seat belt use. In particular, Stuart et al. (2002) found that the injury rate was more than doubled among junior ice hockey players while wearing no protection, as compared to those wearing partial protection, and almost seven times higher than those wearing full protection. However, many players reported that they did not like to wear facial protection.

### *Helmets for Snowsports*

An Internet retailing website stated, "Regardless of your abilities and level of expertise in snowboarding, a good snowboard helmet is essential for your protection. Keep in mind that even a low speed, back slip on the back of your head can already cause serious head injury. A good snowboarding helmet will give you maximum protection from head injuries without getting in the way of your snowboarding fun" ("Helmet Buying Guide and Shop," n.d.). According to Taylor (personal communication, October 10, 2005), there is no difference between snowboarding and skiing helmets: "style is the only difference, one can ski in a snowboard helmet and the other way around."

Brown, Ramsey, and Weiss (1997) indicated that manufactured helmets were designed to match the speed and ability level of skiers, thus affording different degrees of head protection. They described that all helmets, in general, were constructed from three layers: the inner and middle layers, and the outer shell. The inner and middle layers were made similarly across all helmets. The middle layer of all helmets was designed with polystyrene, a dense and compressible material, to relieve impact on the head during falls and collisions. The inner layer

was bonded with nylon tricot to provide warmth, cushion, and comfort. The outer shell determines the strength and protectiveness of the helmet for head safety. They stressed that a firm and sung fit would be crucial to proper functioning, and that the helmet should be comfortable with minimal twisting or sliding.

Brown et al. (1997) further classified helmets into 3 categories, based on the end user and cost. Level 1 was designed for the recreational skier. This helmet consisted of a Polypropylene shell. Level 2 was for advanced skiers or members of racing teams. This helmet had a polycarbonate shell. Finally, Level 3 helmets were designed for advanced downhill skiers or racers who rode skiing at 70 miles per hours or more. This helmet had a Carbon/Kevlar shell. The U.S. consumer product safety commission (1999) reported helmet prices for adults ranging from $75 to $300, and helmets for children ranging from $70 to $150. McDonah (2000) indicated that helmet cost depended on the manufacturer and design, and ranged from $95 to $170 in his study. A current Internet search found that polypropylene shell helmets for $59.99 (Pro-Tex Freeride ski and snowboarding helmet); polycarbonate shell helmets for $109 (Giro Nine.9 ski and snowboard helmet); and carbon/Kevlar shell helmets for $149.99 (Giro streif ski and snowboard helmet).

Hennessey et al (2002) emphasized that the effectiveness of a helmet was related to how the helmet was used. In addition, to provide adequate protection, helmets should not be substituted for different sports. For example, a helmet used for hockey might not be effective when it was used for football. Researchers have consistently stated that bike helmets would not provide sufficient protection for skiing and snowboarding; and versatile helmets designed for multi-purposes might be too bulky and heavy, causing the wearers neck injuries (Brown et al., 1997; “Helmet Safety, Standards and Design.” n.d.). Furthermore, Macnab et al. (2002) found

that some children suffered significant head injuries due to wearing a hockey or kayaking helmet rather than one specifically designed for skiing.

McCrory (2002) viewed the importance of specific helmet design, imperative helmet maintenance, and fit for sports. McCrory recommended suitable helmet standards being developed for protective helmets. Corra et al. (2004) suggested that helmet use should be enforced by law. In addition, the American Medical Association recommends that helmet use should be mandatory for young skiers and snowboarders. Both the American and Canadian Medical organizations advise young players to voluntarily use head protection (Macnab et al., 2002).

### *State Laws*

Currently, there are no safety standards or state laws in the U.S. for skiing helmets (McDonah, 2000; U.S. Consumer Product Safety Commission, 1999; Hagel et al., 1999; Josefson, 1998). Most skiing helmets are imported from Europe and must meet the safety standards regulated by the Comite European de Committee for Standardization (Consumer Product Safety Commission, 1999; McDonah, 2000; U.S.). Although no helmet laws are in force, the United States Ski Association (USSA) and the United States of America Snowboard Association (USASA) require helmets be worn for all competitions and official training, such as by national and Olympic teams (T. Collins, personal communication, September 2, 2005; U.S. Consumer Product Safety Commission, 1999).

According to a current Internet site regarding information on helmet standards, they suggested that consumers read the accompanying literature to make sure the helmet meets one of

the three following helmet standards: the Common European Norm (CEN), the American Society of Testing and Materials (ASTM), or the Snell Memorial Foundation (SNELL) ("Helmet Safety, Standards and Design." n.d.). The specifications associated with these standards are listed in Table 3. The website stated "the U.S. Consumer Product Safety Commission (CPSC) endorsed the use of snowsports helmets in January of 1999. The CPSC noted that while the then proposed ASTM standard (the ASTM standard was not adopted until May 2000) and the CEN standard may differ in test parameters, a helmet that meets either of the standards "will produce adequate protection to reduce the risk of head injury." The Snell standard, presumably, would be considered adequate as well since it's the most stringent of the three standards" (Helmet Safety, Standards, and Design." n.d.).

Table 3

*Information of a Standard for Manufacturing Helmets*

| Standard(s) | Information |
|---|---|
| CEN<br>(The Common Norm) | a) A large European Standard Organization.<br>b) The CEN 1077 standard: the European Ski European Helmet standard.<br>c) The least demanding in impact management requirements. |
| ASTM<br>(The American Society of Testing standard and Materials U.S.) | a) A not-for-profit organization.<br>b) Adopted a U.S.'s recreational snowsports helmet F2040 standard in May 2000 and became to which helmets manufactured in the U.S.<br>c) Ski and snowboard helmets manufactured in should confirm to the ASTM snowsports helmet standard. |
| SNELL<br>(The Snell Memorial Foundation) | a) A not-for-profit organization<br>b) Founding in 1957 and has been a leader in helmet safety in the U.S. and around the world.<br>c) The Snell RS-98 standard: the most stringent ski helmet standard in the world. |

## A Needs Assessment

Unruh and Unruh (1984) defined a needs assessment as both structured and informal procedures used to identify gaps between the actual condition and the preferred condition of goals. Rouda and Kusy (1995) ensured that a needs assessment is a systematic method of analyzing gaps between the current situation and the desired or necessary situation. Mullet (1984) considered a needs assessment as a developmental process to determine and measure gaps between actual objects and the ideal of objects.

Researchers have computed needs assessments for functional clothing and equipment in an effort to improve garments for special end users, such as the disabled or sports participants. Yu (2000) discussed that functional design for special needs of different users enhances both people's independent living and their self-assurance.

Mullet (1998) indicated that there is an increasing need for specialized clothing for sports participants in modern society to enhance the quality of their performance. However, since very little research has focused on a needs assessment of snowboarders in terms of their protective gear (helmets), it may be necessary to investigate if there is a gap between helmets in the current market and an ideal helmet desired by snowboarders.

### *Needs of Active Sports Participants*

Needs of active sport participants include comfort, fit, protection, safety, mobility, thermal balance, quality of materials (fabrics, sewing construction, durability, and abrasion resistant), and performance (Bye & Hakala, 2005; Dickson & Pollack, 2000; Mullet, 1984). For sports, the

most important functional needs may be dependent on the type of sport. In Mullet's (1984) study, for example, the most important characteristic for an ideal padding jacket was protection from the wind and fit. Bye and Hakala (2005) found that sailors expressed the strong need for thermal balance and mobility for their sailing apparel. Similarly, the design and construction of ski boots were related to comfort, major injury prevention, and performance (Reilly & Lees, 1984). Dickson and Pollack (2000) indicated that appropriate fit and comfort seemed to be the dominant design criteria for in-line skaters to evaluate their physical performance with clothing. McCullough (2003) considered that comfort and safety contributed to an increased value for protective clothing and sports equipment.

Outcomes from needs assessments provide crucial design considerations for functional clothing and protective devices. Fit was an important attribute for kayakers, so that they could have free and effective movement for paddling (Mullet, 1984). Also, fit was a significant factor in determining the function and performance of sailing garments, while simultaneously affecting how the garments would feel and look on sailors (Bye & Hakala, 2005).

In addition to fit, comfort has been shown to enhance the overall physical and psychological performance of sports participants or special users (e.g., the elderly, workers in the hazardous environment, military, etc). In the development of functional clothing, Rosenblad-Wallin (1995) applied user-oriented product development to him design considerations, and found comfort to be one of the most important functional values of clothing. He found that the concept of comfortable clothing interacted with several functional features: 1) thermal climate 2) ease of movement 3) weight/load 4) fit 5) pressure on the body 6) friction against the body 7) tactility and 8) static electricity. Similarly, Reilly and Lees (1984) pointed out that the comfort of sport equipments (e.g., ski boots and bindings) increased injury prevention and performance.

*Functional/Protective Clothing and Equipment*

Protective clothing is designed to keep the wearer safe from bodily injury or from other dangerous factors such as heat, chemicals, and infection, by covering the body with clothing ("Personal Protective Equipment." n.d.). Protective equipment includes forms of protection, such as eye, ear, or head protection, or devices incorporated into garments, such as hip devices or padding for hockey players.

Studying protective clothing and equipment has primarily focused on active and aggressive sports. McCullough (2003) indicated that protective clothing might contribute to heat stress due to the number of garment layers required to protect the body surface of the wearer. In addition to protective equipment for athletic fields, the ergonomic design for personal protective equipment has been researched. Ergonomic design takes people's capabilities and restrictions into consideration to ensure that the product performs properly for the target users; thus, ergonomics embodies everything that involves people in work systems, sports and leisure, health and safety ("Ergonomics Society: Ergonomics." 2004, August 17).

Reilly and Lees (1984) investigated ergonomic aspects of sports equipment and indicated that the equipment must be harmonized with the individual needs and characteristics of the user; for example, helmets, face guards, shoulder pads, and groin and knee protectors should be effective for football or hockey players. To be effective, protective equipment must alleviate harmful impact on the user. Kwon, Kim, Kim, and Byun, (2002/2003) evaluated personal protective equipment for Korean policemen and determined that heat stress was the primary concern across all equipment. They found that the helmet had the following major problems: static loading on the neck due to lack of counter-balancing, heat stress, lack of visibility, and

difficulty in wearing. They redesigned the protective clothing and helmet to improve ventilation and enhanced ease of donning and doffing. They concluded that the process of redesigning personal protective equipment is to meet the needs of the users through enhancement of work performance and job safety. McCullough (2003) emphasized the importance of helmet design to provide significant protection for people who engage in aggressive sports, since the head is one of the most vulnerable and critical body regions.

## The Design Process

Yu (2000) indicted that many researchers and educators in functional design fields consistently use the design processes to meet the needs of their users. LaBat and Sokolowski (1999) discussed that design processes from fields such as education, psychology, and philosophy have had an affect on all applied design fields. The major goal with the design process is to meet the special needs of the end users.

Koberg and Bagnall (1981) introduced a seven-stage itinerary for completing a systematic problem-solving design evaluation. The seven stages are as follows: 1) accept as getting started, 2) analyze as gathering facts and feelings, 3) define as determining the destination (essentials for success), 4) ideate as generating alternatives, 5) select as choosing from the options, 6) implement as taking action, and 7) evaluate as measuring success. They considered these procedures as a connected chain of events, processing circularly rather than linearly. Watkins (1995) recognized her design process originated from Koberg and Bagnall's but simplified her process to: 1) accept, 2) analyze, 3) define, 4) ideate, 5) select, 6) implement,

and 7) evaluate. Her seven-phase process contributes to exploring a change from a problem to a solution.

### *The FEA Consumer Needs Model*

Lamb and Kallal (1992) advanced the development of a design process for multipurpose intentions in apparel design. They proposed a conceptual framework integrating three apparel design themes: functional, expressive, and aesthetic (FEA) needs (Figure 2). They indicated that their conceptual framework included the design process features from other models (Hank, Belliston, & Edwards, 1977; Koberg & Bagnall, 1981). This model emphasized the needs and wants to be met by a wide variety of customers: functional requirements such as fit, mobility, protection, thermal comfort, donning and doffing, and ease of movement; expressive requirements such as values, roles, status, and self-esteem; and aesthetic requirements such as art elements, design principles, and body/garment relationship. In addition, the researchers proposed that framework could be applied to all types of apparel design, because they did not classify differences between functional apparel design and fashion design. The model can solve various design projects; such as, skating costumes, design of clean room garments, or customized designs for a client.

Lamb and Kallal (1992) suggested the target consumer (intended user) was located at the heart of their proposed model (Figure 3). They indicated that identifying the needs and wants from the target consumer establish the design criteria. In addition, they viewed culture as a mediator to narrow the gap between the intended users and their requirements or desires in their

clothing items. Furthermore, they suggested that designers should be thoughtful of culture in developing user profiles and in defining their needs.

The FEA model has been applied to a functional design study conducted by Bye and Hakala (2005). They developed design criteria for female sailors from the user need categories of functional, expressive, and aesthetic needs. They reviewed previous studies that used the FEA consumer needs model and Watkins' design process to organize the written needs criteria of the users including thermal balance, safety, mobility, fit, and quality for functional needs; self-esteem related size issues for expressive needs; and uniqueness of feminine body silhouette and traditional colors for aesthetic needs to enhance female sailing clothing. However, since the target customers were competitive sailors, many garment attributes of design criteria were found from aspects of functional needs to improve the wearer's efficiency.

Similarly, Kim and Farrell-Beck (2003) applied the FEA design model as a well-organized approach to provide an experimental design course for clothing and textiles students. The researchers indicated that the FEA model appeared to be the most effective approach to be adopted by students to conceptualize and implement experimental design plans and for further class activities and assignments. In addition, the researchers concluded that students evaluated some positive feedback (feasibility, usefulness, and benefits) of the model for creative apparel design. Furthermore, the researchers suggested that the model would be helpful to have an effect on both functional design courses and creative/experimental courses.

After reviewing some design processes, the FEA consumer need model tends to be the most applicable framework for design projects because the three needs of functional-expressive-aesthetic themes, can be easily applied to a variety of designs regardless of the types of design

projects. The FEA model is a concise procedure, so it can be efficiently used to enhance designs to meet the needs of consumers.

*Figure 2.* Apparel Design Framework for the FEA Model

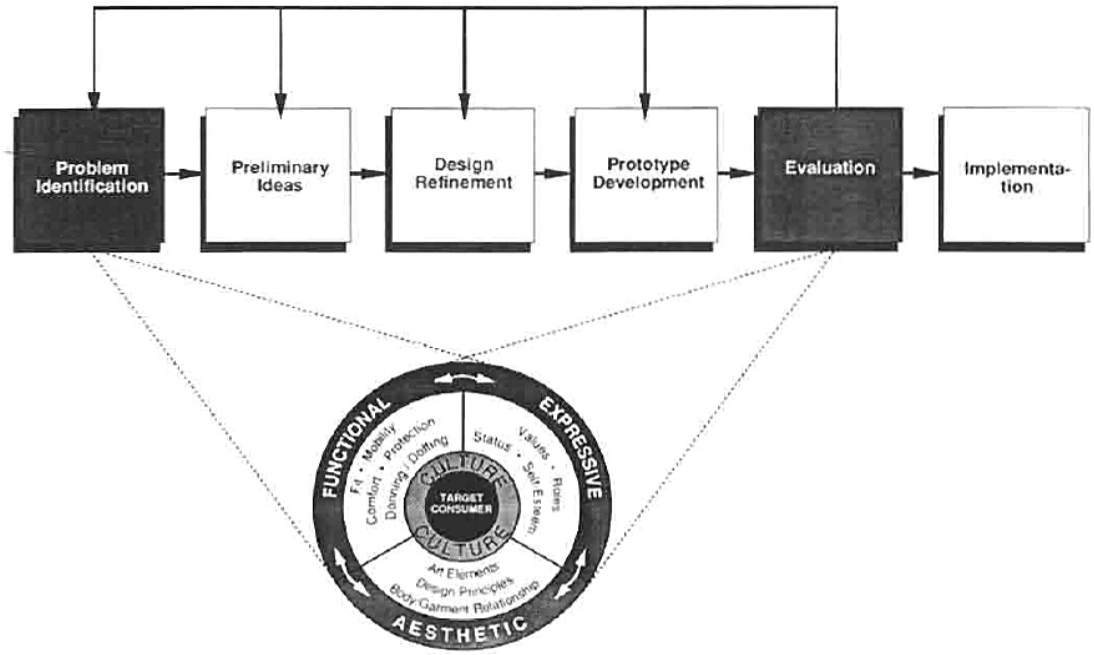



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*Figure 3.* The FEA Consumer Needs Model


"The apparel design framework for the FEA model" used with permission from Lamb, J. M. and Kallal, M. J., whose study was appeared in "Clothing and Textiles Research Journal" 1992, 10 (2) p. 42-47. Copyright 1992 by International Textile and Apparel Association. Adopted with permission of the author.

## Studies on Expressive Needs

Many areas of clothing research have studied expressive components of dress. Dress can be defined as modification to the body, such as coiffed hair, pierced ears, or tattoos, or as supplements to the body, such as garments, jewelry, and accessories (Roach-Higgins & Eicher, 1992). The expressive components of dress convey communicative and symbolic messages about the wearer, as well as pleasure obtained through dress (Lamb & Kallal, 1992). In addition, Roach-Higgins and Eicher stated that dress functions to provide role information about the wearer, to communicate social standards and expectations for that role, as well as announcing the social position of the wearer. Snyder (1983) indicated that identity roles could provide important

messages about the behavior of the individual, and help the viewer in understanding the situation. Furthermore, Roach-Higgins and Eicher indicated that individual elements of dress, such as color or shape, might be a better indicator of an individuals' identity than a total ensemble of dress.

Beyond individual identity, group identity can also be established through elements of dress. However, when a group is first establishing itself, there are no well-established norms for behaviors or dress associated with that group (Dickson & Pollack, 2000). Emerging sports, such as snowboarding and in-line skating, are groups that have limited history, as well as fewer role models for group association. Dickson and Pollack suggested that identifying what criteria athletes in emerging sports use for evaluating and selecting sport clothing would be helpful to serve the expressive and protective needs of these athletes. As such, Dickson and Pollack investigated the needs and preferences of athletic females who participated in in-line skating. They found that female in-line skaters appeared to be interested in having a distinctive appearance by in-line skating appearance so that they could enhance their identities as a skater. The researchers identified distinct behaviors of buying and wearing those sport clothing products, in an effort to define them as an in-line skater. They also found that style and brand characteristics would be essential to contribute to a special and distinctive sport identity for those athletes. Furthermore, they identified comfort, quality, and other physical performance-enhancing characteristics of clothing as imperative in providing a successful athletic role.

Cassleman-Dickson and Damhorst (1993) assumed that an individual who has accumulated more time and achievements in an athletic role, would have high role knowledge. The researchers examined female bicyclists for differences in the level of sports involvement and their interests in using bicycling apparel for role support. The researchers found that the level of

involvement was associated with some differences in interest in cycling dress; lower involved cyclists expressed more concern in showing an attractive appearance, while higher involved cyclists were more concerned with presenting a competent cyclist image. Although cycling clothing interests were different based on the level of involvement, all cyclists identified the need for clothing that is appropriate for cycling and enhances their physical performance.

Wheat and Dickson (1999) also researched athletes and clothing, investigating causes for dissatisfaction and role conflicts for collegiate female golfers. They indicated that a limited number of style and brands for athletic uniforms might result in a lack of choice, forcing teams to change their uniform expectations. For instance, teams might purchase men's uniforms due to more readily available men's clothing in a variety of school colors. Wheat and Dickson addressed that gender styling and sport roles have a negative effect on satisfaction with golf team uniforms. In addition, they found that quality, performance, and athletics of uniforms were the most frequently reported evaluative criteria among the female golfers. Although role conflict did not contribute to dissatisfaction with their uniforms, the dual needs for performance and aesthetic components in golf uniforms were identified. Furthermore, they indicated the importance of aesthetic and expressive characteristics for sport clothing.

Scanlan, Carpenter, Schmidt, Simons, and Keeler (1993) defined sport commitment as "a psychological construct representing the desire or resolve to continue sport participation" (p.6). In addition, the researchers indicated that sport commitment would play an important role in predicting actual sport participation. Dickson and Pollack (2000) anticipated that an individual with greater commitment to a sport and more hours dedicated to practicing the sport (e.g., greater identity salience) would purchase more specialized clothing. This idea was supported by their study; greater commitment to in-line skating was an important predictor of purchasing skating

clothing. Similarly, in Chae's (2002) study on women's tennis wear, there was a significant relationship between the level of tennis commitment and the level of tennis clothing interest for women. Women who participated in tennis with greater commitment seemed to present more interest in clothing that served uniqueness, attractiveness, and performance-enhancement needs. Therefore, appropriateness of clothing (e.g., fit, sizing, etc) seems to be important to be harmonized with sport commitment since an individual who dedicates more time to perform a specific sport has a tendency to search for more specialized clothing.

As shown in previous studies on expressive needs for those who participate in sports, their interests in sport clothing seem to be an important factor that may serve to psychologically enhance their athletic performance. In addition, examining expressive needs for participants in sports maybe provide a better understanding of their needs and wants associated with sports to be physically and psychologically beneficial to them. Thus, investigating expressive needs may be necessary to improve overall athletic performance. However, no research has focused on snowboard clothing or protective equipment that may be associated with commitment to the sport for expressing unique and identifiable snowboarding participants.

## Theories in Predicting and Understanding Behavioral Factors

Research has used models of reasoned action or planned behavior to predict and understand factors in determining behavior in specific conditions. The theory of reasoned action has been primarily used to predict consumers' intentions and behaviors. Similarly, the theory of planned behavior has been used to predict and explain human behavior, such as the use of protective helmets among schoolboys or predicting dishonest actions among college students in

certain situations. Since these theories are supportive of understanding attitudes and predicting human behaviors, studying these theories may be useful in understanding snowboarders' attitude towards helmet use.

### *The Theory of Reasoned Action*

Ajzen and Fishbein introduced the Theory of Reasoned Action in 1975. The purpose of the theory was to predict consumers' purchase behaviors (McAllister, 2004). Harrison, Thompson, and Rodgers (1985) explained that the Theory of Reasoned Action was developed to provide a statement of roles, attitudes, and social influences on determining behavioral intentions and behaviors. Ajzen and Fishbein (1980) theorized that a person's attitude toward a behavior would be related to a belief that the particular behavior would direct the individual to obtain a certain outcome, which might be beneficial to the individual; as a result, the individual might then intend to act or actually participate in that particular behavior. They added that a persons' behavior would be influenced by the individuals with whom they interact, or a subjective norm. Similarly, Rejeski (1992) explained attitudes as values attached to outcomes, and social norms as normative beliefs of significant others that provide an individual with motivation to act. In addition, Ajzen and Fishbein pointed out that attitudes toward a behavior could lead to an intention to behave. Likewise, Blackwell, Miniard, and Engel (2001) explained intentions as "subjective judgments about how one will behave in the future" (p.283) and attitudes as "what we like and dislike" (p.289).

Studies using the Theory of Reasoned Action have been conducted in different fields of consumer behavior. Ulleberg and Rundmo (2002) investigated risk-taking attitudes among

young drivers since adolescents were more frequently involved with traffic accidents than other age groups. They found that the "ideal" attitude was negatively correlated with the preference for risk-taking; this meant that a high score on an attitude item such as "if you possess good driving skills, speeding is OK" was less favorable for safe driving. Thus, the more concerned with safety young drivers were, the fewer risk-taking behaviors in driving were evident.

Ha (1998) examined the relationships among several factors of behavioral brand loyalty. Ha found that both favorable attitudes and behaviors contributed to consumers becoming a brand loyal supporter. However, conflicts between attitude toward the purchase and subjective norms would significantly reduce buyers' brand loyalty. Additionally, the researcher pointed out that consumers' personality traits would be an influential factor in causing inconsistency between attitude toward the purchase of a product and subjective norms for consumers.

*The Theory of Planned Behavior*

The Theory of Planned Behavior was an extension of the theory of reasoned action, and was theorized to predict behaviors of individuals in incomplete volitional control, which was a limitation of the original model (Ajzen, 1991). Ajzen indicated that the individual's intent or willingness to perform a given behavior was a major element of the theory of planned behavior. He indicated that the stronger the intent, the more likely the behaviors would be performed. In addition, he addressed that perceived behavioral control referred to people's perception of the ease or difficulty linked to the performance of a particular behavior or interest. Perceived behavioral control with behavioral intention could be used to predict behavioral achievement; for instance, if two individuals have equally strong intentions to learn to ski, and both try to do so, the person who is confident with his ability in this sport is more likely to persevere than the person who is unsure of his ability.

Quine, Rutter, and Arnold (1998) stated that social psychology theories, such as the planned behavior model could provide valuable tools for predicting and understanding road user behaviors. Quine et al., using the Theory of Planned Behavior, investigated helmet use among 162 schoolboy cyclists, aged between 11 and 18 years. They assumed that cyclists influenced more by positive beliefs pertaining to beneficial outcomes of wearing a helmet than by beliefs regarding negative outcomes, should lead to helmet use. They found that intention was significantly correlated with actual helmet use. However, wearing a helmet among those schoolboy cyclists was a public behavior, so subjective norms (e.g., parental or friends attitudes) were influential in encouraging or discouraging helmet usage. In addition, some negative factors

like forgetting to put the helmet on, being too much effort, or having no where to store the helmet at school, were found to intervene between the intention and behavior.

On the other hand, Beck and Ajzen (1991) conducted a study to examine the prediction of dishonest actions using the Theory of Planned Behavior framework. They indicated that the theory of planned behavior evidently supported their main study and found that intentions of acting dishonest behaviors were powerfully affected by beliefs about possible difficulties and opportunities. Furthermore, they addressed that prior behavior was influential in understanding later behavior, and expected the two to correlated. This study showed that there was significant consistency in dishonest behaviors over time.

Findings from studies associated with predicting behaviors may be important in predicting snowboarders' attitudes towards helmet use; it may be related to negative perceptions of subjective norms, personality traits, or outcomes from helmets they have worn. Thus, the model of reasoned action or planned behavior may be useful for this study to give details that snowboarders' attitude toward wearing a helmet could lead to an intention to act (wear a helmet) or not to act (do not wear a helmet) for snowboarders.

# CHAPTER 3

# METHODOLOGY

The approach utilized in conducting this study is an Internet survey. The techniques are designed to obtain results from a group of snowboarders in order to identify their needs for snowboarding helmets and to test a proposed conceptual framework for examining attitudes towards helmets. In particular, this chapter delineates the procedures for proposed model, variables, instrument development, sample, administration, advantages and disadvantages of online surveys, and data analysis.

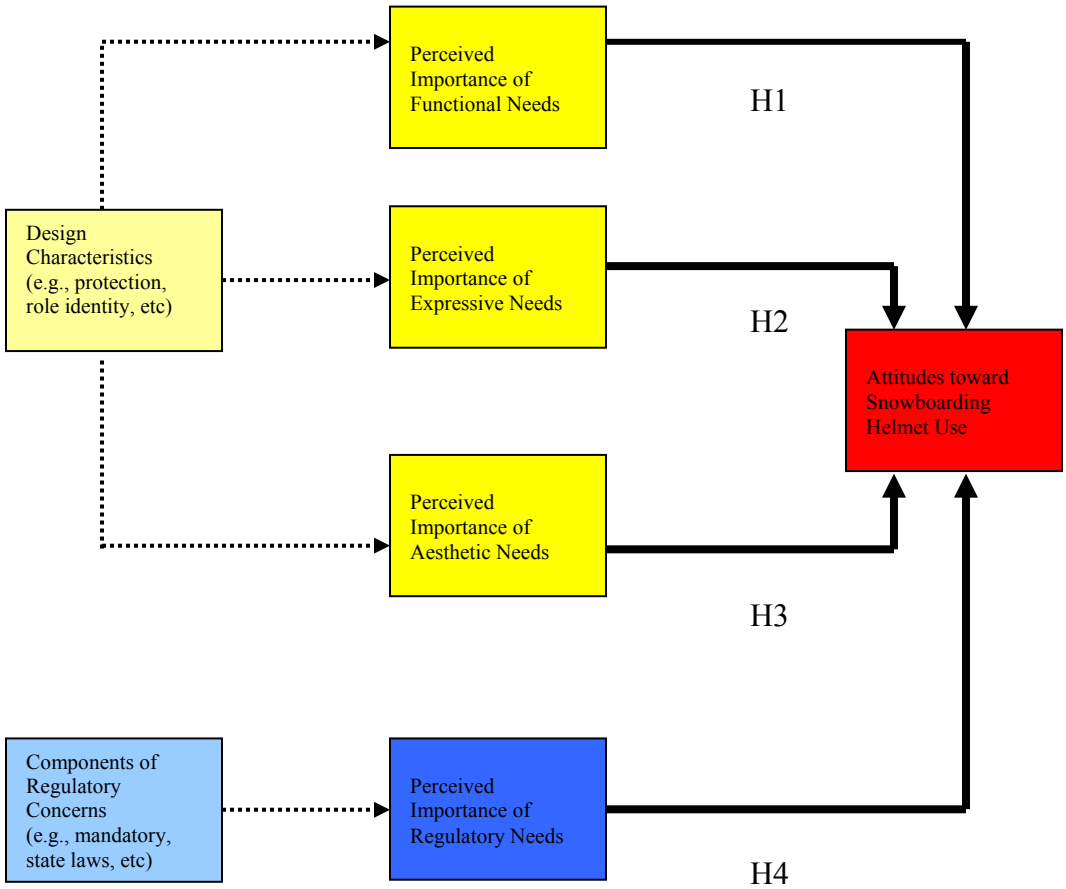
## Proposed Model

The proposed model for this study is an adaptation of the functional-expressive-aesthetic (FEA) consumer needs model developed by Lamb and Kallal (1992). The model is used to generate an understanding of user needs for snowboarding helmets. An additional component, regulatory needs (R), is integrated into the FEA needs model to see if this additional variable will impact attitudes towards helmet use for snowboarders (Figure 4). The relationships in the proposed FEAR model may enable the explanation of helmet usage among snowboarders.

A paper survey was developed to identify the specific design criteria for snowboarding helmets that may be reflected in the FEAR needs desired by current snowboarders (Appendix C). The questions for the FEA needs were formatted as open-ended questionnaires in a basis on the study of functional design conducted by Bye and Hakala (2005). In addition, the questions for the regulatory needs were formatted as close-ended questionnaires with the Likert scale ranging

from 1 (strongly disagree) to 5 (strongly agree), based on the studies of cycling helmets conducted by DiGuiseppi, Rivara, & Koepsell (1990) and Finch (1996); and rugby headgear conducted by Finch, Mclntosh, & McCrory (2001). .

*Figure 4.* Proposed Framework



## Variables

Individual domains that were used to measure the FEAR factors were identified after conducting paper surveys with 20 volunteers who attended a regular meeting of the Virginia Tech snowboarding club on October 31, 2005. These domains were added into the original components of the FEA model developed by Lamb and Kallal (1992). Components for the regulatory needs factor were adopted from previous studies on cycle helmets and rugby headgear. Thus, the independent variables for this study were the specific design criteria factors identified from the exploratory survey placed within the FEA model, and the identified regulatory factors. The dependent variable was attitudes towards snowboarding helmet use measured by the proposed FEAR model.

## Instrument Development

The purpose of using the instrument is to investigate the relationships between the proposed FEAR model and attitudes towards helmet use among snowboarders. A structured questionnaire was developed to collect data on independent variables (functional, expressive, aesthetic, and regulatory needs of snowboarding helmets) and dependent variables (attitudes towards helmet use) for snowboarders: this is the main concern of this study. However, the additional questionnaire was also administered to identify important characteristics of snowboarding helmets in terms of user's functional, expressive, aesthetic, and regulatory needs that may influence attitudes towards helmet use among snowboarders. Questions were adopted and modified from previous studies on functional design, snowboarding attitudes, and attitudes towards helmet usage. To establish content validity of questionnaires for this study logically

rather than empirically, the tables of specifications (content validity charts for FEAR needs) have been created to ensure that domains of the FEAR needs factors match with items of content areas (Appendix E-H).

Demographic information (e.g., age, gender, occupation, income, education, marital status, experience and involvement in snowboarding, ownership of helmets, preferred place to shop, preferred brand, and preferred price to spend on helmets) was an additional part of the instrument. Therefore, the instrument consisted of main sections of FEAR needs, attitudes towards helmets, importance of FEAR factors, and general information about demographic characteristics for the respondents.

The questionnaire was pilot-tested for increasing ease of use and interpretability by respondents. The pilot study was conducted with snowboarders who are currently enrolled in the Virginia Tech snowboarding club. A direct link to the online surveys was sent out via email, so that they could participate in this pilot study. An open-ended scroll box was included at the end of each section of the questionnaire for comments from the respondents. Comments were evaluated and necessary changes were made to the instrument.

## Sample

The population for this study consisted of adults (over 18) who participate in snowboarding. The snowboarders were selected from current members of the United States of America Snowboard Association (USASA) in the current listing of email addresses. In addition, snowboarding clubs were informed about this study by posting a direct link on the club's website bulletin boards (e.g., snowboard. com, etc) so that eligible respondents would be able to

participate in the online survey. The special web site (e.g., surveymonkey.com) was used to create the format of questions for this online survey. In addition, this web survey would control the flow of skipping answers and of participating in this survey only once rather than multiple times by respondents, so that this web survey would eliminate bias. The planned population size would be approximately estimated to be 1000-1669 respondents, but the target sample size would be anticipated to be between 300-500 respondents (30% response rate).

## Administration

The developed instrument was administered online, according to the instructions suggested by Dillman (2000): 1) utilize a multiple contact strategy similar to face-to-face, telephone, and regular mail surveys, 2) send a prenotice –email message that is very important to leave a positive impression for the recipient; 3) personalize all e-mail contacts so that individuals should be encouraged to complete questionnaire; 4) keep the cover letter brief so that respondents can get to the first question without having to scroll down the page; 5) offer them an alternative response method, such as printing and sending back their responses; 6) include an effective and imperative replacement questionnaire with the reminder message; 7) begin with an interesting but simple-to-answer question; and 8) consider limiting scale lengths and encourage respondent to see items individually rather than as a part of large group.

The data for this study was generated from the online survey, distributed in one of two ways 1) emails sent directly to the sample population or 2) survey information posted on a bulletin board of snowboard organizations. The single instrument contained multiple sections of

questions regarding attitudes towards helmet use, the design criteria of functional-expressive-aesthetic needs, and the additional component of the regulatory needs for helmet usage.

For collecting data via emails, an email was sent to each selected member of USASA member list, with a notice that they had been selected to participate in this research. The email included a brief explanation of the study, a direct link to the online questionnaire, a request to complete the online survey, and a brief notice of appreciation for their participation in this study. Two days (48 hours) after this initial email, a follow-up email was sent reminding them to participate in this study and to thank those who had already completed and returned their responses. For collecting data through bulletin boards of snowboard organizations, information of this study, a brief plea for participation, and a direct web survey address was posted on the web bulletin board page. In addition, the expected length of this online survey was approximately 15 minutes.

## Advantages and Disadvantages of Online Surveys

Utilizing online surveys include both advantages and disadvantages. Dillman (2000) stated that online surveys are simpler to compose and send, but external validity is a problem, since online surveys are not conducted by probability sampling. Similarly, Taylor (2000) indicated that collecting data via online is a form of volunteer or convenience sampling. However, Taylor stated that online research might be effective as a visual medium, allowing respondents to see images and address sensitive issues (e.g., depression, anxiety disorders, etc). In addition, he pointed out that the Internet enables researchers to survey a large sample of people, or tiny sub-samples of the population, incredibly fast and at affordable costs. Similarly,

Wright (2005) discusses that the Internet provides access to unique populations, irrespective of geographical locations. In addition, Wright says that online surveys have relatively inexpensive costs and can save time, as compared to traditional paper-and-pencil format surveys.

In contrast to the advantages associated with online surveys, Wright (2005) mentions that self-reported data may not guarantee that participants provide accurate demographic or characteristics information. In addition, access issues may be a disadvantage of web surveys due to wrong addresses and email blocking technology. Although online surveys can be delivered to respondents quickly, sensitive timing of online surveys may contribute to delayed or ignorant responses (Ilieva, Baron, & Healey, 2002).

## Data Analysis

The statistical software program (SPSS) was used for analysis of the specific hypotheses of this study. Data analysis was based on valid questionnaires returned responses. Multiple regression analyses were used to statistically analyze the data for examining the relationships between the independent variables (e.g., FEAR needs) and the dependent variable (e.g., attitudes towards snowboarding helmets) based on the proposed hypotheses for this study. In addition, descriptive analysis was used to show frequency distributions, percentages, means, and standard deviations.

As this study is to determine the relationships between the independent variables and dependent variable, the multiple regression equation was used;

$$Y_i = \beta_o + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \varepsilon_i$$

where $Y_i$ is the score of attitudes towards snowboarding helmet use for person i on outcome;

$\beta_o$ is the intercept (value of Y when all X's equal 0) in the population;

$\beta_j$ is the slope for predictor $X_j$ in the population, where the slope is the predicted change in Y for one unit increase in $X_j$, holding all other X's constant: Specifically,

$\beta_1$: The partial slope for predictor $X_{1i}$ (functional needs) in the population,

$\beta_2$: The partial slope for predictor $X_{2i}$ (expressive needs) in the population,

$\beta_3$: The partial slope for predictor $X_{3i}$ (aesthetic needs) in the population,

$\beta_4$: The partial slope for predictor $X_{4i}$ (regulatory needs) in the population

; and $\varepsilon_i$ is the error for person i.

Background information (e.g., gender, age, race or ethnic group, experience, income, etc) of the participants in this study was controlled so that variables of background information was under control over the independent variables to avoid confounding between the variable of interest and the backgrounds. In addition, interaction effects between predictor variables (FEAR independent variables) and predictor variables and covariates (background variables) were tested to reach the final model.

Six assumptions of multiple regression are: 1) Errors are normally distributed; 2) Assumption of a linear relationship between the independent variables and the dependent variables; 3) Variables are measured without error (reliably); 4) Assumption of homoscedasticity (the variable of errors is the same across all levels of X's); 5) No model misspecification; and 6) Independent observations (Osborne & Elaine, 2002). Some of the assumptions can be checked

statistically, and some of them are only checked through logical consideration. This study was checked whether the assumptions are tenable, and if the assumptions are violated. Therefore, this study would take appropriate actions to alleviate the problems such as adding omitted independent variables.

## Limitations

1. The sample was selected non-randomly.
2. The sample was restricted to adults, aged over 18.
3. The survey was conducted with people who are currently enrolled as a member of the United State of America Snowboard Association (USASA) and other snowboarding clubs. These respondents have e-mail addresses and/or Internet access; therefore, the results of this study might not be extended to the general population of non-members of snowboarding participants across the U.S.
4. The status of the dependent variable was restricted by the range of the five point Likert scale.
5. For testing the proposed hypotheses, the dependent variable was treated as a continuous variable to utilize multiple linear regressions; although, rigorously speaking, it is at most an ordinal variable. However, this study found evidence to justify such an approximation.

# CHAPTER 4

# FINDINGS AND RESULTS

The major purpose of this research was to identify the design characteristics and to test statistically a proposed conceptual framework for snowboarders' helmet attitudes that could impact the use of snowboarding helmets. Statistically, this study was largely divided into two main concerns: 1) to investigate the level of perceived importance of the combined design characteristics and regulatory needs (FEAR requirements) as well as attitudes towards snowboarding helmet use; and 2) to investigate the relationships in the proposed conceptual framework for determining the impacts of the FEAR needs on attitudes towards the use of snowboarding helmets. This chapter presents findings from the online survey, analysis of results and hypotheses, and discussions of the data. In addition, a summary of findings and analysis are tabulated. All the computations were done via Statistical Package for the Social Sciences (SPSS).

## Reliability of Instruments

Reliability deals with consistency and repeatability of measurement to ensure the quality of the instruments for the study. A coefficient alpha was calculated for each portion of the FEAR needs instruments to determine reliability. For the scale of functional needs with 10 items, the alpha was approximately .77 ($\alpha$=.7657); for the scale of expressive needs with 10 items, the alpha was approximately .88 ($\alpha$=.8791); for the scale of aesthetic needs with 8 items, the alpha was .92 ($\alpha$ =.9246); and for the scale of regulatory needs with 7 items, the alpha score was .96

(α=.9605). According to Leedy (1997), if an alpha value of a scale is greater than 0.70, the scale is considered as a reliable instrument to differentiate the subjects. Therefore, the reliability results for FEAR needs were acceptable for this study, since each of the four scales had greater values of reliability: regulatory needs indicated 96% reliable, with only 4% of the measure unreliable; aesthetic needs indicated 92% reliable, with 8% unreliability; expressive needs was 88% reliable, with 12% unreliable; and functional needs 77% reliable, with 23% of the measure unreliable.

## Pilot Study

The study was approved by the Human Subject Review Board on March 3rd, 2006 (Appendix A). Following approval, a pilot study was conducted by snowboarders of a large-scale university in the Southeast region of the U.S. A total of 83 respondents completed the online survey during a March 12th through March 16th, 2006 time period. The pilot study was conducted to determine if the questionnaire contained errors, and to determine if the directions were written correctly. Although minor changes were made, there were no major content changes to the questionnaire. Approximately, 80% of respondents in the pilot study were recreational snowboarders, and all respondents were between 18 and 25 years of age. In addition, approximately 57% reported no helmet ownership, and approximately 63% showed negative attitudes toward helmet use. Furthermore, although the majority of respondents (81.2%) in the pilot study have experienced snowboarding-related accidents, only 21.7% reported wearing a helmet at the time of their accidents.

## Sample and Survey Response Rates

An email list was obtained from the United States of America Snowboard Association (USASA) a national snowboarding organization (Appendix N). In addition to the list, an explanation of the study and a direct link to the survey was posted on home page websites of several snowboarding organizations. It is assumed that the majority of participants are currently enrolled in the USASA, as each individual member was sent a participatory email; however, a small number of participants from other snowboarding clubs may have also participated. The exact number of participants from each snowboarding club could not be ascertained due to anonymous participation.

The USASA list contained 3,014 individual email addresses, and each addressee was sent a pre-notice letter (Appendix O). Of these, 154 emails were undeliverable. Two days after the initial mailing, the modified email list of 2, 860 addressees were sent the main survey email, which explained the study and contained a direct link to the survey (http://www.surveymonkey.com/s.asp?u=264501953005) (Appendix D). Twenty four hours later, the first follow-up email was sent out as a reminder to participate in the survey and to thank those who had already taken part in the survey (Appendix P). The second follow-up email was sent nine days later, asking those who had not yet participated to complete the survey. Two days later, the main survey link was closed. Thus, the survey was conducted for a two week time period from March 28th through April 11th, 2006. During the two weeks, three hundred ninety five responses were received, with a response rate of 13.81%, calculated using only the number of individual emails sent (395 / 2860 = 13.81). Four surveys were unusable as the respondents were under age and not eligible for this study.

The final sample was composed of 391 respondents, which represented a 13.67% response rate (391 / 2860 = 13.67). There were no missing data for FEAR needs, which were the main components of this study, because the website (surveymonkey.com) could eliminate skipping questions by customizing the path that respondents had to answer and requiring each question be answered before they could advance to the next question.

## Demographic Characteristics of Respondents

For this study, 391 usable surveys were obtained from the online survey. The sample included both males and females over the age of 18 who participate in snowboarding.

### *Age*

Of those respondents completing the age question on the survey, the largest percentages of participants in this study were between 18 and 25 years of age (56.6%, n= 185). The second largest group of respondents were 45 years old and over (20.5%, n=67). Surprisingly, the 26 to 35 years old category represented the smallest percentage of participants with only 9.8%. It is noted, however, that 64 participants chose not to respond to this question. The summary of respondent's age is tabulated in Table 4.

Table 4

*Age of Respondents*

| Age | Number of Respondents | Percentage |
|---|---|---|
| 18-25 | 185 | 56.6% |
| 26-35 | 32 | 9.8% |
| 36-45 | 43 | 13.1% |
| 45 and Older | 67 | 20.5% |
| Total | 327 | 100.0% |

*Note.* Missing Data = 64

*Gender*

The majority of the respondents were male, as suggested by the literature. However, 94 female snowboarders participated in this study, representing approximately 28% of the sample (Table 5). Although snowboarding is still dominated by male participants, the percentage of female participants in snowboarding may be increasing. This study found a higher percentage of women's participation than the previous study conducted by Anderson (1999), which indicated only a 9% female participation rate in her snowboarding research. In addition, fifty-three respondents did not indicate their gender, so even more females may have participated in this study.

Table 5

*Gender of Respondents*

| Gender | Number of Respondents | Percentage |
|---|---|---|
| Male | 244 | 72.2% |
| Female | 94 | 27.8% |
| Total | 338 | 100.0% |

*Note.* Missing Data = 53

*Ethnic Affiliation*

The predominant ethnic group among the participants was Caucasian, representing 93.5% of the sample population. Asians comprised 1.8% of the sample. The "other" category represented the second largest group of respondents, but only consisted of 2.7% of the population (Table 6).

Table 6

*Ethnic Affiliation of Respondents*

| Race and Ethnic Group | Number of Respondents | Percentage |
|---|---|---|
| Caucasian | 314 | 93.5% |
| Asian | 6 | 1.8% |
| Hispanic | 3 | 0.9% |
| African-American | 2 | 0.6% |
| Native-American | 2 | 0.6% |
| Other | 9 | 2.7% |
| Total | 336 | 100.0% |

*Note.* Missing Data = 55

*Education*

Approximately 30% of respondents had completed some college, while twenty-two percent of respondents had obtained bachelor's degree. An additional 20.8% had completed high school. Approximately 12% of respondents had accomplished either graduate or professional degrees (Table 7). However, the large number of respondents between 18 and 25 years of age may have skewed the data. Some respondents may be too young to have yet finished college, although they are on track to do so, and some may not have finished high school at the time of the survey.

Table 7

*The Level of Education among Respondents*

| Education | Number of Respondents | Percentage |
|---|---|---|
| Less than High School | 37 | 11.1% |
| High School | 69 | 20.8% |
| Some College | 99 | 29.8% |
| Bachelor's Degree | 73 | 22.0% |
| Some Graduate Work | 15 | 4.5% |
| Graduate or Professional Degree | 39 | 11.7% |
| Total | 332 | 100.0% |

*Note.* Missing Data = 59

*Employment Status and Occupation*

Using an open-ended format, the respondents were asked to indicate their employment status and occupation. According to responses, a total number of 325 respondents reported their employment status and occupation, revealing a total of 335 jobs. Some of the respondents indicated double or triple jobs as their current occupation. However, the occupations mentioned by the respondents appear to fall within five categories of employment status and occupation: 1) General employment, including everything but snowboarding-related occupations; 2) Snowboarding-related occupations; 3) Students; 4) Unemployed; and 5) Retired. Approximately 48% of the occupations fell into the general employment category, such as a CEO, teacher, designer, business owner, television host, therapist, architect, and so on. The second highest percentage was student, representing approximately 38%. In addition, approximately 11% of the

respondents reported that they were employed in jobs related to snowboarding such as professional or semi-professional snowboarders, snowboarding coaches, instructors, trainers, directors, a ski and snowboarding school manager and a snowboarding website editor. Finally, eight respondents reported that they were unemployed, while two respondents indicated that they were retired (Table 8).

Table 8

*Employment Status and Occupation of Respondents*

| Employment Status and Occupation | Number of Occupation | Percentage |
|---|---|---|
| General employments | 161 | 48.1% |
| Students | 127 | 38.0% |
| Snowboarding-related | 37 | 11.0% |
| Pro/Semi Snowboarders | (14) | (4.2%) |
| Instructors | (12) | (3.6%) |
| Coaches | ( 6) | (1.8%) |
| Trainers | ( 2) | (0.6%) |
| Director | ( 1) | (0.3%) |
| Ski and Snowboarding School Manager | ( 1) | (0.3%) |
| Snowboarding Website Editor | ( 1) | (0.3%) |
| Unemployed | 8 | 2.4% |
| Retired | 2 | 0.6% |
| Total | 335 | 100.0% |

*Note.* Missing Data = 66

## *Income*

The respondents were asked to indicate their gross household income over the past year. Fifty-two percent of the respondents revealed they earned over $75,000. In contrast, the second largest income bracket, representing approximately 19%, made less than $10,000. The split in the income data coincides closely with the educational data, as those who are still in school would presumably have considerably lower income.

Table 9

*Household Income of Respondents*

| Income | Number of Respondents | Percentage |
|---|---|---|
| Less than $10,000 | 57 | 18.8% |
| $10,000 to $24,999 | 22 | 7.2% |
| $25,000 to $49,999 | 30 | 9.9% |
| $50,000 to $74,999 | 37 | 12.2% |
| $75,000 and more | 158 | 52.0% |
| Total | 304 | 100.0% |

*Note.* Missing Data = 87

*Location of Residence*

The participants were asked their current place of residence. Thirty-one different places, including 30 different states, were represented (Table 9). Over 50% of the sample resided in just five states: Colorado (17.91%), California (12.54%), New Work (8.96%), Massachusetts (8.06%), and Vermont (5.67%). In addition, there were two respondents from Canada. As shown in the Table 10, it appears that geographical factors, such as cold climate or proximity of mountains influence people to participate in snowboarding.

Table 10

*Residence of Respondents*

| Residence | Number of Respondents | Percentage |
|---|---|---|
| Colorado | 60 | 17.91% |
| California | 42 | 12.54% |
| New York | 30 | 8.96% |
| Massachusetts | 27 | 8.06% |
| Vermont | 19 | 5.67% |
| Minnesota | 17 | 5.07% |
| New Hampshire | 16 | 4.77% |
| Utah | 11 | 3.28% |
| Maine | 11 | 3.28% |
| Virginia | 10 | 2.99% |
| North Carolina | 9 | 2.69% |
| Pennsylvania | 9 | 2.69% |
| Oregon | 8 | 2.39% |
| Idaho | 6 | 1.79% |
| Illinois | 6 | 1.79% |
| Nevada | 6 | 1.79% |
| New Jersey | 6 | 1.79% |
| Ohio | 6 | 1.79% |
| Alaska | 5 | 1.49% |
| Michigan | 5 | 1.49% |
| Washington | 5 | 1.49% |
| Maryland | 4 | 1.19% |
| Wisconsin | 3 | 0.90% |
| Wyoming | 3 | 0.90% |
| Iowa | 2 | 0.60% |
| New Mexico | 2 | 0.60% |
| West Virginia | 2 | 0.60% |
| Canada | 2 | 0.60% |
| Florida | 1 | 0.30% |
| Nebraska | 1 | 0.30% |
| Texas | 1 | 0.30% |
| Total | 335 | 100.00% |

*Note.* Missing Data 56

## Snowboarding Participation

The participants were asked to indicate if they ride a snowboard competitively, recreationally, or both. The majority of the respondents reported that they ride a snowboard both competitively and recreationally (72.8%). There were 13.4% of the sample population who rated themselves as competitive snowboarders, and 13.7% who indicated that they were recreational snowboarders. In addition, the amount of participation in snowboarding was investigated. The questions included how long they have been riding a snowboard as well as how often they ride per season. Moreover, the questions were included for how many hours they ride per visit as well as how often they wear a helmet while riding.

### *The Length of Time in Snowboarding*

The largest percentage of participants indicated that they have been snowboarding between 6 and 10 years (47%). Approximately 31% of the respondents reported that they have been riding between 1 and 5 years. In addition, there were three individuals who indicated that they have been snowboarding over 20 years, with the longest length of participation being 24 years. There were also three respondents who indicated that they have been snowboarding less than one year, with the shortest time being 3 months (Table 11).

Table 11

*Length of Time in Snowboarding*

| Length of Participation | Number of Respondents | Percentage |
|---|---|---|
| Less than 1 year<br>(The shortest length for 3months) | 3<br>(1) | 0.8%<br>(0.3%) |
| Between 1 and 5 years | 107 | 31.5% |
| Between 6 and 10 years | 160 | 47.1% |
| Between 11 and 15 years | 41 | 12.1% |
| Between 16 and 20 years | 26 | 7.7% |
| Between 21 and 25 years<br>(The longest length for 24 years) | 3<br>(1) | 0.8%<br>(0.3%) |
| Total | 340 | 100.0% |

*Note.* Missing Data = 51

*Snowboarding Participation Per Season*

The respondents were asked to fill out that how often they go snowboarding in a single snowboarding season. Participation among the respondents ranged from 2 times to 400 times during a snowboarding season. However, two respondents indicated "countless" times. The largest percentage of the respondents (11.5%) indicated that they went snowboarding 100 and more times, followed by 11.2% who reported between 46 and 50 times per a season (Table 12).

Table 12

*Snowboarding Participation Per Season*

| Times Per Season | Number of Respondents | Percentage |
|---|---|---|
| Between 1 and 5 | 14 | 4.1% |
| (The smallest times) | (2) | (0.6%) |
| Between 6 and 10 | 15 | 4.4% |
| Between 11 and 15 | 20 | 5.9% |
| Between 16 and 20 | 17 | 5.0% |
| Between 21 and 25 | 16 | 4.7% |
| Between 26 and 30 | 28 | 8.3% |
| Between 31 and 35 | 7 | 2.1% |
| Between 36 and 40 | 27 | 7.9% |
| Between 41 and 45 | 10 | 2.9% |
| Between 46 and 50 | 38 | 11.2% |
| Between 51 and 55 | 6 | 1.8% |
| Between 56 and 60 | 25 | 7.4% |
| Between 61 and 65 | 6 | 1.8% |
| Between 66 and 70 | 5 | 1.5% |
| Between 71 and 75 | 7 | 2.1% |
| Between 76 and 80 | 9 | 2.7% |
| Between 81 and 85 | 4 | 1.2% |
| Between 86 and 90 | 19 | 5.6% |
| Between 91 and 95 | 0 | 0% |
| Between 96 and 100 | 27 | 7.9% |
| 100 and more | 39 | 11.5% |
| (The largest times for 400) | (3) | (0.9%) |
| Total | 339 | 100.0% |

*Note.* Missing Data = 52

*Hourly Time Per Snowboarding Visit*

Respondents were asked how much time they spend on the slope per snowboarding visit. Participation ranged from 1 ½ hours to 150 and more hours. The largest group of respondents spent between 6 and 10 hours riding (57.1%). The second largest group participated between 1 and 5 hours per visit (37.6%). Approximately 3% indicated that they ride a snowboard all day

when they visit the slope (Table 13). One of the respondents responded "all day, no lunch, maybe an orange" to describe his enthusiastic participation in snowboarding.

Table 13

*Hourly Participation in Snowboarding*

| Hours of participation | Number of Respondents | Percentage |
|---|---|---|
| Between 1 and 5 hours | 128 | 37.6% |
| (The shortest hours for 1 ½) | (1) | (0.3%) |
| Between 6 and 10 hours | 194 | 57.1% |
| Between 11 and 15 hours | 1 | 0.3% |
| Between 16 and 20 hours | 0 | 0% |
| Between 21 and 24 hours | 4 | 1.2% |
| All days | 11 | 3.3% |
| 100 hours | 1 | 0.3% |
| 150 and more hours | 1 | 0.3% |
| Total | 340 | 100.0% |

*Note.* Missing Data = 51

## Snowboarding Helmets

The participants were asked to describe their snowboarding information in terms of helmet ownership and use. In addition, the respondents were asked to identify their characteristics regarding places to shop, preferred brand names, and expenditures for snowboarding helmets.

*Helmet Ownership of Respondents*

Respondents were asked if they currently own a snowboarding helmet. The majority of the respondents, approximately 97%, reported that they have a helmet (Table 14). Although approximately 3% of respondents reported no helmet ownership, some interesting reasons for not having a snowboarding helmet were recorded: too expensive, inappropriate fit, not cool enough style, bulky, ugly, and uncomfortable. One respondent reported inappropriate fit as his reason for not owning a helmet,

> " I have a triple extra large head and I have never been able to find a helmet that fits."

In addition, there were some respondents who reported substituting skateboard and motorcycle helmets because they were perceived as more functional:

> " I use a skateboard helmet because it is more lightweight and not as bulky. It improves my overall style."
>
> " I wear a skateboard helmet which is lightweight, slim, and allows me to wear my hat underneath."
>
> " I wear an off-road motorcycle helmet when competing because snowboarding helmets do not provide facial protection."

Table 14

*Snowboarding Helmet Ownership of Respondents*

| Helmet Ownership | Number of Respondents | Percentage |
|---|---|---|
| Yes | 326 | 96.4% |
| No | 12 | 3.6% |
| Total | 338 | 100.0% |

*Note.* Missing Data = 53

*Helmet Use*

In addition to a helmet ownership, respondents were asked to indicate how often they wear a helmet while riding. This question was measured on a five-point Likert scale ranging from (1) "Always" to (5) "Never". Approximately 72% of the respondents reported that they always wear a helmet while snowboarding; only 2% of the respondents indicated that they never wear a helmet (Table 15). Although no previous information regarding helmet use among participants in snowboarding was found, respondents in this study surprisingly revealed very positive responses to helmet use. The high helmet use in this study is in contrast to the respondents in the preliminary study; where only 20% responded positively to the use of helmets.

Table 15

*Helmet Use while Snowboarding*

| How Often | Number of Respondents | Percentage |
|---|---|---|
| (1) Always | 243 | 71.5% |
| (2) Very Often | 40 | 11.8% |
| (3) Sometimes | 29 | 8.5% |
| (4) Rarely | 21 | 6.2% |
| (5) Never | 7 | 2.1% |
| Total | 340 | 100.0% |

*Note.* Missing Data = 51

*Preferred Shopping Places for Snowboarding Helmets*

The respondents identified various shopping places for snowboarding helmets: snowboarding shops, specialty stores, discount stores, ski shops, skateboard shops, sponsorships, catalog, online, anywhere, and ski/golf shops. Snowboarding shops were the most common shopping location (39.9%). Specialty shops, such as Burton, REI, and Sunny Breeze were the second most frequent location (15.2%). Approximately 9% indicated a preference for online shopping. Some sites indicated were the House.com, Ride.com, Troy Lee Designs, AASI and Ebay. Less than 1% of respondents mentioned catalog shopping.

Some respondents noted the lack of need for shopping. A number of participants noted that place was not as important as criteria. For example, 44 participants stated they would shop anywhere for their snowboarding helmets. Some of those respondents indicated that they would shop anywhere as long as a couple of factors were met, such as price/and or styles. In addition, 49 respondents noted ski shops, and 7 respondents purchased in skateboard shops. Eleven respondents indicated sponsorships as their source for helmets. One respondent mentioned that he has use of a couple of helmets for a year from his sponsor. Pro Tec and Sup Board Shop were identified as snowboarding helmet sponsors. An additional eight respondents reported that they did not go shopping, explaining that they received a helmet from friends or family as a gift. The summary of places to shop for snowboarding helmets among respondents is presented in Table 16.

Table 16

*Places to Shop for Snowboarding Helmets among the Respondents*

| Places | Number of Responses | Percentage |
|---|---|---|
| Snowboarding Shops | 139 | 39.9% |
| Specialty Stores | 53 | 15.2% |
| Ski Shops | 49 | 14.0% |
| Anywhere | 44 | 12.6% |
| Online | 32 | 9.2% |
| Sponsors | 11 | 3.2% |
| Do Not Shop | 8 | 2.3% |
| Skateboard Shops | 7 | 2.0% |
| Catalogs | 3 | 0.9% |
| Discount Stores | 2 | 0.6% |
| Total | 348 | 100.0% |

*Note.* A total number of 324 responses with a total number of 348 responses

### *Preferred Brands of Snowboarding Helmets*

In addition to preferred shopping places, helmet brands were investigated. This was a two-step process. First, respondents were asked if they have helmet preferences. Second, if they did have a preference, with an open-ended question they were asked to identify their preferred brand. Approximately 62% of the respondents indicated that they have preferred brands, as shown in Table 17. Some of the respondents indicated that they have more than one single preferred brand. Other respondents reported that they have no preferred brand, as long as their criteria are met; such as fit, price, style, and/or comfort. Specific concerns included:

> "Whatever fits the best and works with goggles.
> Goggle gap is the worst."

"No, I go for fit."

"No, I look for comfort, style, and a good price."

"Whatever does not look stupid."

Overall, there were 24 different brand names of snowboarding helmets indicated. The most preferred brand was R.E.D. (Riding Enhancement Device), a Burton brand, chosen by 49.7% of the sample. The second most preferred brand name selected was Pro-Tec (17.4%), followed by Giro (12.8%) (Table 18). Again, indicating dissatisfaction with snowboarding helmets, one respondent noted skateboard shops for purchasing his helmet.

Table 17

*Preferred Brand Names of Snowboarding Helmets*

| Preferred Brand Names of Snowboarding Helmets | Number of Responses | Percentage |
|---|---|---|
| Yes | 228 | 61.9% |
| No | 140 | 38.1% |
| Total | 368 | 100.0% |

*Note.* A total number of 321 respondents with a total number of 368 responses.

Table 18

*Lists of Preferred Brand Names of Snowboarding Helmets*

| Preferred Brand Names | Number of Responses | Percentage |
|---|---|---|
| R.E.D (Burton) | 109 | 49.7% |
| Pro-tec | 38 | 17.4% |
| Giro | 28 | 12.8% |
| Boeri | 9 | 4.1% |
| Bern | 3 | 1.4% |
| Leedom | 3 | 1.4% |
| Carrera | 2 | 0.9% |
| Salomon | 2 | 0.9% |
| Hi-Fi | 2 | 0.9% |
| Troy Lee Designs | 2 | 0.9% |
| Bolle | 1 | 0.5% |
| Additional 16 more different names | 16 (1x16) | 7.3% |
| Shops | 4 | 1.8% |
| Total | 219 | 100.0% |

*Note.* Information for only identified preferred brand names for the respondents

*Snowboarding Helmet Expenditure among Respondents*

The respondents were asked to indicate how much they would be willing to spend for a snowboarding helmet. This question was open-ended; the responses were grouped into eleven categories, seven that were numerical and four more that were comments. The range of snowboarding helmet expenditure among the respondents was $0 to $350 (Table 19). The largest percentage of respondents (57.6%) indicated that they would spend between $50 and $100. Almost 22% mentioned they would spend more than $100 but less than $150.

Some of the respondents indicated that the cost of a helmet would not matter; they just wanted the safest one to protect them from snowboarding-related accidents, as suggested by their comments:

"I would spend a lot if it were proven better."

"I believe unlimited for a great helmet."

"I would spend as much as it takes to protect me."

In addition, two respondents responded that what they would spend depended on the quality of the helmet. In contrast, some of the respondents reported that they would spend as little as possible for their snowboarding helmets. There were 8 positive comments and 4 negative comments reported (Table 20). According to the positive comments, it appears that safety and protection would be more important factors than price for some of respondents. On the other hand, negative comments were related to high prices.

Table 19

*Snowboarding Helmet Expenditure*

| Expenditure | Number of Respondents | Percentage |
|---|---|---|
| $0 | 3 | 0.9% |
| Less than $50 | 23 | 6.9% |
| Between $50 and $100 | 193 | 57.6% |
| Between $101 and $150 | 73 | 21.8% |
| Between $151 and $200 | 16 | 4.8% |
| Between $201 and $300 | 3 | 0.9% |
| More than $300 *($350) | 1 | 0.2% |
| Don't know (care) | 4 | 1.2% |
| Depending on the quality | 2 | 0.6% |
| 8 Positive comments on expenditure | 12 | 3.6% |
| 4 Negative comments on expenditure | 5 | 1.5% |
| Total | 335 | 100.0% |

*Note.* Missing Data = 56
* The highest snowboarding helmet expenditure identified from responses

Table 20

*Comments on Snowboarding Helmet Expenditure*

| Positive Comments | Negative Comments |
|---|---|
| "whatever it takes" | "not much" |
| "cost does not matter-I want the safest" | "as little as possible" |
| "as much as it takes to protect me" | "can't beat free" |
| "a lot if it were proven better" | "already expensive" |
| "as much as needed" | |
| "unlimited for a great helmet" | |
| "best price for appropriate gear" | |
| "current pricing is fine" | |

*Snowboarding-Related Accidents/Injuries and Helmet Use Information*

Snowboarding-related accidents and/or injuries were investigated to see if those who had experienced snowboarding-related accidents might be more aware of the use of helmets than those who had not had accidents. Respondents were asked to identify if they had ever had an accident on a snowboarding ride. The majority reported having experienced at least one snowboarding-related accident (86.9%).

If they answered yes to snowboard-related accidents, they were asked to specify all injuries they had experienced. A total of 280 participants reported snowboarding-related injuries for a total of 622 injuries. Injuries were then split into major three categories: upper body (191), lower body (119), and head-related injuries (122). There were 17 additional injuries that didn't

directly fit into the three categories, such as necks, faces, lower back, nerve damages, etc, and one more identified no injury at all. However, many of the respondents indicated that their heads were protected from injuries by helmets. Two respondents wrote about their experiences with injuries:

> " I broke 4 ribs in the boarder cross at the 2004 USASA Nationals in Angel Fire, New Mexico. I am sure that if I were not wearing a helmet, my injuries would have been more extensive."
>
> " Hit a good sized tree in the woods. My head (inside the helmet) just bounced off the tree like a ping pong ball. Without the helmet, I'd be a different person today, if I survived at all."

Additionally, some of respondents noted that they had multiple concussions, regardless of helmet use. Eighty-seven respondents indicated that they had concussions with or without helmets on. Furthermore, there were two respondents who reported they had too many injuries to report.

The largest number of snowboarding-related injuries were concussions (n=87), followed by wrists (n=63), knee injuries (n=59), shoulder injuries (n=56), head injuries (n=35), and ankle injuries (n=32). A total of 122 head-related injuries were found, including head injuries (n=35) and concussions (n=87). Ten respondents had minor injuries, but didn't specify further. Fourteen respondents indicated that they hadn't received any injuries yet. Snowboarding-related injuries information is tabulated in Table 21.

Table 21

*Snowboarding-Related Injuries among the Respondents*

| Injuries | Number of Respondents | Percentage |
|---|---|---|
| Upper Body | 191 | 30.7% |
| Arms | (20) | (3.2%) |
| Shoulders | (56) | (9.0%) |
| Wrists | (63) | (10.1%) |
| Ribs | (24) | (3.9%) |
| Elbows | (7) | (1.1%) |
| Collar bones | (13) | (2.1%) |
| Other parts of the body (e.g., abdomen) | (8) | (1.3%) |
| Lower Body | 119 | 19.1% |
| Legs | (9) | (1.4%) |
| Feet | (2) | (0.3%) |
| Hips | (3) | (0.5%) |
| Knees | (59) | (9.5%) |
| Ankles | (32) | (5.1%) |
| Tail Bones | (14) | (2.3%) |
| Head-Related | 122 | 19.6% |
| Heads | (35) | (5.6%) |
| Concussions | (87) | (14.0%) |
| Other remainders | | |
| Necks | 9 | 1.4% |
| Lower back | 15 | 2.4% |
| Faces | 24 | 3.9% |
| Hands | 4 | 0.6% |
| Fingers | 23 | 3.7% |
| Broken bones | 7 | 1.1% |
| Fractures | 7 | 1.1% |
| Bruises | 36 | 5.8% |
| Sprains | 11 | 1.8% |
| Scrapes | 5 | 0.8% |
| Cuts | 6 | 1.0% |
| Crashes | 3 | 0.5% |
| Whiplashes | 4 | 0.6% |
| Strained muscles | 9 | 1.4% |
| Nerve Damages | 1 | 0.2% |
| Minors | 10 | 1.6% |
| Too many | 2 | 0.3% |
| None | 14 | 2.3% |
| Total | 622 | 100.0% |

*Note.* Total more than n due to multiple responses

*Helmet Use When Having Accidents on Snowboarding Rides*

After the respondents identified their snowboarding-related injuries, they were asked to indicate whether they were wearing a helmet when they received their accidents. Approximately, 87% of the respondents indicated that they wore a helmet at the time of their accidents (Table 22).

Table 22

*Helmet Use When Accidents Were Received*

| Helmet Use | Number of Respondents | Percentage |
|---|---|---|
| Yes | 258 | 86.9% |
| No | 39 | 13.1% |
| Total | 297 | 100.0% |

*Note.* Missing Data = 94

*Unique Features of Snowboarding Helmets for Snowboarders*

In addition to benefits of wearing a snowboarding helmet, respondents were asked to indicate unique features they would like to see incorporated into helmets. Three hundred and sixty-one ideas were suggested. The most common theme (n=82) was related to improving design elements, such as textures, graphics, styles, colors, animal prints, stickers, shapes, etc. The second theme noted was related to goggles (n=24), including better fit, more comfortable strap holders, good width, and better helmet integration. Increased technology was a third theme (n=23); for instance, MP3 players, headphones, cellular phones, activated voices, helmet

cameras, and/or lightweight solar paneled head-massagers. Comfort, in the form of adjustable ventilation (n=17), was also suggested.

Improved interior designs (n=11) was another theme. This included features such as memory foam liners, removable and washable liners, and graded padding options to improve functionality. Many more enhanced design factors for snowboarding helmets were also found: comfort (n=18), thinner (n=12), fit (n=10), lightweight (n=10), comfortable chin straps (n=8), neck and ear covering for cold days (n=7), safety (n=6), good visibility (n=5), compactness (n=4), warmth (n=3), smaller size (n=3), lower profiles (n=3), removable face/chin/mouth guards (n=3), sunshades (n=3), mouth/teeth protection (n=3), sleek look (n=2), head protection (n=2), better ear protection without reducing hearing (n=1), durability (n=1), convenience (n=1), and spikes (n=1).

A few respondents specified wanting increased feminine features (n=4) in snowboarding helmets to not only accent their femininity but to improve the function, such as styles, colors, and pony-tail slots in back. Seven respondents indicated wanting new helmet looks, similar to skateboard helmets, and one respondent suggested a helmet bag to protect helmet from scratches when not in use. In contrast, 38 respondents were satisfied with existing features of helmets, while an additional 21 respondents indicated that they did not know or not care about unique helmet features.

## Findings and Results

Multiple comparisons were used to compare the perceived importance of the elements represented in each item in respective domains, protected from a family wise Type I error rate ($\alpha_W$) at .05 level of significance using the Bonferroni method. Pairwise multiple comparisons were made of the item means in the functional, expressive, aesthetic, and regulatory (FEAR) need question groupings. In addition, a frequency was calculated for the single question item that asked the overall rating for attitudes toward helmet use. Assuming the theory of reasoned action would influence helmet use (Ajzen & Fishbein, 1975), respondents were asked to indicate the benefits that would affect the helmet usage. Descriptive statistics were used to analyze the benefits described by respondents. The items were measured on a five-point Likert scale ranging from "not important at all" (1) to "very important" (5) for FEAR needs as well as attitudes toward helmet use ranging from "strongly negative" (1) to "strongly positive" (5). A paired-samples t-test with the Bonferroni method for all paired items in FEAR needs was used to assess statistically significant mean differences and to make sure that a pair of the items would be significantly different from each other.

### *Functional Needs*

Functional needs were measured with a 10 item scale; 1) comfort, 2) fit, 3) protection, 4) ventilation, 5) insulation, 6) price, 7) goggle integration with helmets, 8) less bulky, 9) convenience, and 10) overall functional needs. The last item, labeled as overall functional needs, was included to examine the overall perceptions of respondents toward the importance and improvement of functional needs for helmets. Goggle integration with helmets ($\underline{M}$ = 4.67, $\underline{SD}$ =

0.71) ranked as the highest mean among the functional needs elements. Helmets being less bulky (M = 4.36, SD = .079) scored second, and insulation had the lowest mean score (M = 3.44, SD = 0.97) (Table 23).

Table 23

*Importance of Functional Needs Elements*

| | Importance | |
|---|---|---|
| Items of Functional Needs | Mean | Std. Deviation |
| Goggle integration with Helmets | M = 4.67 | SD = 0.71 |
| Not Bulky | M = 4.36 | SD = 0.79 |
| Convenience | M = 4.23 | SD = 0.83 |
| Protection | M = 3.97 | SD = 0.99 |
| Fit | M = 3.91 | SD = 0.97 |
| Comfort | M = 3.74 | SD = 0.99 |
| Ventilation | M = 3.73 | SD = 0.97 |
| Price | M = 3.60 | SD = 1.03 |
| Insulation | M = 3.44 | SD = 0.99 |
| Overall Functional Needs | M = 4.07 | SD = 0.82 |

*Note.* Value of Response (n= 391)

Paired-samples t-test, utilizing the Bonferroni correction, was conducted to determine statistically-significant mean differences among variables in the same domain. According to Howell (2002), the Bonferroni correction is utilized to reduce falsely significant results in statistical analyses. He explained that the Bonferroni method is based on the principle of dividing up a desired family wise (FW) error rate ($\alpha_{FW}$) for a family of contrasts among each of the individual contrasts, testing each one at $\alpha_{ind} = .05$ of a Type I error.

There were a total of 36 functional need pairs for multiple comparisons (Appendix I). The sample means for each functional need item, from highest to lowest, were presented in a table. Each cell was calculated from a mean score in a column subtracted from a mean score in a row; for example, mean of goggle (4.67) – mean of less bulky (4.36) = 0.31. If the observed t-value exceeds the critical value, it can be concluded that the difference is statistically significant at $\alpha_{FW} = .05$ (t-value = 3.291, (degrees of freedom (df) = 390, 36 comparisons).

All paired sample mean differences were statistically significant except six pairs: 1) less bulky-convenience, 2) fit-protection, 3) comfort-ventilation, 4) comfort-price, 5) ventilation-price, and 6) insulation-price. In terms of non-significant mean differences among pairs, it can be explained that those pairs have the same degree of importance although the actual mean scores may be different from each other.

*Expressive Needs*

Expressive needs for wearing a snowboarding helmet also consisted of a 10 item instrument: 1) seeing myself as a competitive snowboarder; 2) distracting from my professionalism; 3) distracting from my toughness/aggressiveness; 4) making me look funny; 5) helping me convey my athletic identity as a snowboarder; 6) helping me perform an appropriate role, either masculine or feminine; 7) helping with my self-image as a confident snowboarder; 8) being important for my commitment to snowboarding;
9) playing an important model to convey the importance of helmet use to others; and 10) overall expressive needs, an additional item to determine overall perceptions of importance of, and improvement for expressive needs. The highest mean was willingness to play an important role

model to others (M = 4.04, SD = 1.04). Respondents were also concerned that helmets should not make them look funny (M = 3.98, SD = 1.13). The lowest mean score of the expressive needs item was that a snowboarding helmet helps respondents perform an appropriate role, either masculine or feminine (M = 2.74, SD = 1.27) (Table 24).

Table 24

*The Level of Expressive Needs Elements*

| | Importance | |
|---|---|---|
| Items of Expressive Needs | Mean | Std. Deviation |
| Willing to Play an Important Role | M = 4.04 | SD = 1.04 |
| Should Not Look Funny | M = 3.98 | SD = 1.13 |
| Should Not Distract Professionalism | M = 3.62 | SD = 1.20 |
| Importance of Commitment to Snowboarding | M = 3.57 | SD = 1.35 |
| Should Not Distract Toughness/Aggressiveness | M = 3.50 | SD = 1.23 |
| Convey Athletic Identity | M = 2.93 | SD = 1.33 |
| Help Confident Self-Image | M = 2.90 | SD = 1.33 |
| Seeing My Competitiveness | M = 2.89 | SD = 1.35 |
| Appropriate Role Play as either Masculine or feminine | M = 2.74 | SD = 1.27 |
| Overall Expressive needs | M = 4.04 | SD = 0.99 |

*Note.* Value of Response (n = 391)

There were 36 paired variables for expressive needs, of which 27 pairs resulted in statistically significant mean differences, while mean differences between 9 pairs did not show statistical significance: 1) willingness to play an important role to others-helmet should not make them look funny; 2) helmet should not distract from professionalism-commitment; 3) helmet should not district from professionalism-helmet should not distract from toughness; 4)

commitment-helmet should not distract from toughness; 5) athletic identity-self image; 6) athletic identity-seeing my competitiveness; 7) self image- seeing my competitiveness; 8) self image-appropriate role play; and 9) seeing my competitiveness- appropriate role play. The multiple comparisons of all means for expressive needs were tabulated and are presented in Appendix J.

### *Aesthetic Needs*

There were eight items to measure aesthetic needs: 1) color; 2) style; 3) texture; 4) uniqueness; 5) design features; 6) sleekness; 7) gender characteristics; and 8) overall aesthetic needs. The highest mean score of aesthetic needs was styles (M =3.56, SD =1.08). The uniqueness of helmets (M = 3.37, SD = 1.13) was ranked as the second highest mean score, and the lowest mean score was texture of the helmets (M = 3.03, SD = 1.10) (Table 25).

Table 25

*Importance of Aesthetic Needs Elements*

| | Importance | |
|---|---|---|
| Items of Aesthetic Needs | Mean | Std. Deviation |
| Styles | M = 3.56 | SD = 1.08 |
| Uniqueness | M = 3.37 | SD = 1.13 |
| Sleekness | M = 3.35 | SD = 1.14 |
| Design Features | M = 3.21 | SD = 1.24 |
| Colors | M = 3.16 | SD = 1.18 |
| Gender Characteristics (Masculine vs Feminine) | M = 3.07 | SD = 1.18 |
| Texture | M = 3.03 | SD = 1.10 |
| Overall Aesthetic Needs | M = 3.49 | SD = 1.07 |

*Note.* Value of Response (n = 391)

A total of 21 aesthetic needs were obtained to check multiple comparisons. Most mean differences were statistically significant; however, eight pairs were not significantly different from each other: 1) uniqueness-sleekness; 2) sleekness-design features; 3) design features-colors; 4) design features-gender characteristics; 5) design features-textures; 6) colors-gender characteristics; 7) colors-design features; and 8) gender characteristics-texture. All multiple comparisons for aesthetic needs are shown in Appendix K.

*Regulatory needs*

A total of seven items were used to measure regulatory needs: 1) mandatory for all snowboarders in public ski resorts; 2) mandatory for all snowboarders at any time and at any place; 3) federal laws; 4) education; 5) violation for non-helmet users with receiving fines; 6) restriction for non-helmet users; and 7) overall regulatory needs. Similar to other overall needs, the overall regulatory needs were asked to determine the overall perception toward helmets and regulatory requirements.

Education ($\underline{M}$ = 3.46, $\underline{SD}$ = 1.39) ranked as the highest mean score for regulatory needs. The respondents also considered that helmet use should be mandatory for all snowboarders in public ski resorts ($\underline{M}$ = 3.27, $\underline{SD}$ = 1.61). On the other hand, the lowest mean score of regulatory needs was that individuals who do not wear a helmet should be fined ($\underline{M}$ = 2.30, $\underline{SD}$ = 1.52). The importance of regulatory needs is summarized and shown in Table 26.

Table 26

*Importance of Regulatory Needs Elements*

| | Importance | |
|---|---|---|
| Items of Regulatory Needs | Mean | Std. Deviation |
| Education | M = 3.46 | SD = 1.39 |
| Mandatory in public ski resorts | M = 3.27 | SD = 1.61 |
| Mandatory at any time and at any place | M = 3.15 | SD = 1.60 |
| Federal Laws | M = 2.65 | SD = 1.59 |
| Restriction for non-helmet users | M = 2.65 | SD = 1.62 |
| Violation with fines | M = 2.30 | SD = 1.52 |
| Overall | M = 3.01 | SD = 1.55 |

*Note.* Value of Response (n = 391)

Utilizing the Bonferroni correction for the items of regulatory needs, 15 pairs of variables were examined, and all means were statistically significant except two pairs: 1) education and mandatory in public ski resort; and 2) federal laws and restriction for non-helmet users (Appendix L).

### *Overall FEAR Needs*

Multiple comparisons were also calculated for the "overall" question in each FEAR section (Appendix M). A total of six pairs were created for the Bonferroni correction. The mean score of overall functional needs ranked the highest, while the mean score of overall regulatory needs was ranked the least lowest. However, although the mean score of overall functional needs (M = 4.07, SD = 0.82) was slightly higher than the mean score of overall expressive needs

($\underline{M}$ = 4.04, $\underline{SD}$ = 0.99), the mean difference between overall functional needs and overall expressive needs was not statistically significant.

### *Attitudes toward Helmet Use*

Finally, the respondents were asked to indicate their overall attitude toward helmet use. This item was treated as the dependent variable for this study. Descriptive statistics (i.e., frequencies and percentages) were used to analyze the findings for overall attitudes toward helmet use among respondents. The level of perceived importance for overall attitudes toward helmet use was measured on a five-point Likert scale, ranging from "strongly negative" (1) to "strongly positive" (5). Over 89% of the respondents reported positive attitudes, while less than 5% revealed negative attitudes (Table 27).

Table 27

*Overall Attitude toward Helmet Use of the Respondents*

| Attitude toward Helmet Use | Number of Respondents | Percentage |
|---|---|---|
| Strongly Negative | 4 | 1.0% |
| Negative | 14 | 3.6% |
| Neutral | 23 | 6.4% |
| Positive | 88 | 22.5% |
| Strongly Positive | 262 | 67.0% |

*Note.* Value of Response (n = 391)

In addition to the frequencies of overall attitudes toward helmet use, benefits that would affect respondents for wearing a helmet were also examined. According to Ajzen and Fishbein (1980), if an outcome appears to be beneficial to the individual, that person might intend or actually participate in a certain behavior. In other words, if protection/safety seems beneficial to the snowboarder, that snowboarder might wear a helmet. If a snowboarder experiences benefits from helmet use, he/she would have more positive attitudes toward helmet use than those who do not experience benefits. Thus, benefits were considered as important factors to evaluate the perceived importance of overall attitudes toward helmet use.

Respondents were asked to identify what they considered were the benefits of wearing a snowboarding helmet. This question was asked in an open-ended format. Six themes of benefits were found: 1) Protection/ Safety; 2) Warmth; 3) Confidence; 4) Comfort; 5) Role Model; and 6) Others. Protection (61.2%) and safety (21.2%) were seen as the greatest benefits of wearing a snowboarding helmet. A total of 327 respondents indicated protection, as well as safety from concussions (n=31), and injuries of the head (n=205), jaw (n=1), neck (n=1), mouth (n=1), and

sunburn (n=1). The third largest category identified was warmth for head and/or ears. Moreover, respondents indicated that wearing a helmet would provide them with confidence for riding faster and/or doing challenging tricks. Comfort was regarded as a benefit by five respondents, and three respondents mentioned being a role model for others as their reason for wearing a snowboarding helmet. Additional benefits, such as goggles being able to stay on, and being rain proof, were also identified, as shown in Table 28.

Although the benefits of wearing helmets were identified, some respondents noted that helmets were not sufficient for complete protection.

> "Probably just protection from skull fractures.
> I mean the face is still vulnerable and the helmets
> with the hard styrofoam may prevent fractures
> but do not protect from concussions or brain damage.
> There needs to be a dense foam as well as another
> padding material. The outer shell needs to be strong,
> but the inside needs to be firm, but allow shock absorption
> so it has some give to it."

> "Only protection. They are generally uncomfortable and
> restricting, the only reason I started wearing one was
> because it was required for racing."

Table 28

*Benefits of Wearing a Snowboarding Helmet among Respondents*

| Benefits | Number of Respondents | Percentage |
|---|---|---|
| Protection and Safety | 327 | 82.4% |
| Protection | (243) | (61.2%) |
| Safety | (84) | (21.2%) |
| Head Injuries | (205) | (51.6%) |
| Concussions | (31) | 7.8% |
| Neck | (4) | 1.0% |
| Jaw | (1) | 0.3% |
| Mouth | (1) | 0.3% |
| Sunburn | (1) | 0.3% |
| Warmth | 42 | 10.1% |
| Confidence | 16 | 4.0% |
| Comfort | 5 | 1.3% |
| Role Model | 3 | 0.8% |
| Others | 4 | 1.2% |
| Goggles stay on | (1) | 0.3% |
| Style | (1) | 0.3% |
| Rain Proof | (1) | 0.3% |
| Lots | (1) | 0.3% |
| Total | 397 | 100.0% |

*Note.* Total more than n due to multiple responses
(A total number of 397 responses by a total number of 321 respondents)

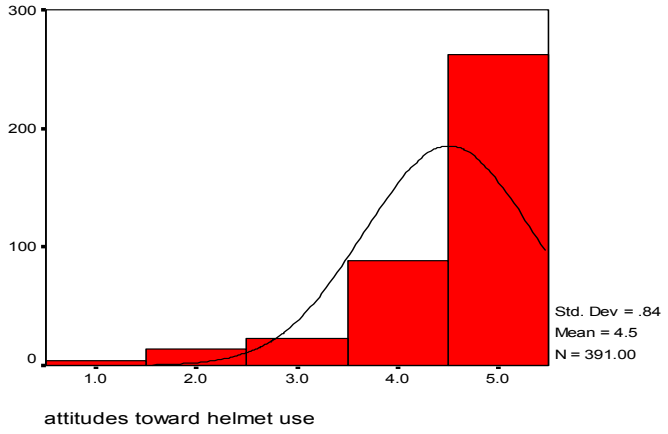
## Tests of Hypotheses

In order to test the hypotheses, a multiple regression was calculated, where attitudes toward helmet use was the outcome variable, and functional, expressive, aesthetic, and regulatory needs were the independent variables. Since the data was collected via an online survey using non-random sampling, impacts from the covariates needed to be controlled. The covariates that were considered were age, education, gender, helmet ownership, participation experience, income, snowboarding-related accidents, and helmet usage. For the data analysis, univariate descriptive statistics (e.g., frequencies, distributions, etc) were calculated. Next, bivariate relationships (e.g., correlation, crosstabs, means differences, etc) among the variables of interest were determined. Lastly, multiple regressions were completed.

### *Univariate Descriptive Statistics*

For the first phase of the analysis, a histogram of the dependent variable (overall attitudes toward helmet use) was created. The distribution of the dependent variable was negatively skewed since a higher number of respondents indicated positive attitudes toward helmet use (Figure 5).

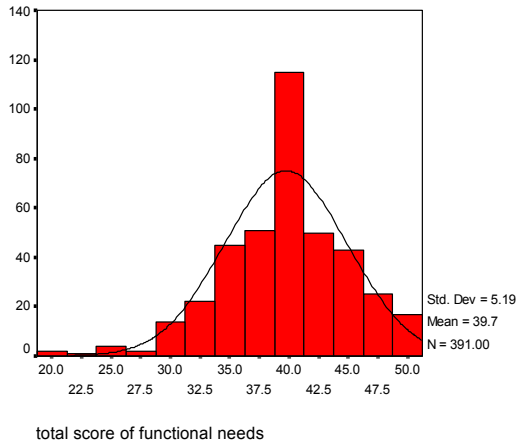
*Figure 5*. Histogram of the Dependent Variable (Attitudes toward Helmet Use)



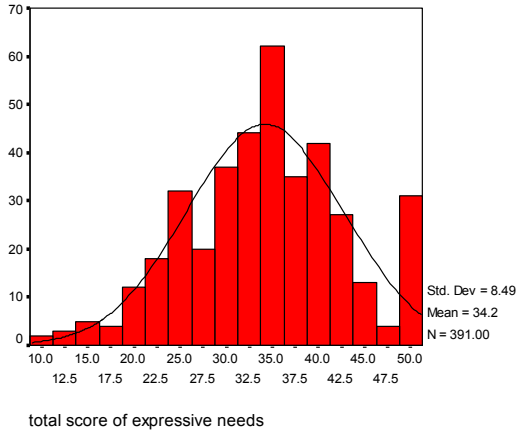

Additionally, distributions of the independent variables (FEAR needs) were created and are shown in Figure 6. Expressive needs show the most normal distribution except the peak at the very end of a tail on the right side of the histogram. The distribution of functional needs looks roughly normal, although there is a distribution peak at 40 on the total scores of functional needs. Aesthetic needs showed the least normal distribution among functional, expressive, and aesthetic needs. The distribution of regulatory needs was not expected to be a normal shape since the respondents perceived regulatory needs either as most importantly or least importantly, so the frequencies were distributed on the lower (left) or higher (right) end. Moreover, univariate properties, such as measures of mean, standard deviation, skewness, and Kurtosis, for dependent variables and independent variables were computed (Table 29).

*Figure 6*. Histograms of Independent Variables (FEAR needs)

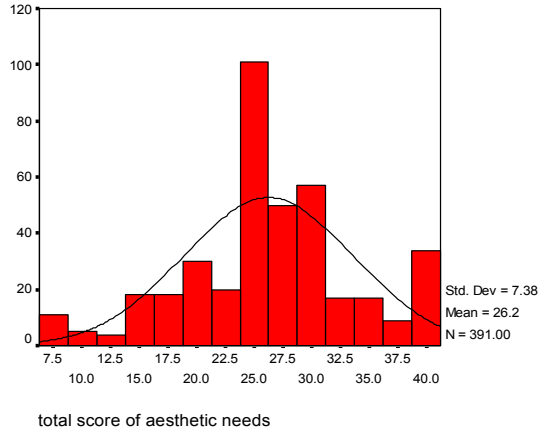
a. Functional Needs




b. Expressive Needs




c. Aesthetic Needs




d. Regulatory Needs

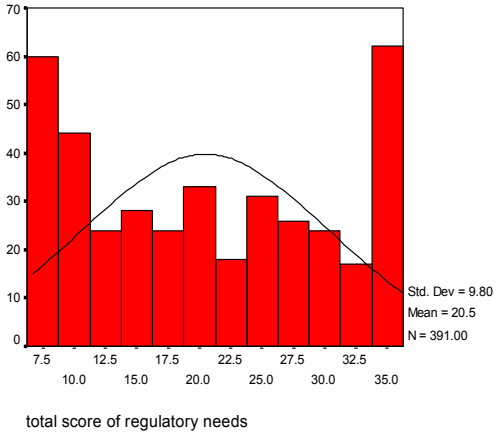


Table 29

*Descriptive Statistics of the Dependent Variable and the Independent Variables*

| | N | Min. | Max. | Mean | Std. Deviation | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| | | | | | | Statistic | Statistic |
| AH | 391 | 1.00 | 5.00 | 4.5090 | .84082 | -1.966 | 3.757 |
| TF | 391 | 20.00 | 50.00 | 39.7289 | 5.19202 | -.477 | .864 |
| TE | 391 | 10.00 | 50.00 | 34.1969 | 8.48586 | -.148 | -.172 |
| TA | 391 | 8.00 | 40.00 | 26.2455 | 7.38440 | -.163 | .131 |
| TR | 391 | 7.00 | 35.00 | 20.4783 | 9.79502 | .119 | -1.374 |

*Note.* AH (Attitudes toward Helmet Use); TF (Total Scores of Functional Needs); TE (Total Scores of Expressive Needs); TA (Total Scores of Aesthetic Needs); and TR (Total Scores of Regulatory Needs)

Assuming that background information might have an influence on the dependent variable, background information variables (age, education, gender, helmet ownership, participation experience, income, snowboarding-related accidents, and helmet usage) that might have an association with the dependent variable (attitudes toward helmet use) were examined. Gender, helmet ownership, and snowboarding-related accidents were represented as dummy variables, in order to use a single regression equation to represent multiple groups of respondents. Descriptive statistics of dummy variables are shown in Table 30.

Table 30

*Descriptive Statistics of Dummy Variables for Background Information*

| Dummy Variables of Background Information | Value Label | Number of Respondents |
|---|---|---|
| Dfemale | Female (0) | 93 |
| (Gender) | Male (1) | 242 |
| Total (n) | | 335 |
| Downership | No (0) | 12 |
| (Helmet Ownership) | Yes (1) | 327 |
| Total (n) | | 339 |
| Daccident | No (0) | 54 |
| (Snowboarding-Related Accident) | Yes (1) | 275 |
| Total (n) | | 329 |

Four demographic variables (age, education, income, and helmet usage) were recoded so that those variables could be used conveniently. These recoded variables were indicated as follows: ager, edur, incomer, and usager. For example, the lowest level coded for education as 1, but that was converted to 0 so that the intercept in the regression model can represent the expected value for the subjects whose values of independent variables are at the first category.

Other variables were recorded in a similar manner (Table 31). Following the recoding, the new variables were treated as continuous variables, even though those variables were still ordinal. As justification, the distances between the categories were created to be approximately equal. For example, education was divided into categories that approximated 2 years between them, <12 years for less than high school, 12 years for high school, 14 years for some college, 16 years for bachelor's degree, 18 years for some graduate work, and 20+ years for graduate or professional work. Further information of descriptive statistics for those continuous variables was summarized in Appendix N.

Table 31

*Summary of Recoded Variables for Demographic Information*

| Initial Code | Recode | | Value Label | N |
|---|---|---|---|---|
| Age | | | | |
| 1 | Ager | 0 | 18-25 | 186 |
| 2 | | 1 | 26-35 | 32 |
| 3 | | 2 | 36-45 | 43 |
| 4 | | 3 | >45 | 67 |
| Education | | | | |
| 1 | Edur | 0 | <12 (less than High School) | 36 |
| 2 | | 1 | 12 (High School) | 68 |
| 3 | | 2 | 14 (Some College) | 97 |
| 4 | | 3 | 16 (Bachelor's Degree) | 73 |
| 5 | | 4 | 18 (Some Graduate Work) | 15 |
| 6 | | 5 | 20+ (Graduate or Professional Work) | 38 |
| Income | | | | |
| 1 | Incomer | 0 | <$10,000 | 54 |
| 2 | | 1 | $10,000<X<$24,999 | 22 |
| 3 | | 2 | $25,000<X<$49,999 | 30 |
| 4 | | 3 | $50,000<X<$74,999 | 37 |
| 5 | | 4 | >$75,000 | 158 |
| Helmet usage | | | | |
| 1 | Usager | 4 | always | 239 |
| 2 | | 3 | very often | 40 |
| 3 | | 2 | sometimes | 29 |
| 4 | | 1 | rarely | 21 |
| 5 | | 0 | never | 7 |

*Bivariate Relationships among Variables of Interest*

For the second phase of the analysis, the bivariate relationships among the variables of interest were checked. Associations between variables were assessed in three ways: 1) Correlation was used to assess the relationships between two continuous variables (total scores of FEAR needs, attitudes toward helmet use, highest level of education, helmet usage, and participation experience); 2) Cross-tabs were used to detect the association between two categorical variables (age-gender, gender-helmet ownership, income-snowboarding-related accidents, etc); and 3) One-way ANOVA, including mean plots, investigated the association between a continuous variable (attitudes toward helmet use) and categorical variables (age, gender, helmet ownership, income, and snowboarding-related accidents).

The Pearson Correlation Coefficients were used to check the strength and direction of a linear relationship between the dependent (attitudes toward helmet use) and independent variables (FEAR needs). The correlation was primarily concerned with measuring the relationships between the dependent variable and the independent variables. However, relationships among independent variables and covariates were also analyzed.

In general, attitudes toward helmet use were significantly correlated with two independent variables; total scores of expressive needs ($r = .337$, $p < .05$) and total scores of regulatory needs ($r = .416$, $p < .05$), as well as with two covariates, education ($r = .126$, $p < .05$) and helmet usage ($r = .723$, $p < .05$). The remaining independent variables (total scores of functional needs and total scores of aesthetic needs), as well as the covariate (participation experience) showed a low correlation with attitudes toward helmet use, and was not statistically significant.

Among those statistically significant correlations, the correlation between attitudes toward helmet use and helmet usage was the most highly associated, while the correlation between attitudes toward helmet use and participation experience ($r = .048$, $p < .05$) was the least highly associated.

According to the result of the correlation among the independent variables, total scores of functional needs were significantly correlated with the three other independent variables and with one covariate, participation experience ($r = -.051$, $p < .05$). Total scores of expressive needs were significantly correlated with all other variables. Total scores of aesthetic needs were significantly associated with only two variables; total scores of regulatory needs ($r = .312$, $p < .05$) and participation experience ($r = -.212$, $p < .05$). Total scores of regulatory needs were significantly correlated with participation experience ($r = -.283$, $p < .05$) and helmet usage ($r = .357$, $p < .05$). In addition, participation experience was correlated with education ($r = .166$, $p < .05$). The Pearson correlation matrix indicating the correlation among the variables is shown in Table 32.

Table 32

*Pearson Correlation Matrix of Two Continuous Variables*

| Continuous Variables | (1)AH | (2)TF | (3)TE | (4)TA | (5)TR | (6)PE | (7)ED | (8)HU |
|---|---|---|---|---|---|---|---|---|
| (1) AH | 1.000 | .060 | .337* | .049 | .416* | .048 | .126* | .723* |
| (2) TF | | 1.000 | .198* | .280* | .131* | -.166* | -.051 | -.014 |
| (3) TE | | | 1.000 | .544* | .470* | -.202* | -.116* | .285* |
| (4) TA | | | | 1.000 | .312* | -.212* | -.100 | -.079 |
| (5) TR | | | | | 1.000 | -.283* | -.074 | .357* |
| (6) PE | | | | | | 1.000 | .166* | .037 |
| (7) ED | | | | | | | 1.000 | .028 |
| (8) HU | | | | | | | | 1.000 |

* Correlation is significant at the 0.05 level (2-tailed)

AH (Attitudes toward Helmet Use); TF (Total Scores of Functional Needs); TE (Total Scores of Expressive Needs);
TA (Total scores of Expressive Needs); TR (Total Scores of Regulatory Needs); PE (Participation Experience);
ED (Highest level of Education); and HU (Frequency of Helmet Usage)

For assessing the association between the dependent variable (attitudes toward helmet use) and the covariates (age, gender, helmet ownership, income, and snowboarding-related accident), a one-way ANOVA (Table 33), including means plots (Figure 7), was completed. The dependent variable was found to have statistically significant differences among age, helmet ownership, and income; whereas, gender and snowboarding-related accidents were not statistically related. Mean plots of the dependent variable and the covariates were tested to see if there were any distinct patterns in the shifts of location.

There were interesting fluctuations with age and income. Although the sample mean plot of age did not show big changes in locations, there was one shift of location after the 35 and 45 age groups. Those age groups seemed to show higher attitudes toward helmet use than the other age groups. Likewise, for income the sample mean plot was very changeable, with those who earned $75,000 and over showing the highest attitudes toward helmet use, while those who made between $10,000 and $24, 000 showed the lowest attitudes toward helmet use. This finding may imply that age and income can influence snowboarders' attitudes toward helmet use. In addition, the gender sample mean continued to increase toward male, and the sample mean of helmet ownership consistently increased toward positive helmet ownership.

For looking at the association between two categorical variables, cross-tabs were used to produce contingency tables. Chi-square was used to determine whether an overall statistically significant difference between two categorical variables existed. A total of 10 sets of categorical variables was composed and analyzed. Out of the10 sets, there was only one set of categorical variables, age – income, that showed a statistically significant difference.

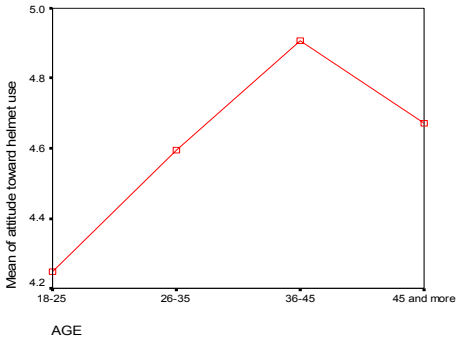
Table 33

*One-Way ANOVA*

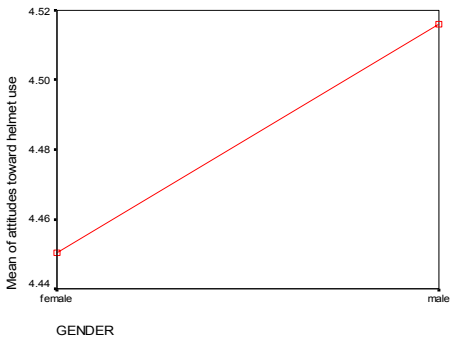
| I. One-Way ANOVA for Attitude toward Helmet Use by Age | | | | | |
|---|---|---|---|---|---|
| | Sum of Squares | df | Mean Square | F | Sig. |
| Between Groups | 20.568 | 3 | 6.856 | 10.063 | .000 |
| Within Groups | 220.746 | 324 | .681 | | |
| Total | 241.314 | 327 | | | |
| **II. One-Way ANOVA for Attitude toward Helmet Use by Gender** | | | | | |
| | Sum of Squares | df | Mean Square | F | Sig. |
| Between Groups | .290 | 1 | .290 | .397 | .529 |
| Within Groups | 243.131 | 333 | .730 | | |
| Total | 243.421 | 334 | | | |
| **III. One-Way ANOVA for Attitude toward Helmet Use by Helmet Ownership** | | | | | |
| | Sum of Squares | df | Mean Square | F | Sig. |
| Between Groups | 9.824 | 1 | 9.824 | 14.108 | .000 |
| Within Groups | 234.660 | 337 | .696 | | |
| Total | 244.484 | 338 | | | |
| **IV. One-Way ANOVA for Attitude toward Helmet Use by Income** | | | | | |
| | Sum of Squares | df | Mean Square | F | Sig. |
| Between Groups | 12.472 | 4 | 3.118 | 4.427 | .002 |
| Within Groups | 208.478 | 296 | .704 | | |
| Total | 220.950 | 300 | | | |
| **V. One-Way ANOVA for Attitude toward Helmet Use by Snowboarding-Related Accidents** | | | | | |
| | Sum of Squares | df | Mean Square | F | Sig. |
| Between Groups | 6.558E-03 | 1 | 6.558E-03 | .009 | .925 |
| Within Groups | 241.513 | 327 | .739 | | |
| Total | 241.520 | 328 | | | |

*Figure 7.* Mean Plots of the Dependent Variable and Covariates

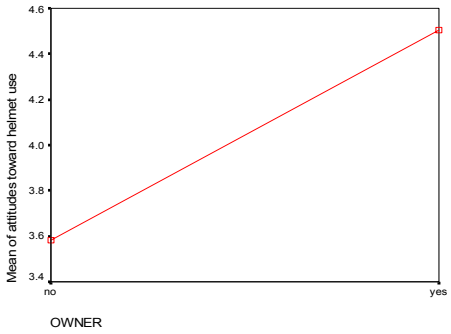
I. Attitudes toward Helmet Use and Age



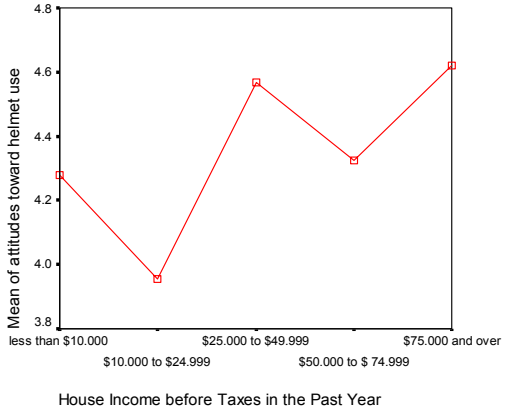

II. Attitude towards Helmet Use and Gender



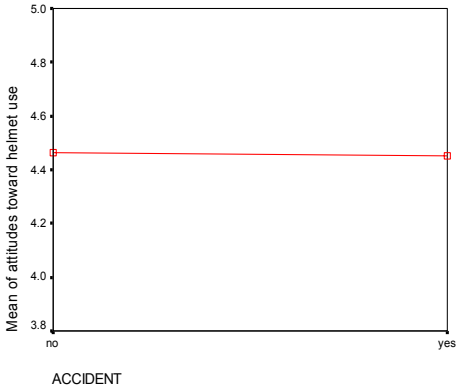

III. Attitudes toward Helmet Use and Helmet Ownership




IV. Attitudes toward Helmet Use and Income




V. Attitudes toward Helmet Use and Snowboarding-Related Accidents

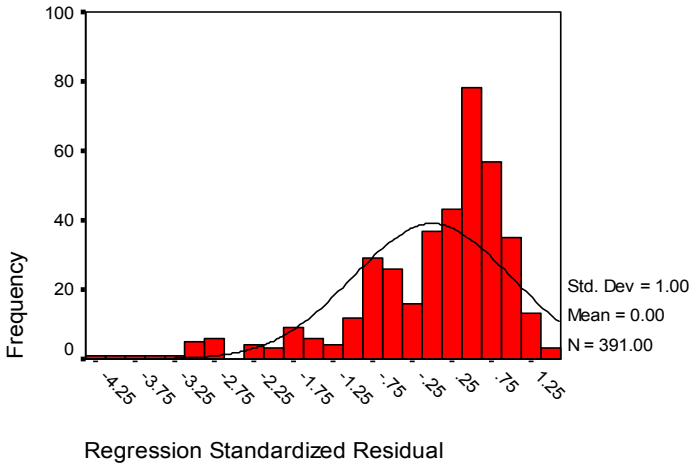


## *Regression Model*

### *Procedure for Model Building*

To construct the regression model that represents the relationships between the dependent variable (attitudes toward helmet use) and the four independent variables (total scores of FEAR needs), the General Linear Model procedure was used, adjusting for covariates (age, education, gender, helmet ownership, participation experience, income, snowboarding-related accident, and helmet usage). One justification for using linear regression rather than an ordinal regression model, was that the histogram of residuals for the dependent variable showed that the errors were roughly normal distributed (Figure 8), meeting one of assumptions of multiple regression (Long, 1997).

*Figure 8.* Histogram of the Residual for Attitudes toward Helmet Use



First, a model with only the main effects was fitted (four main effects of the independent variables and eight covariates). The main effects of the independent variables, with the exception of functional needs, and three covariates (education, helmet usage, and helmet ownership) were statistically significant. The covariates that were not statistically significant in the main effects model were eliminated for the rest of the analysis. Functional needs, though it was not statistically significant in the main effects model, was kept for further analysis since it was a key independent variable, and potentially may have an interaction effect. Next, the full two-way interaction model (four independent variables and three covariates) was fitted to consider interaction effects between the independent variables and covariates. Any non-significant interaction terms were then eliminated from the model. After determining the necessary terms in the regression model, variables were centered to facilitate the interpretation of the results.

*Centering of the predictors*

To describe the relationships between attitudes toward helmet use and FEAR needs, centering was used. Centering was utilized to contribute to the interpretation of the results, since interaction effects of covariates would be difficult to interpret. Centering is calculated by subtracting a mean score from the covariates before fitting into the final regression model. Centering was indicated as "C" and calculated as the following example: TFC = TF – mean; TFC*USAGERC = (TF – mean) x (USAGERC – mean). Thus, the mean scores of all new centered variables were considered as zero. The centered variables were used in the final multiple regression model in order to find the regression coefficients in the final regression

model. The regression coefficients measure how strongly each independent variable is associated with the dependent variable ("Data and Statistical Services", 2006, January 06) and the intercept gives a prediction equation.

*Results*

The following is the final model that was reached after executing the model building procedure mentioned in the previous section.

Equation 1

$$Y_i = \beta_o + \beta_1 (f_i - \bar{f}) + \beta_2 (e_i - \bar{e}) + \beta_3 (a_i - \bar{a}) + \beta_4 (r_i - \bar{r}) + \beta_5 (edu_i - \overline{edu})$$

$$+ \beta_6 (usage_i - \overline{usage}) + \beta_7 \{ (f_i - \bar{f})(e_i - \bar{e}) \} + \beta_8 \{ (f_i - \bar{f})(a_i - \bar{a}) \}$$

$$+ \beta_9 \{ (f_i - \bar{f})(usage_i - \overline{usage}) \} + \beta_{10} \{ (e_i - \bar{e})(usage_i - \overline{usage}) \}$$

$$+ \beta_{11} \{ (a_i - \bar{a})(usage_i - \overline{usage}) \} + \varepsilon_i$$

where Yi is the attitudes toward helmet use for the subject i;

$\beta_o$ is the intercept and represents the expected attitudes toward helmet for typical subjects when all of FEAR needs, education, and helmet usage are equal to the means;

$f_i$ is the functional needs for the subject i, and it is centered around the sample mean $\bar{f}$;

$e_i$ is the expressive needs for the subject i, and it is centered around the sample mean $\bar{e}$;

$a_i$ is the aesthetic needs for the subject i, and it is centered around the sample mean $\bar{a}$;

$r_i$ is the regulatory needs for the subject i, and it is centered around the sample mean $\bar{r}$;

$edu_i$ is the level of education for the subject i, and it is centered around the sample mean $\overline{edu}$;

$usage_i$ is the level of helmet usage for the subject i, and it is centered around the sample mean $\overline{usage}$;

$\beta_1$ is the slope for predictor ( $f_i - \bar{f}$ ) in the population, where the slope is the change in attitudes toward helmet use for one unit increase in ( $f_i - \bar{f}$ ), holding other variables in the model constant ;

$\beta_2$ is the slope for predictor ( $e_i - \bar{e}$ ) in the population, where the slope is the change in attitudes toward helmet use for one unit increase in ( $e_i - \bar{e}$ ), holding other variables in the model constant ;

$\beta_3$ is the slope for predictor ( $a_i - \bar{a}$ ) in the population, where the slope is the change in attitudes toward helmet use for one unit increase in ( $a_i - \bar{a}$ ), holding other variables in the model constant ;

$\beta_4$ is the slope for predictor ( $r_i - \bar{r}$ ) in the population, where the slope is the change in attitudes toward helmet use for one unit increase in ( $r_i - \bar{r}$ ), holding other variables in the model constant ;

$\beta_5$ is the slope for predictor ( $edu_i - \overline{edu}$ ) in the population, where the slope is the change in attitudes toward helmet use for one unit increase in ( $edu_i - \overline{edu}$ ), holding other variables in the model constant ;

$\beta_6$ is the slope for predictor ( $usage_i - \overline{usage}$ ) in the population, where the slope is the change in attitudes toward helmet use for one unit increase in ( $usage_i - \overline{usage}$ ) , holding other variables in the model constant;

$\beta_7$ is the interaction effect between functional needs and expressive needs, holding other variables in the model constant ;

$\beta_8$ is the interaction effect between functional needs and aesthetic needs, holding other variables in the model constant ;

$\beta_9$ is the interaction effect between functional needs and helmet usage, holding other variables in the model constant ;

$\beta_{10}$ is the interaction effect between expressive needs and helmet usage, holding other variables in the model constant ;

$\beta_{11}$ is the interaction effect between aesthetic needs and helmet usage, holding other variables in the model constant ;

$\varepsilon_i$ is the random error for the subject i, and it is assumed to be independent and identically normal distributed with mean 0 and the variance, $\sigma^2$, that is $e_i \sim^{i.i.d} \sim n(0, \sigma^2)$.

Table 34 – I provides the ANOVA table for the regression, and Table 34 – II provides regression coefficients (both unstandardized and standardized) with t-test. From Table 34 – I, a set of independent variables in the model has some explanatory power (F = 44.35, P-value < .001). In fact, R Squared ($R^2$) = .61, explaining that 61% of the total variation in attitudes toward helmet use is accounted for by functional, expressive, aesthetic, and regulatory needs.

Table 34 – I

*Regression Coefficients for the Centered Variables*

ANOVA[b]

| Model | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Regression | 144.325 | 11 | 13.120 | 44.350 | .000[a] |
| Residual | 92.302 | 312 | .296 | | |
| Total | 236.627 | 323 | | | |

*Note.* a. Predictors (Constant), TAC_URC, TAC, USAGERC, EDURC, TFC_TEC, TFC_URC, TRC, TFC, TFC_TAC, TEC_URC

b. Dependent Variable: attitudes toward helmet use

Table 34 – II shows that there are five, two-way interaction effects in the model. Two out of five interaction effects are among key independent variables, and the remainder of the interaction effects is between the independent variables and the covariate. Specifically, helmet usage has a significant interaction effect with all independent variables, except regulatory needs. From the standardized coefficient, the most substantive interaction effect is between expressive needs and helmet usage ($\beta$ = -.185), followed by the interaction effects between aesthetic needs

and helmet usage (β = .164), functional needs and expressive needs (β = -.129), functional needs and aesthetic needs (β = .102), and between functional needs and helmet usage (β = -.095).

Table 34 - II

*Coefficients*[a]

| Model | Unstandardized Coefficients B | Unstandardized Coefficients Std.Error | Standardized Coefficients Beta | t | Sig. |
|---|---|---|---|---|---|
| 1 (Constant) ($\beta_0$) | 4.530 | .035 | | 130.396 | . 000 |
| TFC ($\beta_1$) | .013 | .007 | .080 | 1.935 | .054 |
| TEC ($\beta_2$) | .014 | .005 | .132 | 2.928 | .004 |
| TAC ($\beta_3$) | -.012 | .006 | -.092 | -2.116 | .035 |
| TRC ($\beta_4$) | .010 | .004 | .103 | 2.529 | .012 |
| EDURC ($\beta_5$) | .070 | .022 | .117 | 3.226 | .001 |
| USAGERC ($\beta_6$) | .458 | .042 | .551 | 10.806 | .000 |
| TFC*TEC ($\beta_7$) | -.002 | .001 | -.129 | -2.569 | .011 |
| TFC*TAC ($\beta_8$) | .002 | .001 | .102 | 1.964 | .050 |
| TFC*USAGERC ($\beta_9$) | -.016 | .007 | -.095 | -2.307 | .022 |
| TEC*USAGERC ($\beta_{10}$) | -.015 | .004 | -.185 | -3.392 | .001 |
| TAC*USAGERC ($\beta_{11}$) | .019 | .005 | .164 | 3.554 | .000 |

*Note*. a. Dependent Variable: attitudes toward helmet use
$R^2$ = .610 (Adjusted R Squared = .596)
$p < .05$

*Prediction equations*

To better understand the nature of the relationships between attitudes toward helmet use and FEAR needs, graphs were needed. In order to draw the graphs, the prediction equation was needed. The prediction equation can be obtained by inserting the estimates of the regression intercept and slopes in Table 34 – II in the final regression model as in Equation 1.

<u>Equation 2</u>

$$\hat{y}_i = 4.530 + .013\,(f_i - \bar{f}) + .014\,(e_i - \bar{e}) - .012\,(a_i - \bar{a}) + .010\,(r_i - \bar{r})$$
$$+ .070\,(edu_i - \overline{edu}) + .458\,(usage_i - \overline{usage}) - .002\,\{(f_i - \bar{f})(e_i - \bar{e})\}$$
$$+ .002\,\{(f_i - \bar{f})(a_i - \bar{a})\} - .016\,\{(f_i - \bar{f})(usage_i - \overline{usage})\}$$
$$- .015\,\{(e_i - \bar{e})(usage_i - \overline{usage})\}$$
$$+ .019\,\{(a_i - \bar{a})(usage_i - \overline{usage})\}$$

Each impact for FEAR needs was obtained through the general prediction equation. Since no interaction effect for education was found, the impact of education was simply to increase the mean level of attitudes toward helmet use (β = .458). Therefore, considering typical subjects, with education level at the sample mean, the education term is dropped from the model equation. However, helmet usage showed significant interaction effects for this study. Therefore, three levels of helmet usage were considered to obtain each impact of FEAR needs. The three levels of helmet usage were as follows; Case 1: mean of helmet usage; Case 2: one standard deviation below the mean of helmet usage; and Case 3: one standard deviation above the mean of helmet usage.

*CASE 1.*

Case 1 considered that the subjects whose helmet usage was at the mean, so the helmet usage term could be dropped from Equation 2. Subsequently, the following prediction equation was obtained:

Equation 3

$$\hat{y}_i = 4.530 + .013\,(f_i - \bar{f}) + .014\,(e_i - \bar{e}) - .012\,(a_i - \bar{a})$$
$$+ .010\,(r_i - \bar{r}) - .002\,\{(f_i - \bar{f})(e_i - \bar{e})\}$$
$$+ .002\,\{(f_i - \bar{f})(a_i - \bar{a})\}$$

Four prediction equations were needed to obtain the impacts of FEAR needs when helmet usage was at the mean. The squared box in each equation indicates the impact of each FEAR need.

Equation 4

1) Impact of Functional Needs

$$\hat{y}_i = \{4.530 + .013\,(f_i - \bar{f}) + .014\,(e_i - \bar{e}) - .012\,(a_i - \bar{a}) + .010\,(r_i - \bar{r})\} +$$
$$\boxed{\{.013 - .002\,(e_i - \bar{e}) + .002\,(a_i - \bar{\ })\}}\,(f_i - \bar{f})$$

Equation 5

2) Impact of Expressive Needs

$$\hat{y}_i = \{4.530 + .013\,(f_i - \bar{f}) - .012\,(a_i - \bar{a}) + .010\,(r_i - \bar{r})$$
$$+ .002\,(f_i - \bar{f})(a_i - \bar{a})\} + \boxed{\{.014 - .002\,(\ _i - \bar{\ })\}}\,(e_i - \bar{e})$$

Equation 6

3) Impact of Aesthetic Needs

$$\hat{y}_i = \{ 4.530 + .013 (f_i - \bar{f}) + .014 (e_i - \bar{e}) + .010 (r_i - \bar{r})$$

$$-.002 \{ (f_i - \bar{f})(e_i - \bar{e}) \} + \boxed{\{ (-.012) + .002 (f_i - \bar{\ }) \}} (a_i - \bar{a})$$

Equation 7

4) Impact of Regulatory Needs

$$\hat{y}_i = \{ 4.530 + .013 (f_i - \bar{f}) + .014 (e_i - \bar{e}) - .012 (a_i - \bar{a})$$

$$-.002 \{ (f_i - \bar{f})(e_i - \bar{e}) \} + .002 \{ (f_i - \bar{f})(a_i - \bar{a}) \} \}$$

$$+ \boxed{.010} (r_i - \bar{r})$$

*CASE 2.*

The general prediction equation was reformed to obtain impacts of FEAR needs when the impact of helmet usage was at one standard deviation above the mean. Since the prediction equation was used to look at the impacts of FEAR needs at higher level of helmet usage, the standard deviations of helmet usage (Sdu = 1.02) were inserted into Equation 1 to obtain the following prediction equation for the subjects whose average was one standard deviation above the mean:

Equation 8

$$\hat{y}_i = 4.530 + .013 (f_i - \bar{f}) + .014 (e_i - \bar{e}) - .012 (a_i - \bar{a}) + .010 (r_i - \bar{r})$$

$$+ .458 \text{ Sdu} - .002 \{ (f_i - \bar{f})(e_i - \bar{e}) \} + .002 \{ (f_i - \bar{f})(a_i - \bar{a}) \}$$

$$- .016 \text{ Sdu} (f_i - \bar{f}) - .015 \text{ Sdu} (e_i - \bar{e}) + .019 \text{ Sdu} (a_i - \bar{a})$$

Each FEAR impact at higher than average was calculated by this prediction equation. The summary of FEAR impacts at helmet usage above the mean was presented with the squared box indicating the impact of FEAR needs.

Equation 9

1) Impact of Functional Needs

$$\hat{y}_i = \{ 4.999 - .0013 ( e_i - \bar{e} ) + .0074 ( a_i - \bar{a} ) + .010 ( r_i - \bar{r} ) \} + \boxed{\{ .0034 - .002 ( e_i - \bar{e} ) + .002 ( a_i - \bar{} ) \}} ( f_i - \bar{f} )$$

Equation 10

2) Impact of Expressive Needs

$$\hat{y}_i = \{ 4.999 - .0034 ( f_i - \bar{f} ) + .0074 ( a_i - \bar{a} ) + .002 ( f_i - \bar{f} )( a_i - \bar{a} ) + .002 ( f_i - \bar{f} )( a_i - \bar{a} ) \} + .010 ( r_i - \bar{r} ) \} + \boxed{\{ -.0013 - .002 ( \quad_i - \bar{} ) \}} ( e_i - \bar{e} )$$

Equation 11

3) Impact of Aesthetic Needs

$$\hat{y}_i = \{ 4.999 - .0034 ( f_i - \bar{f} ) - .0013 ( e_i - \bar{e} ) - .002 \{ ( f_i - \bar{f} )( e_i - \bar{e} ) + .010 ( r_i - \bar{r} ) \} + \boxed{\{ .0074 + .002 ( f_i - \bar{} ) \}} ( a_i - \bar{a} )$$

Equation 12

4) Impact of Regulatory Needs

$$\hat{y}_i = \{ 4.999 - .0034 ( f_i - \bar{f} ) - .0013 ( e_i - \bar{e} ) + .0074 ( a_i - \bar{a} ) - .002 ( f_i - \bar{f} )( e_i - \bar{e} ) + .002 ( f_i - \bar{f} )( a_i - \bar{a} ) \} + \boxed{.010} ( r_i - \bar{r} )$$

*CASE 3.*

New prediction equations for testing the impact of FEAR needs when helmet usage was at one standard deviation below the mean were created. Because the prediction equation was used to check the impact of FEAR needs at lower levels of helmet usage, the standard deviations of helmet usage (Sdu = 1.02) was inserted into Equation 1 to obtain the following prediction equation for the subjects whose average was one standard deviation below the mean. Prediction equations for the subjects whose helmet usage was one standard deviation below the mean are as follows:

<u>Equation 13</u>

$$\hat{y}_i = 4.530 + .013\,(f_i - \bar{f}) + .014\,(e_i - \bar{e}) - .012\,(a_i - \bar{a}) + .010\,(r_i - \bar{r})$$

$$- .458\ \text{Sdu} - .002\,\{(f_i - \bar{f})(e_i - \bar{e})\} + .002\,\{(f_i - \bar{f})(a_i - \bar{a})\}$$

$$+ .016\ \text{Sdu}\,(f_i - \bar{f}) + .015\ \text{Sdu}\,(e_i - \bar{e}) - .019\ \text{Sdu}\,(a_i - \bar{a})$$

The prediction equations for the impact of FEAR needs when helmet usage was at one standard deviation below the mean, indicated with a squared box were summarized as follows:

<u>Equation 14</u>

1) Impact of Functional Needs

$$\hat{y}_i = \{4.061 + .029\,(e_i - \bar{e}) - .0314\,(a_i - \bar{a}) + .010\,(r_i - \bar{r})\} +$$

$$\boxed{\{.029 - .002\,(e_i - \bar{e}) + .002\,(a_i - {}^{-})\}}\ (f_i - \bar{f})$$

Equation 15

2) Impact of Expressive Needs

$$\hat{y}_i = \{ 4.061 + .029 (f_i - \bar{f}) - .0314 (a_i - \bar{a}) + .002 (f_i - \bar{f})(a_i - \bar{a}) + .010 (r_i - \bar{r}) \} + \boxed{\{ .029 - .002 (\quad_i - \bar{\quad}) \}} (e_i - \bar{e})$$

Equation 16

3) Impact of Aesthetic Needs

$$\hat{y}_i = \{ 4.061 + .029 (f_i - \bar{f}) + .029 (e_i - \bar{e}) - .002 \{ (f_i - \bar{f})(e_i - \bar{e}) + .010 (r_i - \bar{r}) \} + \boxed{\{ -.031 + .002 (f_i - \bar{\quad}) \}} (a_i - \bar{a})$$

Equation 17

4) Impact of Regulatory Needs

$$\hat{y}_i = \{ 4.061 + .029 (f_i - \bar{f}) + .029 (e_i - \bar{e}) - .031 (a_i - \bar{a}) - .002 (f_i - \bar{f})(a_i - \bar{a}) \} + \boxed{.010} (r_i - \bar{r})$$

The level of helmet usage was defined by three levels: 1) higher level of helmet usage (H); 2) mean of helmet usage (M); and 3) lower level of helmet usage (L). The general prediction equations (i.e., Case 1 for equation 4, 5, 6, and 7; Case 2 for equation 9, 10, 11, and 12; and Case 3 for equation 14, 15, 16, and 17) were used to obtain the impacts of FEAR needs on attitudes toward helmet use.

The formulas for the general prediction equations were computed via excel. There were originally 27 possible combinations for FEAR needs with the three levels of helmet usage: 1) EH, AH, RH; 2) EH, AH, RM; 3) EH, AH, RH; 4) EH, AM, RH; 5) EH, AM, RM; 6) EH, AM,

RL; 7) EH, AL, RH; 8) EH, AL, RM; 9) EH, AL, RL; 10) EM, AH, RH; 11) EM, AH, RM; 12) EM, AH, RL; 13) EM, AM, RH; 14) EM, AM, RM; 15) EM, AM, RL; 16) EM, AM, RL; 17) EM, AL, RH; 18) EM, AL, RM; 19) EM, AL, RL; 20) EL, AH, RH; 21) EL, AH, RM; 22) EL, AM, RH; 23) EL, AM, RM; 24) EL, AM, RL; 25) EL, AL, RH; 26) EL, AL, RM; and 27) EL, AL, RL. The other three needs were treated in the same manner to obtain 27 sets of combinations. However, due to the complexity created by 27 combinations, a total of 9 combinations that were consistent with regulatory needs when helmet usage was at the mean were selected to be analyzed since the prediction equation for regulatory needs was simple to predict (e.g., (1) EH, AH, RM; (2) EH, AM, RM; (3) EH, AL, RM; (4) EM, AH, RM; (5) EM, AM, RM; (6) EM, AL, RM; (7) EL, AH, RM; (8) EL, AM, RM; and (9) EL, AL, RM). For example, the impact of regulatory needs on attitudes was illustrated by only positive slopes in the graph, consistently increasing from low to high impact. Thus, the impact of FEAR needs on attitudes toward helmet use was interpreted based on the general patterns of regression lines under these three conditions (i.e., at the mean, one standard deviation above the mean, and one standard deviation below the mean of helmet usage).

With the 9 combinations, a total of 12 regression lines were obtained and used to interpret the results. In addition, the scale range of the attitude toward helmet use in each graph was rearranged from 3.5 to 5 rather than 1 to 5because: 1) the impact slope lines were shown above 3 for FEAR needs; 2) the possible maximum score of attitudes toward helmet use was 5, so the status (height) of attitudes that were higher than 5 on attitudes was excluded from the graphs; and 3) this kept the status of attitudes consistent. The range of FEAR needs was placed on the X axis for possible scores from each case of FEAR needs, such as from minimum to maximum scores.

## Results of the Hypotheses

Four hypotheses were proposed for this study. The following hypotheses were tested using multiple linear regressions.

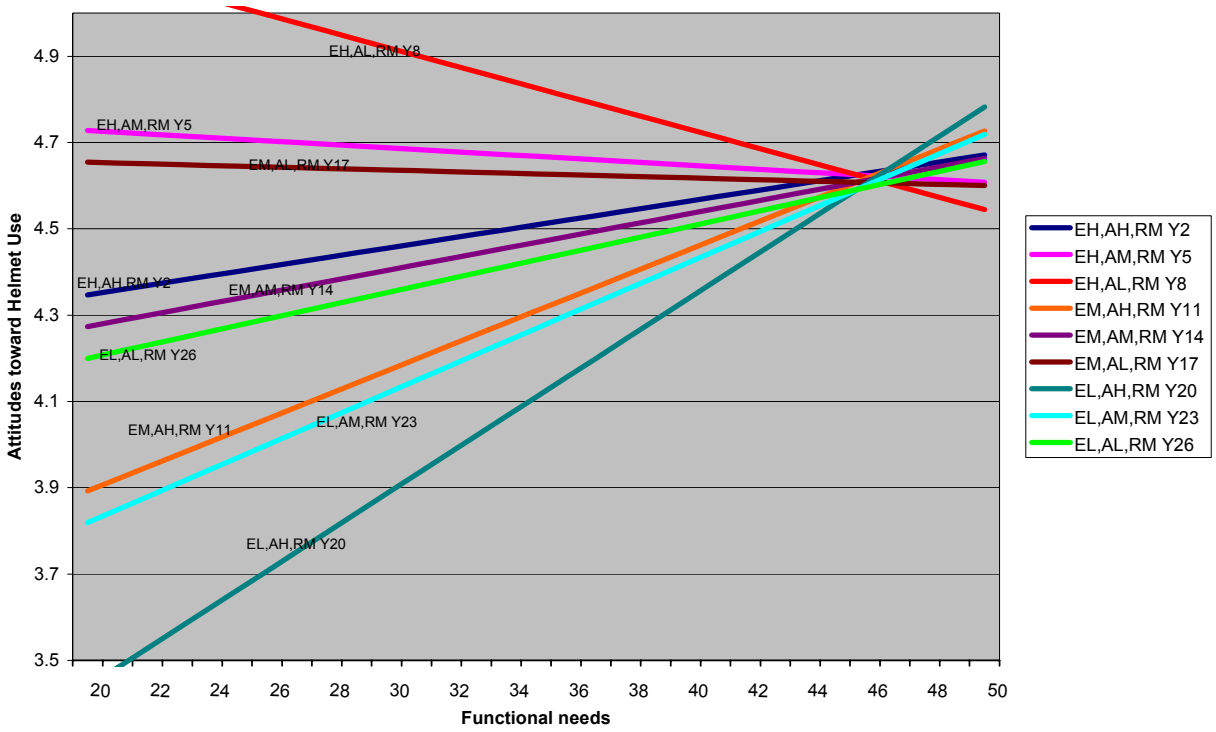
Hypothesis 1: Perceived importance of functional needs for snowboarders would have an impact on attitudes towards snowboarding helmets, controlling for other needs (i.e., expressive, aesthetic, and regulatory needs).

### *The Impact of Functional Needs on Attitudes toward Helmet Use When the Regulatory Needs were at the Mean*

Based on the graph shown, the impact of functional needs on attitudes toward helmet use when the regulatory needs were at the mean of helmet usage (Figure 9), shows a typical pattern on line Y14 (EM, AM, RM), the 14$^{th}$ of the regression lines on the Y axis, in which all expressive, aesthetic, and regulatory needs were at their means. The impact was positive and looked similar to lines Y2 (EH, AH, RM) and Y26 (EL, AL, RM).

Line Y20 (EL, AH, RM) had the lowest starting impact, but positively increased until it represented the largest impact. Lines Y23 (EL, AM, RM) and Y11 (EM, AH, RM) also started with lower impact. In contrast, Y8 (EH, AL, RM) started with the highest impact, decreasing negatively until it showed the lowest impact. Lines Y5 (EH, AM, RM) and Y17 (EM, AL, RM) started with higher impact, but decreased only slightly. All of these lines were intersected by the score of 46 on the X axis of functional needs. This single intersection point represents the point where the impact of functional needs changed either higher or lower impacts of functional needs.

*Figure 9*. Impact of Functional Needs on Attitudes toward Helmet Use When Regulatory Needs were at the Mean

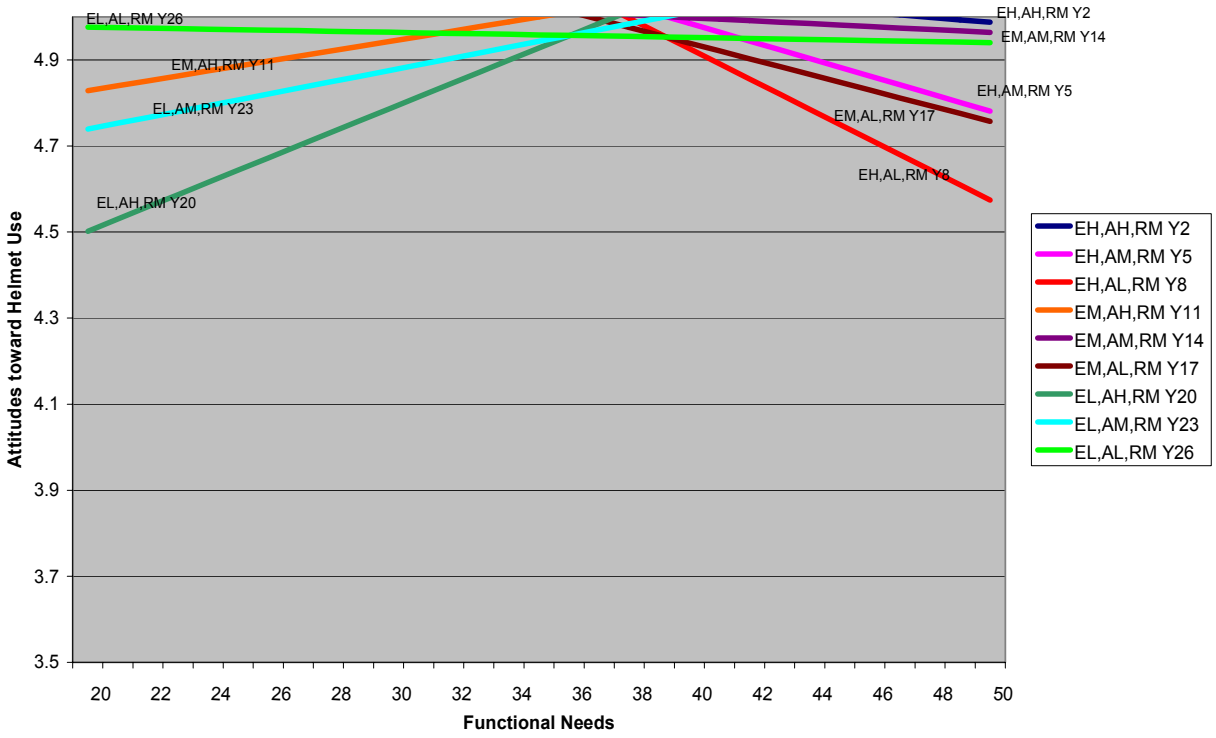



*The Impact of Functional Needs on Attitudes toward Helmet Use When Regulatory Needs were at One Standard Deviation above the Mean*

The impact of functional needs on attitudes toward helmet use when regulatory needs were at one standard deviation above the mean of helmet usage is partially shown in Figure 10. Since the original status of attitudes was rearranged between 3.5 and 5, the impact of functional needs that was shown higher than 5 was eliminated from the graph. A typical pattern of the functional needs under this condition was found in line Y14 (EM, AM, RM). Even though Y14

was only partially shown, this line seemed to be parallel to both Y2 (EH, AH, RM) and Y26 (EL, AL, RM). These lines looked nearly flat, which means there was no impact of functional needs on attitudes. However, three were there positive impacts found; Y11 (EM, AH, RM), Y23 (EL, AM, RM), and Y20 (EL, AH, RM). Line Y20 started with the lowest impact among them. In addition, three negative impact were shown in Y5 (EH, AM, RM), Y17 (EM, AL, RM), and Y8 (EH, AL, RM). With means at one standard deviation above the mean of helmet usage, there was not a single intersection point, but multiple intersections.

*Figure 10*. Impact of Functional Needs on Attitudes toward Helmet Use When Regulatory Needs were at One Standard Deviation above the Mean

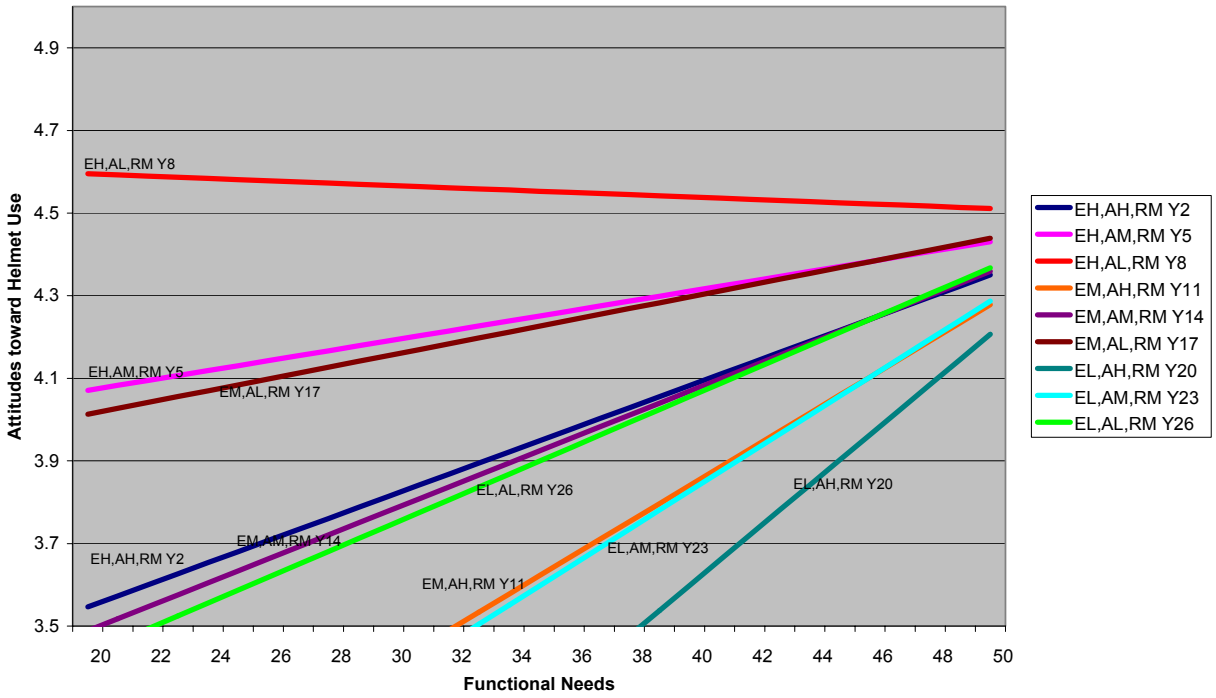


*The Impact of Functional Needs on Attitudes toward Helmet Use*

*When Regulatory Needs were at One Standard Deviation below the Mean*

Looking at the graph in Figure 11, a representative pattern of the impact of functional needs on attitudes toward helmet use when regulatory needs were at one standard deviation below the mean of helmet usage was shown in Y14 (EM, AM, RM). All impacts under this condition were positive, except Y8 (EH, AL, RM). Y8 showed the highest impact of functional needs overall, although it showed a slightly negative relationship. Regression lines Y26 (EL, AL, RM) and Y2 (EH, AH, RM) were nearly parallel to Y14, but overlapped as passing 46 on functional needs. Similarly, the regression line Y17 (EM, AL, RM) was nearly parallel to Y5 (EH, AM, RM), but merged to show the same impact of functional needs on attitudes as they approached 44 on functional needs. Lines Y11 (EM, AH, RM) and Y23 (EL, AM, RM) were very similar, indicating almost identical impact with their overlapping lines. Finally, Y20 (EL, AH, RM) had a similar pattern to Y11 and Y23, but appeared to have a stronger positive relationship than the others, based upon the stiffness of their slopes.

*Figure 11*. Impact of Functional Needs on Attitudes toward Helmet Use When Regulatory Needs were at One Standard Deviation below the Mean




The first hypothesis of this study states that there is a relationship between attitudes toward helmet use and the perceived importance of functional needs, as measured by multiple linear regressions. Table 34 – II presents the association between attitudes toward helmet use and functional needs. Functional needs were correlated with the level of expressive needs, aesthetic needs, and helmet usage. Thus, the relationship between attitudes toward helmet use and the perceived importance of functional needs depends on the level of expressive needs, aesthetic needs, and helmet usage among snowboarders. All correlations contained in Table 31 are in a positive direction, ranging for .048 to .723. The highest positive correlation with attitude

toward helmet use was helmet usage ($r = .723$, $p < .05$), followed by regulatory needs ($r = .416$, $p < .05$), expressive needs ($r = .337$, $p < .05$), and education ( $r = .126$, $p < .05$).

There were positive, negative, and slightly no impact of the association between attitudes toward helmet use and functional needs. The typical impact of functional needs on attitudes toward helmet use is positive, when all other variables are at their respective means. The correlation was significant at the .05 level. Since the relationship between attitudes toward helmet use and functional needs was mostly positive and negative with only a few represented by a horizontal line showing no relationship, the first hypothesis was given substantial support. Although this hypothesis was supported, from a statistical point of view, the interaction effects between functional needs and the other variables compound the results, so you can't really state that the hypothesis was supported.

Hypothesis 2: Perceived importance of expressive needs for snowboarders would have an impact on attitudes towards snowboarding helmets, controlling for other needs (i.e., functional, aesthetic, and regulatory needs).

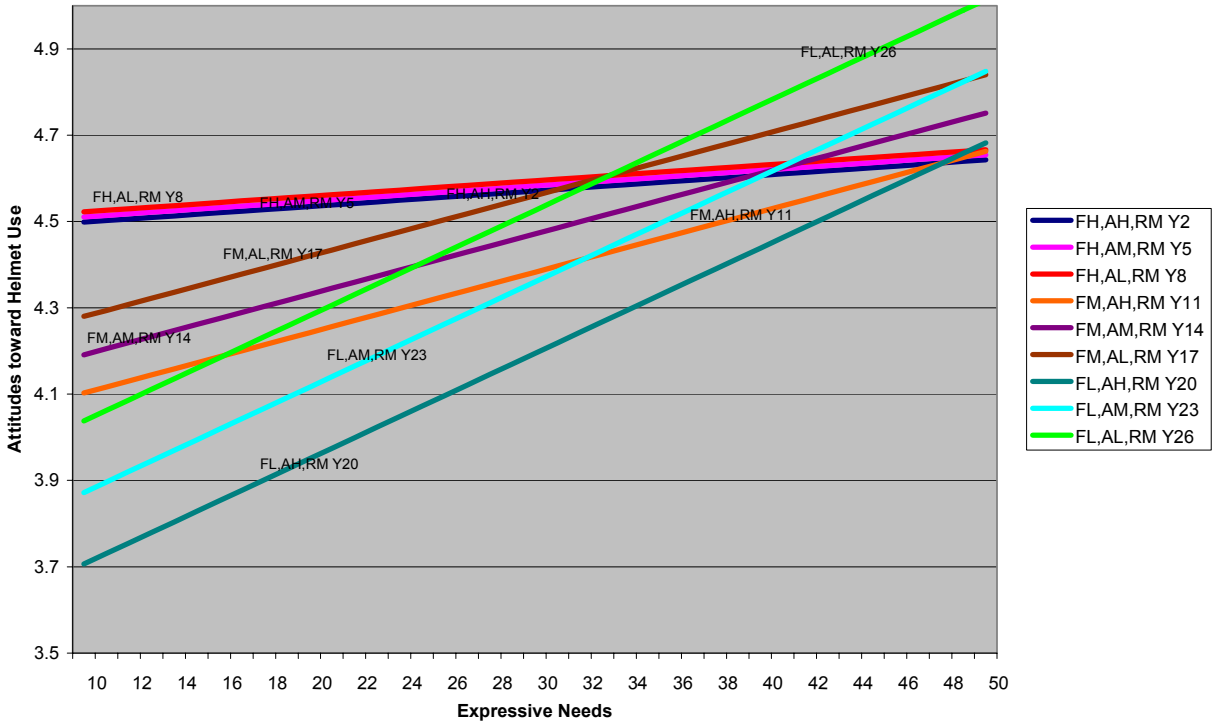
*The Impact of Expressive Needs on Attitudes toward Helmet Use When Regulatory Needs were at the Mean*

A typical pattern of the impact of expressive needs on attitudes toward helmet use when all functional, aesthetic, and regulatory needs were at their means is shown by the regression line Y14 (FM, AM, RM). The slope (.014) and the status of attitudes toward helmet use (intercept = 4.53) when $e = \bar{e} = 34.2$, is shown in Table 29. In general, all expressive needs impacts were positive (Figure 12).

There were three general patterns that the regression lines follow: 1) Y20 (FL, AH, RM), Y23 (FL, AM, RM), and Y26 (FL, AL, RM) represent strongly positive relationships; 2) Y11 (FM, AH, RM), Y14 (FM, AM, RM), and Y17 (FM, AL, RM) have positive relationships; and 3) Y8 (FH, AL, RM), Y5 (FH, AM, RM), and Y2 (FH, AH, RM) have slightly positive relationships. Each line in the group looked relatively parallel to the others.

Line Y20 started with the lowest impact of expressive needs on attitudes toward helmet use, but gradually increased, similar to Y23 and Y26. Among these strongly positive relationships, Y26 showed the highest impact on expressive needs after passing 34. On the other hand, Y8 initially revealed the highest impact of expressive needs on attitudes toward helmet use, but this impact showed little change, similar to lines Y5 and Y2. Regression line Y11 and Y17 were relatively parallel to Y14, which was the typical pattern of impact.

*Figure 12*. Impact of Expressive Needs on Attitudes toward Helmet Use When Regulatory Needs were at the Mean



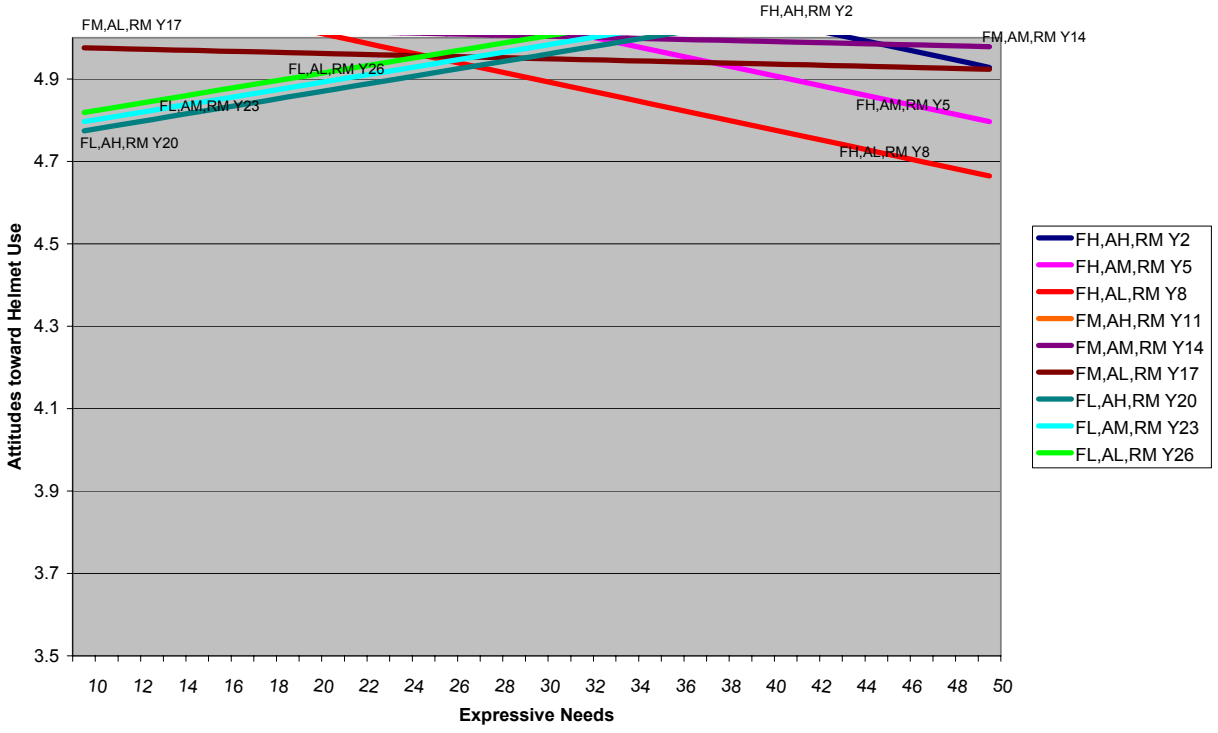

*The Impact of Expressive Needs on Attitudes toward Helmet Use*

*When Regulatory Needs were at One Standard Deviation above the Mean*

A typical pattern of expressive needs on attitudes toward helmet use when regulatory needs were at one standard deviation above the mean of helmet usage was found in the line of Y14 (FM, AM, RM). This typical pattern of impact seemed to be minimal, as represented by the nearly flat line in Figure 13. Minimal impact was also found in Y17 (FM, AL, RM). Because the status of attitudes was set between 3.5 and 5, Y11 (FM, AH, RM), which showed higher than

5 on attitude scores, was not included in the graph. There were also positive and negative relationships under this condition. LineY20 (FL, AH, RM) showed the lowest impact at the beginning, but continuously increased. This line was relatively parallel to Y23 (FL, AM, RM) and Y26 (FL, AL, RM), which had the second and third lowest impact, respectively. Three lines, Y8 (FH, AL, RM), Y5 (FH, AM, RM), and Y2 (FH, AH, RM), showed a negative relationship. In addition, there were multiple intersections under this condition.

*Figure 13.* Impact of Expressive Needs on Attitudes toward Helmet Use When Regulatory Needs were at One Standard Deviation above the Mean



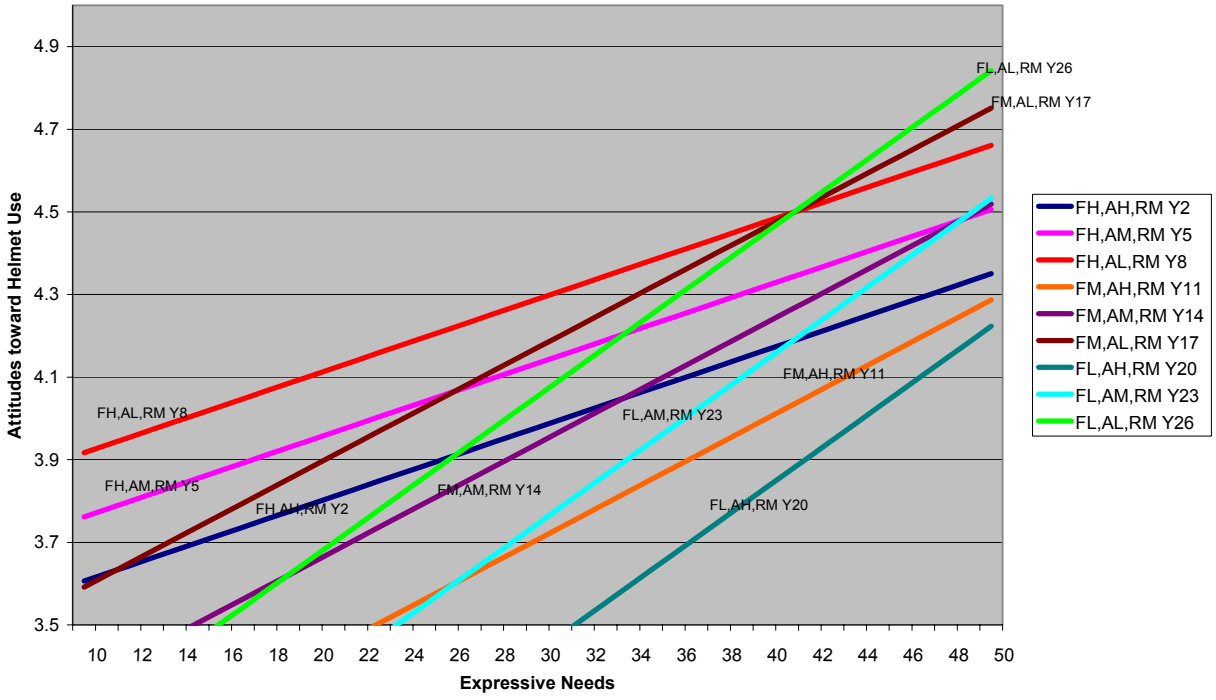
*The Impact of Expressive Needs on Attitudes toward Helmet Use*

*When Regulatory Needs were at One Standard Deviation below the Mean*

As displayed in Figure 14, a typical pattern of impact of expressive needs on attitudes toward helmet use when regulatory needs were at one standard deviation below the mean of helmet usage was found in Y14 (FM, AM, RM), which showed a positive relationship. In fact, all impacts of expressive needs on attitudes at one standard deviation below the mean of helmet usage were positive.

Within the positive relationships, three distinct patterns were identified. Line Y8 (FH, AL, RM), Y5 (FH, AM, RM) and Y2 (FH, AH, RM) were relatively parallel. Similarly, line Y23 (FL, AM, RM), Y20 (FL, AH, RM), and Y26 (FL, AL, RM) were parallel, with Y26 having the highest impact of expressive needs after crossing 41 on expressive needs. Regression line Y17 (FM, AH, RM) showed the second highest impact at the end, and was parallel to the typical line Y14, as well as Y11 (FM, AH, RM). Furthermore, most regression lines intersected, with the exception of Y20. Since there were multiple intersections under this condition, the change in impact among these regression lines was clearly captured in the graph. For example, Y2 initially showed higher impact than Y14, but the impact of Y14 was greater after 33 on expressive needs. A similar pattern of impact change was also seen in Y8, Y26 and Y17.

*Figure 14*. Impact of Expressive Needs on Attitudes toward Helmet Use When Regulatory Needs were at One Standard Deviation below the Mean




The second hypothesis of this study states that there is a relationship between attitudes toward helmet use and the perceived importance of expressive needs and finds a more positive relationship in general. Table 34 – II presents the correlation between attitudes toward helmet use and expressive needs. Expressive needs were correlated with the level of functional needs and helmet usage. In other words, the relationship between attitudes toward helmet use and expressive needs depends on the level of snowboarders' functional needs and helmet usage. There were positive and slightly negative associations between attitudes toward helmet use and expressive needs. The typical impact of expressive needs on attitudes toward helmet use was

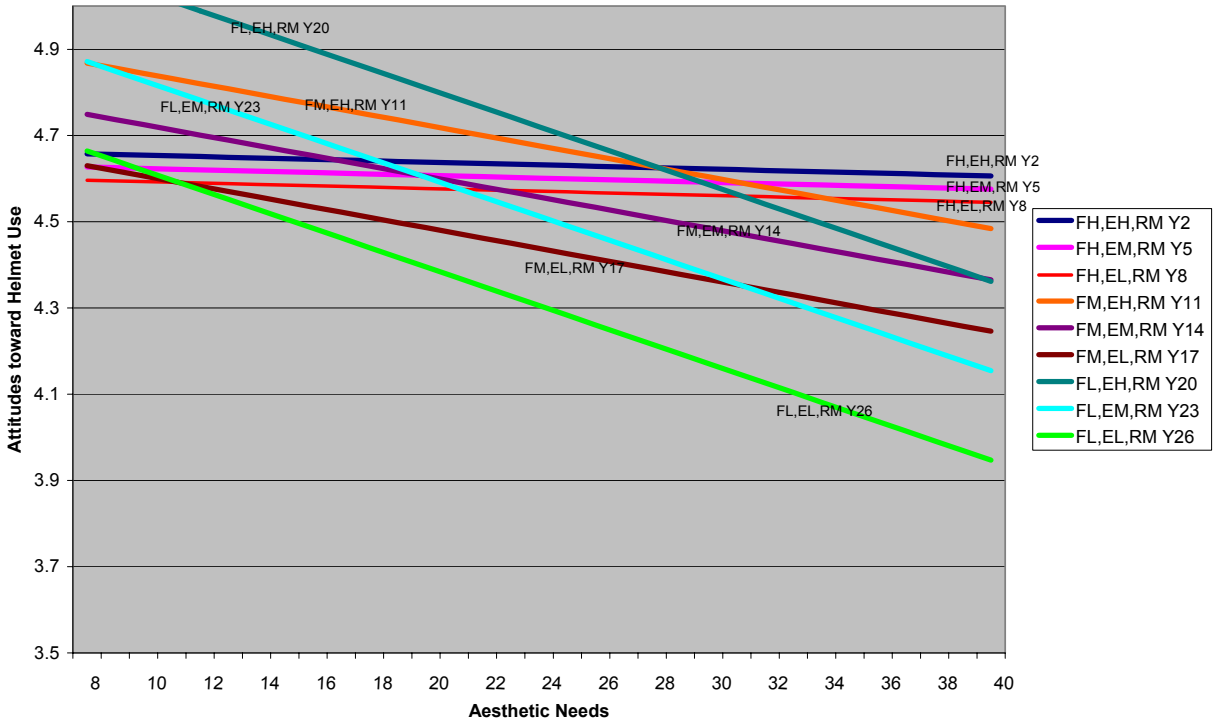
positive when all variables are at their respective means at a .05 significance level. Since the relationships between attitudes toward helmet use and expressive needs were primarily positive and only slightly negative directions, the second hypothesis was supported. However, the interaction effect between expressive needs and functional needs and helmet usage, from a statistical stand point, limits this proof.

Hypothesis 3: Perceived importance of aesthetic needs for snowboarders would have an impact on attitudes towards snowboarding helmets, controlling for other needs (i.e., functional, expressive, and regulatory needs).

*The Impact of Aesthetic Needs on Attitudes toward Helmet Use When Regulatory Needs were at the Mean*

In general, the impact of aesthetic needs on attitudes toward helmet use when regulatory needs were at the mean of helmet usage was a negative relationship, which is displayed in Figure 15. A typical pattern was shown in Y14 (FM, EM, RM), which had a negative slope (-.012) and a status of attitudes of 4.53 when $a_i = \bar{a}$ =26.2, as shown in Table 28. Lines Y17 (FM, EL, RM) and Y11 (FM, EH, RM) were parallel to Y14. Little impact was demonstrated in lines Y8 (FH, EL, RM), Y5 (FH, EM, RM) and Y2 (FH, EH, RM), which almost flat and ran parallel to each other; however, Y8 did have the lowest impact initially. Line Y20 (FL, EH, RM) showed the highest impact of aesthetic needs initially, but gradually declined. Regression lines Y23 (FL, EM, RM) and Y26 (FL, EM, RM) were parallel to Y20 (FL, EH, RM) and these three lines appeared to have strong negative relationships, with Y26 showing the lowest impact at the end.

*Figure 15.* Impact of Aesthetic Needs on Attitudes toward Helmet Use When Regulatory Needs were at the Mean



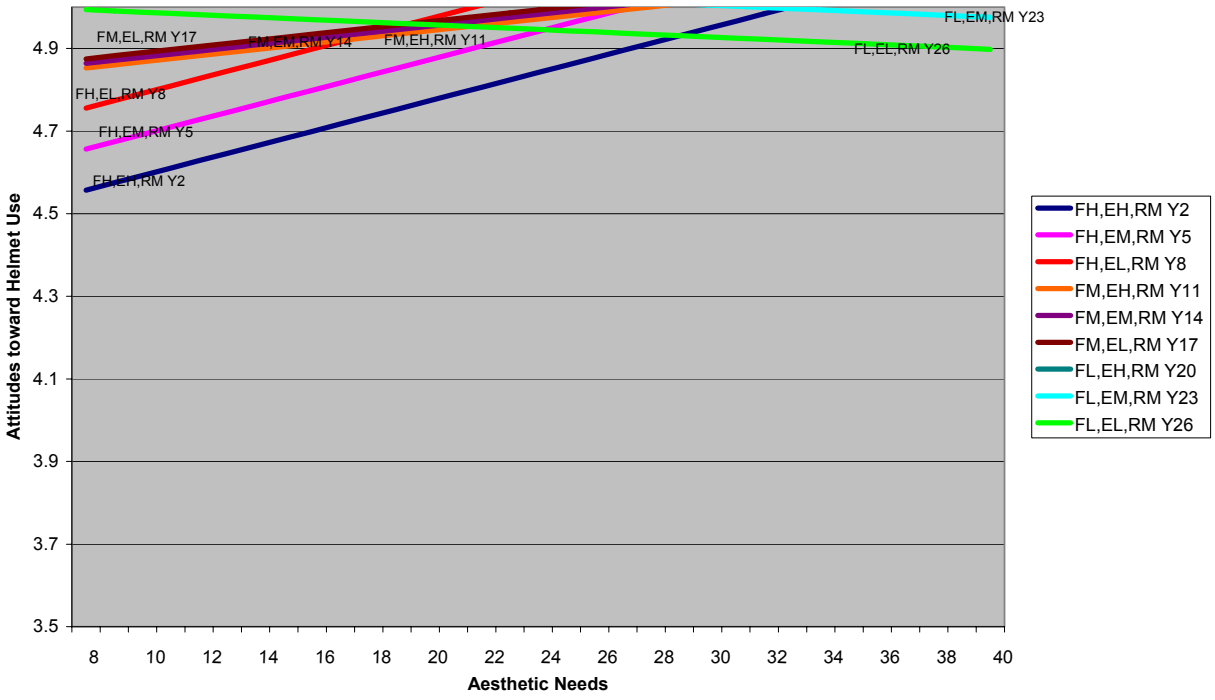

*The Impact of Aesthetic Needs on Attitudes toward Helmet Use*

*When Regulatory Needs were at One Standard Deviation above the Mean*

A typical pattern of the impact of aesthetic needs on attitudes toward helmet use when regulatory needs were at one standard deviation above the mean of helmet usage was a slightly positive relationship shown in the line Y14 (FM, EM, RM) when functional, expressive, and regulatory needs were at their means. This line appeared to overlap with Y11 (FM, EH, RM) and Y17 (FM, EL, RM).

Line Y2 (FH, EH, RM) started with the lowest impact of aesthetic needs and continuously increased, similar to parallel lines Y5 (FH, EM, RM) and Y8 (FH, EL, RM), which had the second and third lowest impact, respectively. Line Y26 (FL, EL, RM) was almost flat across aesthetic needs on the X axis, so six intersections were visualized; Y17 (FM, EL, RM), Y14 (FM, EM, RM), Y11 (FM, EH, RM), Y8 (FH, EL, RM), Y5 (FH, EM, RM), and Y2 (FH, EH, RM). The impact of Y20 (FL, EH, RM) is not visualized in the graph because attitudes toward helmet use were higher than 5.

*Figure 16.* Impact of Aesthetic Needs on Attitudes toward Helmet Use When Regulatory Needs were at One Standard Deviation above the Mean

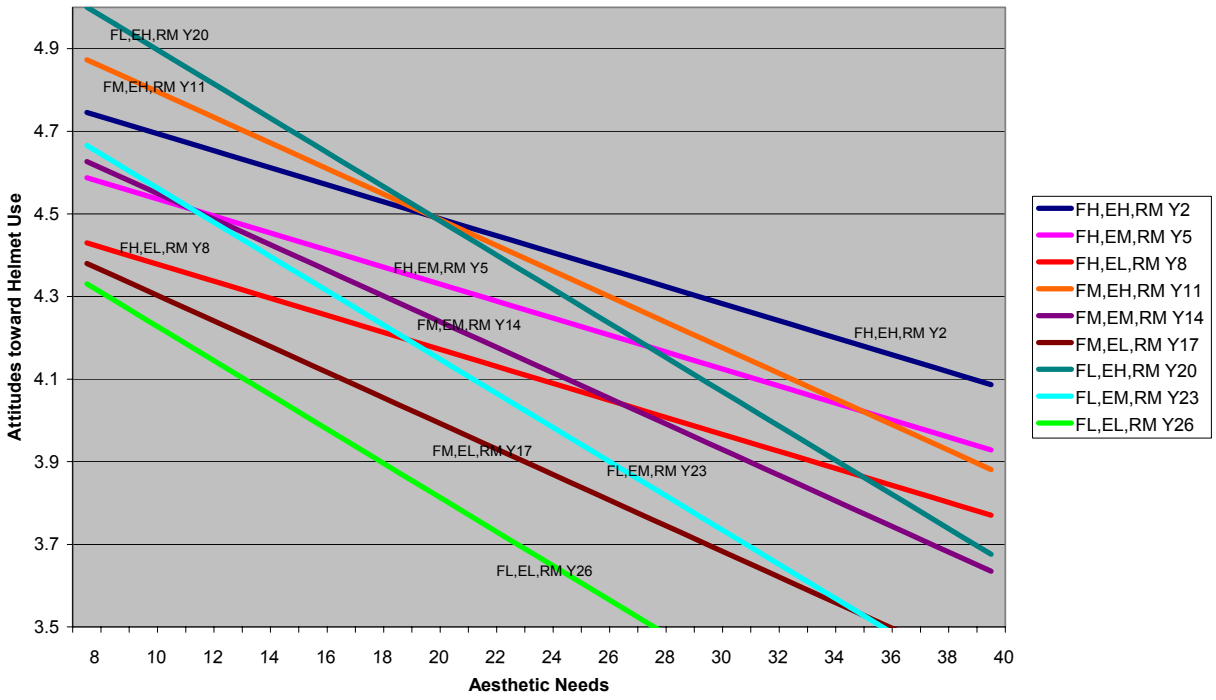


*The Impact of Aesthetic Needs on Attitudes toward Helmet Use*

*When Regulatory Needs were at One Standard Deviation below the Mean*

The general pattern of impact of aesthetic needs on attitudes when regulatory needs were at one standard deviation below the mean of helmet usage was all negative. A typical pattern of this impact was shown in line Y14 (FM, EM, RM). Among all of these negative relationships, Y26 (FL, EL, RM) had the lowest initial impact of aesthetic needs and strongly declined. There were three general patterns captured in this condition. First, the impact of Y26 was parallel to Y23 (FL, EM, RM) and Y20 (FL, EH, RM). Multiple intersections were also found under this condition. Line Y20 showed the highest impact on attitudes initially, but gradually came to have lower impact than Y11 (FM, EH, RM) and Y2 (FH, EH, RM) at crossing 21 on the X axis of aesthetic needs. Second, the regression line Y17 (FM, EL, RM) was parallel to Y14 and Y11. Finally, regression line Y8 (FH, EL, RM) was parallel to Y5 (FH, EM, RM) and Y2 (FH, EH, RM). Although Y2 started with the third highest impact of aesthetic needs, the impact became the highest after reaching 20 on the X axis of aesthetic needs.

*Figure 17.* Impact of Aesthetic Needs on Attitudes toward Helmet Use When Regulatory Needs were at One Standard Deviation below the Mean




The third hypothesis of this study states that there is a relationship between attitudes toward helmet use and the perceived importance of aesthetic needs and shows a more negative relationship than functional or expressive needs in general. Table 34 – II presents the correlation between attitudes toward helmet use and aesthetic needs. Aesthetic needs were correlated with the level of functional needs and helmet usage. Thus, the relationship between attitudes toward helmet use and aesthetic needs depends on the level of snowboarders' functional needs and helmet usage, similar to the relationship between attitudes toward helmet use and expressive

needs. There were positive and negative directions, as well as relatively little impact on the association between attitudes toward helmet use and aesthetic needs. Unlike functional or expressive needs, the typical impact of expressive needs on attitudes toward helmet use was negative when all variables are at their respective means with the significance level at .05. The relationship between attitudes toward helmet use and aesthetic needs was primarily negative, but positive and little impact on the association was also shown. Thus, the third hypothesis is given substantial support. Even though this hypothesis was substantially supported, from a statistical point of view, the interaction effect between aesthetic needs and the variables of functional needs and helmet usage limit the findings.

Hypothesis 4: Perceived importance of regulatory needs for snowboarders would have an impact on attitudes towards snowboarding helmets, controlling for other needs (i.e., functional, expressive, and aesthetic needs).

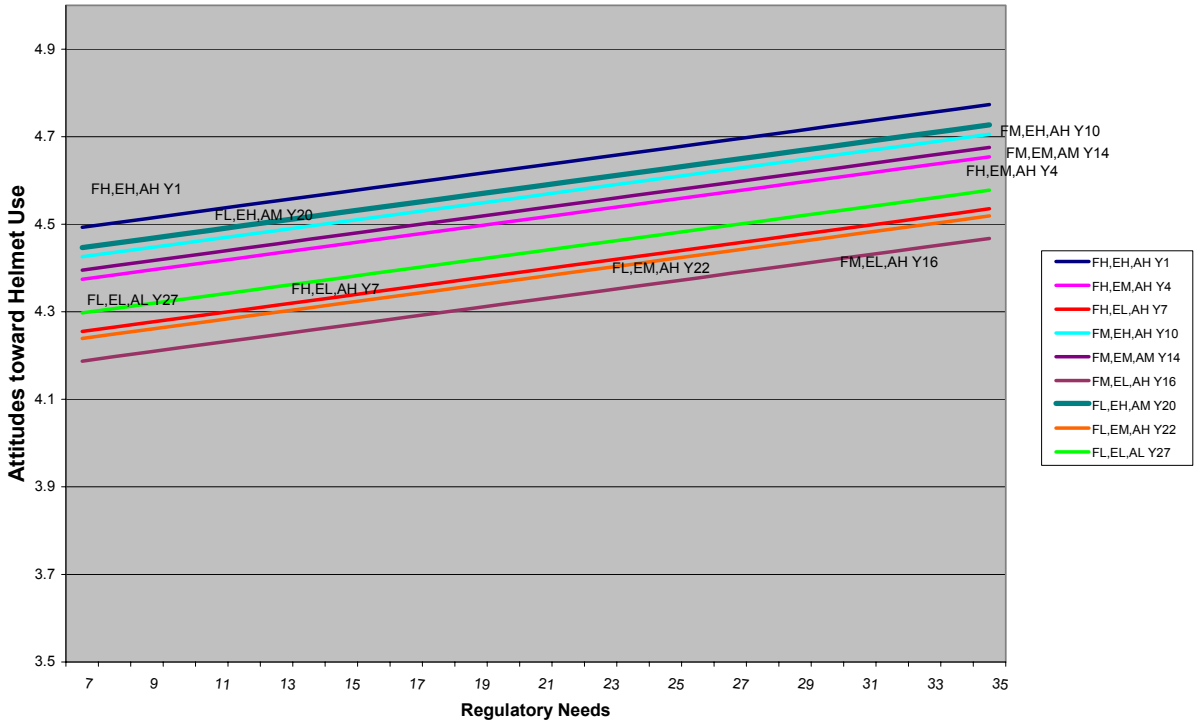
*The Impact of Regulatory Needs*

*on Attitudes toward Helmet Use were at the Mean*

Overall, the impact of regulatory needs at the mean of helmet usage showed positive relationships. The 27 lines that indicated the impact of regulatory needs were reduced to nine lines, which reflected the overall pattern. These lines were selected by taking an appropriate combination of 3 factors at higher (H), mean (M), and lower levels (L), and are displayed in Figure 17. A typical pattern is presented in Y14 (FM, EM, AM), showing a .010 slope and the status of attitudes toward helmet use (4.53) at $r_i = \bar{r} = 20.5$, as shown in Table 29.

Line Y16 (FM, EL, AH) showed the lowest impact, while Y1 (FH, EH, AH) revealed the highest impact of regulatory needs at the mean of helmet usage. All regression lines seemed to be parallel to each other. Among them, Y22 (FL, EM, AH) and Y7 (FH, EL, AH) looked closely parallel, and showed the second and third lowest impact, respectively.

*Figure 18.* Impact of Regulatory Needs on Attitudes toward Helmet Use were at the Mean

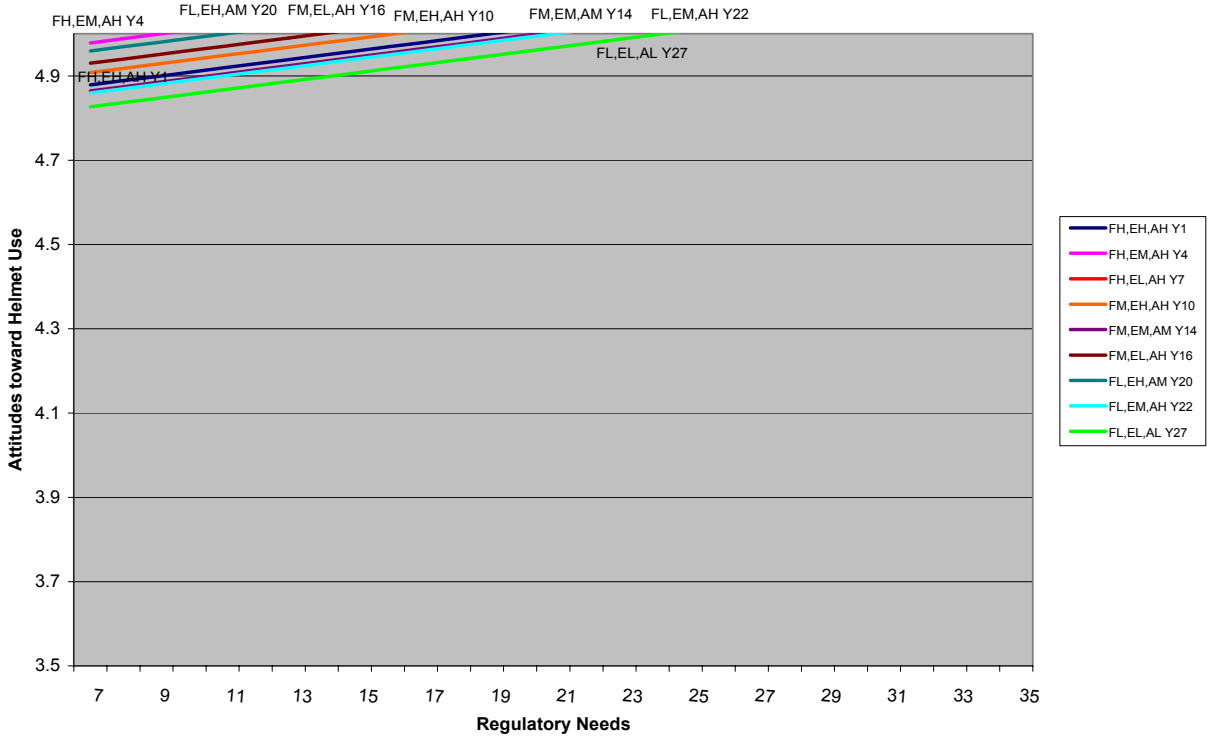


*The Impact of Regulatory Needs on Attitudes toward Helmet Use*

*were at One Standard Deviation above the Mean*

In general, the impact of regulatory needs on attitudes at one standard deviation above the mean of helmet usage showed only positive relationships, presented in Figure 19. A typical pattern shown in Y14 (FM, EM, RM) was very closely parallel to Y1 (FH, EH, AH) and Y22 (FL, EM, AH). Line Y7 (FH, EL, AH) was not represented in the graph because the impact of Y7 exceeded the maximum of 5 on status of attitudes. Line Y27 (FL, EL, AL) initially had the lowest impact of regulatory needs.

*Figure 19.* Impact of Regulatory Needs on Attitudes toward Helmet Use were at One Standard Deviation above the Mean

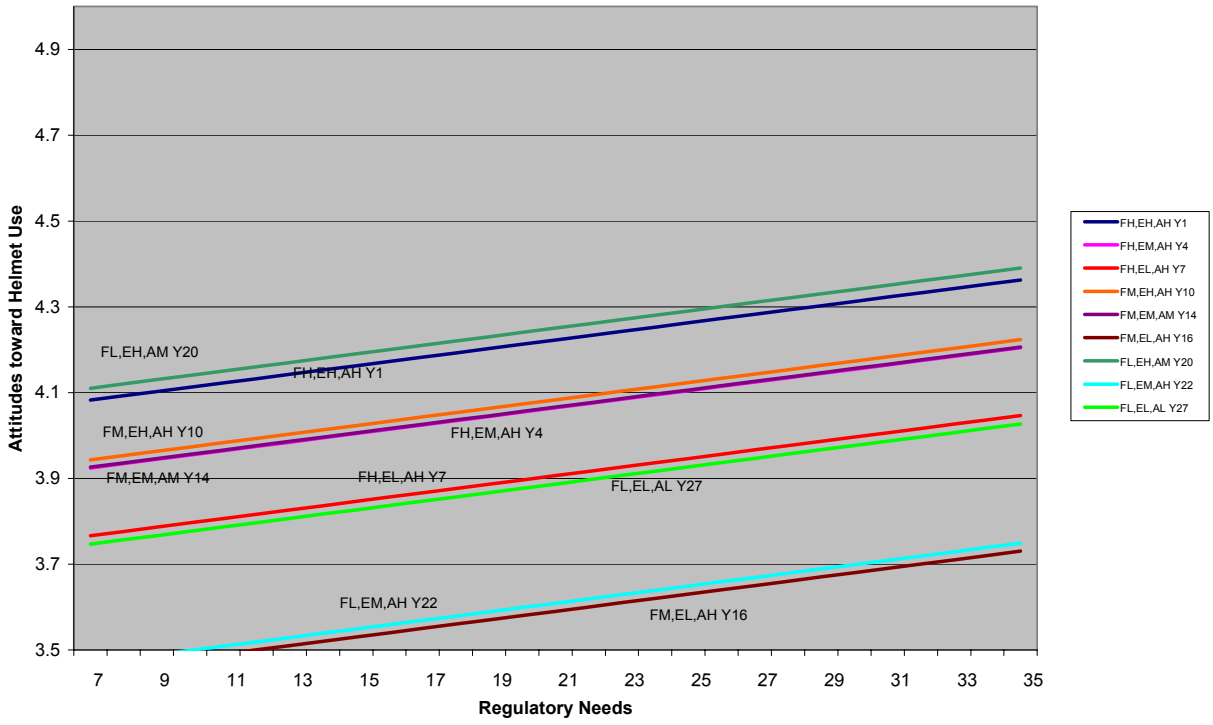


*The Impact of Regulatory Needs on Attitudes toward Helmet Use were at One Standard Deviation below the Mean*

All impact of regulatory needs on attitudes toward helmet use at one standard deviation below the mean of helmet usage also showed positive relationships (Figure 20).

A typical pattern, captured in Y14 (FM, EM, RM), appeared to completely overlap with Y4 (FH, EM, AH), indicating that these two regression lines indicate the same amount of impact. Line Y16 (FM, EL, AH) showed the lowest impact, while Y20 (FL, EH, AM) revealed the highest impact. In addition, these lines seemed to plot closely parallel by pairs. The pairs of Y22 (FL, EM, AH) and Y16 (FM, AL, AH) had the lowest impact of the group, while the pair of Y20 (FL, EH, AM) and Y1 (FH, EH, AH) had the highest impact of the group under this condition.

*Figure 20.* Impact of Regulatory Needs on Attitudes toward Helmet Use were at One Standard Deviation below the Mean




The fourth hypothesis of this study states that there is a relationship between attitudes toward helmet use and the perceived importance of regulatory needs. Table 34 – II presents the correlation between attitudes toward helmet use and regulatory needs. There was a relationship between attitudes toward helmet use and regulatory needs, but regulatory needs were not correlated with other variables (i.e., functional, expressive, aesthetic needs, and helmet usage). In this case, all outcomes of this analysis showed a positive relationship between attitudes toward helmet use and regulatory needs. The typical impact of regulatory needs on attitudes toward

helmet use was positive when all variables are at their respective means, with the significance level at .05. Since the relationships between attitudes toward helmet use and regulatory needs were all positive, the fourth hypothesis is fully supported. The results from the impact of FEAR needs on attitudes toward helmet use were summarized and presented in Table 35.

Table 35

*Summary of the Results from Hypotheses Tests*

| Hypotheses | Results |
|---|---|
| H1: Perceived importance of functional needs for snowboarders will have an impact on attitudes toward snowboarding helmets, controlling for other needs. | Yes, there is an impact, but it depends on the level of expressive needs, aesthetic needs, and helmet usage as a typical impact of functional needs on attitudes toward helmet use is positive (slope = .013) when all variables are at their respective means. |
| H2: Perceived importance of expressive needs for snowboarders will have an impact on attitudes toward snowboarding helmets, controlling for other needs. | Yes, there is an impact, but it depends on the level of functional needs and helmet usage as a typical impact of expressive needs on attitudes toward helmet use is positive (slope = .014) when all variables are at their respective means. |
| H3: Perceived importance of aesthetic needs for snowboarders will have an impact on attitudes toward snowboarding helmets, controlling for other needs. | Yes, there is an impact, but it depends on the level of functional needs and helmet usage as a typical impact of aesthetic needs on attitudes toward helmet use is negative (slope = -.012) when all variables are at their respective means. |
| H4: Perceived importance of regulatory needs for snowboarders will have an impact on attitudes toward snowboarding helmets, controlling for other needs. | Yes, there is an impact, but it does not depend on any others. The impact of regulatory needs on attitudes toward helmet use is positive, and the strength of association is .010. |

# CHAPTER 5

# SUMMARY, DISCUSSION, AND IMPLICATIONS

This study focused on the perceived importance of functional, expressive, aesthetic, and regulatory needs to understanding snowboarders' attitudes toward helmet use. This idea, theorized in the form of a conceptual framework, was proposed and tested statistically. This chapter presents a summary of the research, discussion of the findings and the hypotheses, and suggestions for future research.

## Summary of the Research

The purpose of this study was to identify the design characteristics and attitudes that impact the use of snowboarding helmets, and to test statistically a proposed conceptual framework for snowboarders' helmets, in the hope of contributing to the increased use of helmets for snowboarders. There were three major stages of this study. First, a conceptual framework was developed, adapted from an existing Functional-Expressive-Aesthetic (FEA) needs model with an additional regulatory (R) component added, to complete the new FEAR model. Secondly, questionnaires were developed to obtain data to test the framework. The questionnaire was modified from previous studies in the areas of functional design, attitudes toward helmets, and sport equipment. The questionnaire was tested to assess and improve the reliability and validity of the instrument. Content validity was addressed by creating tables of specifications for FEAR needs, ensuring that the domains of the FEAR factors matched the items in the content areas. Lastly, statistical analyses were utilized to test the relationships in the proposed framework, using multiple linear regressions to examine the hypotheses. Mean

differences were calculated for the FEAR needs using multiple comparisons to determine which means in a pair of FEAR needs were different from each other.

The assumption of this study was that attitudes toward snowboarding helmet use could be influenced by FEAR needs, especially for those who do not wear a helmet. Under this assumption, FEAR needs were considered as major factors to examine the impact of FEAR needs on attitudes toward helmet use. Therefore, this study statistically investigated the relationships between attitudes toward helmet use and the perceived importance of FEAR needs.

For data collection, the online survey website (survey monkey.com) was used as the survey vehicle. A pilot test was completed by 83 snowboarders of a southeast university in March, 2006 to test adequacy of questionnaire and to assess the feasibility of the survey, changes were made as necessary. The completed online survey was emailed to snowboarders in the United States of America Snowboarding Association (USASA) for a two week period from March 28th through April 11, 2006. In addition, an explanation of the study and a direct link to the survey website was posted on other snowboarding clubs sites for the same two week period. Two follow-up emails, reminding participants to complete the survey, were sent to the USASA email addresses.

Three hundred ninety-five participants completed the survey, but four under-age participants were eliminated. The final usable sample size was 391, with a 13.67% estimated response rate. This response rate is only an estimate, as email lists were only available for USASA snowboarding club members.

Based on the research framework, there were four proposed hypotheses to be tested. In addition to the four proposed hypotheses, descriptive statistics and multiple comparisons were used to examine the levels of the perceived importance of FEAR needs and attitudes toward

helmet use, explained as benefits that would affect the wearing of snowboarding helmets for respondents. The proposed hypotheses were analyzed using multiple linear regressions to see if each individual FEAR need would have an impact on attitudes toward helmet use, when controlling for the other needs. The levels of perceived importance of FEAR needs were analyzed by multiple comparisons to determine statistically significant mean differences between all pairs of the FEAR elements. Furthermore, the procedures of checking the univariate properties (e.g., descriptive statistics) and the bivariate relationships (e.g., correlation, crosstabs, mean differences, etc.) among variables were included to describe the data prior to testing the hypotheses.

## Findings and Discussion

The majority of respondents in this study can be described as male (72.2%), Caucasians (93.5%). This study had almost 28% female participants, over 3 times more than Anderson's 1999 study, which had 9% female participants. This result may indicate that women's participation in snowboarding is dramatically increasing, although snowboarding may be still viewed as a male dominated sport. In addition, ethnic affiliation is primarily Caucasian, similar to previous studies (Heino, 2000; Anderson, 1999).

The largest age group of respondents was between 18 and 25 years old (56.6%). Surprisingly, about 34% of the participants in this study were 36 and older, although previous studies did not mention this group of people in snowboarding. Approximately 68% of respondents had obtained at least some college or higher degree, contrasted by 32% of respondents whom have only acquired high school or less. Among this 32%, a number of the

respondents indicated they were students, so they may receive additional education, as the respondents were asked to indicate the highest level of education they have completed.

The largest group of respondents (52%) reported $75,000 or more for household income. Again in contrast, 26% of respondents reported income of $24,999 or less, demonstrating the disparity in age and educational attainment. One hundred sixty-one respondents indicated their employment status or occupation as general, 127 indicated they were students, 37 responded that they had snowboarding-related jobs, and 10 chose other as their occupation. Since a large number of respondents were between18 and 25 years of age, and 38% indicated they were students, the demographic information of the respondents in this study may be skewed.

Overall, there were 31 different locations of residence. The top 5 locations were Colorado, California, New York, Massachusetts, and Vermont, representing over 50% of the sample. There were two respondents from Canada. It appears that geographical and climatic conditions are important factors for snowboarding participation, as few or none of the respondents were from southern areas, such as Florida, Georgia, and Alabama.

Beyond the basic demographic information, respondents' participation in snowboarding, snowboarding helmet preferences, and shopping characteristics were investigated. The majority of respondents considered themselves as both competitive and recreational snowboarders. The length of participation in snowboarding for respondents in this study ranged from 3 months to 24 years. The most common length of time in snowboarding was between 6 and 10 years. Snowboarding participation per season ranged from 2 times to over 400 times, with the most common being around 100 times. Hourly participation per snowboarding visit ranged from 1 hour to over 150 hours. The most common visit was between 6 and 10 hours. Some respondents

noted that they liked to stay on the slope all day, only having an orange for lunch; indicating the enthusiasm of many snowboarders.

Although little information of helmet usage among the snowboarding population has been found, the use of helmets for respondents in this study seems to be fairly high (83.3%); thus, the sample population seems biased. This finding may be related to membership of the participants in a national snowboarding organization, USASA, and the fact that the organization sponsors competitions and requires helmet use for all competitors. Since the majority of USASA members who participated in this research tended to be more aware of the importance of helmet use, snowboarding helmet ownership ranked high, with 96.4% of respondents reporting that they own a helmet. In contrast, the majority (76.9%) of respondents in the pilot study were recreational snowboarders, with only 32.3% of the pilot study sample indicating they use a helmet, and only 43.1% indicating they own a helmet. Although the pilot study found that less than 10% of respondents had negative attitudes toward helmet use, the more recreational snowboarders retain negative attitudes toward helmets.

In addition, it appears that helmet use for safety should still be considered a primary issue for snowboarders; many of the respondents reported having experienced snowboarding-related accidents, including head injuries and concussions. Many reported that wearing a helmet saved their life and/or helped them not to have more extensive injuries. Some respondents indicated that even while wearing a helmet they experienced a concussion. In fact, respondents regarded protection and safety as two of the most important benefits of wearing a snowboarding helmet. They considered the helmet as protection to the head, as well as protection for the neck, jaw, mouth, and sunburn. It seems that helmets provide multifunctional benefits to users, as this study found a total 397 responses to the question of the benefits of wearing a helmet.

Participants in snowboarding, especially recreational snowboarders, should not be ignorant of helmet safety, regardless of their athletic ability or gender.

Snowboarding helmet preferences in terms of shopping places, brands, and helmet expenditures were assessed to understand shopping characteristics of participants. Snowboarding shops were the most preferred shopping place for respondents, followed by specialty stores, ski shops, etc. Nineteen respondents indicted no preferred shopping place for their snowboarding helmets, as they received free helmets from sponsors, friends, or families. Interestingly, seven respondents mentioned skateboard shops, due to the light weight of skateboarding helmets. Similar to female sailing garments researched by Bye and Hakala (2005), lighter weight tends to be one of the important components in meeting functional needs. The lighter weight of helmets enables snowboarders to enhance their snowboarding performance. However, it is necessary to note that the lighter weight should not reduce the quality of protection and safety for users. The interior design elements should be integrated with high performance to provide ultimate helmet quality to snowboarders.

In terms of preferred brands of snowboarding helmets, R.E.D (Riding Enhancement Device) was the most preferred helmet. However, some indicated no preferred brands; they just wanted a helmet that would meet their criteria for fit, price, style, and/or comfort. Furthermore, the preferred price to spend for helmets ranged from $0 to $350. The most common preferred helmet expenditure was between $50 and $100.

To examine the objective 1 and 2, paired-sample t-tests with the Bonferroni correction was used to obtain the results of multiple comparisons for comparing the level of the perceived importance of FEAR needs. Objective one was to compare the level of importance of design characteristics (functional-expressive-aesthetic [FEA] requirements) of snowboarding helmets,

as defined as user needs. All possible pair-wise comparisons for the items of FEA needs were compared and found that the majority of pairs showed statistically significant mean differences. Examining the perceptions and acceptance that snowboarders have concerning regulatory needs was the second study objective. Similarly, all possible pair-wise combinations of regulatory needs were compared and found that all means revealed statistically significant differences, except two pairs (i.e., education-mandatory in public ski resorts and federal laws-restriction for non-helmet users).

Based on the results of the multiple comparisons, goggles that are nicely integrated with helmets was the most important functional need for respondents. The mean of this item was significantly different from the other functional needs items (i.e., less bulky, convenience, protection, etc). This finding is similar to the findings of the pilot study; many snowboarders perceived that goggle / helmet integration was one of the most important functional needs. The highest mean score among the expressive needs was the willingness to mentor others. The mean of this item was significantly different from all other expressive needs items, with the exception of the expressive need that helmets should not make snowboarders look funny. Among aesthetics, the "styles" mean was the most highly ranked need, significantly different from all other aesthetic needs. Education was the most highly ranked regulatory need, similar to the findings of the pilot study. The education mean was significantly different from all other regulatory needs elements, except for the need stating that helmets should be mandatory in public ski resorts.

In addition, the mean differences between the perceived importances of overall FEAR needs were compared. The highest actual mean score among overall FEAR needs was functional needs, with statistically significant mean differences than overall aesthetic and overall regulatory

needs, but not from overall expressive needs. Since snowboarding is an intense snow activity, participants in snowboarding may have a tendency to perceive the importance of functional needs as more important than aesthetic or regulatory needs, similar to competitive sailors who addressed design characteristics such as safety, thermal balance, mobility, fit, and quality as categories of important functional needs (Bye & Hakala, 2005).

As the data suggests, functional and expressive needs are perceived as equally important snowboarding helmets. Expressive needs have been used by many researchers to identify the important association between objects (e.g., sports clothing) and the expression by the specific objects (Dickson & Pollack, 2000; Wheat & Dickson, 1999; Cassleman-Dickson & Damhorst, 1993; Lamb & Kallal, 1992). Some snowboarders may perceive the functional needs of helmets are met, so find equal importance in expressive needs, such as expressing symbolic messages of success and/or attractiveness.

To determine the perceived importance of attitudes toward snowboarding helmet use, which was objective 3, descriptive statistics (frequencies) were used. Results were used to verify the importance of overall attitudes toward helmet use. Approximately 89% of respondents had positive attitudes toward helmet use, determined as those who chose either "important" or "very important" on the overall attitude toward helmet use item on the instrument. In contrast to previous studies, including the pilot study, fairly high percentages of positive attitudes toward helmet use was unexpected. According to Liotta's (2004), approximately 10% of skiers and snowboarders wore a helmet in his study. The current study found very high positive attitudes toward helmet use, almost 8 times more than Liotta's study. This finding may be related to the high number of competitive snowboarders in this study.

In addition, to incorporate the theory of reasoned action (Ajzen & Fishbein, 1980) in the study, benefits that would affect snowboarders wearing a helmet were analyzed using descriptive statistics. Respondents indicated 361 design features they would like to see incorporated into helmets, largely divided into four themes: improving design elements, enhancing goggles, increasing technology, and improving interior designs. In particular, design features related to goggles including better fit, more comfortable strap holders, good width, and better integration with helmets were found as common issues in both the current and the pilot study.

Similar to Langran's study (2003), factors negatively influence some respondents not to wear or buy a helmet, including that they perceive that helmets are too expensive, uncomfortable, and/or don't provide appropriate fit. In terms of suitable fit for helmets, an increased variety of helmets with various sizes may be necessary to satisfy the number of diverse participants in snowboarding. Regardless of gender or age, fit and sizing issues appear to be common negative comments from respondents. One respondent described that he is frustrated with being unable to find an appropriate helmet size due to his oversized head. Similar to women's tennis wear (Chae, 2002), the appropriateness of sport clothing and/or equipment should provide sport participants with methods to enhance their performance.

This study found that there seems to be a gap between actual helmets in the current market and an ideal helmet desired by current snowboarders. Therefore, snowboarding helmets should be improved to meet the requirements of snowboarders; such as, better goggle integration with helmets, helping mentor others on the importance of helmet use, improved styles, and education on helmet safety. Further, understanding attitudes towards helmet use and identifying user needs, introduced by Bye and Hakala (2005), was useful for narrowing the gap between the actual and the ideal helmet preferred by snowboarders.

To evaluate the proposed FEAR conceptual framework, as outlined in objective 4, multiple linear regressions were used to analyze the relationships between attitudes toward helmet use and the perceived importance of FEAR needs in the four proposed hypotheses. Prior to running the multiple linear regressions, univariate descriptive statistics and bivariate relationships among the variables of interest, were computed and checked. To control for background information that might affect attitudes toward helmet use, the General Linear Model procedure was utilized by adjusting for covariates (i.e., age, education, gender, helmet ownership, participation experience, income, snowboarding-related accidents, and helmet usage). Throughout the process of checking main and interaction effects within the variables, the main effect of education and the interaction effect of helmet usage were identified and incorporated into the final model. Since the interaction effect of helmet usage with functional, expressive, and aesthetic needs existed, this interaction variable, which would change the relation between two original variables (attitudes toward helmet use and the perceived importance of FEAR needs), was added into the equation model to incorporate the combined effect of two variables (total scores of functional needs x helmet usage) on the dependent variable (attitudes toward helmet use). The relationship between attitudes toward helmet use and the perceived importance of FEAR needs might be moderated, depending on the level of helmet usage (e.g., always, sometime, rarely, etc). By reading the prediction equation (Equation 1) of the final model, the relationships between attitudes toward helmet use and FEAR needs could be predicted. The interaction effects were found between functional needs and expressive needs, between functional needs and aesthetic needs, between functional needs and helmet usage, between expressive needs and helmet usage, and between aesthetic needs and helmet usage. Thus, a) there is a linear relationship between attitudes toward helmet use and functional needs, but this

linear relationship depends on the level of expressive needs and aesthetic needs as well as helmet usage; b) there is a linear relationship between attitudes toward helmet use and expressive needs, but this linear relationship depends on the level of functional needs and helmet usage; c) there is a linear relationship between attitudes toward helmet use and aesthetic needs, but this linear relationship depends on the level of functional needs and helmet usage, and d) there is a linear relationship between attitudes toward helmet use and regulatory needs, but this is directly associated and is not dependent on any other variables. Based on these relationships, the new conceptual framework for FEAR needs was illustrated and is included in Appendix O.

Hypothesis 1 was concerned with the relationships between attitudes toward helmet use and the perceived importance of functional needs for snowboarders. The results showed both positive and negative relationships between attitudes toward helmet use and the perceived importance of functional needs, depending on a combination of values of other variables. Those respondents who had lower attitudes toward helmet usage tended to perceive higher importance of functional needs, as presented in the positive slope of the regression line. A slightly negative slope was also found, indicating that those with higher attitudes toward helmet use seemed to perceive lower importance of functional needs. Both the positive and negative regression slope can be explained by the interaction effect; the relationships between attitudes toward helmet use and functional needs would be dependent on the level of expressive needs, aesthetic needs, and helmet usage. In other words, respondents' attitudes toward helmet use could be expected, based on their perceived importance of functional needs and depending on their level of perceived importance of expressive needs, aesthetic needs, and helmet usage.

Negative attitudes toward helmet use were anticipated in this study, as suggested by Langran's (2003) research, but were expected to show the positive relationship between attitudes

toward helmet use and the perceived importance of functional needs. Most respondents in this study revealed fairly positive attitudes toward helmet use, but the positive relationship between their attitudes toward helmet use and the perceived importance of functional needs was supported. The negative relationship between attitudes toward helmet use and the perceived importance of functional needs was not anticipated in this study, as previous research had not indicated positive attitudes toward helmet use among snowboarders. Again, both the positive and negative relationships between attitudes toward helmet use and the perceived importance of functional needs among respondents that were identified would be dependent on their level of expressive needs, aesthetic needs, and helmet usage.

Hypothesis 2 was concerned with the relationships between attitudes toward helmet use and the perceived importance of expressive needs for snowboarders. The results showed both positive and negative relationships, similar to Hypotheses 1 on functional needs. This study also found that expressive needs interacted with the level of functional needs and helmet usage. Thus, respondents' attitudes toward helmet use could be expected by their perceived importance of expressive needs, depending on their level of functional needs and helmet usage. The impact of expressive needs on attitudes toward helmet use was positive (slope = .014) when functional, aesthetic, and regulatory needs were at their respective means; those who showed lower attitudes toward helmet use tended to perceive more importance of expressive needs. The positive relationship between attitudes toward helmet use and the perceived importance of expressive needs was supported by previous studies relevant to sports clothing (Chae, 2002; Dickson & Pollack, 2000; Wheat & Dickson, 1999). According to Dickson and Pollack (2000), the individual who was more committed to the sport tended to purchase specialized sport clothing. Based on this concept, this study assumed that enthusiastic snowboarders would be interested in

buying an appropriate helmet so that they could identify themselves as a snowboarder and provide other expressive messages. Also, Wheat and Dickson (1999) indicated that inappropriate sport uniforms caused wearer dissatisfaction. Therefore, this study assumed that snowboarders who might be dissatisfied with their helmets would perceive more importance in expressive needs. The positive relationship between attitudes toward helmet use and the perceived importance of expressive needs was supported by this assumption. Surprisingly, a negative relationship between attitudes toward helmet use and expressive needs was also found, which was not indicated in previous studies (Chae, 2002; Dickson & Pollack, 2000; Wheat & Dickson, 1999). Regardless of the positive or negative relationships, the respondents' attitudes toward helmet use would be influenced by their perceived importance of expressive needs, mitigated by the interaction between expressive needs and two other factors (i.e., functional needs and helmet usage).

Hypothesis 3 was concerned with the relationships between attitudes toward helmet use and the perceived importance of aesthetic needs for snowboarders. Although the results found both positive and negative relationships, similar to functional and expressive needs, primarily the impact of aesthetic needs on attitudes toward helmet use was negative (slope = -.012) when functional, expressive, and regulatory needs were at their respective means; those who indicated higher attitudes toward helmet use appeared to perceive less importance of aesthetic needs. Referring to the positive relationship, those who showed lower attitudes toward helmet use tended to perceive more importance of aesthetic needs. Since aesthetic needs also had interaction with the level of functional needs and helmet usage, the positive and negative relationships would depend on the level of functional needs and helmet usage for respondents.

Although this study found primarily negative relationships, a positive relationship between attitudes toward helmet use and the perceived importance of aesthetic needs was found by previous studies. Roach-Higgins and Eicher (1992) indicated an element of dress, such as color or shape, would better help the identity of the individual rather than a whole outfit. Based on their research, this study assumed that aesthetic needs, such as style, color, uniqueness of helmets, etc, would be important in determining the level of their attitudes toward helmet use. Also, Dickson and Pollack (2000) indicated that female in-line skaters tended to show more interest in having a unique in-line skating appearance to enhance their overall performance. This study assumed that those who perceived more importance in aesthetic needs would show higher attitudes toward helmet use, similar to Dickson and Pollack's study. However, the gender ratio (male: female = 7:3) was male dominated. Due to the majority of snowboarders in this study being male, the negative relationships might be explained that males seem to be less sensitive than females to fashion perspectives, such as styles, colors, etc. A positive relationship was also found, but only for those who were at one standard deviation above the mean for helmet usage. Those respondents indicated higher attitudes toward helmet use and seemed not to perceive the importance of aesthetic needs for their snowboarding helmets.

Hypothesis 4 was concerned with the relationships between attitudes toward helmet use and the perceived importance of regulatory needs for snowboarders. The results showed only positive relationships. Respondents who indicated lower attitudes toward helmet use tended to perceive more importance of regulatory needs. Since there were no interaction effects between regulatory needs and other independent variables, including the covariate (i.e., helmet usage), there was only single association between attitudes and regulatory needs, which was not influenced by any others. Therefore, respondents' attitudes toward helmet use could be expected

by their perceived importance of only regulatory needs. The impact of regulatory needs was positive, and the strength of association between attitudes toward helmet use and regulatory needs was .010. Regulatory needs was an additional component in this study, included to examine the relationship between attitudes toward helmet use and the perceived importance of regulatory needs, as no safety standards or state laws were included in most previous studies (Hagel et al., 1999; Josefson, 1998; McDonah, 2000; U.S. Consumer Product Safety Commission, 1999). Referring to the positive relationship between attitudes toward helmet use for snowboarders, this study would expect that respondents tended to perceive the importance of regulatory needs. Among regulatory needs, respondents perceived that education of regulatory needs for helmet use was equal to the importance of helmet use being mandatory in public ski resorts. Due to the fact that the majority of respondents belong to a professional snowboarding organization, where helmets are required for competitions, the majority of respondents tended to show fairly positive attitudes toward helmet use, and therefore may not perceive the importance of federal laws for helmet usage. Regardless, the respondents believed that helmet safety education would be the most important contribution to the increase helmet usage among non-helmet users.

Although the possibly biased sample may not generalize to other populations, the findings of this study would imply that the perceived importance of FEAR needs would be essential to determine the level of their overall attitudes toward helmet use. The FEA consumer needs model was very useful in identifying important factors to meet the needs of snowboarding helmets. Although not much information about regulatory needs was available for this study, snowboarders appeared to perceive the importance of improving regulatory needs, regardless of competitive or recreational participation in snowboarding. Based on information obtained from

respondents in this study, the application of a FEAR needs assessment of snowboarding helmets would potentially help to increase helmet usage, which would have an additional potential of enhancing their overall performance. In other words, the improvement of helmet functionality, expressive qualities, aesthetic attributes and regulatory needs would provide a more enjoyable snow activity to participants. Thus, the conceptual framework of the perceived importance of FEAR needs would be acceptable to understand the attitudes toward helmet use among snowboarders.

## Recommendations

The following suggestions are for manufacturers and retailers of snowboarding helmets.

1. Designers and manufacturers need to provide snowboarding helmets that integrate better with goggles.
2. Manufacturers and designers need to improve assessment of snowboarding helmets to meet the needs and wants of current snowboarders.
3. Researchers and manufacturers need to improve their helmet safety education through better informative materials, such as magazines, televisions, radios, internet, etc.
4. Retailers need to offer wider styles and price ranges to snowboarding customers.
5. Manufacturers and designers of snowboarding helmets need to improve their analysis of head types and sizes for non-averaged people who have had frustrations with selecting helmets in the current market.

## Suggestions for Future Study

Based on the results and implications of the study, the following suggestions are presented for future research:

1. This study should be replicated and expanded using a random sample; for example, using all potential participants in snowboarding to improve generalizability and validity.
2. Prototype development based on the significant factors identified in this study.
3. Further investigation of the needs for snowboarders with various protective devices (e.g., wrist guards, knee pads, padded shorts, etc) and /or clothing to enhance snowboarders performance, as well as prevent from the higher injury risk.
4. Investigation of minors participating in snowboarding to examine the needs of their snowboarding equipments and clothing.
5. Gender differences among participants in snowboarding, in order to enhance the characteristics and differences between male and female snowboarders.
6. Future investigation could focus on snowboarders that typically do not choose to wear helmets, or related to what kind of snowboarding they do.
7. The improvement of methodology to collect data. To avoid common method variance, future research may combine a mixed methodology of both qualitative and quantitative approaches, such as personal or focus group interviews, direct observations, etc.
8. The development of scales for the dependent variable with multiple items.
9. Future studies could use ordinal regression (Long, 1977) to see if there are changes in the results as compared to the current research, which used linear regression.
10. The application of this model could be used for research in other sports.

11. Differentiated marketing strategies should be merged with helmet safety education for snowboarders, especially, non-users.

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APPEDINX A

Human Subject Approval

(IRB Exempt Approval)

VirginiaTech

**Office of Research Compliance**
1880 Pratt Drive (0497)
Blacksburg, Virginia 24061
540/231-4358 Fax: 540/231-0959
E-mail: ctgreen@vt.edu
*www.irb.vt.edu*

FWA00000572( expires 7/20/07)
IRB # is IRB00000667.

DATE: March 3, 2006

MEMORANDUM

TO: Sherryl A. Schofield-Tomschin
Myung-Hee Chae

FROM: Carmen Green

SUBJECT: **IRB Exempt Approval:** "Perceived Functional, Expressive, Aesthetic, and Regulatory Needs of Snowboarding Helmets" , IRB # 06-133

I have reviewed your request to the IRB for exemption for the above referenced project. I concur that the research falls within the exempt status. Approval is granted effective as of March 3, 2006.

As an investigator of human subjects, your responsibilities include the following:

1. Report promptly proposed changes in previously approved human subject research activities to the IRB, including changes to your study forms, procedures and investigators, regardless of how minor. The proposed changes must not be initiated without IRB review and approval, except where necessary to eliminate apparent immediate hazards to the subjects.

2. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

cc: File
Department Reviewer:Marjorie J. Norton

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APPENDIX B

Copyright Permission from International Textile and Apparel Association (ITAA)

October 3, 2006

1720 Patrick Henry Dr. #17
Blacksburg, VA 24060

Dear Myung-Hee Chae:

**In response to the following:**

I am writing to request, on behalf of International Textile and Apparel Association (ITAA) at Monument, Colorado – copyright permission pertaining to the items listed on Clothing and Textiles Research Journal, 10 (2) of 42-47 pages. Our aim is to provide you permission for two diagram features of functional, expressive, and aesthetic (FEA) consumer needs model, developed by Lamb and Kallal (1992), for current research. As we understand, the theoretical framework of your dissertation is adopted from the FEA model.

**Permission Granted**: Sandra S. Hutton, Executive Director, 10/03/2006

Credit must accompany model:

**Reprinted from the Clothing & Textiles Research Journal by permission of the International Textile and Apparel Association.**

# APPENDIX C

Paper Version of Survey

Questionnaires

**I. Rate the following** Functional Needs **are Important to You that Purchasing and/or Wearing a Snowboarding Helmet.**

Please click in the appropriate box of the score for each question on the scale.

| Questions | 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|---|
| 1. The comfort of snowboarding helmets should be improved. | | | | | |
| 2. The fit of snowboarding helmets should be improved. | | | | | |
| 3. The protection of snowboarding helmets should be improved. | | | | | |
| 4. The ventilation quality (be able to feel cool) of snowboarding helmets should be improved. | | | | | |
| 5. The insulation quality (be able to feel warm) of snowboarding helmet should be improved. | | | | | |
| 6. The price of snowboarding helmets should match the performance level of helmets. | | | | | |
| 7. A snowboarding helmet interacted with goggles should not impair my vision. | | | | | |
| 8. A snowboarding helmet should not be bulky. | | | | | |
| 9. A snowboarding helmet should be convenient to wear and transport. | | | | | |
| 10. Overall, the functional needs of snowboarding helmets are important to me and should be improved. | | | | | |

**II. Rate the following** Expressive Needs **are Important to You that Purchasing and/or Wearing a Snowboarding Helmet.**

Please click in the appropriate box of the score for each question on the scale.

| Questions | 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|---|
| 1. Wearing a helmet helps me see myself as a competitive snowboarder. | | | | | |
| 2. A snowboarding helmet should not distract from professionalism. | | | | | |
| 3. A snowboarding helmet should not distract from toughness/aggressiveness. | | | | | |
| 4. Wearing a snowboarding helmet should not make me look funny. | | | | | |
| 5. Wearing a snowboarding helmet helps me convey my athletic identity as a snowboarder. | | | | | |
| 6. A snowboarding helmet helps me perform an appropriate role (either masculine or feminine). | | | | | |
| 7. Wearing a helmet helps with my self-image as a confident snowboarder. | | | | | |
| 8. Wearing a helmet is important for my commitment to snowboarding. | | | | | |
| 9. I am willing to play an important role of conveying the importance of helmet use to other snowboarders. | | | | | |
| 10. Overall, the expressive needs of snowboarding helmets should be improved to increase helmet usage among snowboarders. | | | | | |

**III. Rate the following** Aesthetic **Needs are Important to You that Purchasing and/or Wearing a Snowboarding Helmet.**

Please click in the appropriate box of the score for each question on the scale.

| Questions | 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|---|
| 1. The color of snowboarding helmets should be improved. | | | | | |
| 2. The style of snowboarding helmets should be improved. | | | | | |
| 3. The texture of snowboarding helmets should be improved. | | | | | |
| 4. The uniqueness of snowboarding helmets should be improved. | | | | | |
| 5. A unique design feature should be added to make snowboarding helmets unique to other sport helmets. | | | | | |
| 6. The sleekness of a snowboarding helmet should be improved. | | | | | |
| 7. Masculine vs feminine designs of snowboarding helmets should be improved. | | | | | |
| 8. Overall, the aesthetic needs of snowboarding helmets should be improved. | | | | | |

**IV. Rate the following** Regulatory Needs **are Important to You that Purchasing and/or Wearing a Snowboarding Helmet.**

Please click in the appropriate box of the score for each question on the scale.

| Questions | 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|---|
| 1. Snowboarding helmet use should be mandatory for all snowboarders while participating in snowboarding in public ski resorts. | | | | | |
| 2. Snowboarding helmet use should be mandatory for all snowboarders while participating in snowboarding at any time and at any place. | | | | | |
| 3. The federal government should require that states enact helmet use laws for all snowboarders. | | | | | |
| 4. Education of regulatory needs for helmet use should be improved. | | | | | |
| 5. Violations for not wearing a snowboarding helmet should be fined. | | | | | |
| 6. Non-helmet users on the mountain should be restricted. | | | | | |
| 7. Overall, the regulatory needs of snowboarding helmets should be seriously considered to increase helmet use for all snowboarders. | | | | | |

**V. Attitude toward Helmet Use**

Please click in the appropriate box of the score for the question on the scale.

| Question | 1. Strongly Negative | 2. Negative | 3. Neutral | 4. Positive | 5. Strongly Positive |
|---|---|---|---|---|---|
| What is your overall attitude toward wearing a helmet when snowboarding? | | | | | |

VII. General Questions.

1. Do you snowboard competitively or recreationally?
Competitively _____Recreationally _____ Both _____

2. How long have you been snowboarding? _____Years ___Months

3. Approximately how often do you go snowboarding in a snowboarding season?
_____Times

4. Approximately how many hours do you ride a snowboard when you visit the slope?
_____Hours

5. Do you own a snowboarding helmet? Yes _____ No_____
If not, please specify why not? _____
_____
_____

6. How often do you wear a snowboarding helmet while riding a snowboard?

1) Always 2) Very often 3) Sometimes 4) Rarely 5) Never

7. Where do you shop for snowboarding helmets? _____

8. Do you have a preferred brand name of snowboarding helmet?
_____

9. How much would you be willing to spend for a snowboarding helmet?_____

10. Have you ever had an accident on a snowboarding ride?
_____ Yes _____No
If yes, what types of injuries have you experienced? _____
Did you wear a helmet at that time?_____Yes _____No

11. What do you see as the benefits of wearing a snowboarding helmet?
_____
_____
_____
_____

12. If you would like snowboarding helmets to be unique to other helmets, what features would you like to see? _____
_____
_____
_____
_____

13. What is your gender? Male _____ Female_____
14. How old are you?
    1) 18-25
    2) 26-35
    3) 36-45
    4) 45 and older

15. What is your race or ethnic group?
    1) Caucasian
    2) African-American
    3) Hispanic
    4) Asian
    5) Native-American
    6) Other

15. Where do you live? City/Town _____ State _____

16. Are you employed? Yes _____ No_____
    If yes, please specify your occupation._____

17. What is the highest level of education that you have completed?
    1) Less than high school
    2) High school
    3) Some college
    4) Bachelor's degree
    5) Some graduate work
    6) Graduate or professional degree

18. What was your total household income before taxes in the past year?
    1) Less than $10.000
    2) $10.000 to $24.999
    3) $25.000 to $ 49.999
    4) $50.000 to $74.999
    5) $75.000 and over (Please specify _____ )

APEENDIX D

Online Version of Survey

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**Perceived Functional-Expressive-Aesthetic-Regulatory Needs for Snowboarding Helmets**

## 1. Informed Consent

Dear Fellow Snowboarders,

The study is being conducted by May (Myung-Hee) Chae who is a Ph.D candidate and Sherry Schofield Tomschin, her major advisor at Virginia Polytechnic Institute and State University in Blacksburg, Virginia. We are conducting research on perceived functional, expressive, aesthetic, and regulatory needs for snowboarding helmets. The PURPOSE of this research is to identify the DESIGN CHARACTERISTICS and ATTITUDES that IMPACT the USE of SNOWBOARDING HELMETS. This study is important as it will help professionals understand snowboarders' attitudes toward helmet use, and will contribute to increased helmet usage among snowboarders. Previous research has indicated that although helmet use could prevent or reduce injuries, helmet use is infrequent in the snowboarding community.

You (over 18 years old) are being asked to voluntarily participate in an online survey. Once you click on this website, you will be taken directly to the survey, which should take approximately 15 minutes to complete.

Let me assure you of complete confidentiality. The information gathered from this study will be only used for research purposes. Your e-mail address will never be distributed for any other purpose. Responses to the survey will remain anonymous. Completion of the survey will be considered your consent to participate in the study.

As a small token of appreciation for assisting with our research, each participant will be entered in a drawing for INCENTIVES.

Thank you very much for your time and help. It's only with your generous help that my research can be successful. If you have any questions, please contact Myung-Hee Chae at chae@vt.edu / 540-230-8674 or my major advisor, Dr. Sherry Schofield-Tomschin at sherryst@vt.edu / 540-231-6282.

Sincerely,

May Chae
Ph.D Candidate in Clothing and Textiles
Apparel, Housing, and Resource Management
Virginia Tech

**Next >>**

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## Perceived Functional-Expressive-Aesthetic-Regulatory Needs for Snowboarding Helmets

### 2. Perceived Functional Needs

I. Rate the following Functional Needs are Important to You that Purchasing and/or Wearing a Snowboarding Helmet.
Please click in the appropriate box of the score for each question on the scale.

*** 1. The comfort of snowboarding helmets should be improved.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 2. The fit of snowboarding helmets should be improved.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 3. The protection of snowboarding helmets should be improved.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 4. The ventilation quality (be able to feel cool) of snowboarding helmets should be improved.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 5. The insulation quality (be able to feel warm) of snowboarding helmet should be improved.**

| 1. Not important at | 2. Hardly | 3. Neutral | 4. Important | 5. Very |
|---|---|---|---|---|

Perceived Functional-Expressive-Aesthetic-Regulatory Needs for Snowboarding Helmets - Mozilla Firefox

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## Perceived Functional-Expressive-Aesthetic-Regulatory Needs for Snowboarding Helmets

### 3. Percieved Expressive Needs

II. Rate the following Expressive Needs are Important to You that Purchasing and/or Wearing a Snowboarding Helmet.
Please click in the appropriate box of the score for each question on the scale.

*** 11. Wearing a helmet helps me see myself as a competitive snowboarder.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 12. A snowboarding helmet should not distract from professionalism.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 13. A snowboarding helmet should not distract from toughness/aggressiveness.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 14. Wearing a snowboarding helmet should not make me look funny.**

| 1. Not important at | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|

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## Perceived Functional-Expressive-Aesthetic-Regulatory Needs for Snowboarding Helmets

### 3. Percieved Expressive Needs

II. Rate the following Expressive Needs are Important to You that Purchasing and/or Wearing a Snowboarding Helmet.
Please click in the appropriate box of the score for each question on the scale.

*** 11. Wearing a helmet helps me see myself as a competitive snowboarder.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 12. A snowboarding helmet should not distract from professionalism.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 13. A snowboarding helmet should not distract from toughness/aggressiveness.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 14. Wearing a snowboarding helmet should not make me look funny.**

| 1. Not important at | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|

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## Perceived Functional-Expressive-Aesthetic-Regulatory Needs for Snowboarding Helmets

### 4. Perceived Aesthetic Needs

III. Rate the following Aesthetic Needs are Important to You that Purchasing and/or Wearing a Snowboarding Helmet.
Please click in the appropriate box of the score for each question on the scale.

*** 21. The color of snowboarding helmets should be improved.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 22. The style of snowboarding helmets should be improved.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 23. The texture of snowboarding helmets should be improved.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 24. The uniqueness of snowboarding helmets should be improved.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 25. A unique design feature should be added to make snowboarding helmets unique to other sport helmets.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|

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## Perceived Functional-Expressive-Aesthetic-Regulatory Needs for Snowboarding Helmets

### 5. Perceived Regulatory Needs

IV. Rate the following Regulatory Needs are Important to You that Purchasing and/or Wearing a Snowboarding Helmet.
Please click in the appropriate box of the score for each question on the scale.

*** 29. Snowboarding helmet use should be mandatory for all snowboarders while participating in snowboarding in public ski resorts.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 30. Snowboarding helmet use should be mandatory for all snowboarders while participating in snowboarding at any time and at any place.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 31. The federal government should require that states enact helmet use laws for all snowboarders.**

| 1. Not important at all | 2. Hardly important | 3. Neutral | 4. Important | 5. Very important |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

*** 32. Education of regulatory needs for helmet use should be improved.**

1. Not 2. Hardly 5. Very

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## Perceived Functional-Expressive-Aesthetic-Regulatory Needs for Snowboarding Helmets

### 6. Attitude toward Helmet Use

V. Attitude toward Helmet Use
Please click in the appropriate box of the score for the question on the scale.

*** 36. What is your overall attitude toward wearing a helmet when snowboarding?**

| 1. Strongly Negative | 2. Negative | 3. Neutral | 4. Positive | 5. Strongly Positive |
|---|---|---|---|---|
| ○ | ○ | ○ | ○ | ○ |

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**Perceived Functional-Expressive-Aesthetic-Regulatory Needs for Snowboarding Helmets**

7. General Questions

VI. Please provide us with your background information to help us understand needs of snowboarding helmets.

**37. Do you snowboard competitively or recreationally?**

1. Competitively 2. Recreationally 3. Both

**38. How long have you been snowboarding? (Years and Months)**

**39. Approximately how often do you go snowboarding in a snowboarding season? (Times)**

**40. Approximately how many hours do you ride a snowboard when you visit the slope? (Hours)**

**41. Do you own a snowboarding helmet?**

1. Yes 2. No

Done

file:///C:/Documents%20and%20Settings/May%20Chae/Desktop/online%20survey%20pages/ooniine%20survey8.htm

VirginiaTech
Invent the Future

Exit this survey >>

**Perceived Functional-Expressive-Aesthetic-Regulatory Needs for Snowboarding Helmets**

8. Appreciation

Thank you very much for your time and support!!!

<< Prev  Done >>

APPENDIX E

Domains of the FEAR Needs Factors

Table of Specifications (Content-Validity Chart): for Functional Needs

Table of Specifications (Content-Validity Chart): Functional Needs

| Content of functional needs / Domains of "functional needs" factor | Comfort | Fit | Thermal Balance (warm) | Ventil-ation (cool) | Sizing | Dur-ability | Light Weight | Maintain good visions | Donning And Doffing | Mobility | Safety | Protec-tion | Price | Adjust-ability | Easy to wear my goggles | Thinner and smaller shape |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. helmet should be comfortable. | X | | | | | | | | | | | | | | | |
| 2. helmet should prevent from head injury. | | | | | | | | | | | | X | | | | |
| 3. helmet should fit properly on my head. | | X | | | | | | | | | | | | | | |
| 4. helmet safety should be important for snowboarders who tries jumping. | | | | | | | | | | | X | | | | | |
| 5. helmet should not make me feel heavy | | | | | | | X | | | | | | | | | |
| 6. helmet should not make me uncomfortably hot. | | | | X | | | | | | | | | | | | |
| 7. comfort of helmets should be improved. | X | | | | | | | | | | | | | | | |
| 8. fit of helmets should be improved. | | X | | | | | | | | | | | | | | |
| 9. protection of helmet should be improved. | | | | | | | | | | | | X | | | | |
| 10. safety of helmets should be improved. | | | | | | | | | | | X | | | | | |
| 11. thermal balance of helmets should be improved to make snowboarders feel comfortable and wear it for a long time. | | | X | X | | | | | | | | | | | | |
| 12. the price of snowboarding helmets should deserve the performance of the helmets. | | | | | | | | | | | | | X | | | |
| 13. helmet should not impair my vision. | | | | | | | | X | | | | | | | | |

| Domains of " functional needs" factor / Content of functional needs | Comfort | Fit | Thermal Balance (warm) | Ventil-ation (cool) | Sizing | Dur-ability | Light Weight | Maintain good visions | Donning And Doffing | Mobility | Safety | Protec-tion | Price | Adjust-ability | Easy to wear my goggles | Thinner and smaller shape |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14. helmet should be thinner and smaller. | | | | | | | | | | | | | | | | X |
| 15. helmet should be convenient to wear goggles and carry. | | | | | | | | | | | | | | | X | |
| 16. helmet sizing should be improved. | | | | | X | | | | | | | | | | | |
| 17. helmet should not reduce my mobility of head movement. | | | | | | | | | | X | | | | | | |
| 18. helmet strips should be easily adjustable. | | | | | | | | | | | | | | X | | |
| 19. helmet should be durable. | | | | | | X | | | | | | | | | | |
| 20. helmet should be easy to put on and take off. | | | | | | | | | X | | | | | | | |
| 21. Overall, functional needs of helmets should be improved. | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Total 21 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 |

APPENDIX F

Domains of the FEAR Needs Factors

Table of Specifications (Content-Validity Chart): for Expressive Needs

Table of Specifications (Content-Validity Chart): Expressive Needs

| Domains of "expressive needs" factor / Content of expressive needs | Identity As a competitive or recreational snowboarder | Athletic ability | Roles As a masculine or feminine snowboarder | Snowboarding Commitment | Profession -alism / | Toughness | Aggressiveness | Self-Image | Risk-taking | Speeding and excitement | Success |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Wearing a helmet helps me see myself as a competitive /recreational snowboarder. | X | | | | | | | | | | |
| 2. A snowboarding helmet distract from professionalism. | | | | | X | | | | | | |
| 3. A snowboarding helmet distract from toughness/aggressive ness. | | | | | | X | X | | | | |
| 4. A snowboarding helmet makes myself look funny. | | | | | | | | X | | | |
| 5. A snowboarding helmet does not look cool to me for conveying my athletic identity. | | X | | | | | | | | | |
| 6. A snowboarding helmet makes myself see a unique snowboarder. | | | | | | | | X | | | |
| 7. A snowboarding helmet helps me perform an appropriate role (either manly or feminine). | | | X | | | | | | | | |
| 8. A snowboarding helmet helps my self-image as a successful snowboarder. | | | | | | | | X | | | X |

| Domains of "expressive needs" factor / Content of expressive needs | Identity As a competitive or recreational snowboarder | Athletic ability | Roles As a masculine or feminine snowboarder | Snowboarding Commitment | Profession -alism | Toughness | Aggressiveness | Self-Image | Risk-taking | Speeding and excitement | Success |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9. I spend considerable time, effort, and money to be a more competent snowboarder. | | | | X | | | | | | | |
| 10. I ride snowboarding frequently. | | | | X | | | | | | | |
| 11. I give riding a snowboard higher priority than other activities. | | | | X | | | | | | | |
| 12. Riding a snowboard helps me relax. | | | | X | | | | | | | |
| 13. I ride a snowboard even when I am very busy. | | | | X | | | | | | | |
| 14. I have to force myself to ride a snowboard. | | | | X | | | | | | | |
| 15. I feel enjoyable when I ride a snowboard. | | | | | | | | | | X | |
| 16. I have fun riding a snowboard. | | | | | | | | | | X | |

| Domains of "expressive needs" factor / Content of expressive needs | Identity As a competitive or recreational snowboarder | Athletic ability | Roles As a muscular or feminine snowboarder | Snowboarding Commitment | Profession -alism | Toughness | Aggressiveness | Self-Image | Risk-taking | Speeding and excitement | Success |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 17. Wearing a helmet distracts my risk-taking behavior. | | | | | | | | | X | | |
| 18. Wearing a helmet helps me commit to snowboarding more positively. | | | | X | | | | | | | |
| 19. Overall, expressive needs of snowboarding helmets should be important for me and should be improved. | X | X | X | X | X | X | X | X | X | X | X |
| Total 19 | 2 | 2 | 2 | 8 | 2 | 2 | 2 | 4 | 2 | 3 | 2 |

APPENDIX G

Domains of the FEAR Needs Factors

Table of Specifications (Content-Validity Chart): for Aesthetic Needs

Table of Specifications (Content-Validity Chart): Aesthetic Needs

| Domains of "aesthetic needs" factor / Content of aesthetic needs | Uniqueness | Muscular or feminine attractiveness | Color | Sophisticated design /style | Overall good-looking on wearer | Texture |
|---|---|---|---|---|---|---|
| 1. Color of snowboarding helmets is important to me. | | | X | | | |
| 2. Style of snowboarding helmets is important to me. | | | | X | | |
| 3. Texture of snowboarding helmets is important to me. | | | | | | X |
| 4. Uniqueness of snowboarding helmets influences me to purchase and wear a helmet. | X | | | | | |
| 5. A snowboarding helmet should not be ugly or goofy on me. | | | | | X | |
| 6. An interesting design of a snowboarding helmet should be improved. | | | | X | | |
| 7. Attractiveness of a snowboarding helmet should be improved. | | X | | | | |
| 8. A unique design feature should be improved to meet the aesthetic need of a snowboard helmet. | X | | | | | |
| 9. Overall, aesthetic needs of snowboarding helmets should be important for me and should be improved. | X | X | X | X | X | X |
| Total 9 | 3 | 2 | 2 | 3 | 2 | 2 |

APPENDIX H

Domains of the FEAR Needs Factors

Table of Specifications (Content-Validity Chart): for Regulatory Needs

Table of Specifications (Content-Validity Chart): Regulatory Needs

| Domains of "regulatory needs" factor / Content of regulatory needs | Mandatory helmet use | Establish helmet use As a law to states | Champaign to Educate non-helmet users | Strict restrictions for helmet use on the mountain | Charges on fine if not being used | Importance of regulatory needs |
|---|---|---|---|---|---|---|
| 1. The snowboarding helmet use should be mandatory for all snowboarders while participating in snowboarding. | X | | | | | |
| 2. Federal government should require the states to enact helmet use laws for all snowboarders. | | X | | | | |
| 3. Regulatory needs would be helpful for snowboarders to prevent from head injuries. | | | | | | X |
| 4. Violation of a snowboarding helmet should be fined. | | | | | X | |
| 5. Education of regulatory needs for helmet use would be important for non-helmet users. | | | X | | | |
| 6. Regulatory needs of helmet use at the ski resort should be strict to snowboarders. | | | | X | | X |
| 7. Overall, regulatory needs of snowboarding helmets would be able to increase helmet use for snowboarders. | X | X | X | X | X | X |
| Total 7 | 2 | 2 | 2 | 2 | 2 | 3 |

# APPENDIX I

## Multiple Comparisons for Functional Needs Elements

I. Multiple Comparisons for Functional Needs Elements

| Items | Goggle | Less bulky | Convenience | Protection | Fit | Comfort | Ventilation | Price | Insulation |
|---|---|---|---|---|---|---|---|---|---|
| Mean | 4.67 | 4.36 | 4.23 | 3.97 | 3.91 | 3.74 | 3.73 | 3.60 | 3.44 |

| | Goggle | Not bulky | Convenience | Protection | Fit | Comfort | Ventilation | Price | Insulation |
|---|---|---|---|---|---|---|---|---|---|
| Goggle | | 0.31* | 0.44* | 0.70* | 0.76* | 0.93* | 0.94* | 1.07* | 1.23* |
| Less bulky | | | 0.13 | 0.39* | 0.45* | 0.62* | 0.63* | 0.76* | 0.92* |
| Convenience | | | | 0.26* | 0.32* | 0.49* | 0.50* | 0.63* | 0.79* |
| Protection | | | | | 0.06 | 0.23* | 0.24* | 0.37* | 0.53* |
| Fit | | | | | | 0.17* | 0.18* | 0.31* | 0.47* |
| Comfort | | | | | | | 0.01 | 0.14 | 0.30* |
| Ventilation | | | | | | | | 0.13 | 0.29* |
| Price | | | | | | | | | 0.16 |
| Insulation | | | | | | | | | |

Note. *represents that the mean difference is statistically significant at $\alpha_{FW} = .05$ using Bonferroni correction for all possible pair wise comparisons (in this case 36), where $\alpha_{FW}$ is family wise Type I error rate.

APPENDIX J

Multiple Comparisons for Expressive Needs Elements

II. Multiple Comparisons for Expressive Needs Elements

| Items | Willingness to play an important role | Should not look funny | Should not distract professionalism | Commit -ment | Should not distract toughness | Athletic identity | Self-image | Seeing my competitiveness | Appropriate role play |
|---|---|---|---|---|---|---|---|---|---|
| Mean | 4.04 | 3.98 | 3.62 | 3.57 | 3.50 | 2.93 | 2.90 | 2.89 | 2.74 |

| | Willingness To play an important role | Should not look funny | Should not district profession-alism | Commitment | Should not distract toughness | Athletic identity | Self-image | Seeing my compete-titiveness | Appropriate role play |
|---|---|---|---|---|---|---|---|---|---|
| Willingness to play an important role | | 0.06 | 0.42* | 0.47* | 0.54* | 6.97* | 1.14* | 1.15* | 1.30* |
| Should not look funny | | | 0.36* | 0.41* | 0.48* | 1.05* | 1.08* | 1.09* | 1.24* |
| Should not district professionalism | | | | 0.05 | 0.05 | 0.69* | 0.72* | 0.73* | 0.88* |
| Commitment | | | | | 0.07 | 0.64* | 0.67* | 0.68* | 0.83* |
| Should not district toughness | | | | | | 0.57* | 0.60* | 0.61* | 0.76* |
| Athletic identity | | | | | | | 0.03 | 0.04 | 0.19* |
| Self-image | | | | | | | | 0.01 | 0.16 |
| Seeing my competitiveness | | | | | | | | | 0.15 |
| Appropriate role play | | | | | | | | | |

*Note.* * represents that the mean difference is statistically significant at $\alpha_{FW} = .05$ using Bonferroni correction for all possible pair wise comparisons (in this case 36), where $\alpha_{FW}$ is Family Wise Type I error rate.

APPENDIX K

Multiple Comparisons for Aesthetic Needs Elements

III. Multiple Comparisons for Aesthetic Needs Elements

| Items | Style | Uniqueness | Sleekness | Design Features | Colors | Gender Characteristics | Texture |
|---|---|---|---|---|---|---|---|
| Mean | 3.56 | 3.37 | 3.35 | 3.21 | 3.16 | 3.07 | 3.03 |

| | Style | Uniqueness | Sleekness | Design Features | Colors | Gender Characteristics | Texture |
|---|---|---|---|---|---|---|---|
| Style | | 0.19* | 0.21* | 0.35* | 0.40* | 0.49* | 0.53* |
| Uniqueness | | | 0.02 | 0.16* | 0.21* | 0.30* | 0.34* |
| Sleekness | | | | 0.14 | 0.19* | 0.28* | 0.32* |
| Design Features | | | | | 0.05 | 0.14 | 0.18 |
| Colors | | | | | | 0.09 | 0.13 |
| Gender Characteristics | | | | | | | 0.04 |
| Texture | | | | | | | |

*Note.* * represents that the mean difference is statistically significant at $\alpha_{FW} = .05$ using Bonferroni correction for all possible pair wise comparisons (in this case 21), where $\alpha_{FW}$ is Family Wise Type I error rate.

# APPENDIX L

## Multiple Comparisons For Regulatory Needs Elements

## IV. Multiple Comparisons for Regulatory Needs Elements

| Items | Education | Mandatory in public ski resorts | Mandatory at any time and at any place | Federal Laws | Restriction for non-helmet users | Violation with fines |
|---|---|---|---|---|---|---|
| Mean | 3.46 | 3.27 | 3.15 | 2.65 | 2.65 | 2.30 |

| | Education | Mandatory in public ski resorts | Mandatory at any time and at any place | Federal Laws | Restriction for non-helmet users | Violation with fines |
|---|---|---|---|---|---|---|
| Education | | 0.19 | 0.31* | 0.81* | 0.81* | 1.16* |
| Mandatory in public ski resorts | | | 0.12* | 0.62* | 0.62* | 0.97* |
| Mandatory at any time and at any place | | | | 0.50* | 0.50* | 0.85* |
| Federal Laws | | | | | 0.00 | 0.35* |
| Restriction for non-helmet users | | | | | | 0.35* |
| Violation with fines | | | | | | |

*Note.* * represents that the mean difference is statistically significant at $\alpha_{FW} = .05$ using Bonferroni correction for all possible pair wise comparisons (in this case 15), where $\alpha_{FW}$ is Family Wise Type I error rate.

APPENDIX M

Multiple Comparisons for Overall

Functional, Expressive, Aesthetic, and Regulatory Needs Elements

V. Multiple Comparisons for Overall Functional-Expressive-Aesthetic-Regulatory Needs Elements

| Items | Overall Functional needs | Overall expressive needs | Overall aesthetic needs | Overall regulatory needs |
|---|---|---|---|---|
| Mean | 4.07 | 4.04 | 3.49 | 3.01 |

| | Overall functional needs | Overall expressive needs | Overall aesthetic needs | Overall regulatory needs |
|---|---|---|---|---|
| Overall functional needs | | 0.03 | 0.58* | 1.06* |
| Overall expressive needs | | | 0.55* | 1.03* |
| Overall aesthetic needs | | | | 0.48* |
| Overall regulatory needs | | | | |

*Note.* * represents that the mean difference is statistically significant at $\alpha_{FW} = .05$ using Bonferroni correction for all possible pair wise comparisons (in this case 6), where $\alpha_{FW}$ is Family Wise Type I error rate.

# APPENDIX N

Descriptive Statistics of Continuous Variables for

Age, Education, Income, and Helmet Usage

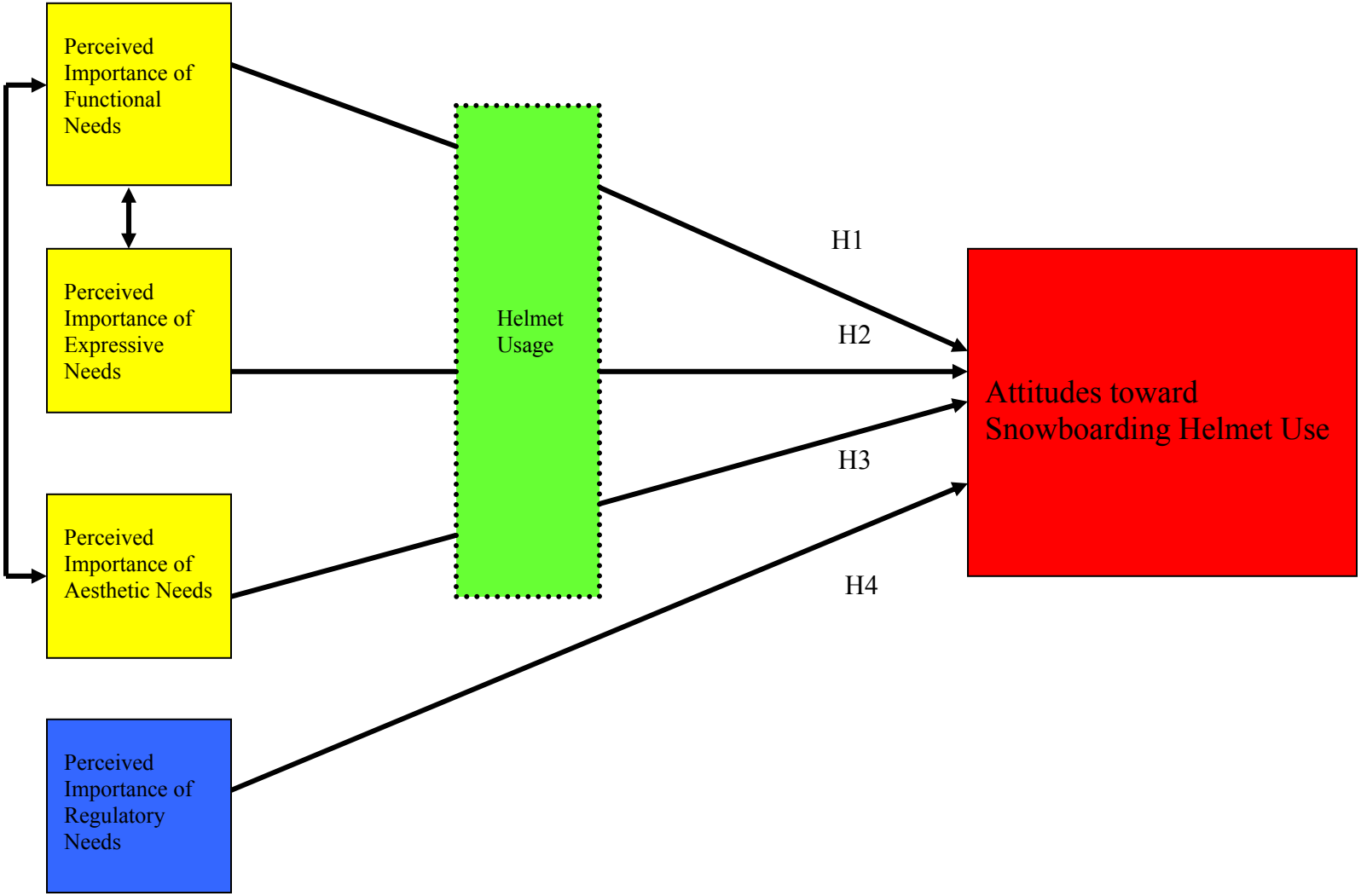
I. Descriptive Statistics for Continuous Variables for Age, Education, Income, and Helmet Usage

| | N | Min. | Max. | Mean | Std. Deviation | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|
| | | | | | | statistic | statistic |
| Age | 328 | 1.00 | 4.00 | 1.9726 | 1.2325 | .713 | -1.211 |
| Edu | 327 | 1.00 | 6.00 | 3.2355 | 1.4324 | .406 | -.469 |
| Income | 301 | 1.00 | 5.00 | 3.7409 | 1.5725 | -.798 | -.997 |
| Helmet Usage | 336 | 1.00 | 5.00 | 1.5625 | 1.0231 | 1.782 | 2.153 |

APPENDIX O

The Conceptual Model for FEAR Needs

The Conceptual Model for FEAR Needs



APPENDIX P

Cover Letter to the USASA Executive Director for Current Members of Email Lists

Feb 27, 2006

Dear Mr. Collins, Executive Director,

My name is May Chae and I am working on my dissertation at Virginia Polytechnic Institute and State University in Blacksburg, Virginia. I am conducting research on the special needs of helmets for snowboarders.

The purpose of this research is to identify the design characteristics and attitudes that impact the use of snowboarding helmets. This study could contribute to increased helmet usage among snowboarders, since previous research has addressed that in the snowboarding community, helmet use is infrequent, although helmet use could prevent or reduce injuries. I am planning to conduct an online survey, collecting data from snowboarding organization. I believe that the members of USASA would be very important participants in the research, so would like to ask you for help. I need email addresses of current enrolled USASA members, so that I might send an email to each member with the direct survey link (www.surveymonkey.com) and a brief explanation about the survey. In addition, I need to know that how many members are currently registered in USASA. **I will never distribute email addresses of your members for any other purpose. Responses to the survey will remain anonymous, and each participant will sign a consent form before being allowed to participate.**

**Without your help, it seems very different to continue the research project. Please consider helping with the project.**

As a small token of appreciation for assisting with our research, each participant will be entered in a drawing for incentives.

Thank you very much for your time and help. It's only with the generous help of people like your members that my research can be successful. If you have any questions, please call May Chae at chae@vt.edu / 540-230-8674 or my major advisor, Dr. Sherry Schofield-Tomschin at sherryst@vt.edu / 540-231-6282.

Sincerely,

**May Chae**
Ph.D Candidate in Clothing and Textiles
Apparel, Housing, and Resource Management
Virginia Tech

**Sherry Schofield-Tomschin Ph.D**
Associate Professor, Major Advisor
Apparel, Housing, and Resource Management
Virginia Tech

APPENDIX Q

Email Pre-Notice Letter

Hello fellow snowboarders,

A few days from now you will receive an email labeled "Perceived needs for snowboarding helmets: requesting you to fill out a brief questionnaire for an important nationwide research project being conducted at Virginia Polytechnic Institute and State University. Your email was selected from the list of the United States of America Snowboard Association (USASA) and your participation would be greatly appreciated.

Within this email you will be asked to click on the website link (I will let you know the link shortly). Once you click on this website, you will be taken directly to the survey which should take approximately 15 minutes to complete.

This study will focus on perceived functional-expressive-aesthetic-regulatory needs for snowboarding helmets since helmet use is uncommon in the snowboarding community.

As a small token of appreciation for assisting with our research, each participant will be entered in a drawing for incentives.

Thank you very much for your time and help. It's only with the generous help of people like your members that my research can be successful. If you have any questions, please call May Chae at chae@vt.edu / 540-230-8674 or my major advisor, Dr. Sherry Schofield-Tomschin at sherryst@vt.edu / 540-231-6282.

Sincerely,

**May Chae**
Ph.D Candidate in Clothing and Textiles
Apparel, Housing, and Resource Management
Virginia Tech

APPENDIX R

Email Follow-Up Letter

Hello fellow snowboarders,

This is a follow-up email. We are still conducting a nationwide snowboarding study. Your participation would be greatly appreciated. Please use the link below.

Here is the link to the survey:
http://www.

Without your help, it seems very different to continue the research project. Please consider helping with the project.

Thank you very much for your participation.

May Chae.

APPENDIX S

VITA

**Myung-Hee (May) Chae**

1720 Patrick Henry Dr. #17
Blacksburg, VA 24060
(540) 230-8674
Email: chae@vt.edu

---

## EDUCATION

**Ph.D, Apparel, Housing, and Resource Management,** 2006
***Emphasis:* Apparel Product Design and Analysis**
Virginia Tech, Blacksburg, Virginia
***Dissertation***: The Development of a Conceptual Framework of Identifying Functional, Expressive, Aesthetic, and Regulatory Needs for Snowboarding Helmets
***Advisor***: Dr. Sherry Schofield-Tomschin

**MS, Textiles and Consumer Sciences**, 2002
***Emphasis:* Apparel Product Development**
Florida State University, Tallahassee, Florida
***Thesis***: An Assessment of Women's Tennis Wear
***Advisor***: Dr. Catherine Black

**BS, Textiles and Consumer Sciences,** 1999
Florida State University, Tallahassee, Florida
***Major*:** Apparel Design and Technology

## WORK EXPERIENCES

- Summer Merchandising Internship, Moving Comfort Women's Active Wear, Chantilly, Virginia 2004
- Summer Design Internship, DerDan Tattoo Wear, Tallahassee, Florida 1998

## GRADUATE TEACHING ASSISTANTSHIPS

**Virginia Polytechnic Institute and State University, Fall 2003-Spring 2006**

- Fashion Illustration (Teaching and Grading)

- Flat Pattern Making (Assisting Students and Class, Teaching, and Grading)

- Fit (Assisting Students and Grading)

- Assembly / Construction (Assisting Students and Class)

- Idea Development and Creativity
  (Assisting Class and Presenting an Oral Presentation in the Design Process)

- Oris Glisson Historic Costume and Textiles Collection
  (Developing Themes and Installing Window Displays)

- Introduction to Fashion Industry (Assisting Class)

**Florida State University, Spring 2000-Fall 2001**

- Apparel Design Lab Technician
  (Assisting Students for Flat Pattern Making and Sewing as well as Maintaining the Lab)

## ACADEMIC HONORS AND AWARDS

- Outstanding Graduate Student Award, Department of Apparel, Housing, and Resource Management (AHRM), Blacksburg, Virginia 2006

- Graduate Student Endowed Scholarship, College of Liberal Arts and Human Sciences (CLAHS), Blacksburg, Virginia 2006

- 1st Place in Arts, Architecture, and Urban Studies, 22nd Annual Graduate Student Assembly Research Symposium, Blacksburg, Virginia 2006

- Aesthetic Award, 21st Annual Graduate Student Assembly Research Symposium, Blacksburg, Virginia 2005

- 3rd Place in Arts and Architecture at 21st Annual Graduate Student Assembly Research Symposium, Blacksburg, Virginia 2005

- Outstanding Graduate Student, Mildred Pepper Design Competition, Tallahassee, Florida 2001

- Kappa Omicron Nu National Honor Society, 1998-present

- Korean Honor Scholarship, Miami, Florida 1998

## INTERESTS IN TEACHING AND RESEARCH

- Teaching in Apparel Design Courses (Fashion Illustration, CAD, Assembly, Pattern Making, Draping, Creativity, etc) and Functional Design

- Research in Functional Design and Performance Evaluation/ Aesthetics/ Textile Design/ Social Psychological and Cultural Aspects of clothing/ Creativity/ Surface Design/ Technical Design/ Co-Design

## PROFESSIONAL PUBLICATIONS AND PRESENTATION

### REFEREED JOURNAL

- Chae, M., Black, C., & Heitmeyer, J, (2006). Pre-purchase and post-purchase satisfaction and fashion involvement of female tennis wear consumer, *International Journal of Consumer Studies, 30* (1), 25-34

### REFEREED ABSTRACTS

- Chae, M. (2006). "Perceived functional, expressive, aesthetic, and regulatory needs for snowboarding helmets" [abstract]. *Proceedings of the Hawaii International Conference on Social Sciences,* Honolulu, Hawaii.

- Chae, M., & Black, C. (2003). "An assessment of women's tennis wear" [abstract]. *Proceedings of the International Textiles and Apparel Association,* Savannah, Georgia.

- Chae, M. (2006). "Festival" [abstract]. Visual Display Research Session, the 22nd Annual Graduate Student Assembly Research Symposium, Blacksburg, Virginia.

- Chae, M. (2005). "Harmony" [abstract]. Visual Display Research Session, the 21st Annual Graduate Student Assembly Research Symposium, Blacksburg, Virginia.

## PRESENTATIONS

- Chae, M., & Schofield-Tomschin, S. (2006). Perceived functional, expressive, aesthetic, and regulatory needs for snowboarding helmets. Poster Research Session, Hawaii International Conference on Social Sciences, Honolulu, Hawaii.

- Chae, M. (2006). Festival. Visual Display Research Session, the 22nd Annual Graduate Student Assembly Research Symposium, Blacksburg, Virginia.

- Chae, M. (2005). Harmony. Visual Display Research Session, the 21st Annual Graduate Student Assembly Research Symposium, Blacksburg, Virginia.

- Chae, M., & Black, C. (2003). An assessment of women's tennis wear. Poster Research Session, International Textile and Apparel Association, Savannah, Georgia.

- Chae, M., & Black, C. (2002). Functional Needs of women's tennis wear. Oral Presentation, Graduate Consortium Research, Auburn, Alabama.

- Chae, M., & Black, C. (2002). Women's tennis wear. Poster Research Session, Human Sciences Showcase Research and Creativity Day, Tallahassee, Florida.

## GRANTS AND OTHER FUNDING

- Graduate Research Development Project (GRDP) Research Fund, Blacksburg, Virginia 2005

- Travel Fund Program (TFP) of the Graduate Student Assembly, Blacksburg, Virginia 2006

## PATICIPATION IN PROFESSIONAL WORKSHOPS

- Graduate Assistant for Teaching, Blacksburg, Virginia 2003

- Photoshop, Blacksburg, Virginia 2006

- Dreamweaver, Blacksburg, Virginia 2006

- Writing Successful Grants, Blacksburg, Virginia 2006

## SERVICES

- Fashion Gallery Window Display, Blacksburg, Virginia 2006 and 2003
- Apparel Housing and Resource Management (AHRM) Graduate Council, Blacksburg, Virginia 2005
- Fashion Merchandising and Design Society (FMDS) Fashion Show Entries, Blacksburg, Virginia 2003-2005
- Treasurer, Tallahassee Korean Student Association, Tallahassee, Florida 2000
- Fashion Inc. Fashion Show Entries, Tallahassee, Florida 1998-2001
- Judge, Miss Teen Heritage Pageant, Perry, Florida 1998

## MEMBERSHIPS

- International Textile and Apparel Association 2003-present
- American Association of Textile Chemists and Colorists 2004-present
- Blacksburg Korean Catholic Association 2003-present
- Blacksburg Korean Student Association 2003-present
- Tallahassee Korean Student Association 1998-2002
- Tallahassee Korean Catholic Association 1998-2002
- Fashion Inc., Tallahassee, Florida 1998-1999