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GOLFERS' UV EXPOSURE, HEALTH BELIEFS AND PRACTICES, AND INTENTION TO ADOPT UV PROTECTIVE CLOTHING

By

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ABSTRACT

GOLFERS' UV EXPOSURE, HEALTH BELIEFS AND PRACTICES, AND INTENTION TO ADOPT UV PROTECTIVE CLOTHING

By

Heewon Sung

Since the major factor of developing skin cancer is associated with excessive exposure to ultraviolet radiation (UVR), outdoor enthusiasts, such as golfers, need to be focused on for skin cancer prevention messages. This study was divided into two phases: The first phase focused on the cumulative exposure to UVR during golf rounds and protective nature of clothing, and the standardized images of golfers in magazines and in the local pro golf shops; the second phase focused on golfers' health beliefs and practices regarding sun precautions, and its impact on the intention to wear UV specialized shirts.

In Phase I, polysulphone film badges were used to measure personal and ambient exposures to UVR. The experiments were conducted in August and in October, and seven subjects participated in each experiment. Sixteen bandages were placed on the upper body sites over and under the subject's shirts. In both experiments, the shoulder and back sites over the shirts received the greatest UVR exposure, while the back neck and front neck were the two most exposed areas under the shirts. Results of paired sample t-test between the absorbance values of badges over and under the clothing indicated golf shirts significantly reduced UVR exposure in diverse body locations, and summer shirts were less effective in blocking UVR than the thicker fall shirts or UV specialized shirts.

Market research was conducted as a part of phase I to provide the normative looks of golfers photographed in the magazines and general information of golf clothing available in the local pro shops. The most standardized look of golfers found in market research, was the short-sleeved cotton polo shirts. Only a few UV specialized products, such as hats, short-sleeved shirts, or sunglasses, were available at local stores, since the majority of customers was not interested in them.

In phase II, 158 respondents completed a 58-item questionnaire. Ninety-one percent were male, and their age ranged from 16 to 80 years old. About 30% reported using sunscreen on the face and 20% used it on the body. A psychosocial model was proposed based on two theoretical frameworks, the health belief model and Rogers' attributes of innovations. Among the 11 health belief model variables, peer's sun protective behavior was the most important predictor of sun protective actions, followed by susceptibility, marital status, psychological barrier, benefit, and having family members who have skin cancer, explaining 44% of the variance in the regression model. Triability and relative advantage among five attribute variables were significant predictors of intention to adopt UV specialized shirts ($R^2 = .411$). The intention to adopt was also predicted by behavioral barriers, current sun protection behavior, and ethnicity, increasing the explanatory power to 50% of the variances in the proposed model.

The present study suggests that the health belief model variables play an important role in explaining sun protective behavior and intention to adopt the preventive innovation. Suggestions are given for improving UV protection through clothing design as well as educational program design.

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CHAPTER ONE

Introduction

Cancer is defined as "a group of diseases characterized by uncontrolled growth and spread of abnormal cells" (American Cancer Society, 2002, p. 1). Among several types of cancers, some types, such as skin cancers are preventable or curable if found in their early stages. The major factor of developing skin cancer is associated with excessive exposure to ultraviolet (UV) radiation. In order to reduce the incidence of skin cancer, the American Cancer Society recommends limiting or avoiding sun exposure during the midday hours, from 10 a.m. to 4 p.m. Additional recommendations are to cover the body by wearing a hat, sunglasses, long-sleeved shirt and long pants, and by applying sunscreen when outdoors (American Academy of Dermatology, 2002c; American Cancer Society, 2002).

Although skin cancers are "the most easily and successfully treated human cancers" (Amir, Wright, Kernohan, & Hart, 2000), skin cancer accounts for nearly 50% of new cancer cases, and it is estimated that more than one million new cases will be diagnosed in the U.S. in 2003 (American Academy of Dermatology, 2002a). Due to melanoma, which is the most serious type of skin cancers, one person dies every hour, and melanoma is the fifth most common cancer in men and the seventh in women (American Academy of Dermatology, 2002a). Accordingly, outdoor enthusiasts, such as runners or golfers, should focus on sun protective practices, because their outdoor activities could lead to extensive sun exposure during peak sun hours (Gravel, 1997; Liffrig, 2001).

As Gravel (1997) indicated, golfers are more at risk than the average person because they often spend more than five hours in the sun while playing a game of golf. This study pays particular attention to golfers because they usually expose themselves to the sun during the peak time and because they are free to choose their clothing as compared with others in outdoor sports that require uniforms such as baseball or soccer. Moreover, little effort is being made to target outdoor recreational groups regarding the practice of sun safety with the exception of sunbathing habits (Newman, Woodruff, Agro, & Mayer, 1996; Vail-Smith, & Felts, 1993). Therefore, analyzing golfer's perceptions about skin cancer risks and their current sun protective actions deserves attention. Moreover, to understand golfers' attitudes toward covering up their body while playing golf would be important in developing educational information or improving the design of golf clothing.

UV specialized shirts increase sun protection, since this garment is designed to prevent UV radiation transmission to the skin. In addition, wearing UV specialized clothing could be more convenient than using sunscreen for golfers since individuals have to reapply sunscreen frequently while playing golf for effective protection during the prolonged exposure. Actually, most skin cancer prevention campaigns are inclined to focus on the use of sunscreen (Glanz, Lew, Song, & Cook, 1999), so it is helpful to determine whether the alternative practices, such as use of sun protective clothing, are equivalent or more effective. Analyzing golfers' perceived characteristics of UV specialized clothing would provide results that may assist product development specialists to identify problems and to modify garments to accelerate promotion of UV specialized clothing.

Very little research, however, has focused on the effectiveness of clothing, related to the amount of UV radiation body-specific areas received, nor has site specific data collected from the viewpoint of functional apparel design. Armstrong and Kricker (1993) explain that all body sites are not equally at risk for melanoma. For example, the highest incidence rate of melanoma for males is on the trunk, whereas for females it is the lower limbs (Bulliard, 2000). In addition, depending on gender, ethnicity, and geographic locations, people have different probabilities of developing skin cancer in exposed-body sites. Identifying differences in the amount of UV radiation received by specific body sites would be valuable to apparel designers in planning UV protective clothing.

Objectives and Research Questions

This study consists of two phases. In the first phase, field experiments were conducted to analyze the cumulative UV radiation received by specific body sites. In addition, market research provided background information about typical golf shirts and UV specialized products. In the second phase, golfers' perceptions about skin cancers and attributes of UV specialized clothing were investigated using quantitative methods. The two phases are discussed in separate chapters that include literature review, research methods, and discussion of results. This study is a part of NC-170, "mediating exposure to environmental hazards through textile systems," directed by Dr. Slocum and was financially supported by the Michigan Agricultural Experiment Station.

Phase I – UV Exposure of Golfers and Market Research of Golf Clothing

Objective 1: To determine the cumulative exposure of different body sites to UV radiation during golf rounds.

Research question 1: To what extent do golfers receive UV radiation at 16 upper body sites?

Research question 2: What parts of the upper body receive the most UV radiation while playing golf?

Objective 2: To evaluate the effects of clothing in reducing UV radiation transmissions from sunlight.

Research question 1: To what extent do golf shirts reduce UV radiation, e.g. are there any differences in the absorbance values between over the shirts and under the shirts?

Research question 2: Do the differences in absorbance values under the shirt vary with the types of shirts, UV specialized shirts vs. regular golf shirts?

Objective 3: To provide background information of golf clothing available commercially in the selected market segment.

Research question 1: What is the standardized or normative look of golfers in magazines?

Research question 2: What kinds of traditional clothing are available for golfers in local pro golf stores?

Research question 3: To what extent are UV specialized products commercially available in the local stores?

Phase II – Perceived Beliefs about Health and Attributes toward an Innovation

Objective 4: To assess the state of beliefs and current behaviors regarding sun protection of golfers and examine the relationships between the two.

Research question 1: To what extent do golfers perceive susceptibility to and severity of skin cancer, benefits of sun protective action, barriers to taking action, and what sun protective practices do they engage?

Research question 2: Which variables in the health belief model contribute most to explaining their current sun protective behaviors?

Objective 5: To examine whether perceived attributes of a UV specialized shirt are related to golfers' intention to adopt it.

Research question 1: To what extent and how is each attribute of UV protective clothing related to the intention to adopt?

Research question 2: What is the relative importance among attribute variables in predicting the intention to adopt UV specialized shirts for the potential adopters?

Objective 6: To investigate the relationships among beliefs about sun protection, current sun protective behavior, perceived attributes of a UV specialized shirt, and the intention to adopt a UV specialized shirt.

Research question 1: How are beliefs about skin cancer associated with perceived attributes of a UV specialized shirt as an innovation and the intention to adopt it?

Research question 2: Which variables in the final model contribute most to explaining the intention to adopt the UV specialized shirt?

Rationale for the Study

This study uses a holistic approach to examine UV radiation exposure of golfers, normative looks of golfers in the market, golfers' sun protective beliefs and current practices, golfers' perceived attributes of a UV specialized shirts, and the intention to adopt the UV specialized shirt. Knowing what factors influence golfers' current behaviors would be helpful for designing educational messages. Sun safety messages could be tailored so as to influence their lifestyle changes. Analyzing perceived characteristics of the innovation and cumulative exposure to the specific body sites would provide useful information for apparel designers to develop UV protective clothing. Overall, the two phases of this study would supplement each other by enriching our understanding of the general perspective of golfers regarding UV protection and sun safety issues.

CHAPTER TWO: PHASE I – UV EXPOSURE

Literature Review

Major Types of Skin Cancer

There are three forms of skin cancers. Basal cell carcinomas (BCC) often appear on the head, neck and hands and are "the most common skin cancers found in fair-skinned persons" (American Academy of Dermatology, 2002c, ¶ 10). These tumors grow slowly and do not spread easily to other parts of the body, but can go through the skin to the bone and cause serious damage to the local area (American Academy of Dermatology, 2002c; Keesling & Friedman, 1987).

Squamous cell carcinoma (SCC) is "the second most common skin cancer found in fair-skinned persons" and is typically found on the rim of the ear, the face, the lips and mouth (American Academy of Dermatology, 2002c, ¶ 12). This type is more harmful than BCC because "it can spread easily to internal organs and lymph glands" (Keesling & Friedman, 1987, p. 478). BCC and SCC were categorized as nonmelanoma skin cancer (Keesling & Friedman, 1987) and more than 95 percent of them are curable if detected in the early stages (American Academy of Dermatology, 2002a).

The third type of skin cancer is malignant melanoma, the most serious form of skin cancer. Melanoma is "characterized by the uncontrolled growth of pigment-producing tanning cells"; melanoma accounts for 77% of all deaths caused by skin cancer (American Academy of Dermatology, 2002b, ¶ 1). This type of skin cancer is estimated to be found in about 91,900 new cases in 2003, and "one in 67 Americans have a lifetime risk of developing invasive melanoma, a 2000% increase from 1930" (¶ 2). Caucasians have an incidence rate ten times higher than other ethnic groups diagnosed with melanoma, but melanoma is usually treatable if found in the early stages (American Academy of Dermatology, 2002b).

In 2002, it was estimated that more than one million new skin cancer cases would be diagnosed in the U.S., comprising about 80% of BCC, 16 % of SCC, and 4% of melanoma (American Academy of Dermatology, 2002a). Empirical research suggests that skin cancer is highly associated with cumulative sun exposure (Johnson & Lookingbill, 1984; Newman, et al., 1996) as well as behavioral factors such as outdoor work or leisure activities (Carmel, Shani, & Rosenberg, 1994). Garbe and Buettner (2000) noted that developing malignant melanoma and BCC were related to sun exposure in youth and high intermittent sun exposure during recreational activities, whereas SCC was more attributable to cumulative long-term sun exposure. Due to these factors, skin cancer is one of the most preventable cancers (Marlenga, 1995), and there has been increasing attention paid to skin cancer prevention promotions associated with sun exposure habits.

Ultraviolet Radiation (UVR)

Sunlight wavelengths span from 270 to 5,000nm and the major wavelengths in cutaneous studies were from 270 to 800nm that consisted of visible light (400 to 800 nm), Ultraviolet A (UVA: 320 to 400nm), Ultraviolet B (UVB: 290 to 320 nm), and Ultraviolet C (UVC: 200 to 290 nm) (Davis, 2000). Visible light between 400 and 800nm is "the white light we can see" (Davis, 2000, p.79) and has no harmful effect on skin (Liffrig, 2001). UVC is mostly absorbed by atmospheric ozone so that it does not reach human skin (Davis, 2000). Therefore, UVA and UVB are the most significant factors in damaging skin.

UVA accounts for 95% of all solar UV radiation and penetrates into the skin deeper than UVB. UVA is the major cause of aging skin and tanning beds use a similar wavelength (Davis, 2000; Liffrig, 2001). UVB is the major cause of skin cancer and sunburn because it is "highly reactive with macromolecules in the skin" (Liffrig, 2001, p. 196). UVA and UVB are more intense when "the sun is directly overhead" (between 10 a.m. and 2 p.m.), "at higher altitudes", and "on hot and humid days" due to lower density of air (Davis, 2000, p. 81). The depletion of ozone by chemical reactions and the Antarctic ozone hole also increase the levels of UVR at the earth's surface, resulting in an increase in new cases of skin cancer (Diffey, 1992; Herlihy, Gies, Roy, & Jones, 1994).

UVR Received by Occupation and Activity

Many outdoor occupations and leisure activities expose people to the sun while sunlight is direct and intense. Some empirical studies have identified which occupations receive higher levels of UVR. Larkö and Diffey (1983) compared UVB doses received by different types of indoor and outdoor workers in Sweden during two separate months. They found that people who were engaged in outdoor occupations such as the military or fishermen received UVB doses about 3.75 to 6 times more than did those in indoor occupations. However, the relative differences in UVB doses between the two groups were minimized during the summer season, indicating that indoor workers seemed to devote a large amount of time in their summer vacations to sun seeking activities compared with other seasons.

Gies, Roy, Toomey, MacLennan, and Watson (1995) compared the UVR exposure for two body locations, the top of the shoulder and the center of the chest, among three occupational groups: 16 physical education teachers, 11 grounds staff, and 8 lifeguards during five consecutive weekdays. Overall, physical education teachers received the highest UVR exposure while lifeguards received the lowest. According to subjects' daily reports of outdoor activities, lifeguards usually stayed in the beach shelters during their duty times, so they were relatively less exposed to the UVR. In comparison with the chest site, the shoulder site reached a 1.3 fold to 2 fold greater exposure to the sun across the three occupations. The authors concluded that the amount of the UVR exposure to the three occupational groups exceed the standard exposure limits to a great extent, indicating the importance of educating outdoor workers regarding precautions against sun exposure.

One recent study compared the amounts of UVR received by various body locations for two occupations. Vishvakarman, Wong, and Boreham (2001) examined 12 post mail delivery persons (PMDP) and 6 physical education teachers (PET). The order of body sites, from highest to lowest UVR for PMDP was hand, back, and chest, whereas for PET, it was top of the head, the back, shoulder, and thigh and chest. This study concluded that the different order and amounts of UVR exposure to the body sites were due to the nature of their work and amount of time they spent outside across four seasons. Their findings support the need for obtaining site specific exposure information by occupation and/or activity.

Exposure also varies with outdoor activities. Diffey, Larkö, and Swanbeck (1982) measured the amounts of UVB radiation received by participants in different activities in different geographic locations, and the maximum amount of UVB available. Sunbathers on a beach at Canary Islands (28°N latitude, February, clear and sunny, 11:30-12:30) received 80% of the available UVB, while sunbathers at Corfu (39°N, September, hazy,

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12:00-13:00) received 69% of UVB. The proportion of UVB exposure received by skiers at Gaschurn, Austria (47°N, March, clear and sunny, 8:30-15:30) was 23 %, whereas the proportion received by sailors at Gothenburg, Sweden (58°N, July, sunny, 9:00-20:00) was 15%. Their study shows how the UVB doses received by subjects can vary contingent upon subjects' activities, geographic location, season, weather condition (clear and sunny, light cloud, snow storm), or time of a day (8:00-9:00 vs. 12:00-13:00).

Holman, Gibson, Stephenson, and Armstrong (1983) compared UVR received at five body sites on subjects in nine outdoor activities. The proportion of ambient UVR received from highest to lowest, averaged across body sites by activity was swimming at the ocean, boating, sunbathing, hiking, golf, fishing, tennis, pool swimming, cricket, and gardening. The researchers also reported that the middle of center back (thoracic spine) and the dorsum of the hand were more exposed than the cheek, anterior surfaces of the mid-thigh, or posterior surface of mid-calf. The researchers pointed out the different levels of sun exposure among various outdoor activities. For instance, hiking, golf, and fishing were associated with relatively more UVR exposure than tennis or gardening, perhaps due to open areas or proximity to water. That is, environmental factors also influence the UVR dose received by individuals while they are exposed to the sunlight. Herlihy, et al., (1994) measured the UV doses received at several anatomical sites on 94 subjects in six outdoor activities in Hobart, Tasmania. Tennis, sailing, and golf were the three activities that had the highest proportions of ambient UVR, 1.00, 0.87, and 0.67 respectively, while gardening, walking, and swimming had the lowest proportion of ambient UVR, 0.26, 0.31, and 0.49 respectively. Although the golf course used in Herlihy, et al.'s study was shaded with trees, compared with other activities, golfers were exposed to relatively higher amount of the UVR doses due to the long period of time exposed. The researchers also indicated that the time of a day subjects were engaged in activities affected the amount of UVR. Their findings were different from Holman, et al.'s study (1983) in the order of the proportion of ambient UVR obtained by outdoor activities. The differences in the two studies could be due to the location of tennis courts or topography of golf courses.

Table 1. Summary of Literature regarding UVR Received by Activity and Body Sites

Source	Comparisons	UVR received in order
Larkö & Diffey (1983)	Occupations	Outdoor > indoor workers
Gies, et al., (1995)	Occupations	PET > grounds staff > lifeguards
	Body sites	Shoulder > chest
Vishvakarman, et al., (2001)	Body sites	PMDP: Hand > back > chest
		PET: Top of hat > back > shoulder > thigh > chest
Diffey, et al., (1982)	Recreations	Sunbathing at Canary Islands > at Corfu
		Skiing at Austria > Sailing at Sweden
Holman, et al., (1983)	Recreations	Swimming at the ocean > boating > sunbathing > hiking > golf > fishing > tennis > pool swimming > cricket > gardening
	Body sites	Back, dorsum of hand > cheek, thigh, calf
Herlihy, et al., (1994)	Recreations	Tennis > sailing > golf > swimming > walking > gardening
	Body sites	Shoulder > back > thigh > calf > chest > hands > cheek

In Herlihy, et al's study (1994), the shoulder received the highest proportions of ambient UVR (65%), followed by the back (55%), thigh (36%), calf (33%), chest (30%), hands (26%), and cheek (13%). In the study by Holman, et al. (1983) only two body sites of golfers were recorded, and the hand received higher proportions of ambient exposure (55%) than the cheek (24%), which was consistent with findings of Herlihy, et al.'s study (1994) in terms of order, but not in terms of the proportion of ambient UVR obtained. Table 1 summarizes the previous studies, regarding the extent of UVR received by subject's activities and body-specific sites.

Body-Specific Sites of Skin Cancer Diagnosed

A few researchers identified specific body sites of skin cancer. Among 242 Caucasian residents who were diagnosed with BCC in Kauai, Hawaii, the most frequently diagnosed body sites were the head and neck, followed by the trunk and limbs (Reizner, Chuang, Elpern, Stone, & Farmer, 1993). The mean age of the patients is 56.5 years, and males have higher incidence rates (almost 2 times) than do females. The Kauai residents have higher incidence rates on the trunk, especially the back, than do Minnesota residents in their study. This was attributed to the warm weather in Kauai that lead to limited skin cover during most outdoor activities.

Elwood and Gallagher (1998) investigated the relationships between the body sites and patients' age. One-thousand-thirty-three melanoma patients in British Columbia between 1991 and 1992 were divided into two age groups (under age 50 and over 50) to compare their incidence rates of melanoma tumor per unit area of specific body sites. Among both males and females under age 50, the back was the highest in the incidence rates, while the face was the highest in both sexes at ages over 50. In addition, females over 50 showed higher incidence rates on the upper arm and the leg than other groups. The researchers confirmed the hypothesis that melanoma patients under age 50 had higher incidence rates on body sites that were exposed to the sun intermittently, while incidence rates for patients over 50 were more likely to be associated with body sites receiving continuous sun exposure.

Buettner and Raasch (1998) surveyed 3,536 patients of the three major types of skin cancer between December 1996 and December 1997 in Australia. BCC was mostly found on the face and back, while SCC was diagnosed on the face, legs, and upper limbs. The highest incidence rates of melanoma in males were in the back, neck, and shoulder, while the highest incidence rates in females, by body sites, were the neck, back, and face. The researchers highlighted the positive relationships between the highly sun-exposed body sites, such as the face and the high risk of developing skin cancer. Also, they pointed out that clothing habits would influence developing skin cancers at different body sites. For example, males have higher incidence rate than females on the back, while females have higher incidence rates than males on the legs due to type of clothing worn.

Bulliard (2000) examined 16,117 incidents and 3,150 death records of melanoma between 1968 and 1999 in New Zealand. Overall, the three body sites with the highest incidence and death rates of melanoma were trunk, upper limbs and lower limbs. In comparison with females, males had higher incidence rates on the body sites of trunk, scalp/neck, and ears, whereas females had higher incidence rates than males on the lower limbs and upper limbs. However, males had higher death rates than females in all body sites except for lower limbs. These findings are consistent with previous studies, and indicate the importance of clothing habits and sun exposure behaviors. Table 2 summarizes the previous studies regarding body-specific sites diagnosed with skin cancer.

Table 2. Summary of Literature regarding Body Specific Sites of Skin Cancer

Source	Sample (Years sample was collected)	Types of skin cancer & specific body sites diagnosed
Reizner, et al., (1993)	242 Caucasian residents in Kauai, Hawaii (1983-87)	BCC [a]: Head & neck, trunk, limbs
Elwood & Gallagher (1998)	1033 melanoma patients in British Columbia (1991-92)	Melanoma [a]: Under 50 - Back Over 50 - Face
Buettner & Raasch (1998)	3,536 skin cancer patients in Australia (1996-97)	BCC [a]: Face, back SCC [a]: Face, leg, upper limbs Melanoma [a]: Back Male-Back, neck, shoulder Female-Neck, back, face
Bulliard (2000)	16,117 incidents and 3,150 death records of melanoma in New Zealand (1968-99)	Melanoma [a]: Trunk, upper limbs, lower limb

[a] Both males and females

Golfers and Skin Cancer

Recently, the American Academy of Dermatology with the support of the National Golf Foundation and the Golf Channel national cable network (American Academy of Dermatology, 2000) has targeted golfers with a skin cancer educational campaign. Because of their long time exposure to the sun during peak sun hours, dermatologist MacDougal of Manhattan Beach, California indicated that "it puts golfers especially at risk" (Gravel, 1997, p. 117). The American Academy of Dermatology also has worked with the famous professional golfer, Greg Norman as a role model of sun safety and protection (American Academy of Dermatology, 2001). The campaign focused on "the odds of getting skin cancer (1 in 5) versus the odds of getting a hole in one (1 in 12,000) during your lifetime" (¶ 3).

Hanke, Zollinger, O'Brian, and Bianco (1985) stressed that higher risks of developing skin cancer for professional and amateur golfers were due to the cumulative exposure during their lifetime. When comparing female professional and amateur golfers in developing basal cell carcinoma (BCC), 4 of 51 professional golfers (7.8%) and 11 of 142 amateur golfers (7.7%) were diagnosed (Hanke, et al., 1985). Significant factors related to BCC cases were original hair color (brown and red) and color of eyes (green and blue). The body sites where BCC was most frequently observed from highest to lowest were nose, chin; elbow; cheek, eyelid, eyebrow, temple; and thigh. With respect to use of sunscreen, about 63% of professional golfers used sunscreen regularly while 49.3% of amateur golfers used it, although the differences were not statistically significant. With respect to the mean hours of golf played per day, professional golfers spent much more time, 6.2 hours under the sun, than amateur golfers did, 2.1 hours. In comparison with professional golfers, amateur golfers might ignore their intermittent sun exposure during their golf rounds, resulting in less use of sunscreen, which would lead to similar percentage of diagnosing BCC on amateur golfers.

In summary, previous studies suggest that different occupations or activities yield different amounts of UVR exposure to various body sites (see Table 1). Also, different types of skin cancer were diagnosed at diverse body locations (see Table 2). Perhaps several confounding variables affect the UVR received by individuals: geographic location, topography of the place, time of year, time of a day, period of exposure, and differences in personal habits. In order to offer better protection from UVR, it is necessary to analyze which body sites are exposed to UVR the most when traditional clothing is worn while playing golf. Results of this analysis will assist in generating the design criteria for developing UV protective garments.

Sun Protective Clothing

Use of sunscreen sometimes leads to inadequate sun protection to the body. People use an improper amount of sunscreen, use sunscreen with an insufficient sun protection factor (SPF), fail to cover exposed body sites, and do not sufficiently reapply sunscreen during prolonged exposure (Garbe & Buettner, 2000). Thus, wearing sun protective clothing would be a much simpler and more effective way to practice sun safety than using sunscreen (Gambichler, Altmeyer, & Hoffmann, 2002).

Sun protective clothing indicates garments that provide adequate sun protection for all day exposure and have a SPF of 15 or higher for fabrics (Diffey, 2000; Liffrig, 2001). Protective quality of fabrics varies with the specific characteristics of fabrics: Fabric porosity, fiber types (cotton, wool, polyester, etc), color, weight, and thickness (mass per unit area).

Fabric porosity is related to the fabric construction (woven vs. knit). Woven fabrics generally provide better sun protection than knit fabrics, since knit fabric has larger spaces between yarns, resulting in greater UVR transmission than woven fabric (Capjack, et al., 1994). Fabric stretch also provides less protection by increasing fabric porosity (Gambichler, et al., 2002). In terms of fiber types, polyester fabrics provided 3 to 4 times higher SPF values than cottons did if they were similar in construction, although cotton fabrics were much more comfortable to wear in summer (Davis, Capjack, Kerr, & Fedosejevs, 1997). However, polyester fabric was less effective in preventing UVA than UVB transmission.

The color of a fabric could enhance SPF, since "the absorption band for some dyes extends into the UVR spectral region so that such dyes act as UVR absorbers" (Curiskis & Pailthorpe, 1996, p. 16). Dark and bold colors provide better sun protection than white, light, or pastel colors (Osterwalder & Rohwer, 2002). Fabric weight or thickness is a significant factor in influencing SPF: The higher the weight per unit area, the better UV protection (Capjack, et al., 1994). Other factors such as bleach and wetness also influence SPF (Gambichler, et al., 2002). Unbleached cotton or silk provides better protection from UV radiation than their bleached counterparts "due to UV-absorbing natural pigments and other impurities" (p. 18). Wet fabric reduces the values of SPF significantly compared with a dry condition, especially for cotton fabrics, because the presence of water in the spaces between yarns scatters light, increasing UV transmission. In addition, repeated laundry with a detergent containing optical brightening agent would increase SPF of some types of fabrics, such as cotton or cotton-and-polyester blend fabrics (Gambichler, et al., 2002).

For better UV protection, UVR absorbers have been incorporated in the construction process of fiber or in the finishing process of fabrics (Capjack, et al., 1994). Clothing with UVR absorbers provides a 30 or higher SPF and is advertised as medical devices (Liffrig, 2001). However, as Capjack et al. mentioned (1994), the usefulness of

UVR absorbers in increasing sun protection values in comparison to other "normal" fabrics have not been consistent, although the price of UVR-absorber specialized garments may be higher than normal garments. Most regular clothing provides some basic level of sun protection. About 85% of 5000 fabrics tested at Australian Radiation Laboratory provided SPF of more than 20, and most summer fabrics provided SPF of 10 or higher (Diffey, 2000).

For this study, a UV specialized garment is defined as a garment that is designed to maximize UV protection by using fabrics that are specialized with UVR absorbers. Very little research has focused on the effectiveness of UV specialized garments in terms of UV radiation received by body-specific areas, compared with other normal garments. Hence, this study examined the cumulative exposure of different body sites and effects of different types of fabrics in preventing UV radiation transmissions during golf rounds.

Methodology

Preparation of the Polysulphone Film Dosimeter

Ultraviolet B (UVB), ranging from 280 nm to 315 nm is a significant factor in causing skin cancer (Liffring, 2001). A number of researchers (Diffey, 1989; Gies, et al., 1995; Herlihy, et al., 1994; Larkö & Diffey, 1983) have used polysulphone films to measure personal exposure to UVB after Davis, Deane, and Diffey introduced it in 1976. When this film is exposed to UVB, it degrades (depolymerizes) with a change in its absorbance that is measurable at a wavelength of 330nm (Holman, et al., 1983; Rosenthal, Lew, Rouleau, & Thomson, 1990).

The Composite Materials and Structures Center, Michigan State University made the film used in this study. Polysulphone crystals were dissolved in CH_2Cl_2 (Dichloromethane). The solution was poured onto a flat glass plate (approximately 11 inch x 8.5 inch) and spread evenly by rolling a glass bar over the liquid several times. When the solvent vaporized in approximately three minutes, the film was removed from the glass plate. The film is colorless, transparent, very thin and fragile. The process was repeated to produce the quantity needed.

The change of UVB absorbance (ΔA) was measured at 330nm. The change was determined by measuring each film badge before and after exposure to UV radiation (UVR) in the UV spectrophotometer. For this study, a Perkin Elmer Lambda 900 UV spectrophotometer with a beam of 32mm × 13mm with a central aperture of 18mm × 7mm was used. This beam size is larger than previous studies (Larkö & Diffey, 1983; Rosenthal, et al., 1990; Vishvakarman, et al., 2001), so the size of film badges was increased. The film was cut into 35mm × 13mm rectangles for the badges.

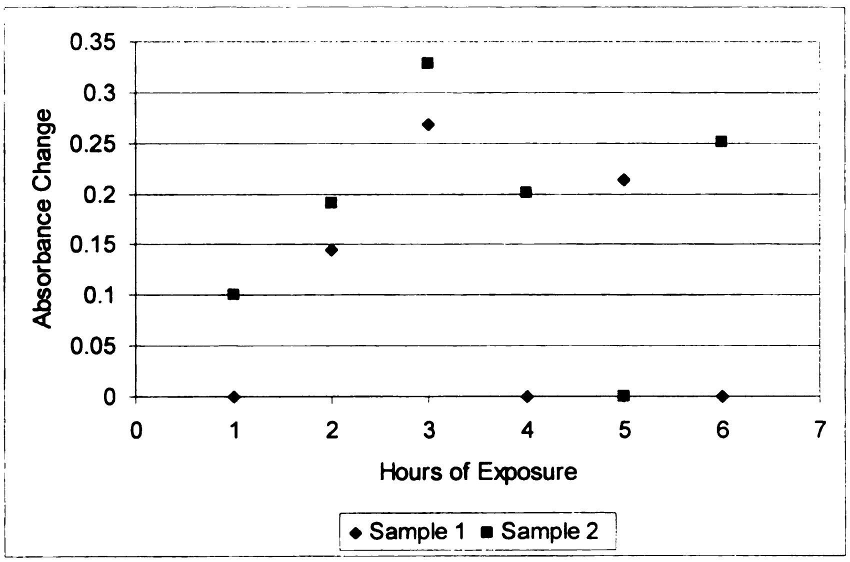
To measure absorbance, first, each film badge was cleaned with isopropyl alcohol to remove the contamination from the surface which might increase the absorbance value (Rosenthal, et al., 1990). Second, the film badge was stood against the beam by matching the center of the film with the center of the beam aperture. Finally, in the spectrophotometer, a light passed through the film, and the absorbance value of an unexposed film badge was recorded at 330nm. The film was measured again after exposed to UVB. Then the change in absorbance (ΔA) of each film badge was calculated by subtracting the value of the unexposed film from the value of the exposed.

The film badges for each subject and ambient exposure were stored in separate envelopes which were put into separate small boxes. Those small boxes were put again in a large shoe box for the purpose of blocking UVR during storage.

Pretests of the Polysulphone Films

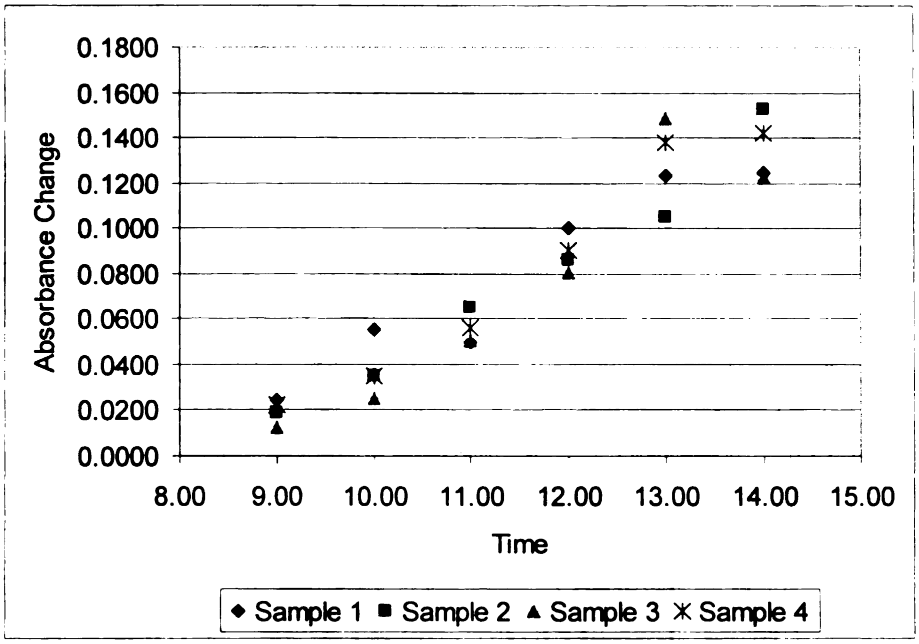
After preparing the films, the ambient level of radiation during six hours was measured on August 10, 2002 in order to test the measurement capacity of the film badges to determine if they were practical. Twelve film badges were prepared and placed on papers on the top of a car that was located in an unshaded, open area. It was a sunny day, the temperature was over 80 °F, and the UV index was 8. Between 10:30 a.m. and 4:30 p.m., two film badges were removed from the car every hour. Four out of 12 badges were damaged, so four of six time intervals are represented by only one sample. Figure 1 shows the distribution of the absorbance changes in the first pretest. After four hours of exposure, the absorbance changes of the film badges were decreased. Because only one sample represented between four hours and six hours exposure, the researcher decided to increase the numbers of badges in the second pretest. In addition, because the films were made by hand, the absorbance values of unexposed film badges varied, which might cause inconsistent distributions of the data in Figure 1. Hence, the range of variability in absorbance values of unexposed film badges was limited to 0.035 variation from minimum to maximum.

Figure 1. Absorbance Changes of Ambient Dosimeters by Hours Exposed in Pretest



A second pretest was conducted on August 18, 2002, to examine the absorbance changes by hour on a very sunny day with a temperature of about 80 °F, and a UV index of 7. Twenty four film badges were prepared. The absorbance values of unexposed film badges between 0.08 and 0.105 were selected. Beginning at 8 a.m., four badges were exposed to the sun for an hour. They were then removed and four more badges were exposed for an hour. Badges were changed each hour until 2 p.m. Figure 2 shows that the values of the absorbance increased steadily over time. Hence, the researcher decided to use the polysulphone films as a UVR dosimeter for this study.

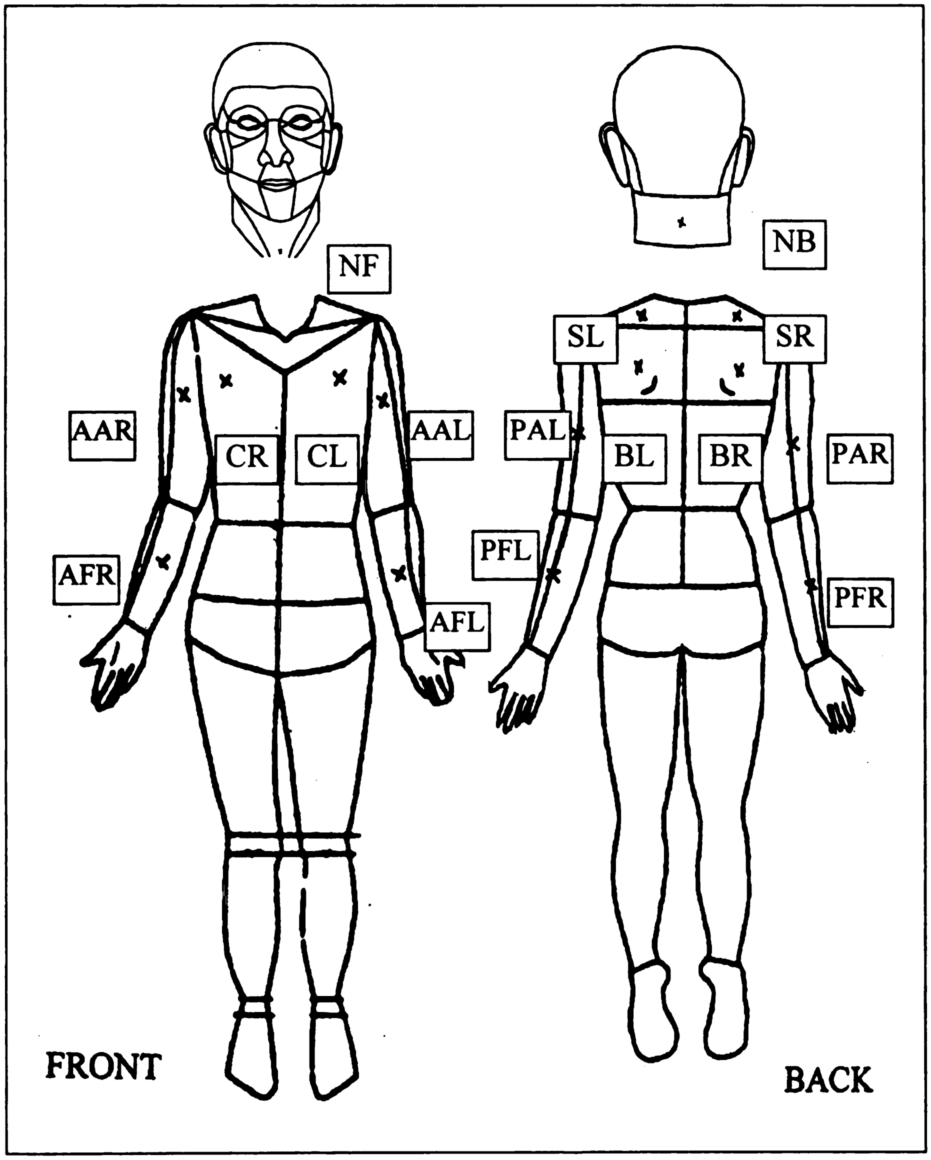
Figure 2. Absorbance Change in One Hour of Ambient Exposure by Time of Day



Experiment I

For experiment I, a total of 196 film bandages were constructed to measure UVB doses: 84 bandages for 12 body locations under clothing and 112 bandages for 16 locations over clothing or areas directly exposed to the sun for seven subjects. In addition, 30 film badges were prepared to measure the ambient level while subjects played golf for six hours. To minimize the variation among film badges, films with absorbance values outside the 0.035 range were excluded.

To prepare a personal dosimeter, both sides of a film badge were attached onto an adhesive bandage by using double sided tape and/or transparent tape. The aperture of the film badge was kept at 23mm × 13mm. Then the bandage was labeled with an abbreviation for a subject and a specific body location. A code identified films placed over and under clothing. For instance, the film bandage attached at the front neck over the clothing for subject A was labeled as A1NF whereas the film bandage attached at the same location but under the clothing was as A0NF. The sixteen locations of the upper body included neck (front & back), shoulder (left & right), chest (left & right), back (left & right), anterior arm (left & right), posterior arm (left & right), anterior forearm (left & right), and posterior forearm (left & right). Specific sites are marked in Figure 3.



NF	Neck-Front
NB	Neck-Back
CR	Chest-R
CL	Chest-L
SR	Shoulder-R
SL	Shoulder-L
BR	Back-R
BL	Back-L
PAR	Posterior Arm-R
PAL	Posterior Arm-L
AAR	Anterior Arm-R
AAL	Anterior Arm-L
PFR	Posterior Forearm-R
PFL	Posterior Forearm-L
AFR	Anterior Forearm -R
AFL	Anterior Forearm -L

Figure 3. 16 Body Locations for Film Badges in Experiments
(Modified from Buettner & Raasch, 1998, p. 588)

Experiment II

The Polysulphone films for personal dosimeters and for ambient tests were prepared in the same way as Experiment I. To control the variance, the unexposed films with absorbance values only between 0.073 and 0.103 at 330nm were included. A total of 254 film bandages were constructed for Experiment II: 224 bandages for 16 body locations under and over clothing for seven subjects (16 x 2 x 7) and 30 film badges for ambient tests (5 x 6 hr) with the badges labeled and stored in the same way as in experiment one.

Sampling Method

The population of this study is golfers who are 18 years of age or older, living in Michigan. From this population, 10 volunteers participated in the experiments. The sample was obtained by snowball sampling method. The researcher contacted three male golfers by phone and asked them to participate in this study after explaining the study purpose, and elements of informed consent. Also, the researcher explained the incentive that participants would play 18 holes of golf without charge on the day of the experiment and receive a gift certificate to play another day. When the subject voluntarily agreed to participate, the researcher scheduled a date for the experiment and asked them to recommend others with whom they played golf. Although participants in experiments might be diverse in height, weight, body size, or age, it was assumed that those variations would not bias the data for UV exposure to the body.

Data Collection

Experiment I

The first experiment was conducted at Forest Akers Golf Course East, at Michigan State University on August 28, 2002. The day was mostly sunny with a temperature in the mid 70s and a UV index of 7.

The researcher met subjects at the golf course 30 minutes before tee time. She explained the experimental procedure, and obtained their written informed consent. In addition, specific features of subjects' clothing such as fiber content, fabric structure, hue, shade of hue, and style of shirt were recorded on Table A1 in Appendix A because these characteristics influence protection from UVR transmission (Davis, et al., 1997; Gambichler, et al., 2002). Based on Figure 3, twelve bandages were placed on the skin of each subject on 12 body locations under the shirts and 12 bandages were placed on the surface of the shirts close to, but not directly over the badge that was under the clothing. Four bandages were attached to the skin of both right and left forearms that were directly exposed to the sun, because all subjects wore short-sleeve shirts. The subjects were exposed to the sun for approximately four and half hours: The first team of four subjects was exposed to the sun between 10:20 a.m. and 3 p.m., and the second team of three subjects was exposed from 11:10 a.m. to 3:20 p.m. After they finished playing golf, the film badges were retrieved and restored in double boxes as previously described.

To measure ambient exposure, 30 film badges were placed on papers on the roof of a car. The car was located in an open, unshaded area of the parking lot of the same golf course. Thirty badges were initially exposed when the subjects started playing golf. Five were removed each hour during the time participants were playing. Although the play was finished within five hours, the researcher obtained a total of six hours of exposure for the maximum length of play. Again, ambient films were stored in double boxes after retrieval.

Of the total 196 film badges for the subjects, nine were lost (4.6%) and 44 were damaged or torn (22.4%). Some loss and damage was probably due to the fact that the subjects had to carry the golf bags on the shoulder and the motion of the arm caused rubbing against film surfaces. Two out of 30 films for ambient measurement (6.7%) were damaged. The absorbance value of retrieved film badges was measured by spectrophotometer between 24 hours and 36 hours after exposure, since exposed film continued to degrade even though it was stored in UVR black boxes (Diffey, 1989).

Experiment II

The second experiment was conducted at the same golf course of Michigan State University on October 11, 2002. Since the subjects had to wear long-sleeved UV specialized shirts on the date of the second experiment, the researcher waited until the weather was cooler to avoid any potential problem with heat stress. Four of seven in the first experiment agreed to participate in the second experiment and to wear UV specialized shirts.

The day was mostly sunny with the temperature in the mid 50 °F in the morning and about 70 °F in the afternoon; the UV index was 4. The researcher met the subjects at East golf course 30 minutes before the tee time. After explaining the experiment purpose and process and obtaining subjects' written informed consent, the researcher placed 16 bandages under a subject's shirt and 16 bandages on the surface of the shirt on the basis of Figure 3. Four subjects who participated in Experiment I wore UV specialized shirts, which were constructed to block approximately 97% of UV radiation. Three wore their own shirts. All subjects wore long-sleeved shirts, but one subject rolled up his sleeves during the experiment. Thus, one set of film badges on his forearms was directly exposed to the sun. The researcher recorded the absorbance values of those four film badges for this subject as being over clothing because those films were directly exposed to the sun although they were attached on the skin. Then, the front and back sides of a subject were photographed, and clothing features were recorded on Table A2, in Appendix A. The first team of three subjects was exposed to the sun between 10 a.m. and 3 p.m., and the second team of four subjects was exposed from 11 a.m. to 3:40 p.m. The ambient levels were measured in the same manner as the first experiment. In order to reduce damage to the film badges on the shoulder and back sites, each participant used a pull cart to carry the golf bag.

When the film badges were retrieved after the experiment, 22 (10%) were damaged or torn and 2 (0.9%) were lost among 220 film badges for personal dosimeters. Among 30 film badges for the ambient test, two were damaged (6.7%). The absorbance value of exposed film badges were measured within 24 to 36 hours after film badges were retrieved. Eventually, the data obtained from the experiments would help to determine which body sites were exposed most among upper parts of the body and where golfers need additional protection.

Data Analysis and Discussion

Experiment I

Descriptions of Subjects' Garments

All seven subjects wore short sleeved knit shirts (see Table A1 in Appendix A). Four of them wore polo knit shirts (two or three buttons with knit collar), and one wore wool-and-nylon blend knit tee in black color. The other two wore cotton tees, and one of them wore a cotton vest over the tee. For this subject, the researcher attached film badges for under clothing measurement under the vest but over the tee. Six subjects wore 100% cotton shirts; three were white and three were of dark colors. All participants wore hats; five wore baseball caps and two wore visors. Only two of seven subjects wore sunglasses while playing golf. Six subjects were right handed, so they wore gloves on the left hands.

Absorbance Changes of Personal Dosimeters

Table 3 presents the mean and standard deviation of the absorbance changes (ΔA) among different body locations and results of paired sample t-test between over and under the shirts. The means of absorbance changes at each body location varied from 0.008 to 0.123 under clothing and from 0.062 to 0.254 over clothing. The amount of exposure at different body sites was influenced by the individual's movement, posture and orientation of the body to the sun as they were playing golf. A comparison of the mean scores shows that the most exposed site of the upper body over the shirts was the right shoulder, followed by the right back, the left back, and the left shoulder. The back of the neck and the front of the neck were the two most exposed areas under the shirts. This probably indicates that the badges were exposed directly to the sun even though they were intended to be covered by clothing. Although four of seven subjects wore t-shirts with collars, the collars did not prevent exposure from UVB due to golfers' stance while playing. Bending at the waist, resulted in high absorbance mean scores at the back of the neck both under and over the clothing (ΔA_U = .123; ΔA_O = .159). For this reason, the back of the neck had the highest absorbance value among the body locations under clothing. The front neck under the clothing also had a high mean score, because subjects unbuttoned the shirts exposing the badge under the shirt to the sun. The effects of clothing cannot be compared for forearm sites since all subjects wore short sleeve shirts.

Table 3. Site-Specific UV Exposures and Paired Sample T-test between Under and Over Clothing in Experiment I

Body Locations	Under Clothing (ΔA_U)		Over Clothing (ΔA_O)		t-value (df)[b]	p
	Mean (N)[a]	SD	Mean (N)[a]	SD		
Neck-Front	.072 (7)	.043	.094 (7)	.057	1.140 (6)	.298
Neck-Back	.123 (4)	.059	.159 (7)	.072	0.951 (3)	.412
Chest-R[c]	.019 (7)	.025	.135 (5)	.040	5.877 (4)	.004**
Chest-L[d]	.008 (6)	.002	.107 (4)	.022	9.276 (3)	.003**
Shoulder-R	.012 (6)	.013	.254 (4)	.046	11.662 (3)	.001**
Shoulder-L	.010 (6)	.009	.183 (4)	.037	11.529 (3)	.001**
Back-R	.010 (5)	.008	.205 (4)	.062	4.067 (2)	.055
Back-L	.011 (4)	.010	.185 (5)	.041	2.629 (1)	.231
Posterior Arm-R	.006 (6)	.008	.113 (6)	.029	7.692 (4)	.002**
Posterior Arm-L	.018 (5)	.027	.132 (5)	.018	10.104 (2)	.010*
Anterior Arm-R	.012 (3)	.019	.062 (3)	.045	n.a.[e]	n.a.
Anterior Arm-L	.016 (4)	.026	.105 (6)	.027	2.766 (2)	.110
Posterior Forearm-R	n.a.	n.a.	.088 (4)	.028	n.a.	n.a.
Posterior Forearm-L	n.a.	n.a.	.091 (6)	.052	n.a.	n.a.
Anterior Forearm -R	n.a.	n.a.	.125 (7)	.026	n.a.	n.a.
Anterior Forearm -L	n.a.	n.a.	.107 (3)	.035	n.a.	n.a.
TOTAL	.029 (45)	.044	.143 (45)	.064	9.452 (44)	.000 ***

(N)[a]: Numbers of samples. (df)[b]: Degree of freedom of t-test. R[c]: Right. L[d]: Left. n.a.[e]: cannot analyzed

*p < .05, **p < .01, ***p < .001

Paired sample t-test was used to analyze the differences between the absorbance values of dosimeters placed over and under the clothing since the two values at the same body sites of a subject were obtained under the same conditions and were dependent on subjects' movement. The mean difference between absorbance values over and under clothing across all body sites was significant at the .001 level ($t = 9.452$, $df = 44$, $p = .000$). Specifically, significant differences in absorbance changes between over and under clothing were found at the right and left of the chest, the right and left of the shoulder, and the right and left of posterior arm in Table 3 ($p < .05$). This finding indicated that the regular golf t-shirts that were worn by the subjects reduced the UVR transmission to some extent although the characteristics of t-shirts varied.

Interestingly, absorbance values for the back site were not significant statistically either at the right or the left side although it approached significance for the right side of the body. This may be due to the limited number of paired samples. The anterior arm was not significantly different in the absorbance values between over and under clothing while the posterior arm was significant. This finding might imply that swing movement is less influential than movement from walking. Anterior arm is mostly exposed to the sun while swinging the golf club, whereas the posterior arms as well as the shoulder sites are always exposed to the sun during golf rounds.

In comparison of the absorbance values between left and right sides of the same body location in Table 4, paired sample t-test showed that only the shoulder site over the clothing was significant. The explanation of this difference is not readily apparent. It might be attributable to carrying a golf bag on the shoulder or to measurement errors.

These findings might be useful information for golf wear designers, indicating that golfers could be exposed to different amounts of UVR in relation to body sites.

Table 4. Comparison between Left and Right Sides of the Body Over Clothing and Paired Sample T-test in Experiment I

Body Location	Left Side (ΔA_O)		Right Side (ΔA_O)		t-value (df) [b]	p
	Mean (N)[a]	SD	Mean (N)[a]	SD		
Shoulder	.186 (2)	.033	.267 (2)	.031	53.995 (1)	.012*

(N)[a]: Numbers of samples. (df)[b]: Degree of Freedom of t-test.

*p < .05.

Absorbance Changes of Ambient Dosimeters

Table 5 presents the absorbance changes (ΔA) of five film badges exposed to ambient conditions for each time interval, and Figure 4 shows the scatterplot of these data. The absorbance values increased from one to four hours of exposure and then dropped for the 5th and 6th hours. The reduced value after four hours indicates that the polysulphone film when exposed to UVB was saturated after four hours (Gies, et al., 1995; Herlihy, et al., 1994). In addition, a few outliers were found as shown in Figure 4 and Figure 5.

Table 5. Absorbance Change of Ambient Dosimeter by Hours Exposed in Experiment I

Time	Film 1	Film 2	Film 3	Film 4	Film 5	Mean	SD
10:20-11:20	.1184	.1158	.0961	.0968	.0929	.104	.012
10:20-12:20	.1917	X	.1368	.1737	.2384	.185	.042
10:20-13:20	.3370	.3183	.3208	.1891	.2850	.290	.060
10:20-14:20	.3853	.4081	.3677	.4083	.3792	.390	.018
10:20-15:20	.4564	.3777	.3803	.3740	.2905	.376	.059
10:20-16:20	.1715	.3747	X	.2476	.2815	.269	.084

Figure 4. Scatterplot of Cumulative Ambient Exposure by Hours in Experiment I

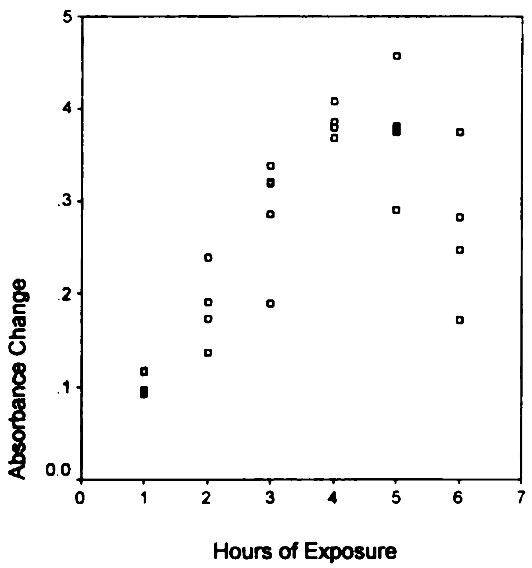
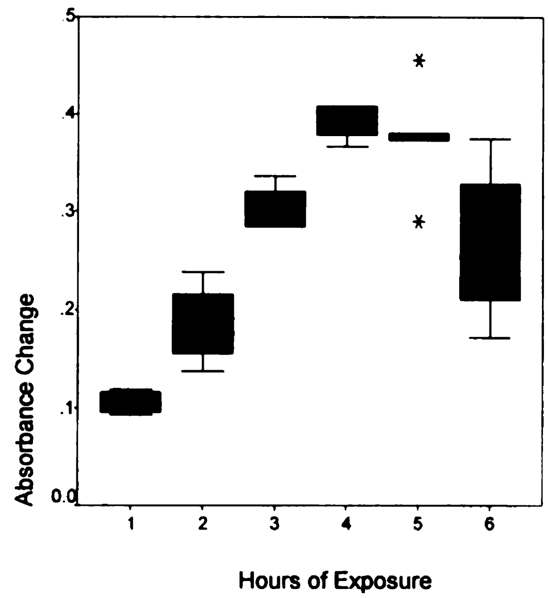


Figure 5. Box Plot of Cumulative Ambient Exposure by Hours



Z-scores reported in Table 6 were calculated in order to find out "how many standard deviations the observed score lies from the mean" (Shavelson, 1995, p. 125). The formula of z-score is:

$$z = \frac{X - \overline{X}}{SD}$$

where: X = variable X

$\overline{X}$ = mean of a set of scores on variable X

SD = standard deviation

Table 6. Z-scores for Ambient Dosimeters by Hours Exposed in Experiment I

Time	Film 1	Film 2	Film 3	Film 4	Film 5
10:20-11:20	1.1922	.9763	-.6534	-.5981	-.9170
10:20-12:20	.1547	X	-1.1453	-.2708	1.2614
10:20-13:20	.7887	.4743	.5175	**-1.6965**	-.0841
10:20-14:20	-.2470	1.0228	-1.2223	1.0292	-.5827
10:20-15:20	**1.3720**	.0330	.0777	-.0302	**-1.4525**
10:20-16:20	-1.1553	1.2566	X	-.2521	.1507

Based on z-scores and the box plot (Figure 5), three values ($z \geq 1.3$, bold, Table 6) were deleted as outliers.

Comparison of Personal Dosimeters with Ambient Exposure

In order to compare the absorbance change of each body location with the ambient level, the regression line of the ambient data was necessary. As Holman, et al. (1983) indicated after some period of time a linear relationship did not exist in the absorbance changes of ambient exposure, and this is consistent with the data in Table 6. It happened because the polysulphone films were saturated at some point as UV radiation dosages increased. That is, it could be considered that the absorbance changes of film badges would increase as time increases if there were no saturation limits of the polysulphone film. In Figure 4, the relationship was approximately linear between the absorbance changes and one- to four-hour exposure. The researcher included only this four-hour interval and cleaned the data by deleting three outliers in Table 6, and excluded the data for the 5th and 6th hour due to the nonlinearity. The linear regression equation was obtained by regression analysis. The result is reported in Table 7.

$$Y = 0.098X + 0.003119$$

where: Y = total amount of ambient exposure received by a subject

X = total amount of hours exposed to UVR

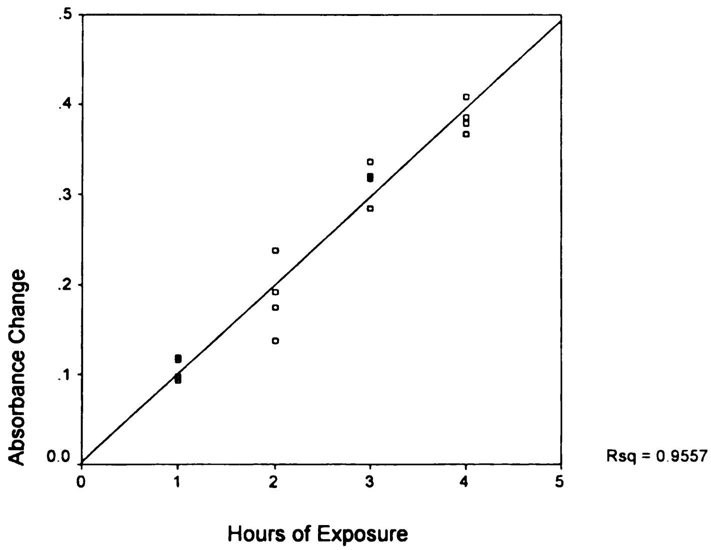
Table 7. Regression Analysis for Hours Exposed Predicting Absorbance Change on Ambient Exposure

Variable	B	SE B	β	p
Constant	.003	.015		.833
Hours exposed	.098	.005	.978	.000***

***p < .001

An R^2 of .956 (Adj. R^2 = .953) indicated that the regression line was fitted well to the sample data. The scatter plot and the fitted line of the absorbance changes of the ambient UVB exposure between 10:20 a.m. and 2:20 p.m. are presented in Figure 6.

Figure 6. Scatterplot of Cumulative Ambient Exposure and Regression Line for Experiment I



From this equation, it is possible to obtain the total corresponding amount of UVR exposure received by golfers during play. The proportion of total ambient exposure to each body site for each subject was obtained for comparisons among different body locations. The two teams of golfers were exposed to the sun for different amounts of time, so the total amount of the absorbance changes of ambient exposure was calculated separately as follow:

Team 1: $Y = 0.098 \times (4.67 \text{ hr}) + 0.003119 = 0.460779 \approx 0.461$

Team 2: $Y = 0.098 \times (4.17 \text{ hr}) + 0.003119 = 0.411779 \approx 0.412$

Then the fraction of total ambient UVB received at each body site was obtained by dividing the absorbance change of each location of a subject by the total ambient exposure during the subject's golf rounds.

Table 8 presents the mean proportion of the total ambient exposure for each body location received by seven golfers during Experiment I. The data show that the amounts of UVB radiation received under the clothing during playing golf ranged from 1.3% to 29% of the total ambient UVB, while subjects received 14.7% to 59% of ambient UVB directly over the clothing. Since ambient UVB was measured at the same golf course in an open, horizontal, unshaded area, the proportions indicate that golfers were not exposed fully to UVB. Exposure was influenced by golfer's position and orientation to the sun while playing, golfer's clothing characteristics, weather, and topography of the golf course.

Table 8. Mean Proportion of Ambient UVR Received at 16 Body Sites in Experiment I

Body Locations	Under Clothing		Over Clothing	
	Mean ± SD	Sample size	Mean ± SD	Sample size
Neck-Front	.166 ± .097	7	.210 ± .122	7
Neck-Back	.289 ± .152	4	.357 ± .153	7
Chest-R[a]	.042 ± .053	7	.309 ± .106	5
Chest-L[b]	.018 ± .006	6	.238 ± .042	4
Shoulder-R	.028 ± .031	6	.586 ± .119	4
Shoulder-L	.023 ± .020	6	.421 ± .090	4
Back-R	.022 ± .018	5	.469 ± .128	4
Back-L	.025 ± .022	4	.421 ± .098	5
Posterior Arm-R	.013 ± .018	6	.262 ± .078	6
Posterior Arm-L	.040 ± .058	5	.301 ± .048	5
Anterior Arm-R	.026 ± .041	3	.147 ± .111	3
Anterior Arm-L	.037 ± .062	4	.237 ± .065	6
Posterior Forearm-R	n.a.[c]		.196 ± .059	4
Posterior Forearm-L	n.a.		.204 ± .112	6
Anterior Forearm -R	n.a.		.285 ± .061	7
Anterior Forearm -L	n.a.		.241 ± .071	3

R[a]: Right. L[b]: Left. n.a.[c] cannot analyzed

The lower proportion of ambient UVB under the clothing compared with the proportion over the clothing indicated how important wearing a shirt would be to reduce UVB exposure while exercising outside. In addition, body sites over the clothing that were directly exposed to the sun were diverse in the proportion absorbed as well. This can be explained by the effect of shadows from body posture, movement of the golfer, or individual's different techniques. These data would be useful to compare with the data collected under a different ambient condition such as the different UV index.

Experiment II

Descriptions of Subjects' Garments

On the date of the second experiment, all subjects wore long-sleeved shirts. The description of subjects' garment characteristics are provided in Table A2 in Appendix A. Four subjects were asked to wear beige UV specialized woven shirts that were provided by the researcher. The shirts were purchased at Sun Precautions, Inc. They were made of 100% nylon, constructed to block approximately 97% of UVA and UVB radiation. Mesh panels were inserted under the arms in the sleeve and side line, and in the back yoke of the shirt for ventilation. The other three participants wore their own shirts. Two wore cotton knit sweatshirts in white and in navy color, and the other wore a brown corduroy woven shirt with a collar. All subjects wore hats: six wore baseball caps and one wore a visor. No one wore sunglasses during their play. Six subjects were right handed, so they wore gloves on the left hands.

Absorbance Changes of Personal Dosimeters

Comparison between different types of shirts. For personal exposure measurements, first, the researcher compared the effect of clothing on the absorbance changes of film badges in the same locations under the clothing. Table 9 shows the comparison of the mean differences between the absorbance changes under UV protective shirts and under subject's own shirts.

Table 9. Site-Specific UV Exposures Under Clothing and Independent Sample T-test between UV Shirts and Regular Shirts in Experiment II

Body Locations	UV Shirts Under Clothing (ΔA_{UUV})		Regular Shirts Under Clothing (ΔA_{UT})		t-value	p
	Mean (N)[a]	SD	Mean (N)[a]	SD		
Neck-Front	.0471(4)	.019	.0476 (3)	.041	.19	.99
Neck-Back	.0535 (3)	.018	.0000 (1)	n.a.[b]	-2.60	.12
Chest-R [c]	.0000 (4)	.000	.0046 (3)	.008	1.00	.42
Chest-L [d]	.0038 (3)	.005	.0018 (3)	.003	-.64	.56
Shoulder-R	.0001 (4)	.000	.0010 (2)	.002	.89	.54
Shoulder-L	.0014 (4)	.003	.0000 (3)	.000	-.85	.44
Back-R	.0018 (4)	.003	.0000 (3)	.000	-.94	.39
Back-L	.0011 (4)	.002	.0000 (2)	.000	-.67	.54
Posterior Arm-R	.0010 (3)	.002	.0000 (2)	.000	-.78	.50
Posterior Arm-L	.0027 (4)	.005	.0000 (3)	.000	-.85	.44
Anterior Arm-R	.0037 (4)	.006	.0014 (3)	.003	-.65	.55
Anterior Arm-L	.0008 (3)	.001	.0000 (2)	.000	-.78	.45
Posterior Forearm-R	.0227 (4)	.029	.0000 (2)	.000	-1.03	.36
Posterior Forearm-L	.0098 (3)	.006	.0000 (2)	.000	-2.39	.01*
Anterior Forearm -R	.0114 (4)	.008	.0000 (1)	n.a.	-1.25	.30
Anterior Forearm -L	.0128 (2)	.018	.0000 (2)	.000	-1.01	.42

(N)[a]: Numbers of samples. n.a.[b]: cannot analyzed R[c]: Right. L[d]: Left.

*$p < .05$.

There was no significant difference in amount of UVB absorbed through two different types of shirts, except for the left posterior forearm. The mean absorbance value of the left posterior forearm was higher in UV specialized shirts ($\Delta A_{UUV} = .0098$) than regular shirts ($\Delta A_{UT} = .0000$). This difference could be attributed to subject's clothing habits (unfastening the sleeve cuffs), clothing characteristics (a slit in the sleeve), or a measurement error. Table 9 suggests that UV specialized shirts do not block UV radiation more effectively than the regular fall shirts. It might be due to the thickness and weight of subject's own shirts: The sweatshirts and a corduroy shirt were thicker than UV specialized shirts as well as summer knit golf shirts, thus they offered more sun protection.

Comparison between under and over clothing. Table 10 presents the means and standard deviations of absorbance changes in each body location. In addition, it includes the results of paired sample t-test, comparing the absorbance values of the dosimeters in the same location between under and over clothing. Since there were no significant differences in the absorbance changes between two types of shirts except for the posterior forearm (Table 9), the data of under UV specialized shirts were combined with the data under regular shirts to increase the sample size. Significant differences of the mean absorbance values between under clothing and over clothing were found in all body locations except for the front neck area. It is noteworthy that wearing UV specialized shirts or fall shirts would prevent UVR transmission to a great extent. The only body site where the mean exposure over clothing was not significantly greater than the corresponding position under clothing was at the front neck. This might be due to the fact that the film bandage location of the front neck over clothing was inconsistent across subjects, because five of six subjects unbuttoned their shirts, and one wore a shirt without a collar.

Under clothing. Among the body sites under clothing, the most exposed area was the front neck ($\Delta A_U = .047$), followed by the back of the neck ($\Delta A_U = .040$). Because most subjects unbuttoned their shirts when they were playing, it might have led to greater exposure of the front neck to the sun than the other sites. Although the difference between under and over clothing at the back of the neck was significant because shirts with collars could generate shade, the neck was highly exposed to the sun due to the body posture required to play golf. The least exposed areas under clothing were the shoulder and back, perhaps because these areas were covered with two layers of fabric of the bodice back yoke.

Table 10. Site-Specific UV Exposures and Paired Sample T-test between Under and Over Clothing in Experiment II

Body Locations	Under Clothing (ΔA_U)		Over Clothing (ΔA_O)		t-value (df)[b]	p
	Mean (N)[a]	SD	Mean (N)[a]	SD		
Neck-Front	.0473 (7)	.027	.0558 (5)	.033	.891 (4)	.423
Neck-Back	.0401 (4)	.030	.0954 (7)	.027	12.327 (3)	.001**
Chest-R[c]	.0020 (7)	.005	.0904 (6)	.016	13.644 (5)	.000***
Chest-L[d]	.0028 (6)	.004	.0893 (5)	.028	5.386 (3)	.013*
Shoulder-R	.0004 (6)	.001	.1237 (6)	.012	26.023 (5)	.000***
Shoulder-L	.0008 (7)	.002	.1480 (6)	.020	17.287 (5)	.000***
Back-R	.0010 (7)	.003	.1148 (7)	.014	25.245 (6)	.000***
Back-L	.0007 (6)	.002	.0996 (7)	.015	17.990 (5)	.000***
Posterior Arm-R	.0006 (5)	.001	.0664 (7)	.027	5.218 (4)	.006**
Posterior Arm-L	.0015 (7)	.004	.0762 (7)	.011	13.953 (6)	.000***
Anterior Arm-R	.0027 (7)	.004	.0694 (7)	.029	5.786 (6)	.001**
Anterior Arm-L	.0005 (5)	.001	.0562 (6)	.025	3.766 (3)	.033*
Posterior Forearm-R	.0151 (6)	.026	.0682 (6)	.017	3.575 (4)	.023*
Posterior Forearm-L	.0059 (5)	.007	.0664 (7)	.025	10.147 (4)	.001**
Anterior Forearm -R	.0091 (5)	.009	.0497 (6)	.015	7.334 (3)	.005**
Anterior Forearm -L	.0064 (4)	.013	.0437 (7)	.015	5.403 (3)	.012*
TOTAL	.0074 (85)	.016	.0853 (85)	.034	18.569 (84)	.000***

(N)[a]: Numbers of samples. (df)[b]: Degree of freedom of t-test. R[c]: Right. L[d]: Left.

*p < .05, **p < .01, ***p < .001

Over clothing. The most highly exposed areas over the clothing were the left shoulder (ΔA_U = .148), followed by the right shoulder (ΔA_U = .124), the right back (ΔA_U = .115), and the left back (ΔA_U = .10), consistent with the findings of Experiment I. When golfers play, they have to bend at the waist, causing greater UVR exposure for these sites than the chest sites. Also, the back sites might be more directly exposed to the sun when golfers walked on the golf course during play. The least exposed areas among the upper body sites were the anterior forearm areas and front neck.

Comparison between left and right sides. When comparing the absorbance changes between left and right sites of the upper body, a significant difference was found only in the back over clothing at α = .05 level (Table 11). There were no statistical differences for the other sites, indicating that left and right sides of the upper body under clothing or over clothing, except for the shoulder area, were exposed to the sun in a similar way while playing golf. In comparison to Table 4 in Experiment I, the difference between left and right sides of body was revealed on the shoulder during the summer season and on the back during the fall. This might be related to the angle of the sun and golfer's orientation to the sun.

Table 11. Comparison between Left and Right Sides of the Body Over Clothing and Paired Sample T-test in Experiment II

Body Location	Left Side (ΔA_O)		Right Side (ΔA_O)		t-value (df)[b]	p
	Mean (N)[a]	SD	Mean (N)[a]	SD		
Back	.0996 (7)	.015	.1148 (7)	.014	3.027 (6)	.023*

(N)[a]: Numbers of sample data. (df)[b]: Degree of Freedom of t-test.

*p < .05.

Absorbance Changes in Ambient Dosimeters

Table 12 shows the absorbance changes (ΔA) of ambient exposure measurements for each time interval and provides the means, and standard deviations. When comparing the mean of each time interval, the absorbance change increased steadily from one hour to four hours of exposure, but did not increase after four-hour exposure. The absorbance value at six hours dropped. The variation of the absorbance values after five hours exposure might be due to exceeding the saturation limit of the polysulphone films with the increase of UV radiation dosage.

Table 12. Absorbance Change of Ambient Dosimeter by Hours Exposed in Experiment II

Time	Film 1	Film 2	Film 3	Film 4	Film 5	Mean	SD
10:00-11:00	.0318	.0440	.0431	.0179	.0221	.032	.012
10:00-12:00	.0643	.0630	.0830	.0364	.0616	.062	.017
10:00-13:00	.1195	.0778	.1080	.1062	.0904	.100	.016
10:00-14:00	.0797	.1353	.1359	.1439	.1076	.121	.027
10:00-15:00	.1337	.1260	.1356	X	.1272	.131	.005
10:00-16:00	.1304	.1007	.1094	.1636	X	.126	.028

Figure 7 is the scatterplot of the absorbance changes of ambient exposure in Experiment II and Figure 8 is the box plot of the same data, demonstrating the location of the mean and the potential outliers. The data that were far away from the mean would result in large standard deviation.

To check the outlier, the researchers obtained the z-scores in Table 13 in the same manner as experiment I and four values of z-scores (bold) that were greater than the absolute value of 1.3 (1.3 standard deviation away from the mean) were considered as outliers.

Figure 7. Scatterplot of Cumulative Ambient Exposure by Hours in Experiment II

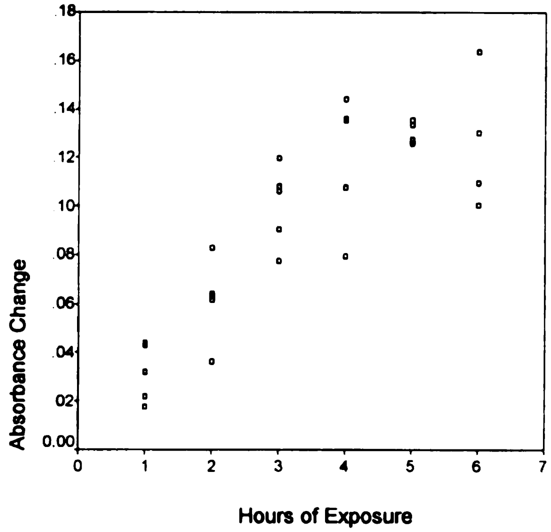


Figure 8. Box Plot of Cumulative Ambient Exposure by Hours

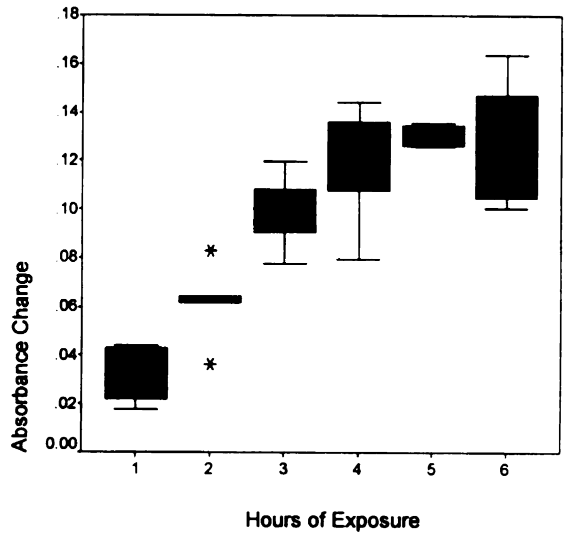


Table 13. Z-scores for Ambient Dosimeters by Hours Exposed in Experiment II

Time	Film 1	Film 2	Film 3	Film 4	Film 5
10:00-11:00	.0063	1.0320	.9484	-1.1694	-.8173
10:00-12:00	.1593	.0822	1.2851	**-1.5220**	-.0047
10:00-13:00	1.1701	**-1.3826**	.4682	.3557	-.6113
10:00-14:00	**-1.5317**	.5572	.5796	.8792	-.4843
10:00-15:00	.6495	-.9855	1.0485	X	-.7124
10:00-16:00	.1559	-.9060	-.5928	**1.3429**	X

Comparison of Personal Dosimeters with Ambient Exposure

In order to standardize the absorbance values of personal exposure to the ambient UVB, the researcher needed to determine the equivalent absorbance changes in the ambient level as in Experiment I. As Herlihy, et al. (1994) emphasized that the absorbance change of the film badges "should be kept within the linear region" (p. 289), the researcher included only the data between one hour and four hours of exposure and ignored the data for the 5th and 6th hour due to the nonlinear relationships. The data from one to four hours of exposure was comparable with the first experiment. A regression equation was obtained by a regression analysis as follows:

$Y = 0.0336X - 0.00003$

where: Y = total amount of ambient exposure received by a subject

X = total amount of hours exposed to UVR

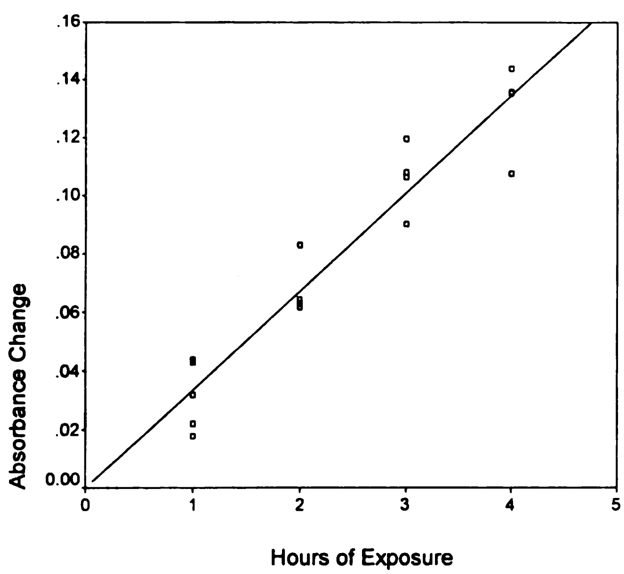
Table 14. Regression Analysis for Hours Exposed Predicting Absorbance Change in Ambient Exposure

Variable	B	SE B	β	p
Constant	-.0030	.007		.997
Hours exposed	.0336	.003	.958	.000***

***p < .001

From the equation, it is predicted that for every additional hour of exposure, the absorbance value will increase by .0336. R^2 is .918 (adjusted $R^2 = .912$), suggesting that the regression line is fitted well to the sample data. Figure 9 shows the scatterplot and the regression line of the ambient exposure during four hour intervals.

Figure 9. Scatterplot of Cumulative Ambient Exposure and Regression Line for Experiment II



However, if $X = 0$ (zero hours exposed to the sun), the calculated absorbance value is -.00003, which is very small value and illogical because the absorbance change has to start at zero when the film badges are not exposed to the sun. Accordingly, the equation of $Y = 0.0336X$ was used for Experiment II. From this equation, the total corresponding amount of UVR exposure received by golfers during play was obtained. The first team was exposed between 10 a.m. and 3 p.m., and the second team was exposed between 11 a.m. and 3:40 p.m. The total amount of ambient exposure for each team was calculated separately as follows:

Team 1: $Y = 0.0336 \times (5 \text{ hr}) = 0.168$

Team 2: $Y = 0.0336 \times (4.67 \text{ hr}) = 0.156912 \approx 0.157$

Then the amount of UV radiation each body site received was expressed as a proportion of the total ambient exposure by dividing the absorbance change of each body location by the total amount of ambient exposure of each team.

Table 15 presents the proportion of the total ambient exposure for each body location received by golfers during Experiment II. The proportions of ambient UVB under the shirts (first column) ranged from 0.3% (right shoulder & anterior left arm) to 29% (front neck), whereas the proportions over the clothing (last column) ranged from 27.2% (anterior left forearm) to 92.5% (left shoulder). The most exposed sites over clothing after the left shoulder, in order were the right shoulder (76%), the right back (71%), the left back (62%), the back of the neck (59%), and the right (56%) and left (54%) of the chest sites. Under the clothing, the body sites, such as the shoulder, back, posterior arm, and the anterior left arm received less than 1% of ambient UVB across all types of shirts. That is, the trunks of golfers was exposed to UVB to a great extent, but UVB penetrated the shirts less than 1% of the ambient while playing golf when golfers wore UV specialized shirts or heavy fall shirts.

Table 15. Mean Proportion of Ambient UVR Received at 16 Body Sites in Experiment II

Body Locations	Under Clothing			Over Clothing
	Mean ± SD (Total)[a]	Mean ± SD (UV Shirt)[a]	Mean ± SD (Regular Shirt)[a]	Mean ± SD (Total)[a]
Neck-Front	.290 ± .165 (7)	.288 ± .107 (4)	.293 ± .253 (3)	.349 ± .209 (5)
Neck-Back	.252 ± .195 (4)	.336 ± .121 (3)	n.a. (1)	.592 ± .176 (7)
Chest-R[b]	.012 ± .031 (7)	0 (4)	.027 ± .047 (3)	.562 ± .094 (6)
Chest-L[c]	.017 ± .022 (6)	.023 ± .027 (3)	.011 ± .018 (3)	.543 ± .162 (5)
Shoulder-R	.003 ± .005 (6)	.001 ± .001 (4)	.006 ± .009 (2)	.763 ± .091 (6)
Shoulder-L	.005 ± .013 (7)	.009 ± .017 (4)	0 (3)	.925 ± .144 (6)
Back-R	.006 ± .016 (7)	.011 ± .021 (4)	0 (3)	.712 ± .102 (7)
Back-L	.005 ± .011 (6)	.007 ± .014 (4)	0 (2)	.617 ± .093 (7)
Posterior Arm-R	.004 ± .008 (5)	.006 ± .010 (3)	0 (2)	.411 ± .170 (7)
Posterior Arm-L	.009 ± .024 (7)	.016 ± .032 (4)	0 (3)	.473 ± .079 (7)
Anterior Arm-R	.016 ± .026 (7)	.022 ± .033 (4)	.008 ± .015 (3)	.430 ± .180 (7)
Anterior Arm-L	.003 ± .007 (5)	.005 ± .009 (3)	0 (2)	.347 ± .158 (6)
Posterior Forearm-R	.095 ± .163 (6)	.143 ± .187 (4)	0 (2)	.420 ± .103 (6)
Posterior Forearm-L	.036 ± .040 (5)	.059 ± .032 (3)	0 (2)	.410 ± .144 (7)
Anterior Forearm -R	.056 ± .053 (5)	.071 ± .049 (4)	n.a (1)	.307 ± .098 (6)
Anterior Forearm -L	.038 ± .076 (4)	.076 ± .106 (2)	0 (2)	.272 ± .094 (7)

(N)[a]: Numbers of samples. R[b]: Right. L[c]: Left.

Specifically, the highest proportions of the ambient UVB under the UV specialized shirts (second column), if the front and back of the neck were excluded due to the inconsistent measurement, was the posterior right forearms. This site received about 14% of ambient UVB. The other forearm sites also received higher proportions of UVB compared with the other body sites. This might be because the film badges under the UV shirts were exposed through the unfastened cuffs of the sleeves. The proportions of ambient UVB among the body sites under the regular shirts ranged between 0% and 3%

except the front neck. Most of body sites under the typical fall shirts did not register UVB penetration through the fabrics. That is, if golfers wore sweatshirts or corduroy shirts, which were much heavier and thicker than UV specialized shirts while they played, those shirts were more effective in preventing UVB exposure than UV specialized shirts.

Summary

The objectives of this chapter are to determine the cumulative exposure of different body sites to UVB during golf rounds and to evaluate the effects of clothing to prevent UV transmissions from the sunlight.

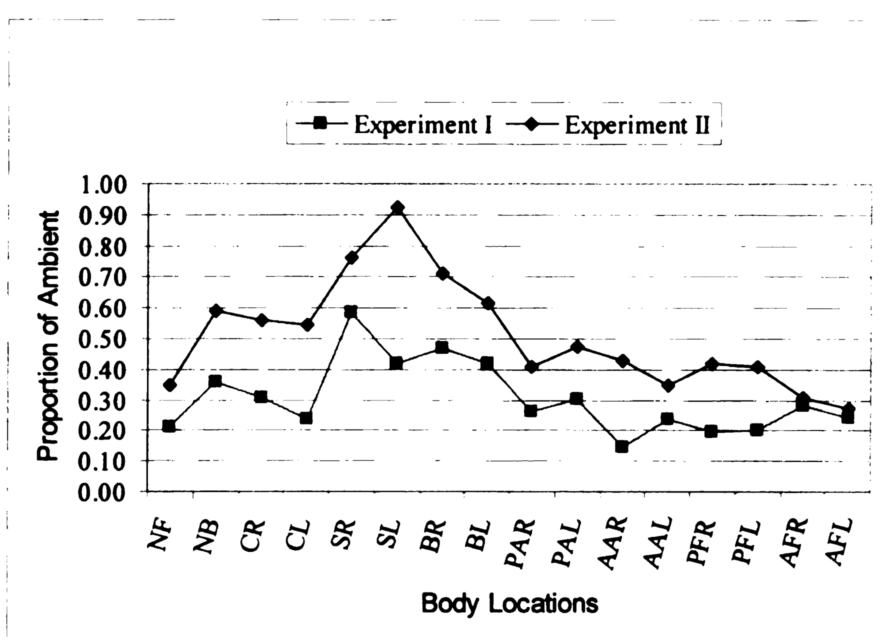
Research Question 1 for Objective 1

- To What Extent do Golfers Receive UV Radiation with respect to 16 Upper Body Sites?

Figure 10 presents the mean proportion of ambient UVB at each body site over the clothing for Experiment I and Experiment II. The proportions over the clothing indicate the amount of UV radiation received directly by the different body sites with respect to the ambient conditions of each experiment date. It indicates how much a golfer is exposed to the sun relative to the available ambient exposure. The proportion allows direct comparison in two different ambient conditions.

In both experiments, each body location received different amounts of UVR, but there was a pattern for the data for body locations. Although the graphs do not match exactly in both experiments, the shoulder and back sites receive the greatest UVR exposure, followed by the back of the neck, chest, posterior arms, and anterior forearms. These findings are comparable to the study of Elwood and Gallagher (1998) that melanoma was more likely to be diagnosed at the back and the upper arms of males under ages 50 years old. The other sites such as anterior arm (AAR & AAL) and posterior forearm (PFR & PFL) were not consistent for absorbance proportions, which might be due to individual's movements.

Figure 10. Mean Proportions of Ambient UVR Exposure Over Clothing for Experiment I and II



NF	Neck-Front
NB	Neck-Back
CR	Chest-R
CL	Chest-L
SR	Shoulder-R
SL	Shoulder-L
BR	Back-R
BL	Back-L
PAR	Posterior Arm-R
PAL	Posterior Arm-L
AAR	Anterior Arm-R
AAL	Anterior Arm-L
PFR	Posterior Forearm-R
PFL	Posterior Forearm-L
AFR	Anterior Forearm -R
AFL	Anterior Forearm -L

The graph of Experiment II in Figure 10 shows higher proportions of ambient UVR than that of Experiment I. The proportion was obtained by dividing the absorbance change of each body location by the total amount of ambient exposure, and the total amount of the ambient exposure received by golfers in Experiment II (ΔA_{ambII} = .168 for team 1 & .157 for team 2) were much lower than those in Experiment I (ΔA_{ambI} = .461 for team 1 & .412 for team 2). The amount of UVR during both experiments would be influenced by the ambient conditions, such as UVR intensity. The UV indexes which indicate "UV intensity levels on a scale of 0 to 10+" (U.S. Environment Protection Agency, 2002) are different on the two experiment days. The day of the first experiment (summer), the UV index was 7; the day of the second experiment (fall), the UV index was 4. Hence, the difference in the proportions shown in Figure 10 may reflect the different intensity of the UV radiation.

Research Question 2 for Objective 1

- What Parts of the Upper Body Receive the Most UV Radiation while Playing Golf?

When comparing the mean absorbance changes across body-specific sites in Table 3 and in Table 10, the shoulder and back on both right and left sides had the highest mean scores among all body sites, followed by the back of the neck, chest, and posterior arms. These findings are consistent with the findings of Gie, et al.'s study (1995) and Herlihy, et al.'s (1994). The back sides of golfers seem to be more exposed to the sun than the front sides of their bodies while they play golf. The anterior arm, the anterior forearms, and the front neck received relatively lower mean scores than other sites, although the right and left sides of those areas differed for both experiments.

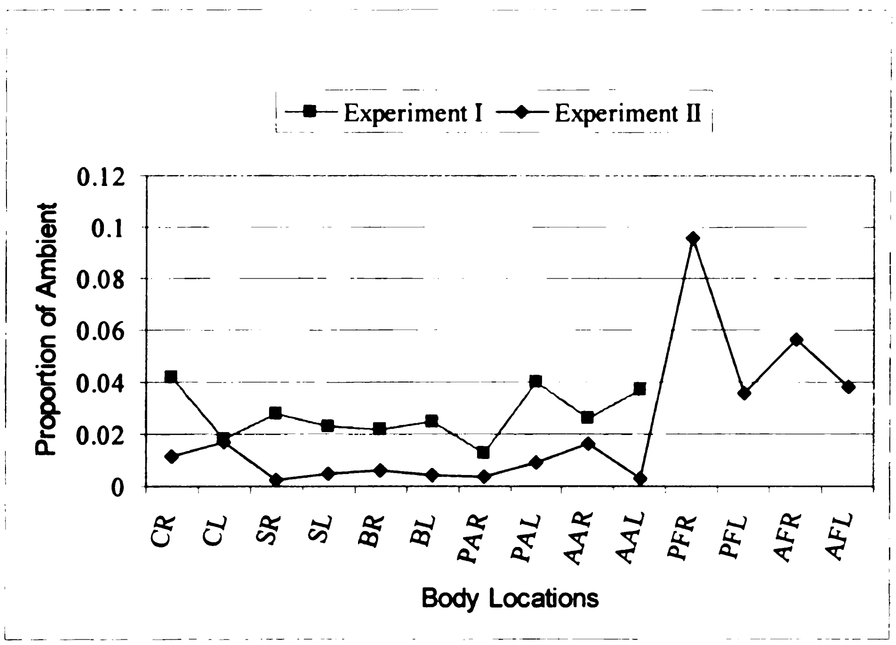
Research Question 1 for Objective 2

- To What Extent do Golf Shirts Reduce UV Radiation?

Results of paired sample t-test in Table 3 and Table 10 show significant differences in the mean absorbance changes between over and under clothing. While the chest, shoulder, and posterior arm in Experiment I were significant in the effects of golf t-shirts to reduce UVB transmission, all body sites except for the front neck were significant in Experiment II.

Figure 11 presents the mean proportion of ambient UVB under clothing for Experiment I and II. The absorbance proportions in Experiment I were higher than those in Experiment II across all body sites. The mean proportions of Experiment I are obtained from summer thin, short-sleeved knit shirts, whereas the data of Experiment II are based on the sum of two types of clothing, the UV specialized shirts and subjects' typical fall shirts. Figure 11 indicates that summer shirts are less effective in blocking UV radiation than the thicker fall shirts or UV specialized shirts. In Figure 10, the shoulder and the back over clothing were exposed to UVR the most, but these locations had lower proportion under clothing in Figure 11. The two layers of back yoke of UV specialized shirts and corduroy shirts would contribute to producing an effective barrier to UVR.

Figure 11. Mean Proportions of Ambient UVR Exposure Under Clothing for Experiment I and II



NF	Neck-Front
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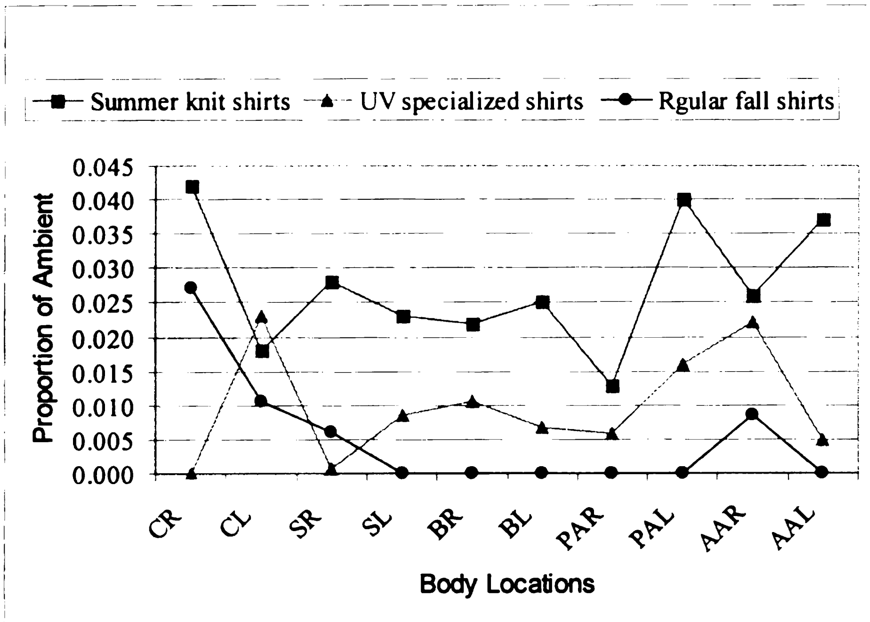
SL	Shoulder-L
BR	Back-R
BL	Back-L
PAR	Posterior Arm-R
PAL	Posterior Arm-L
AAR	Anterior Arm-R
AAL	Anterior Arm-L
PFR	Posterior Forearm-R
PFL	Posterior Forearm-L
AFR	Anterior Forearm -R
AFL	Anterior Forearm -L

Research Question 2 for Objective 2

- Do the Differences in Absorbance Values Under the Shirt Vary with the Types of Shirts, UV Specialized Shirts and Regular Golf Shirts?

Specific comparisons in the two experiments under clothing were possible if the values of the neck sites were excluded because of great differences between the neck sites and the other upper body parts. The data of forearm sites were not included also, because every subject in Experiment I wore short sleeve shirts so the data under clothing were not obtained. Figure 12 presents only the trunk parts and the upper arms of the body and compares the proportions of ambient UVB received by those body sites between Experiment I and Experiment II.

Figure 12. Mean Proportions of Ambient UVR Exposure Under Different Types of Shirts for Experiment I and II



CR	Chest-R
CL	Chest-L
SR	Shoulder-R
SL	Shoulder-L
BR	Back-R
BL	Back-L
PAR	Posterior Arm-R
PAL	Posterior Arm-L
AAR	Anterior Arm-R
AAL	Anterior Arm-L

In Figure 12, the summer shirts of Experiment I had the highest proportion of ambient UV radiation absorbed under clothing at most body locations. Especially, the right of the chest (CR), posterior left arm (PAL), and anterior left arm (AAL) received higher proportions of ambient UVB compared with other types of shirts. In Experiment I, all seven subjects wore short-sleeved knit shirts. The film badges of the left arm under the short sleeves can be exposed to the sun when the golfer swings the club, leading to higher absorbance of UVB doses. Both types of shirts in Experiment II gave more protection than the shirts worn in Experiment I. Regular fall shirts provided better protection from UV transmission than UV specialized shirts, but were not acceptable during the summer season.

In order to examine the significant differences in the mean proportions of ambient UVB among three types of shirts, the ANOVA test was used. No significant difference was found at each body location. Although summer shirts absorbed the higher proportions of ambient UVB than the other two types of shirts in Figure 12, the differences were not significant statistically, perhaps because of the small absorbance values. However, summer polo shirts offer similar UV protection in Sheer's article (1999). She reported that commercially available UV specialized shirts provided SPF of 30 or higher according to Consumer Reports, whereas the typical polo shirts from Land's End or Hanes provided SPF of 15 to 20, which was an acceptable level of SPF for sun protective clothing.

Limitations

The field experiments have several limitations. Several confounding variables might affect the amount of UVB received by the subject: for instance, height of the sun in the sky, the UV index on the date of experiments, topography of golf course (reflection from water or sand), and subject's characteristics, such as different types of clothing, body stance and posture, or golf skills. Those factors probably caused the variances of absorbance changes in this study. Also, the data are based on a small number of participants, and film badges on some of body locations were lost, resulting in lower reliability of the findings. The film provided for this study became saturated after four hours of exposure and could not accurately measure exposure beyond that time. Thus it was impossible to measure exposure for the test hours participants played golf. For these reasons, interpretation of the findings and generalization to the population should be made with caution.

This study focused on only one activity, golf at the same geographic location, repeated twice in order to reduce the variances, while a number of previous studies have investigated different types of activities at the different locations (Herlihy, et al., 1994; Holman, et al., 1983; Vishvakarman, et al., 2001). Because the objectives of this study were to identify the amount of UVB received by golfers and to examine the effect of the typical shirts to protection from UVB, the findings of this study would fulfill these purposes at least.

CHAPTER THREE: PHASE I – MARKET RESEARCH

It would be valuable to investigate what types of garments are worn and available in the selected market segment as background information for understanding consumer needs. Market research is defined as "the process of collecting, manipulating, retaining, and using information for the purpose of decision-making in all areas of the marketing function" (Kurtz, 1969, P. 2). Product research is "the most important area" for providing products that meet consumer tastes and needs, which is directly related to a company's future success (p. 11). For this study, product research, focusing on shirts for golfers was conducted, using two approaches: Observation of published images and a market survey.

First, the standardized look of golfers in current magazines was explored in order to understand the norms that would influence golfers' views about a new product (innovation). If the new item were not compatible with their values or beliefs about the images of golfers, the new product would be unacceptable. For instance, if the UV specialized garments are thought to be inappropriate for the special social settings, such as golf games with peers, the potential adopters would be less likely to consider it as an alternative, although it might offer more protection from UVB. Therefore, finding out the standardized appearance of golfers in recent years will be helpful in developing UV protective shirts.

In addition, it is necessary to have knowledge of the related products, available in the selected market in order to evaluate the innovation. The market survey provides the general scope for UV specialized golf shirts as well as typical golf shirts. It focuses on the general interests and awareness of current consumers regarding UV protective clothing, but not the specific product dimensions, such as color, quality, size, or price.

Standardized Appearance from Published Images

Methodology

In order to determine what the normative appearance or standardized look of golfers is, the researcher examined the golf magazine, *Golf Digest* between January 2001 and December 2002. The unit of analysis was men's golf garments, so images of all male adults who were playing, posing, or practicing on the golf courses, or who were instructing anyone were examined. Criteria for inclusion were: The target model should be in color, hip-level up to head should be visible, and the photograph of the model should be larger than three centimeters because if the picture is smaller than this size, it is difficult to determine the garment characteristics. In addition, front or side views of a golfer were included; pictures from behind were excluded due to the difficulty of clarifying the garment features. Advertisements, drawings/sketches, or black and white photographs were also excluded from the data.

All garments of the target model were observed and recorded in Table A3 in Appendix A. First, the features of t-shirts were examined: Sleeve length (long or short), the existence of sleeve band (yes or no), the existence of a collar (yes or no), and color (specific color, pattern or stripe). Also, other types of clothing were examined. Outerwear was divided into jacket/sweater or vest. If a target model wore a long sleeved jacket or a sweater over the shirt, then it was recorded only as outerwear. If the vest was worn over shirts, the features of the shirt and the vest were marked separately. The length of pants (long or short), types of hats (cap, visor, brimmed, or none), and use of sunglasses (yes or no) were recorded if those were observable. Use of gloves was not included because most golfers wore gloves when the full-swing was necessary, and did not wear them for putting. That is, wearing gloves seemed to be more contingent on a golfer's position/action at each hole than on sun protective purposes. If the target model wore different styles or colors of garments, each style was recorded separately. If the garment characteristics were unobservable or unclassifiable, it was counted in the column U, which stands for unobservable.

Results and Discussion

Table A3 in Appendix A presents the detailed results of clothing features, and Table 16 shows a yearly summary. One issue of Golf Digest was missing, so a total of 23 issues were examined: 270 observations from 12 issues in 2001 and 170 from 11 issues of 2002. Unobservable categories ranged from 0.9% (sleeve length) to 8% (pants length).

Characteristics of Shirts

About 82% of golfers in 2001 and 88% in 2002 wore short-sleeved shirts with collars (89.6%, and 90.5%). That is, the most typical style of golf shirt was a short-sleeved polo shirt. Sleeve band was optional. About 55% of the shirts had sleeve bands in the two consecutive years. The hems of short sleeves were not tight even if they included sleeve bands, so the width was similar with sleeves without sleeve bands. Golfers might prefer to wear loose and short-sleeved (length to elbow) shirts instead of long- or fitted-sleeve shirts. If the golf shirts were long sleeved, most included sleeve bands and neck collars. Shirts colors varied: white (14.1), grey (8.6%), navy or black (16.6%), beige/yellow tone (16.3%), blue tone (18.5%), red tone (21.4%), and green tone (4.5%). Black and navy colors were categorized as one group because in some pictures it was hard to distinguish these two colors. There was no specific color pattern according to seasons. More specific categories of colors and the frequencies are provided in Table A4 in Appendix A.

Table 16. Summary of Garment Characteristics in *Golf Digest*

Garments	Characteristics		2001 Total (%)	2002 Total (%)	Mean (%)
T-shirts	Sleeve Length	Long	17.0	11.8	15.0
		Short	82.2	88.2	84.5
		Unobservable	0.8	0	0.5
	Sleeve Band	Yes	55.2	59.4	56.8
		No	41.5	38.2	40.2
		Unobservable	3.3	2.4	3.0
	Collar	Yes	89.6	91.8	90.5
		No	5.2	3.5	4.5
		Unobservable	5.2	4.7	5.0
	Color	Color	70.4	72.3	71.1
		Stripe	23.7	20.6	22.5
		Pattern	5.9	7.1	6.4
Outwear	Yes	Jacket/Sweater	11.1	8.8	10.2
		Vest	5.2	4.1	4.8
	None		83.7	87.1	85.0
Pants		Long	85.9	94.1	89.1
		Short	3.7	1.8	3.0
		Unobservable	10.4	4.1	7.9
Hats	Yes	Cap	50.4	57.6	53.2
		Visor	7.0	11.2	8.6
		Brimmed	5.6	2.4	4.3
	None		37.0	28.8	33.9
Sunglasses	Yes		8.5	3.5	6.6
	No		87.4	93.5	89.8
	Unobservable		4.1	3.0	3.6
Total Observation			270	170	440

Characteristics of Other Garments

In all the photographs of golfers, only 10% wore jackets (i.e. wind-shirts) or sweaters and about 5% wore vests (Table 16). In most cases, golfers wore jackets or sweaters over polo-type shirts, so the collar was shown over outerwear. About 89% of golfers wore long pants, and only 3% wore shorts. The shorts were usually worn in public ranges, rather than golf courses. The types of hats worn by golfers consisted of caps, 53%, visors, 8.6%, brimmed hats, 4.3%, and non users, 34%. Wearing a hat seemed to be a matter of fashion. Hill and Rassaby (1984) found significant correlations between the intention and barriers to wearing a hat among men. Those barriers were the problem of playing the sport ($r = -.43$), being self-conscious in a hat ($r = -.41$), a nuisance on windy days ($r = -.37$), inconvenient ($r = -.34$), and getting a sweaty head ($r = -.32$). These barriers might be reflected in golfers in the published magazines. Finally, most golfers (90%) did not wear sunglasses while playing golf. It seems to be comparable with reasons for not using a hat that affects play.

Summary

Research Question 1 for Objective 3

- What is the Standardized or Normative Look of Golfers in Magazines?

From the results, the standardized image of current golfers is apparent. Most golfers wore short-sleeved polo shirts that included wide width of sleeve hem and collar, matched with long pants. There appears to be no color preferences among photographed golfers' shirts. Golfers wore long-sleeved shirts or jackets occasionally, probably for cooler weather conditions. A baseball cap was the most preferred head covering if one was worn. Most golfers did not use sunglasses.

Most target models in magazines were professional golfers and were photographed at their professional leagues or during instructional settings. Hence, the results are more reflective of professional and formal images of golfers than images of the general public. Professional golfers seem to select garments that facilitate their movements over other features of garments. Hence, the wide hems of short sleeves or long sleeves with sleeve bands were designed for the golfers' practical performances.

Only two male golfers wore sleeveless shirts and thirteen golfers wore shorts among 440 observations. Although informal observation indicates that these looks are common in public golf courses, it constitutes only a small percentage of the published images. All of the subjects in experiments for this study also wore short-sleeved shirts with shorts when the experiment was conducted during August, and long-sleeved shirts with long pants for the October experiment. This suggests that weather conditions affect their garment selection. Hill and Rassaby (1984) reported that the most significant barrier to wearing a long-sleeve shirt for men was the discomfort from heat.

Market Survey

Methodology

To learn the availability of traditional golf clothing and UV specialized clothing, a survey was conducted of selected local stores. The results would be helpful in understanding the clothing preferences of amateur golfers. The researcher visited 4 of 11 local specialty golf stores listed in the 2002 yellow pages of the Greater Lansing Area telephone directory. First, the researcher contacted the local golf stores listed and asked whether they carried golf clothing because some stores only supplied golf equipment. Only four stores in the Lansing and East Lansing area carried clothing.

After the researcher explained the purpose of the study to a salesperson or a manager in the selected store, the researcher asked whether he or she would be willing to be interviewed. All subjects agreed to the interview and were willing to participate at that time, so the researcher did not need to arrange another meeting. Three stores carry both men's and women's clothing, and one store carries only women's. The researcher asked questions regarding the typical styles of golf shirts, customer's interests in and availability of UV specialized products in the local stores. The interviews took approximately 10 minutes. The interview questions and protocol were standardized and the questions are listed with the results.

Results and Discussion

Two of the four interviewees were males, and three of them were store managers. Interviewees' years of experience in sales span from five to 22 years (5, 8, 15, and 22 years). Interviewees were between 25 and 49 years of age.

Interview Question 1

- What are the Most Popular Styles to Golfers Who Shop in Your Store?

Common and unique styles of shirts. The most popular and typical style to golfers was a short-sleeved polo, made of 100% cotton. Popular colors were soft-tone, solids such as white or grey. Green was another popular color, a symbol of MSU. One retailer indicated that Michigan residents were conservative rather than fashion conscious such as residents on the West Coast area, so they preferred typical styles within soft color ranges. The popular style for women was sleeveless shirts in summer time. The interviewees described wicking away moisture shirts or long-sleeved piqué rugby shirts (cotton, twill collar, rubber buttons, rib trim at cuff) as the unique styles in their stores.

Common and unique styles of hats. The most common style of hats for golfers was the baseball cap (80 to 90%). However, women sometimes looked for a brimmed hat or visor. The wide brimmed hat or straw hat in summer season was a unique style for a few male golfers.

Seasonal differences. All retailers mentioned there were no seasonal differences in customer's search for clothing. Golfers usually looked for short-sleeved shirts. Golfers wear short-sleeved polo shirts in most seasons and they use vests or wind-shirts over short-sleeved shirts in cool weather. Another reason for no seasonal differences in customer's interests was that they shopped and bought short-sleeved shirts during the winter season for vacation use in warmer places.

Search for long-sleeve shirts in summer. Most golfers, especially males would not look for long-sleeved shirts in summer. However, a few female customers bought long-sleeved shirts in summer to protect or cover their skin.

Interview Question 2

- Are Golfers Interested in or Looking for UV Specialized Clothing?

Who and how often. Three interviewees in local stores that carried both men's women's wear said they were rarely asked about UV specialized products. One manager said that he had never been asked, and two said one or two customers in a year asked about UV specialized products. The interviewees mentioned that the purchasing criteria for their customers were design of garments, then the price. Hence, after customers select the design of a shirt, if the shirt provides UV protection, then it is an additional benefit, but not a required option.

However, the manager at a women's golf specialty store mentioned that some female customers in her store were interested in UV specialized products. Those customers were concerned about the UV protective function of clothing products. Prices were not important for them, although UV specialized products were more expensive than other typical products. They were aware of the UV specialized products to protect their bodies from the sun.

Types of clothing. The UV specialized product of most interest during the summer season was a hat, followed by sunglasses and short-sleeved shirts. Customers at the women's golf specialty store were interested in long- or short-sleeved shirts, hats, and sunglasses.

Interview Question 3

- Does Your Store Carry UV Specialized Products?

Types of clothing. Four retail stores carried a small selections of UV specialized products. One store carries only UV protective sunglasses. Two stores carry UV specialized short-sleeved shirts and hats, and one of these carried UV protective sunglasses. The women's specialty store carried the most items, such as shirts, outerwear, sunglasses, and gloves. The manager at the women's golf store explained the importance of gloves for golfers and gardeners. Customers who were interested in UV specialized products at this store were more concerned about the function of UV protection than style or price of the products. However, customers at the other three stores did not care much about the function of UV protection, and the style of garments was the most significant factor in their purchasing decision. These consumers might not be conscious of the risk of skin cancer or aging skin.

Because few customers were interested in UV specialized products, the preferred features of UV specialized products were not discovered. In addition, since the UV specialized products that were available at local stores were not distinguishable in terms of styles or colors, customers could select the garment without information on the UV protective function in advance.

Interview Question 4

- Are Your Suppliers Aware of the Needs of UV Specialized Clothing?

Three retailers mentioned that some suppliers have been aware of the importance of UV specialized products. One retailer mentioned that they had six lines of men's wear and two of them provided UV specialized clothing. However, because their customers were rarely interested in UV specialized products, it was not necessary to make those products available to their customers.

Summary

Research Question 2 for Objective 3

- What Kinds of Traditional Clothing are Available for Golfers in Local Pro Golf Stores?

Based on a market survey in which four salespeople in local pro golf shops were interviewed, the most typical style of golf shirts available and purchased was a short-sleeved polo, made of cotton in soft colors without seasonal differences. This style included a knit collar, and rib trim at cuff or turnback hem. The traditional style of golf shirt was comparable with the findings of the review of published images. A baseball cap was the most common head covering for customers at local golf stores, which was also similar with the findings of published images.

Research Question 3 for Objective 3

- To What Extent are UV Specialized Products Commercially Available in the Local Stores?

The majority of customers in the four local stores surveyed were not interested in UV specialized products. Only a small portion of customers, mainly women, looked for these products, mostly during summer season. Hats, short-sleeve shirts, or sunglasses were the major items for which those customers looked. Accordingly, local stores made available small amounts of UV specialized products in these limited items of interest to customers. To most customers, design and price were more important factors than UV protective functions. Golfers in this selected market seem to be aware of UV protective clothing, but do not acknowledge the importance of the UV protective function of clothing. Golf wear suppliers seem to be becoming aware of the importance of UV protective function for golf clothing.

Limitations

This market survey has limitations. The data were obtained from a small number of retailers. The retailers had to recall their experience when they responded to the questions. In addition, few of their customers looked for UV specialized clothing so it was difficult to characterize customers. However, results from this small study suggest that UV specialized products could be disseminated more quickly into the target market if the design of UV specialized products were appropriate or more attractive than other typical golf shirts at the proper price range, because most male golfers select garments based on design features and prices.

CHAPTER FOUR: PHASE II – HEALTH BELIEFS AND INNOVATION

Literature Review

New cases of melanoma are increasing annually. The American Academy of Dermatology (2002a) has estimated that 1 in 39 Americans could develop melanoma in 2003. Sun protective actions, hence, have been recommended to reduce the risk of skin cancer. Even though males have higher rates of incidence and death from skin cancer than do females, men are less likely to practice sun protective behaviors (U.S. Department of Health and Human Services, 2000). Several factors could account for the different sun protective practices between men and women. As Liffrig (2001) pointed out, "most programs target women since their traditional family role makes them generally more likely than men to purchase and apply sunscreen products" (p. 199). Children and youth are another significant target audience of educational programs due to the cumulative aspect of UVR during childhood (Buller, Loescher, & Buller, 1994; Cockburn, Hennrikus, & Sanson-Fisher, 1989; Labat, et al., 1996).

The present study focused on outdoor enthusiasts, especially golfers. Although increasing attention is being paid to golfers regarding sun safety promotions, golfers' perceived beliefs about skin cancer risk, attitudes toward UV protective clothing, and sun protective behaviors have been insufficiently studied. Since the incidences of skin cancer are associated with unprotected exposure to UVR (Saraiya, Hall, & Uhler, 2002), it is important to analyze sun protective actions practiced by golfers when outdoors. Specifically, whether golfers use sunscreen, wear sun protective clothing, or seek the shade while they play could be significant determinants of skin cancer risk. For the

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second phase, two theoretical frameworks, the health belief model and attributes of innovation were used.

Health Belief Model

The health belief model (HBM) is a useful framework for understanding an individual's health beliefs, attitudes and intentions to comply with recommended protective actions. This model was originally developed by a group of researchers in the Public Health Service as an attempt to explain why people did not comply with preventive health-related recommendations between 1950 and 1960 (Rosenstock, 1974). The basic principles of this model were derived from value-expectancy theory, which "describes behavior or decision-making under conditions of uncertainty wherein behavior is predicted from both the individual's valuation of an outcome and the expectation that a specific action will result in that outcome" (Becker, Maiman, Kirscht, Haefner, & Drachman, 1977, p. 349). That is, an individual would take an action to avoid or prevent disease (expectation to the outcome) for the purpose of maintaining one's health (one's value). To do this, several components were necessary: susceptibility, severity, benefits, barriers, cues to actions, and demographic and socio-psychological variables.

Perceived Susceptibility

Perceived susceptibility is defined as "one's subjective perception of the risk of contracting a health condition" (Rosenstock, 1990, p. 43). Since it is a perceived probability of getting skin cancer in oneself, the range of susceptibility is from a minimum of denying any possibility of occurrence to a maximum of accepting the real risk as a possible personal occurrence to the subject (Rosenstock, 1974).

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Perceived Severity

Perceived severity is one's subjective assessment of the disease potential "for causing physical harm and interfering with social functioning" (Becker, et al., 1977, p. 349). Physical harm includes a person's evaluation of death, disability, or pain. Social functioning includes the consequences of the conditions on work, family life, or social relations, influenced by disease. Perceived severity is an important part of the HBM because "even when an individual recognizes personal susceptibility, action will not occur unless he or she also believes that becoming ill would bring serious organic and/or social repercussions" (Becker & Maiman, 1975, p.14).

Perceived Benefits

Perceived benefits of taking health-related action are one's perceived beliefs about the effectiveness, feasibility or values of a behavior in reducing the health threat (Becker, et al., 1977; Rosenstock, 1990). For example, an individual's perceived benefit of using a sunscreen is for reducing the chance of getting skin cancer, or for increasing a feeling of control over a health-related problem.

Behavioral Barriers

Behavioral barriers refer to one's perceived "potential negative aspects of a particular health action" (Rosenstock, 1990, p. 43) such as physical (safety, side effects), psychological (discomfort, unpleasant, complexity, time-consuming), or financial costs (monetary expense) and situational factors. In the present study, behavioral barriers are based on barriers to practicing the recommended sun protective actions, for instance, the cost of sun protective products, unfashionable appearance of protective clothing, or discomfort of the wearing long-sleeved shirts or wide-brimmed hats.

Psychological Barriers

For this study, the perceived benefit of tanning is included as a psychological barrier to taking sun protective actions. Sunbathing was introduced in the U.S. in 1914 as a medical treatment, called "heliotherapy." Tan skin was perceived as a sign of good health as a result of the success of the therapy (Keesling & Friedman, 1987). Also, after the industrial revolution, darker skin color became a symbol of higher status because wealthier people had time for outdoor sports and leisure activities (Keesling & Friedman, 1987). Fashion designer, Coco Chanel, also stimulated this trend in the late 1920s with her bronzed tanning "as a sign of affluence" (Roach, 1997, p. 116).

The most common motivation for getting a suntan was to look and feel attractive, healthy, and active (Amir, et al., 2000; Arthey & Clarke, 1995; Broadstock, Borland, & Gason, 1992; Keesling & Friedman, 1987). Johnson and Lookingbill (1984) found that attitudes toward suntan varied with age. Among 489 respondents who were outpatients of dermatology and internal medicine clinics, those younger than 30 years of age had much stronger beliefs that a suntan looked healthy. Previous studies revealed that the general propensities of tanners included being more likely to spend time in the sun, to take a risk for the benefit of a suntan, less likely to have knowledge of skin cancer, and less likely to use sunscreen (Arthey & Clarke, 1995; Keesling & Friedman, 1987; Miller, Ashton, McHoskey, & Gimbel, 1990). Accordingly, one's perceived positive aspects of beliefs about tanning would be the major barriers to taking sun protective actions.

Modifying Factors

Cue to action is some instigating event that occurs "to set the process in motion" (Rosenstock, 1974, p. 332) and consists of internal cues (perception of body states or

Fig

symptoms) and external cues (interpersonal interaction, the impact of media). External cues include knowing a person who has skin cancer or having a friend who practices sun protection or who enjoys a suntan (Arthey & Clarke, 1995).

Other variables included in modifying factors are demographic variables (age, sex, ethnicity), socio-psychological variables (social class, personality, peer and reference group pressure), and structural variables (knowledge about the disease, prior contact/experience with the disease). These variables influence perceived benefits and barriers as well as perceived susceptibility and severity (Rosenstock, 1974).

Figure 13 presents the variables that contribute to explaining sun protective behaviors for this study based on the existing literature.

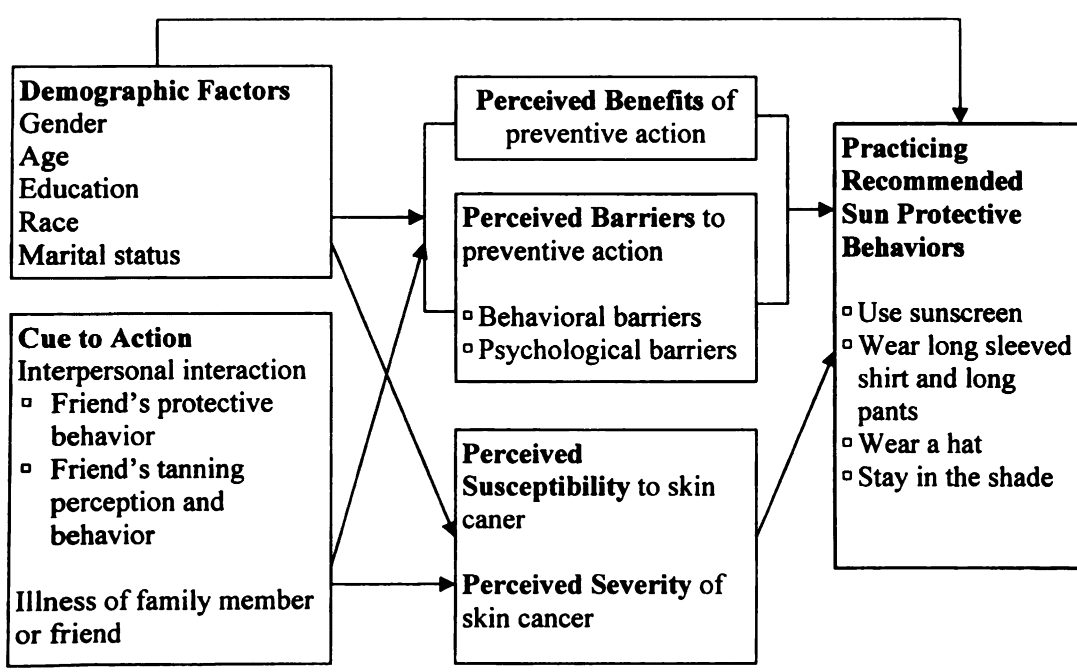

Figure 13. A Conceptual Framework of the Health Belief Model (Modified from Rosenstock, 1974, p. 334)

Relative Importance

The health belief model (HBM) has played an important part in explaining and predicting compliance with professionals' health-related recommendations. As mentioned earlier, the HBM was originally employed to explain preventive behaviors, but many researchers also adapted the HBM to other health-related behaviors.

Janz and Becker (1984) reviewed 29 published studies related to the HBM between 1974 and 1984 with respect to research design and 4 dimensions of the HBM (susceptibility, severity, benefit, and behavioral barrier). These studies were categorized into 3 groups: 13 studies were about compliance with recommendations for preventive health behaviors such as influenza vaccination, screening examination, and avoiding risky behaviors (i.e. seat belt use, drunk driving, smoking behavior, exercise regimen). Thirteen other studies were about compliance with treatment regimens when people were ill. Treatments were for hypertension, diabetes, or mothers' compliance with a regimen for their child's illness. The final category included 3 studies about clinic utilization for various reasons. When analyzing the significant findings from 29 studies, the behavioral barrier dimension was the most significant in explaining compliance with health-related recommendations, followed by benefits, susceptibility, and severity, in that order. Though perceived severity was the poorest variable in explaining compliance with preventive health suggestions, it was the second most important variable in explaining compliance with prescribed treatment for the sick, because "this HBM dimension is more meaningful to individuals diagnosed as ill and/or experiencing symptoms" (Janz & Becker, 1984, p. 37). The susceptibility dimension was more significant in preventive behavioral studies than studies about compliance with recommended treatments for the s

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sick, whereas dimension of benefits revealed the reverse results. In conclusion, the studies confirmed the significance of the HBM as a framework in health-related research and all dimensions of the HBM contributed to understanding individuals' health-related behaviors.

With respect to skin cancer preventive behaviors, a number of researchers have adapted the HBM. Glanz, et al., (1999) investigated the predictors that influenced sun protective practices of children (6-8 years old), their parents, and outdoor recreation staffs. The researchers found that behavioral barriers and benefits were the most significant predictors for explaining parents' preventive behaviors, whereas program policies of sun protection were the most significant to children's and staffs' behaviors.

Behavioral barriers were also the most significant variable among the HBM dimensions to predict skin cancer prevention practices of Australian college students (Cody & Lee, 1989). Jackson and Aiken (2000) explored the causal relationships among HBM variables to predict the intention to practice sun protection among 202 female Caucasian college students. The significant predictors were norms for sun protection, advantage of sunbathing (psychological barrier in the present study), susceptibility, and barriers in order. Severity was not directly related to this dependent variable. In their study, norms for sun protection were set by peer's sun protective behavior, which is considered as cues to action in the present study.

In a study of health beliefs among 202 Wisconsin male farmers, approximately three quarters of them believed that they were more susceptible to skin cancer than the average person, that skin cancer was a serious disease, and that sun protective practices would decrease the probability of developing skin cancer (Marlenga, 1995). However, they did not carry out sun protective behaviors in real life. Almost 70% of the respondents never or rarely wore sunscreen, long-sleeve shirts, or wide brimmed hats. The major reason of not wearing long-sleeved shirts was because they were too hot to wear. Also, respondents did not use sunscreen because they forgot to wear it and/or it took too much time. Their responses indicated that the barriers to wearing sunscreen, long-sleeved shirts or hats seemed to override the other HBM dimensions, since they did not practice sun protective behaviors.

Shern (1986) explored the HBM to predict the likelihood of pesticide applicators to adopting protective clothing as the preventive behavior. She found that risk takers who did not take preventive actions had a lower level of perceived susceptibility to and perceived severity of pesticide-related illness and thought benefits of pesticide use overweighed the risks. Risk avoiders who complied with protective actions possessed opposite perceptions.

In conclusion, most dimensions of the HBM were associated with the decision whether or not to take compliant behavior, although the extent of the significance varied with the research designs. Significant predictors varied with prevention versus treatment status of respondents, types of health-related practices, and demographics of the sample, i.e. gender, age (children, adults, or senior citizen). However, behavioral barriers to practicing protective actions are relatively significant across studies in predicting whether the recommended health actions are followed. Psychological barriers and cues to action are significant as determinants of sun protective behaviors. Overall, analyzing the relative importance among dimensions of the HBM for the specific sub-population group would be necessary for preparing more appropriate information.

Attributes of Innovation

Another theoretical framework employed for this study is Rogers' diffusion theory (1995). According to Rogers, diffusion of an innovation is defined as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (p. 5), and an innovation is defined as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (p. 11). A new style of dress can be explained with respect to diffusion of innovation since dress is an important communication cue between source and receiver who encode and decode its meaning at a given time and place. The innovation for this study is a UV specialized shirt that is specially designed to maximize protection from UV radiation. Adoption of this innovation is related to skin cancer prevention practices. An innovation, like UV specialized shirts adopted for preventive purposes, is defined as a preventive innovation "that an individual adopts at one point in time in order to lower the probability that some future unwanted event will occur" (Rogers, 1995, p. 70).

An innovation can be described by five attributes that influence the rate of adoption of the innovation (Rogers, 1995). Studying attributes of innovation is important due to "its predictive potential to assist in actual diffusion and to increase our theoretical understanding of diffusion" (Dearing, Meyer, & Kazmiereczak, 1994, p. 18). Yet, attributes of an innovation in diffusion of clothing has been insufficiently studied. Understanding the potential adopters' perceptions prior to diffusion would be useful in modifying and developing the innovation to match better with their tastes. Five attributes of innovations are relative advantage, compatibility, complexity, triability, and observability.

Relative Advantage

Relative advantage is defined as "the degree to which an innovation is perceived as being better than the idea it supersedes" and different kinds of advantages such as economic, social prestige, or other noneconomic benefits that could be considered depending on the nature of an innovation (Rogers, 1995, p. 212). The more potential adopters perceive that the innovation possesses the advantages of price, image, or quality, the greater the likelihood that the innovation will be adopted.

Relative advantage then could be illustrated through several dimensions. Since relative advantage "has been defined rather broadly but operationalized more narrowly," Dearing, et al. (1994, p. 20) disaggregated relative advantage into two mutually exclusive attributes, economic (monetary benefit) and noneconomic advantage (effectiveness). Ostlund (1974) disaggregated relative advantage into three dimensions, time saving, effort saving, and monetary value, and showed different rankings of importance as the predictors in discriminating between buyers and non-buyers of two new consumer products. Moore and Benbasat (1991) and Agarwal and Prasad (1997) disaggregated relative advantage into two dimensions, image (social status) and relative advantage.

For this study, relative advantage was subdivided into economic advantage, social prestige (image), and overall usefulness. Economic advantage represents cost effectiveness by adopting the innovation. Since price is an important criterion in clothing purchase decisions (Eckman, Damhorst, & Kadolph, 1990; Lee & Burns, 1993), it is crucial to incorporate the economic aspect of relative advantage.

Rogers (1995) emphasized social prestige as a predictor especially in clothing diffusion. Agarwal and Prasad (1997) used the term, image instead of social prestige, since "image captures the perception that using an innovation will contribute to enhancing the social status of a potential adopter" (p. 562). Image (social prestige) was also an important factor that influenced diffusion of innovation from the perspective of structural equivalence (Moore & Benbasat, 1991).

Overall usefulness of an innovation is another dimension of relative advantage, defined as "the extent to which a potential adopter views the innovation as offering an advantage over previous ways of performing the same task" (Agarwal & Prasad, 1997, p.562). This dimension can be applied in this study by determining to what extent the potential users would perceive UV specialized clothing as better than typical clothing in terms of quality, performance, fashionability and effectiveness of UVR prevention.

Compatibility

Compatibility is defined as "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (Rogers, 1995, p. 224). Compatibility is positively associated with the rate of adoption: The more the innovation is compatible with potential consumers' needs or values, the more likely they will adopt the innovation. For instance, if potential adopters put small value on their susceptibility to develop skin cancer, they would have a lower probability of adopting UV specialized clothing because they do not have sufficient need for the innovation. However, if they are highly concerned about health regarding skin cancer, they are more likely to adopt the innovation because it is compatible with their felt needs.

Rogers (1995) also stressed the importance of compatibility with past experience. People do not accept an innovation if it is too radical or too different from their previous experience with comparable products. Thus compatibility could be viewed in terms of compatibility with the existing wardrobe as Littrell and Miller (2001) used for their study of clothing diffusion. This notion is comparable with the applicability in Dearing, et al.'s study (1994) which was defined as "the degree to which an innovation is communicated as having more than one use or having use in more than one context" (p. 23). Since versatility ("adaptability of the garment to various end users and mix-and-match potential") and matching ("suitable with some other garment or garments they owned") are important criteria when purchasing clothing (Eckman, et al., 1990, p. 17), it would be worthwhile to identify the degree to which the innovation is perceived as compatible (matching) with their own garments.

Compatibility with social norms can inhibit or encourage the likelihood of adoption. Social (interpersonal) or situational factors are important criteria in purchasing dress (Chang, Burns, & Noel, 1996). If the innovation is consistent with or appropriate to the potential adopters' social culture, it is more likely to be adopted. That is, people tend to wear garments similar to their peers' because of a desire for conformity or membership in their social groups (Engel, Blackwell, & Miniard, 1990). Thus, although a preventive innovation (UV specialized clothing) is perceived superior to traditional golf wear, if it is not compatible with the group norm of the potential adopters, the probability to adopt would be lower.

Complexity

Complexity is defined as "the degree to which an innovation is perceived as relatively difficult to understand and use" (Rogers, 1995, p. 242), and negatively associated with the probability of adoption. Agarwal and Prasad (1997) used the term, ease of use for complexity, meaning "relatively free of effort" and "easier to use and less complex" (p. 562). Littrell and Miller (2001) argued that complexity of clothing would be high when additional learning of garment construction, fabric, silhouette, or fasteners were required due to lack of familiarity with the garment. For the present study, complexity was focused on two aspects: ease of wearing and difficulty in understanding the function of UV prevention with respect to the innovation. UV specialized clothing is designed to reduce exposure to UV radiation, but the appearance of clothing is similar to regular garments. Hence, it is expected that there would be little difficulty in wearing or caring for UV specialized clothing compared with other typical golf garments, but potential adopters may not understand the UV protective function.

Triability

Triability is defined as "the extent to which potential adopters perceive that they have an opportunity to experiment with the innovation prior to committing to its usage" (Agarwal & Prasad, 1997, p. 562). Availability of a small sample or a trial period with a 30-day return policy among commercial products could encourage a higher level of triability. If potential users have an opportunity to try or use the innovation before actually adopting, it would reduce uncertainty about the product. Triability will be a more important attribute for highly involved products, such as clothing, computers or automobiles because those product categories have higher economic risk or performance risk, and are more associated with self image than lower-involved products (Assael, 1998). Triability is positively related with the rate of adoption: The higher the degree of triability of the innovation, the more likely consumers adopt the innovation.

Observability

Rogers defines observability as "the degree to which the results of an innovation are visible to others" (1995, p. 244). As Rogers mentioned, the preventive innovation possesses relatively lower observability because it is difficult to identify a causal relationship between the adoption of the innovation and the probability of an unwanted event occurring. For instance, the person who adopts this innovation could develop skin cancer due to cumulative effects of UV radiation that occurred before adopting it. Since the role of a preventive innovation, such as a UV protective shirt, is to prevent a future unwanted event, results of wearing it are invisible and intangible.

Agarwal and Prasad (1997) separated observability into two attributes: result demonstrability and visibility. Result demonstrability refers to the communicability and tangibility of the results of an innovation, while visibility refers to the degree to which potential adopters are able to observe the use of the innovation in their situation or social context. If outcomes of an innovation are more likely to be demonstrated and observed in a social context, people are more likely to adopt it. Therefore, observability would be positively associated with the probability of adoption.

Figure 14 was developed as a conceptual framework to describe the attributes of an innovation and the intention to adopt. Intention to adopt UV specialized shirts was defined in the present study as "a subjective probability… a belief held by the subject about how likely or unlikely it is that they will act" (Hill & Rassaby, 1984). Thus, having an intention to adopt UV specialized shirts indicates that respondents are planning to purchase or wear the innovation.

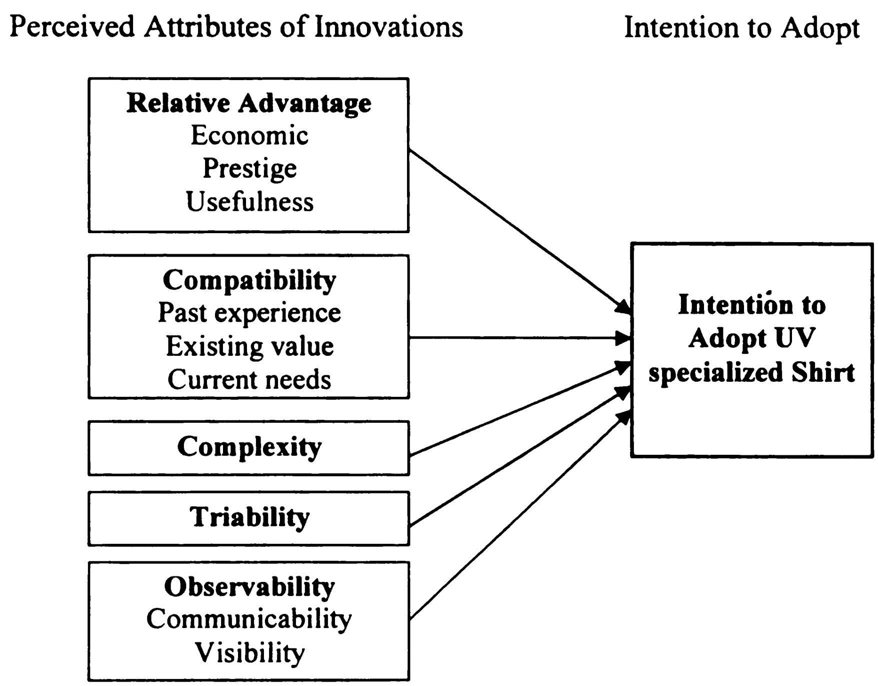

Figure 14. A Conceptual Framework of Attributes of UV Specialized Shirts

Relative Importance

Attributes of innovations were widely employed in the area of information technology. According to Johnson, Meyer, Woodworth, Ethington, and Stengle (1998), perceived attributes of an innovation were significantly different contingent on the nature of innovations in communication of cancer information within one organization. They examined respondents' perceived attributes of four different innovations. Respondents perceived four innovations in a similar way with higher degrees of triability, adaptability, and acceptance (the mean is within 8.0 to 9.1), but lower degrees of complexity and compatibility (mean is within 3.5 to 5.4). In another study, compatibility, visibility and triability were significant predictors of current usage of the World Wide Web, whereas relative advantage and result demonstrability were significant predictors of the intention to continue to use the World Wide Web (Agarwal & Prasad, 1997). This study suggests that emphasizing different sets of attributes of an innovation are necessary for different stages of the innovation-decision process, e.g. initial adoption and intention to continue to use.

There are limited studies in the clothing and textiles area with respect to attributes of innovations. Littrell and Miller (2001) examined the attributes of India-inspired garments to predict consumers' acceptance and intention to purchase the innovation. The perceived characteristics of the innovations consisted of complexity, familiarity with overall garment features (defined as awareness-knowledge, including relative advantage, compatibility with existing value system, and observability by Rogers' definition) and compatibility (matching) with existing wardrobe. Consumers' acceptance and intention to purchase were positively and significantly related to familiarity and compatibility. Perceived complexity of garment features such as construction or silhouette did not have a significant influence on those two dependent variables. In addition, consumers' acceptance of the innovation was a significant predictor of intention to purchase.

Researchers have employed attributes of an innovation to discriminate between adopters and non-adopters of innovations. Shim and Kotsiopulos (1994) explored the influence of perceived characteristics, individual characteristics, and organizational characteristics on retailers' technology innovativeness. They classified apparel and gift retailers into five adopter categories and compared the differences in the perceived characteristics of new retail technology. The results showed significant differences in perceived relative advantage, compatibility, and observability among adopter categories: The innovators or early adopters were more likely to perceive those three attributes positively than late adopters.

The relative importance of attributes of innovations is different based on the nature of an innovation. Analyzing attributes of innovation would help to increase the rate of adoption by modifying negative attributes and strengthening the positive attributes of the innovation. However, very little research has focused on examining attributes of the preventive innovation. Identifying attributes of UV specialized clothing would provide a baseline for implementing strategies to increase sun protection practices by golfers.

Attributes of an Innovation and Health Belief Model

Potential adopters' intention to adopt an innovation would be influenced by the previous experiences or beliefs about a certain situation. According to the innovation-decision process, attitudes toward an innovation are formed after knowledge of the innovation is obtained or received (Rogers, 1995). Knowledge is shaped and influenced by consumers' previous practices, felt needs, and influences of significant others, because they have received information that is relevant to their interests, beliefs, or needs. Analyzing consumers' perceived attributes of an innovation is a diagnostic tool to understand their attitudes toward the innovation, so is an indicator of identifying their intention to adopt it. Relative advantage, compatibility, triability, and observability, as perceived by members of a social system, are positively related to the rate of adoption, while complexity is negatively related to the rate of adoption (Rogers, 1995).

In terms of adopting UV specialized shirts, if an individual has a strong felt need to prevent skin cancer so practices sun protection, s/he is more knowledgeable about UV specialized shirts, which influences her/his perception of characteristics of the preventive innovation. This individual would have more a positive perception of compatibility or relative advantage toward UV specialized shirts than a person who does not have a need for sun protection. Then, the individual's positive attitudes toward the UV specialized shirt would lead to a higher intention to adopt it.

Since researchers have done little work to explain attributes of a preventive innovation related to perceivers' actual health-related practices and beliefs, the associations between these two theoretical frameworks would be worthy of a diffusion study. On the basis of Figure 13 and Figure 14, the two theoretical frameworks are combined to propose a psychosocial model for this study, Figure 15.

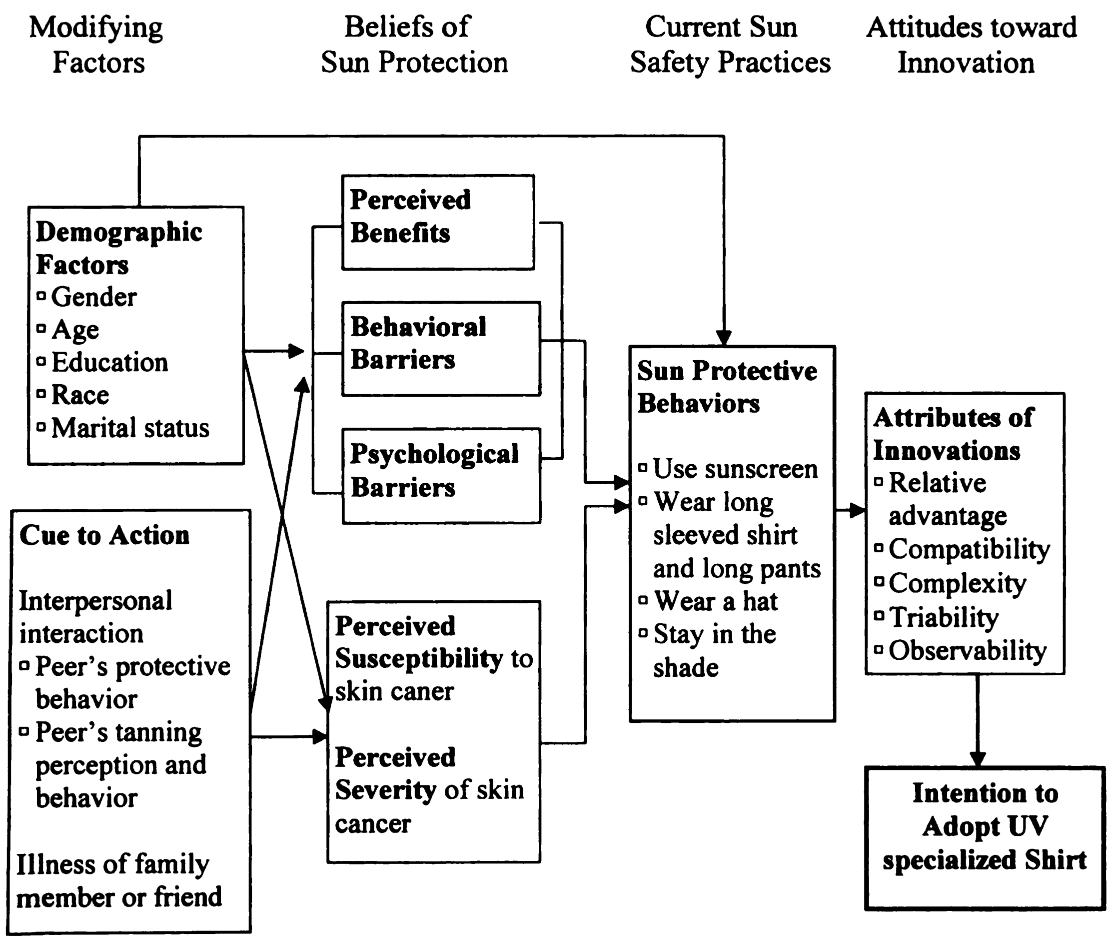

Figure 15. A Proposed Research Model for adoption of a UV Specialized Shirt

Implications

The UV specialized shirt is employed as an innovation for this study, since it is relatively new to golfers based on market research. Although a few UV specialized garments are available in the marketplace, most consumers seem unaware of its availability or importance. Hence, potential adopters seem to be at the knowledge stage in the innovation-decision process. Evaluating their perceived attributes of the innovation would be helpful in understanding their attitudes toward it, thereby influencing their intention to adopt UV specialized shirts. Information about perceived health beliefs regarding sun protection would assist in understanding how attributes of the UV protective shirts are formed.

This study was conducted to learn about the health beliefs and behaviors of the potential adopters. Findings would be useful to sun safety campaign designers who target outdoor enthusiasts by identifying the influential factors in altering their lifestyles and practices. This study would also contribute to our knowledge of diffusion of clothing fashion. Most diffusion studies in the area of clothing and textiles are focused on innovativeness of adopters (fashion opinion leadership or innovators) (Goldsmith, Flynn, & Moore, 1996; Huddleston, Ford, & Bickle, 1993; Shim & Kotsiopulos, 1994; Workman & Johnson, 1993), but research about perceived characteristics of an innovation from the perspective of potential adopters has received little attention. This study would examine golfers' perceived characteristics of a preventive innovation based on their health-related beliefs, and would be beneficial for people in product development by assessing the potential adopters' reactions that could lead to modifying the garment at a pre-diffusion stage.

Sun Protective Behaviors

Several factors were associated with sun protective behaviors. Among 10,048 U.S. white respondents in the 1992 National Health Interview Survey, 53% practiced at least one of three types of sun protective behaviors: 32% reported using sunscreen/sunblock, 28% wearing protective clothing, and 30% staying in the shade (Hall, May, Lew, Koh, & Nadel, 1997). Being old, being single, having sensitive skin, having repeated sunburn experiences, and having a history of skin cancer or skin cancer exams were significant factors for respondents engaging in one or more sun protective behaviors.

In a study comparing two national telephone surveys conducted in 1986 and in 1996 by the American Academy of Dermatology, use of sunscreen increased from 35% in 1986 to 54% in 1996, while regular use of a tanning booth also increased from 2% to 6% (Robinson, Rigel, & Amonette, 1997). When the duration of weekend outdoor exposure was compared, white males working indoors, with higher incomes tended to have longer exposure than their opposites. With respect to awareness of skin cancer prevention information, being white, female, old, and educated were more positively associated than their opposites. They emphasized that analyzing sun protective behaviors of specific subsets of the Caucasian population was important to develop adequate information to the target market. Although the proportion of the population using sunscreen or having an awareness of skin cancer risks had increased, each subset was still associated with some skin cancer risk-creating behaviors. For instance, male adults and those 18-25 years of age tended to experience sunburn more frequently from occupational and recreational exposure, while women 18-25 years of age used tanning booths more frequently than the other subsets.

Sunburn, experienced in childhood or adulthood, has been related to an increased risk of melanoma and basal cell carcinoma (Saraiya, et al., 2002). Purdue, Marrett, Peters, and Rivers (2001) examined the predictors of sunburn among Canadian adults, and found that being young, being male, and having light skin color and non-black hair color were significantly related to sunburn experiences. Furthermore, spending more leisure time in the sun, seeking a tan, working outdoors in the summer, and forgetting about protecting oneself from the sun were significant predictors of sunburn.

Stepanski and Mayer (1998) explained sun protective behaviors among U.S. outdoor workers. Of 312 outdoor workers, 50.4% adequately protected themselves from the sun, but the face and lower arms were the body sites the least protected from the sun. When the researchers surveyed 240 outdoor workers, California transportation workers (Caltrans) tended to practice sun protective behaviors most, followed by construction workers and postal carriers. The researchers pointed out that the clothing policies for each occupation generated different levels of sun protective behaviors. For instance, Caltrans and construction workers were required to wear long pants, resulting in higher mean scores of wearing protective clothing than postal carriers. Across the occupational groups, wearing sunglasses was the most frequently reported sun protective behavior (mean = 3.96, with the maximum possible point of 5), followed by wearing a hat (mean = 3.56), wearing other protective clothing (mean = 2.99), and staying in the shade (mean = 2.54). Using sunscreen with SPF of 15 or higher and limiting mid-day sun exposure were the least frequently reported behaviors.

Vail-Smith and Felts (1993) examined 296 Caucasian college students in the southeastern U.S. The majority (61%) were young women 18 years of age. The college students were concerned about the negative effects of sun exposure, such as getting skin cancer (57.3%) and aging skin prematurely (63.2%). However, only 18.5% of women and 14.7% of men used sunscreen with at least the SPF of 15 when they went to the beach and rarely use it at any other time. The proportion of respondents using sunscreen was much smaller than the proportion of outdoor workers. Half of respondents also enjoyed sunbathing. Female students were likely to sunbathe more frequently than were male students. Students who sunbathed frequently (2 or 3 times per week) tended to have fewer self-perceived risk factors and to have strong beliefs associated with the advantages of a suntan.

Age was a significant predictor of perceived susceptibility to skin cancer in Grubbs and Tabano's study (2000): The older the respondents, the more likely they perceived susceptibility. Grubbs and Tabano stressed the importance of targeting the younger age group regarding skin cancer risks and sun precautions.

In summary, males, whites, and indoor workers were more likely to enjoy outdoor activities. Women, elderly groups, or those having sun sensitive skin or a history of skin cancer were more likely to take at least one sun protective behavior. Outdoor workers tended to be more dependent on wearing protective clothing such as a brimmed hat or long-sleeved shirt than using sunscreen or staying in the shade. Younger age groups and women were more likely to have a suntan.

Methodology

This section describes the research methods for the second phase. Topics include instrument development, sampling, data collection procedures, results of a pretest, and data analysis methods.

Instrument Development

A self-administered questionnaire was developed because standardized instruments to measure the health belief model or attributes of innovation did not exist. Each item was modified from previous studies. The instrument consists of three sections: 1) beliefs about skin cancer risk and tanning, and current sun protective behaviors; 2) perceived attributes of UV specialized shirts and the intention to purchase the shirt; and 3) demographics. Every continuous variable was measured using a Likert scale, since "Likert scaling is widely used in instruments measuring opinions, beliefs, and attitudes" (DeVellis, 1991, p. 69).

The first section was based on the health belief model with 36 items modified from previous studies (Arthey & Clarke, 1005; Carmel, et al., 1994; Grubbs & Tabano, 2000; Jackson, 1997; Jackson & Aiken, 2000; Vail-Smith & Felts, 1993). Each item and its source can be found in Table B1 in Appendix B.

The first two items in the first section are regarding exposed hours of outdoor activities and sunbathing. The next five items relate to current sun protective behaviors, including use of sunscreen on the face and body, use of long-sleeved shirts or pants to cover the body, use of a hat, or use of the shade to avoid exposure. Those five items were measured using five-point Likert-type scales ranging from "never" (1) to "all the time" (5).

Susceptibility to and severity of skin cancer are measured by four items each. Three items measure the benefits of taking sun precautions. Six items measure the behavioral barriers to taking sun protective behaviors, and five items measure the psychological barriers to sun protection (perceived advantages of tanning). Cues to action are measured by 7 items: two items for friend's sun protective behaviors, two for illness of family/friend and influence of media, and three for friend's suntan perception and behavior. Subjects answered each item on five-point Likert-type scales ranging from "strongly disagree" (1) to "strongly agree" (5).

In the second section, a total of 26 items were modified from Jackson and Aiken, (2000), Moore and Benbasat, (1991), Shim and Kotsiopulos (1994), and Strutton, Lumpkin, and Vitell, (1994). There are few scales to measure attributes of innovations with respect to apparel products, so the researcher needed to extensively modify the instrument previously used to measure adoption of information technology.

Eight items measure relative advantage: two items for economic advantage, three for image/prestige, and three for general usefulness. Compatibility and observability each are measured by four items, and complexity and triability by three items each. The intention to adopt UV specialized shirts is measured by four items. All items employed five-point Likert-type scales ranging from "strongly disagree" (1) to "strongly agree" (5). Each item and source of literature is provided in Table B1 in Appendix B.

For the second section, the researcher provided a black-and-white picture for the pretest (Figure B1, in Appendix B) and a color picture for the final test so respondents gave rating on each attribute item based on the same product. The photograph, from a commercial catalog supplying sun protective clothing included a male model wearing a long-sleeved polo shirt with dark long pants. Shirts in different colors and price information were included in order to provide a variety to respondents. The UV specialized shirts in the catalog are designed to offer a SPF (sun protection factor) of 30 or more. The description of the products in the picture was provided to help respondents in understanding the general function of UV specialized shirts.

The last section includes the demographic information: gender, age, education, marital status, and ethnicity. In addition, the questionnaire asked how often and when the respondents usually play golf. These two questions would indicate how enthusiastic the respondents were about golf. The pretest included a total of 69 items.

Sampling

A convenience sampling method was used to collect the data. For this study, golfer is defined as a person who has played golf. Because it is difficult to figure out who has played golf in the general population, the researcher visited the golf courses to select a sample among golfers who finished their plays for the day. Also, students of a professional golf management (PGM) program at Ferris State University were recruited to participate.

Pretest

The pretest was conducted at Forest Akers East Golf Course during September 2002. Of the 21 useful responses, 14 respondents were male and seven were female golfers, ranging in age from 24 to 42 years, with a mean of 30 years.

The pretest was conducted in order to verify the internal consistency among items of each variable and to check for ambiguity. Items were deleted and modified based on the results of internal consistency using Cronbach's alpha coefficients. The alpha for each variable is reported in Table B1 in Appendix B. In addition, three professionals examined the questionnaire for content validity before the final survey was conducted.

As a result of the pretest responses, sun-related activities, current sun protective behaviors (SPB), benefits, and psychological barriers were not changed. However, one item on susceptibility (#10) and one item on severity (#15) were deleted to increase the alpha and to reduce the number of total items. Two of six items in the behavioral barrier measurement (#23 & #24) were deleted for the same reason. One item was added regarding whether wearing a long-sleeved shirt restricted golfer's movement. Thus, the behavioral barrier was focused on the barriers to wearing protective clothing while playing golf. Among the items of cues to action, the fifth and sixth items (#34 & #35) were reverse scored, since these two items were negatively correlated with the other items. Two items in cues to action were removed: The third item (#32) was moved into the demographic section to be asked as binary responses (yes or no), and the fourth item (#33) was deleted due to low inter-item correlations. After deleting two items in the variable cues to action, the alpha increased to 0.68, the minimally acceptable level of alpha (DeVellis, 1991). After the pretest, 31 items in the first section were used in the final questionnaire to measure the beliefs about skin cancer and sun protective behaviors.

In the second section, seven items were deleted in order to increase the alpha scores and reduce the total numbers of items: two items of relative advantage (#1 & #7), one item of compatibility (#9), two items of complexity (#14 & #15), one item of triability (#17), and one item of intention to adopt (#26). One item of observability (#20) was moved to measure complexity, since respondents considered it difficult to understand the UV protective function rather than difficult to communicate the advantages. A total of

19 items was employed to measure the attributes of an innovation and the intention to adopt it.

In section three, an open-ended question covered the frequency of golf rounds per each month. Also, the format for measuring the time of a day respondents play golf was changed. Respondents were instructed to check all that applied, because some respondents mentioned that they were more likely to play golf any time without specific patterns and they played more than 3-4 hours for a round of golf, so 2 hour intervals were not appropriate to the time categories. As mentioned earlier, one item for cues to action, having family members or friends who have skin cancer was included in the demographic section. The final questionnaire included 58 items and was presented with the cover letter (Appendix B).

Data Collection Procedure

A self-administered questionnaire was distributed to golf players between September, 2002 and January, 2003. The superintendent of Forest Akers Golf Courses at Michigan State University was contacted through letter and phone in order to get permission to distribute the survey to golfers at the golf courses or at the official events. After obtaining permission, the researcher visited the two golf courses of Michigan State University on different days of the week between 2 p.m. and 7 p.m. and on the dates of scheduled events between September and October, 2002. The potential subjects who were heading to parking lots after playing golf were randomly approached. Then the researcher explained the purpose of the study and gave out the questionnaire to them so that they had a chance to read the cover letter, since it contained specific information about the purpose of the study and the elements of informed consent. If a subject agreed to participate voluntarily, the researcher considered it as a verbal consent. If a person refused to participate, the researcher approached another person. In addition, the researcher visited two golf practice ranges in Lansing area, and obtained the data in the same way at the golf courses. There is no control of subject's gender, age, or ethnicity.

The researcher also contacted the instructors of professional golf management (PGM) program at Ferris State University to obtain their permission to distribute the questionnaire to their students. The PGM program, authorized by the Professional Golfers' Association of America, trains and educates future golf professionals for the needs of the golf industry. The use of college-aged sample would be helpful to understand this subset of the population who are less likely to take sun protective actions and more likely to have positive attitudes toward sun exposure (Hall, et al., 1997; Robinson, et al., 1997). In addition, analyzing young people's attitudes toward the innovation would be challenging for designers, since this age group is probably less concerned about health and more interested in appearance. The data at Ferris State University were collected between November 2002 and January 2003.

Data Analysis Methods

The summated rating scale was developed based on Cronbach's alpha coefficient as the measure of internal consistency. The items to measure each variable were summed. For instance, to measure the variable sun protective behavior (SPB), the respondent's rating on each of five items was summed, generating a summated score for SPB. The advantage of the summated rating scale is to reduce the errors of measurement by combining multiple items, producing a more reliable measurement of a variable (Spector, 1992).

Three types of data analysis methods were used: descriptive statistics of all the independent and dependent variables in the present study, bivariate relationships among the dependent and independent variables by Pearson correlation coefficients, and multiple regression analyses on the two dependent variables.

Findings and Discussions

This section presents the data analysis and research findings for the second phase of the study. The first part describes the findings of data analysis. Next, the discussion of findings and a summary for each research question are provided.

Data Analysis and Findings

Description of Demographics

A total of 158 useful questionnaires were collected: 106 from golf courses and 52 from the PGM program of Ferris State University. Among eligible participants, the response rate was 68.1%; 21.6% refused to participate and 10.3% did not complete the questionnaire. Ninety-one percent of the respondents was male (n = 143) and the respondents' age ranged from 16 to 80 years (mean age = 30 years). Although the researcher tried to approach both sexes at the same rates, male golfers were dominant in the selected golf courses. About 74% were Caucasians (n = 117) and 65% were single (n = 103). Thirty-five of 158 respondents (22.2%) answered that they have family members or friends who have skin cancer.

Description of Variables in the Health Belief Model

Sun-related activities. Frequency descriptions of sun-related activities are presented in Table 17. Regarding outdoor activities or work in a typical week during the summer, 40% of the respondents spend more than 25 hours in the sun in a week. Approximately 54% did not sunbathe in the summer.

Sun protective behaviors. Table 18 presents the distribution of sun protective behaviors (SPB). About 31% of the respondents often to all the time wore sunscreen on the face and 20% used it on the body when outdoors, while more than 80% never or

Table 17. Sun-Related Activities in a Typical Week in the Summer

	0 hr	1-2 hrs	3-4 hrs	5-7 hrs	8-10 hrs	11-15 hrs	16-20 hrs	21-25 hrs	25 or More	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Outdoor activities/ work	0	3 (1.9)	6 (3.8)	16 (10.1)	22 (13.9)	17 (10.8)	19 (12.0)	12 (7.6)	63 (39.9)	158 (100)
Sunbathe	85 (53.8)	38 (24.1)	18 (11.4)	5 (3.2)	6 (3.8)	1 (0.6)	1 (0.6)	1 (0.6)	0	155 (98.1)

rarely wear a long-sleeved shirt to cover the body from the sun. About 47% of the respondents wore a hat when they were in the sun. This might be attributed to the high proportion of males in the sample, since men are more likely to wear a hat (Garbe & Buettner, 2000). Also, hats are frequently seen in published images of golf players: About 67% of male golfers were wearing hats. Finally, 26% often to all the time tried to stay in the shade when outdoors. Based on the description in Table 18, approximately a quarter of respondents practiced one of the recommended behaviors except for wearing sun protective clothing often to all the times when they were outdoors.

Table 18. Current Sun Protective Behaviors

SPB *(Alpha = .63)*	Never N (%)	Rarely N (%)	Sometimes N (%)	Often N (%)	All the time N (%)	Mean SD
Sunscreen on the face	36 (22.8)	25 (15.8)	48 (30.4)	35 (22.2)	14 (8.9)	2.78 1.27
Sunscreen on the body	41 (26.1)	34 (21.7)	51 (32.5)	25 (15.9)	6 (3.8)	2.50 1.15
Wear Clothing	79 (50.0)	51 (32.3)	21 (13.3)	7 (4.4)	0	1.72 0.86
Wear a hat	15 (9.5)	24 (15.2)	45 (28.5)	43 (27.2)	31 (19.6)	3.32 1.22
Stay in the Shade	21 (13.4)	41 (26.1)	54 (34.4)	31 (19.7)	10 (6.4)	2.80 1.10

In order to find out respondents' overall sun protective behaviors, the summated scale of SPB was obtained by the sum of the scores of all five items. The scores of the SPB variable ranged from 5 to 23, with a mean of 13.1. Higher scores indicate more sun protective behaviors. The scale of SPB was used as a dependent variable in testing the health belief model, and as an independent variable in testing the proposed research model for this study. Cronbach's alpha of all five items was .63.

Susceptibility and severity. In Table 19, about 30% to 50% of the respondents agreed or strongly agreed on being susceptible to getting skin cancer as indicated by three items, whereas 68% to 87% of the respondents agreed or strongly agreed on the two items for severity of having skin cancer. In addition, about 72% were concerned about aging due to sun exposure.

Table 19. Perceived Susceptibility and Perceived Severity

Susceptibility *(Alpha = .75)*	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Mean SD
I am more likely than the average person to get skin cancer.	21	40	52	34	11	2.84 1.12
The possibility of skin cancer worries me.	19	40	44	45	10	2.92 1.13
Whenever I hear of a friend/relative (or public figure) getting skin cancer, it makes me realize I could get it too.	8	25	42	66	16	3.36 1.03
Severity *(Alpha = .71)*						
Getting skin cancer would severely affect my life.	5	20	25	60	48	3.80 1.10
It would be terrible to have skin cancer.	0	6	15	53	83	4.36 0.81
It would be terrible to look older than I really am due to too much sun-exposure.	3	11	31	63	50	3.92 0.98

The summated scale for the two variables was also obtained so that the sum of the items for susceptibility and severity would represent each variable in the regression equations. The higher scores indicated more agreement that they were susceptible to skin cancer and getting skin cancer was serious to them. Cronbach's alphas of susceptibility and severity were .75 and .71 respectively.

Benefits of taking sun protective behaviors. About 80% of the respondents agreed or strongly agreed on the benefits of covering up their body to reduce the chances of getting skin cancer or aging their skins (Table 20). Fewer people strongly agreed with the second item that linked skin cancer with sun exposure compared with the other two items of benefit: Only half of respondents agreed or strongly agreed that sun avoidance was related to skin cancer prevention. Because respondents were enthusiastic about outdoor sports, especially playing golf, they seemed not to connect the outdoor activity with the chance of developing skin cancer, although they believed that taking sun precautions would reduce skin cancer risks.

Scores for the three items relating to benefits were summed, with higher scores indicating more perceived benefits of taking sun protective actions. Cronbach's alpha for the three items of benefits yielded .80.

Table 20. Perceived Benefits of Practicing Sun Protection

Benefits *(Alpha = .80)*	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Mean SD
Wearing a long-sleeve shirt, a brimmed hat, or sunscreen when I am in the sun would reduce my chances of getting skin cancer.	4	4	23	60	67	4.15 0.94
Whether or not a person develops skin cancer is related to how frequently they avoid exposure while spending time in the sun.	4	18	51	62	23	3.52 0.96
If more people cover up their bodies when they are in the sun, they would reduce the chances of getting age spots and wrinkles.	6	13	28	68	43	3.82 1.05

Behavioral barriers and psychological barriers. Most respondents perceived barriers to practicing sun protective behaviors. Table 21 describes behavioral barriers and psychological barriers (perceived advantages of tanning). More than 80% of the respondents answered that they would not wear a long-sleeved shirt or a wide-brimmed hat while playing golf if they were uncomfortable. Regarding the items that represent psychological barriers, about 49% to 54% believed that tanning made persons look healthier and more attractive than people without a tan.

Table 21. Behavioral Barriers and Psychological Barriers

Behavioral Barriers (*Alpha = .60*)	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Mean SD)
If a long-sleeve shirt feels uncomfortable, I would not wear it for golf.	5	9	12	46	86	4.26 1.04
If a wide brimmed-hat feels uncomfortable, I would not wear it for golf.	4	9	18	48	79	4.20 1.02
The cost of UV specialized clothing ($ 60.00-$ 80.00) could keep me from purchasing it.	11	16	45	41	45	3.59 1.20
The style/appearance of UV specialized clothing could keep me from wearing it.	4	18	45	46	45	3.70 1.08
Wearing a long-sleeve shirt while playing golf would restrict my movement.	6	29	40	51	32	3.47 1.12
Psychological Barriers (Advantage of Tanning, *Alpha = .91*)						
I feel more attractive with a tan.	19	21	23	59	34	3.44 1.30
A tan makes me feel better about myself.	25	33	36	44	18	2.98 1.27
I feel healthier with a tan.	25	29	45	46	13	2.96 1.20
A sun-tanned person looks healthier than someone without a tan.	15	19	47	57	20	3.30 1.13
A sun-tanned person looks more attractive than someone who is not tanned.	13	29	30	53	33	3.41 1.24

The summated scale of behavioral barriers was created by summing the five items. The five items had a lower internal consistency than other scales (α = .60) because each item measured a different aspect of sun protective clothing. The sum of the five items, however, would imply the sum of the barriers to wearing sun protective clothing. Higher scores indicated that respondents perceived more barriers to wearing a long-sleeved shirt or a hat. Perceived psychological barrier is another type of barrier. The five items were summed, and the higher the scores, the more advantageous is a tan. Cronbach's alpha for psychological barriers was .91.

Cues to action. Cues to action (CA) were divided into two dimensions (Table 22). CA-SP indicates whether respondents have friends who tend to practice sun protective actions when outdoors. Only 12.6% of the respondents agreed or strongly agreed that their golf friends usually wore long-sleeved shirts, while 23.4% answered that their golf friends used sunscreen when outdoors. CA-Tan represents whether respondents have friends who are more likely to enjoy a suntan and perceive a suntan positively. More than 50% of respondents agreed or strongly agreed that most of their friends had a suntan and perceived a suntan positively.

Table 22. Cues to Action of Practicing Sun Protection and Tanning

Cue to Act *(Alpha = .60)* CA – SP	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Mean SD
People with whom I play outdoor sports usually wear a long-sleeve shirt or hat, when they are in the sun.	44	61	33	16	4	2.21 1.04
People with whom I play outdoor sports usually use sunscreen with an SPF of 15 or more when they are in the sun.	16	45	60	30	7	2.79 1.01
CA – Tan						
Most of my friends have a suntan.	5	24	44	69	15	3.41 0.97
Most of my friends feel that a suntan is a good thing.	5	25	46	70	12	3.37 0.95
My friends disapprove of people who have a dark tan.[a]	45	54	41	14	4	2.23 1.04

[a] Deleted item in the scale construction

The summated scale of CA-SP was composed of two items. The higher the scores, the more friends who take sun protective actions respondents have. The other scale of CA-Tan was composed of two items of the peer's tanning perception and behavior and excluded the last item due to low item-total correlation. High scores indicated that respondents' friends were more likely to enjoy a tan. Cronbach's alpha for the four items of cues to action yielded .60.

Description of Variables in the Attributes of an Innovation

Relative advantage. Table 23 shows the frequency distribution on five items of attributes of UV specialized shirts in the second section of the questionnaire. Although 69% of the respondents agree or strongly agreed on the relative advantage of the UVR protective function over other garments (6th item), only a small proportion of respondents perceived the advantage of monetary value, image, or style of UV specialized shirts positively. The summated scale of relative advantage was created by the sum of the scores of five items, and excluded the fourth item, to increase the internal consistency, yielding Cronbach's alpha of .67. A higher score indicates the UV specialized shirt has more advantages.

Compatibility. More than 27% of the respondents answered that the UV specialized shirts in the photograph would coordinate with their garments and be appropriate for their golf games, but only 18% of the respondents agreed that the product was compatible with their current needs. The scale of compatibility was developed by summing three items, with higher scores indicating higher compatibility with felt needs or values of respondents. Cronbach's alpha of compatibility was .77.

Table 23. Perceived Attributes of UV Specialized Shirts

Relative Advantage *(Alpha = .67)*	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Mean SD
This product would maximize the quality for the money that I spend.	9	46	73	23	6	2.82 0.89
Golfers who have this product would have more prestige than those who do not.	48	60	31	19	0	2.13 0.98
Wearing this product would improve my image among my golfing friends.	53	56	37	8	3	2.06 0.98
I would be self-conscious about wearing this product.[a]	12	49	49	33	14	2.92 1.09
This product would be more fashionable or unique in style than other similar types of shirts.	32	56	49	20	1	2.38 0.97
This product would provide better UV protection than the other garments I have.	4	17	28	66	43	3.80 1.04
Compatibility *(Alpha = .77)*						
This product would coordinate well with the other garments I have.	26	28	61	40	3	2.78 1.06
This product would be compatible with my current needs for a new shirt.	25	53	51	28	1	2.54 0.98
This product would be appropriate for my golf games.	22	39	49	42	5	2.80 1.08
Complexity *(Alpha = .64)*						
It would be difficult to understand how this product works to prevent UV radiation.	12	53	48	32	13	2.88 1.08
I would have difficulty explaining why wearing this product is beneficial.	13	58	49	25	13	2.79 1.07
Triability						
It would be easy to try out this product without a big commitment.[a]	6	23	39	70	19	3.46 1.01
If this product, made especially for golfers, is available in stores where I buy my golf clothes, I would try it on.	20	27	44	59	8	3.05 1.12
Observability *(Alpha = .64)*						
I have seen people wearing this product when I am outdoors.[a]	92	40	17	7	2	1.65 0.93
I could communicate the advantages of wearing this product to others.	16	26	64	46	6	3.00 1.01
If I use this product, the advantages/disadvantages would be readily apparent to me.	11	35	60	44	8	3.02 0.99

[a] Deleted item in the scale construction

Complexity and triability. About 40% of the respondents reported a low level of complexity in understanding the UV protective function, and a high level of triability of UV specialized shirts. The summated scale of complexity consisted of the sum of the two items, with higher scores indicating higher levels of complexity in understanding its function. Triability was measured by an independent item (second one) and excluded the first item due to the ambiguity and less appropriateness to an apparel product.

Observability. Although only 5.7% of the respondents have seen people wearing UV specialized shirts when outdoors, about 33% agreed or strongly agreed that they could perceive or communicate the advantage of UV specialized shirt. The summated scale of observability was built by the sum of the two items; first item was excluded due to the lower item-total correlation. Cronbach's alpha of observability was .64.

Intention to adopt UV specialized shirts. Regarding the Intention to Adopt (IA) UV specialized shirts, approximately 70% of respondents answered that they did not plan to buy or wear UV specialized shirts. The summated scale of IA was composed of the sum of the three items in Table 24. Cronbach's alpha of the three items was 0.83. The higher the scores, the greater the intention to wear or purchase UV specialized long-sleeved shirts. This scale is a dependent variable in attributes of innovations (Figure 14) and in the proposed model (Figure 15), with the possible range of 3 to 15.

Table 24. Intention to Adopt a UV specialized Shirt

Intention to Adopt *(Alpha = .83)*	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Mean (SD)
I plan to wear a UV specialized shirt for most outdoor activities.	45	68	32	12	1	2.09 (0.92)
I intend to wear a long-sleeve shirt while playing golf.	60	54	26	16	2	2.03 (1.03)
I intend to purchase a UV specialized shirt within the next few years.	50	59	31	16	2	2.12 (1.01)

Although Cronbach's alphas of variables in the present study were relatively lower than the alphas in the pretest (Table B1, in Appendix B), all of the alphas were above .60, the minimal acceptable level (DeVellis, 1991).

Description of the Summated Scale

The mean, standard deviation, and minimum and maximum values of the summated scales used in the regression equations are presented in Table 25. SPB was positively skewed with a mean of 13.1, which was lower than the midpoint of 15 within the possible range. Severity, benefits, and behavioral barriers showed higher mean scores compared with the midpoint of the possible ranges, indicating that respondents perceived the severity of skin cancer, and benefits of and barriers to taking sun protective behaviors to some extent.

Table 25. Descriptive Statistics of Variables in the Proposed Research Model

Scales of Health Belief Model	Mean (SD)	Minimum Maximum	Scales of Attributes	Mean (SD)	Minimum Maximum
Sun Protective Behavior (SPB)	13.09 (3.58)	5 25	Intention to Adopt (IA)	6.23 (2.56)	3 15
Susceptibility	9.09 (2.69)	3 15	Relative Advantage	13.16 (3.20)	5 25
Severity	12.05 (2.38)	3 15	Compatibility	8.11 (2.60)	3 15
Benefit	11.49 (2.48)	3 15	Complexity	5.67 (1.84)	2 10
Behavioral Barriers	19.21 (3.23)	5 25	Triability	3.05 (1.12)	1 5
Psychological Barriers	16.00 (5.30)	5 25	Observability	6.02 (1.72)	2 10
Cue to Act-Sun Protect (CA-SP)	5.00 (1.72)	2 10			
Cue to Act-Tanning (CA-Tan)	6.77 (1.69)	2 10			

The right column in Table 25 presents the mean scores of summated scales of variables in the attributes of UV specialized shirts. The mean of IA was 6.23 within the possible ranges of 3 to 15, indicating lower intention to adopt. The mean of relative advantage and compatibility showed lower than the midpoint of 15 and 9 respectively within the possible range, indicating that respondents did not appreciate these attributes of UV specialized shirts positively.

Correlation Analysis

Before conducting regression analyses on the two dependent variables (SPB and IA), Pearson correlation coefficients among independent variables and dependent variables were examined (Table 26). The dependent variable of SPB (sun protective behavior) was significantly and positively related to susceptibility (r = .254), benefits (r = .329), and cues to sun protection (CA-SP) (r = .380), and negatively correlated with psychological barriers (r = -.233). That is, respondents who were more susceptible to skin cancer risks and perceived more benefits of sun precautions, were more likely to practice sun protective actions. Also, if respondents have more friends who practice sun protective actions (CA-SP), the respondents were more likely to take sun protective behaviors. The negative correlation indicates that respondents who perceive more advantages of tanning are less likely to practice sun protective behaviors.

In terms of attributes of innovations, four of five attributes were significantly and positively correlated with IA (intention to adopt); the correlation for complexity was not significant. Relative advantage (r = .524), compatibility (r = .557), and triability (r = .569) present moderate relationships with IA, indicating that the more respondents perceive the relative advantage, compatibility, or triability positively, the greater their intention to purchase or wear the UV specialized shirts.

s in the Research Model

Table 26. Correlations among Variables in the Research Model

Variable	1	2	3	4	5	6	7	8	9	10	11	12	IA	SPB
1. Susceptibility	1.00													
2. Severity	.195*	1.00												
3. Benefits	.236*	.096	1.00											
4. Behavioral Barriers	.125	.124	.118	1.00										
5. Advantage of Tanning	.064	.082	.065	.329*	1.00									
6. Cues to Act – Sun Protect	.050	.002	.139	-.025	-.155	1.00								
7. Cues to Act – Tanning	.164*	.112	-.032	.162*	.395*	-.171*	1.00							
8. Relative Advantage	.144	.001	.175*	-.208*	.052	.230*	-.007	1.00						
9. Compatibility	.127	.017	.141	-.290*	-.093	.217*	-.184*	.672*	1.00					
10. Complexity	-.012	-.120	-.008	.109	.066	-.073	.177*	.082	.075	1.00				
11. Triability	.241*	.128	.224*	-.207*	-.074	.238*	-.138	.506*	.647*	-.124	1.00			
12. Observability	.147	.153	.258*	-.072	-.027	.123	-.001	.388*	.377*	-.127	.380*	1.00		
Intention to Adopt (IA)	.099	-.011	.116	-.339*	-.176*	.274*	-.250*	.524*	.557*	-.036	.569*	.317*	1.00	
Sun Protective Behaviors (SPB)	.254*	.043	.329*	-.080	-.233*	.380*	-.142	.234*	.170*	.065	.270*	.203*	.384*	1.00

* Correlation is significant at the 0,05 level (2-tailed)

With respect to the relationships among variables in the proposed research model, Figure 15, the correlation coefficients among the health belief model and the intention to adopt UV specialized shirts were examined. Behavioral barriers ($r = -.339$), psychological barriers ($r = -.176$), cues to sun protection (CA-SP, $r = .274$) and cues to tanning (CA-Tan, $r = -.250$) were significantly related with IA. Specifically, if respondents believe that there are barriers to wearing sun protective clothing, tanning is beneficial, and their friends enjoy a suntan, respondents are less likely to intend to adopt UV specialized shirts. In contrast, if respondents have more friends who practice sun protective behaviors, they are more likely to intend to adopt UV specialized shirts. Respondents' current sun protective behaviors are significantly and positively correlated with the intention to adopt ($r = .384$).

Regression Analysis

The summated scales of variables were used for the multiple regression analysis. Linear regression models were developed based on the conceptual frameworks on Figure 13, Figure 14, and Figure 15. The normality of the residuals of the dependent variable in the each model was assessed by the Kolmogorov-Smirnov test, and four outliers were deleted for violation of normality of distributions. Each regression model is discussed.

Health belief model in Figure 13. The contribution of independent variables in the health belief model to the dependent variable, sun protective behaviors (SPB) was examined. Since demographic characteristics help to explain the variance of SPB according to Figure 13, three demographic variables, age, ethnicity, and marital status were used as the independent variables for this study: Ethnicity (1 = Caucasian, 0 = others) and marital status (1 = single, 0 = others) were recoded as dummy variables, and age was used as a continuous variable. Since 90% of respondents were male golfers, gender was not used as a variable. The information, years of education completed was also excluded, since this variable was highly correlated with age, and more than 97% of the sample completed at least high school education.

The seven summated variables were entered with three demographic variables. In addition, one variable, the part of cues to act, having family members or friends who have skin cancer, was included as a dummy variable (1 = Yes, 0 = No). The variables and results of the regression analysis are presented in Table 27.

Table 27. Regression Analysis of the Health Belief Model Variables on Sun Protective Behaviors (Model A)

Independent Variables	B	β	p	Adjusted R^2
Constant	8.266		.001	
Age	-.038	-.151	.123	
Marital Status (Single)	-1.958	-.267	.021*	
Race (Caucasian)	-.631	-.079	.358	
Susceptibility	.359	.277	.000***	
Severity	.020	.014	.837	
Benefits	.323	.228	.001**	.398
Behavioral Barriers	-.080	-.075	.277	
Psychological Barriers	-.160	-.242	.001**	
Cues to Act – Sun Protect	.662	.318	.000***	
Cues to Act – Tanning	.172	.082	.284	
Cues to Act – Family Skin Cancer	1.187	.142	.041*	

*p < .05, **p < .01, ***p < .001

Six of 11 independent variables were significant at the .05 level of probability, F (11, 140) = 10.07, p = .000. Peer's sun protective behaviors (CA-SP) was the most important predictor of SPB in comparison among the values of standardized coefficient beta (β = .318), followed by susceptibility (β = .277), marital status (being single, β = -.267), psychological barriers (β = -.242), benefits of taking sun protective behaviors (β = .228), and knowing family members who have skin cancers (β = .142). R^2 value for this model was .442, indicating that 44.2% of the variance of the dependent variable, SPB was explained by the six predictors, with an adjusted R^2 value of .398.

According to regression assumption, the relationship between independent variables (Xs) and the dependent variable (Y) has to be linear (Lewis-Beck, 1980). These linear relationships can be examined by the correlation coefficients in Table 26 as reported in correlation analysis section. In addition, multiple regression analysis generated the partial regression plots, which should present linear relationships between each independent variable and the dependent variable "if the assumption of linearity is met" (Norusis, 1999, p. 501). All of the scatterplots present a linear pattern between X and Y (see Figure C1a – C1k, in Appendix C). Multicollinearity was also examined by the correlation coefficients: The highest correlation coefficient among independent variables in the health belief model was .395 between CA-Tan and psychological barriers (advantages of tanning) that was far smaller than .85, the level Munro (2001) recommends to decide multicollinearity. Thus, it was assumed that there was no problem with multicollinearity.

The assumption regarding the residuals in the regression model was examined in order to test the linear model. First, the normal distribution of the residual of the dependent variable was assessed. The histogram in Figure C2 in Appendix C showed that the residual followed the normal distribution. The normal probability plot indicated that the distributed points clustered around the given straight line (Figure C3 in Appendix C).

In addition, the significant value of the Kolmogorov-Smirnov test indicates the distribution of the residuals does not differ significantly from normal ($p = .200$).

Homoskedasticity refers to whether "the variance in prediction errors is more or less constant across the values of X" (Lewis-Beck, 1980, p. 28). Scatterplots between eleven independent variables and the standardized residuals of the dependent variable were obtained to assess homoskedasticity (Figure C4a to Figure C4k in Appendix C). Distributed values in each stactterplot were similar above and below the regression line across the values of an independent variable to some extent although a few outliers existed. In addition, it was assumed that there were no relationships between independent variables and residuals, since the graphs did not show defined shapes between independent variables and residuals. Also, the horizontal line showing the relationship between independent variables and residuals indicated no relationship existed in all eleven scatterplots. Thus, it was assumed that there were no significant violations in the residual assumptions.

Attributes of innovation in Figure 14. With respect to attributes of innovations, five attributes were entered as independent variables to explain the dependent variable, intention to adopt an innovation (IA). R^2 value for this model was .411, with an adjusted R^2 value of .391, $F(5, 148) = 20.676$, $p = .000$. The beta and standardized coefficients beta are presented in Table 28. Two of the five attribute variables were significant at .05 levels. Triability contributed the most to IA ($\beta = .324$), followed by relative advantage ($\beta = .237$). Complexity and observability were insignificant predictors of IA in this model.

Regression analysis generated the partial regression plot between five independent variables and the dependent variable separately, and showed the linear relationships (Figure C5a – C5e, in Appendix C). Multicollinearity was examined by the correlation coefficients and tolerance value. Tolerance of a variable measured the collinearity, meaning "the proportion of the variance in a variable that is not accounted for by the other independent variables" (Munro, 2001, p. 272). The range of tolerance among five independent variables ranged from 0.42 (compatibility) to 0.91 (complexity). The highest correlation coefficient value in Table 29 was 0.647 between compatibility and relative advantage, which was relatively lower than 0.85, so it was assumed that multicollinearity was not significant in this regression model.

Table 28. Regression Analysis of Five Attribute Variables on Intention to Adopt (Model B)

Independent Variables	B	β	p	Adjusted R^2
Constant	.140		.882	
Relative Advantage	.188	.237	.007**	
Compatibility	.171	.174	.075	.391
Complexity	-.049	-.036	.592	
Triability	.742	.324	.000***	
Observability	.039	.026	.716	

*p < .05, **p < .01, ***p < .001

The normality of residual was examined by a histogram, a normal probability plot, and the Kolmogorov-Smirnov normal test (p = .097). The graphs showed that residuals were distributed to the normal curve, although there was a peak at .00 and at .25 above the mean (Figure C6, Appendix C). The distributed points fall close to the line in the normal probability plot although values around .75 tend to have lower expected values than observed values (Figure C7, Appendix C).

Homoskedasticity and no correlation between the independent variables and residual were examined by the scatterplot between standardized residuals and each independent variable. The scatterplots (Figure C8a to Figure C8e, in Appendix C) indicated that the scatters of the residuals above and below the regression line were similar, and there was no particular pattern across the scatterplots. Hence, it was assumed that the variance of the error term was constant for all values of the independent variables, and there were no relationship between independent variables and residuals.

Final research model in Figure 15. In order to examine the research model in Figure 15, the final regression equation was developed. All variables in the proposed research model were entered in the multiple regression equations to explain the dependent variable of Intention to Adopt (IA) in hierarchical order. Since the research model combined the two theoretical frameworks, it was necessary to force the order of entry of variables. Based on the research model, the independent variables were entered in three blocks: the demographic variables and health belief variables were entered in the first block, sun protective behavior (SPB) as an independent variable was entered in the second, and attribute variables were in the third.

The first block was the same regression equation model as in Table 27. Since not all variables in model A were significant in predicting the dependent variable, as shown in Table 27, a stepwise solution was appropriate as the entry method for each block of variables in order to keep only significant variables in the regression equations. In the second block, SPB was entered based on the research model in Figure 15. According to order of entry of variables in the equation, significant variables in the first and the second blocks were retained in the final model with the significant variables in the third block. In the third block, attribute variables were entered. The third block was the same model as in Table 28, which presented the results of multiple regression equations of five attribute variables on IA.

The results of multiple regression analysis for the proposed model are shown in Table 29. R^2 value for the final regression model was .501, with an adjusted R^2 value of .477, F (7, 144) = 20.641, p = .000. With five independent variables, 50.1% of the variance of IA was explained. Only ethnicity among demographic variables was significant. The Beta of ethnicity (B = -.851) indicated the mean difference between Caucasians and other ethnic groups. Caucasians were less likely to adopt the UV specialized shirts than other ethnic groups when all other predictors are held constant.

Behavioral barriers among the health belief model variables was significant (B = -.138). The slope of behavioral barriers indicated an decrease in the predicted intention to adopt UV specialized shirts for one unit of increase in behavioral barriers with all other variables held constant. In the second block, SPB was the significant variable in predicting IA. Triability and relative advantages were the significant variables among five attributes of innovation in the third bock.

Triability had the largest standardized coefficient of beta (β = .338) among significant variables retained in the final model, so this variable was the most important predictor for IA. Relative advantage was the second most important predictor in this model (β = .250), followed by SPB (β = .217), behavioral barriers (β = -.177), and ethnicity (β = -.147). Susceptibility and CA – SP (cues to sun protection) were retained in the final model, since these two variables were significant in the first block, but insignificant when the variables in the third block were added.

Table 29. Regression Analysis of All Variables in the Research Model on Intention to Adopt (Model C)

Independent Variables	B	β	P	Adjusted R^2 Changed
Constant	2.531		.061	
Ethnicity	-.851	-.147	.038*	
Behavioral Barriers	-.138	-.177	.006**	
CA-SP	-.019	-.013	.858	
Susceptibility	-.001	-.001	.986	.232
SPB	.158	.217	.003**	.281
Relative Advantage	.199	.250	.000***	
Triability	.780	.338	.000***	.477

*p < .05, **p < .01, ***p < .001

Statistical assumptions of the regression analysis had been examined. Since the regression model C used the stepwise method, only significant predictors in this model were reported in the assumption examination in Appendix C. The two insignificant variables, CA-SP and susceptibility were included in the assumption examination of the Model C, since they were retained in the final model. These two variables, however, show no relationships with the dependent variable, IA (Figure C9f and C9g, in Appendix C). Partial regression plots (Figure C9a – C9e, in Appendix C) and correlation coefficients in Table 26 suggest that linear relationships exist between predictors and the dependent variable. The histogram (Figure C10, in Appendix C) and the normal probability plot (Figure C11, in Appendix C) show the normality of residuals. Residuals followed the normal curve, and the plotted values were close to the given straight line in normal probability plot. The Kolmogorov-Smirnov test shows the normal distribution of the residuals (p = .200).

In order to check whether the error terms are independent of all predictors (the correlation between errors and predictor equals zero), scatterplots between the significant independent variables and residual of the dependent variable were obtained (Figure C12a – C12g, in Appendix C). The regression line in each scatterplot showed a zero correlation. Also, the scatters were plotted similarly above and below the regression line across the all predicted values, so homoskedasticity was satisfied.

Discussions and Summary of Research Questions

The majority of respondents in the present study was characterized as male (91%), Caucasian (74%), and relatively young (69% under 30). These characteristics are comparable with other studies of outdoor enthusiasts' characteristics (Robinson, et al., 1997). The sample of the present study also has characteristics similar with the predictors of sunburn found in Purdue, et al.'s study (2001): younger age, males, light skin color (Caucasians), longer leisure time in the sun, and seeking a tan. Respondents in this study are enthusiastic about golf, a game that requires some degree of sun exposure intermittently and cumulatively, leading them to a higher at risk of developing skin cancer.

Research Question 1 for Objective 4

- To What Extent do Golfers Perceive Susceptibility to and Severity of Skin Cancer, Benefits of Sun Protective Action, Barriers to Taking Action, and What Sun Protective Practices do They Engage?

Based on the descriptions of responses between Table 17 and Table 22, respondents in the present study agreed or strongly agreed on severity of skin cancer, benefits, and behavioral barriers, but were less likely to use sun protective behaviors.

Susceptibility and severity. About 30 to 35% of the respondents agreed or strongly agreed that they were susceptible to getting skin cancer. More than 50% agreed or strongly agreed that they were aware of the possibility of getting skin cancer, whenever they heard of a friend/relative getting skin cancer (Table 22). This result suggested that respondents generally did not consider the possibility of developing skin cancer which could be attributable to the age of respondents since younger people tended to think less about the susceptibility to getting skin cancer than older groups (Grubbs & Tabano, 2000). About 57% of the respondents in this study were 16 to 24 years of age. Approximately three quarters believed that getting skin cancer would affect their life.

Benefits and barriers. About 80% agreed that sun precaution practices would help to reduce the possibility of getting skin cancer (Table 20). However, they also agreed that they would not practice sun protective actions if doing so were uncomfortable (Table 21). Cost, style, and movement restriction seemed to be less important as a barrier to wearing UV specialized shirts than discomfort. Another barrier, psychological barriers, was also reported as positive. About 60% agreed that a tan was attractive and 37% thought a tan was healthy (Table 21). In addition, about half of the respondents believed that a suntanned person looked more attractive and healthier than someone without a tan. Their positive perceptions about a tan were significantly and positively correlated with sunbathing behaviors (r = .325). About 44% of respondents reported that they sunbathe 1 hour up to 25 hours per week during the summer. Positive perception about a suntan significantly and negatively related to the intention to practice sun protection in the study of Jackson and Aiken (2000).

Cues to actions. Respondents in the present study were more likely to have friends who enjoyed a tan, but less likely to have friends who performed sun protective behaviors (Table 22). Friends' behaviors or norms play an important part in respondents' sun protective behaviors or sunbathing behaviors. Arthey and Clarke (1995) stressed that "the beliefs that a suntan makes you look more attractive and healthy suggests that the perceived opinions of others are having an important effect on people's sun tanning, and consequently sun protection, behaviour" (p. 267). Although the present study did not examine the degree of the impact of significant others, the variable of cues to action would indicate its importance in predicting the sun protective behaviors.

Outdoor activities. About 70% of the respondents reported that they spent time in the sun for more than 10 hours in a typical week during the summer (Table 17). Their outdoor activities could be associated with golf play. Approximately 52% of the respondents answered that they played at least 10 rounds of golf per month of golfing season. That means they play, on average, two rounds of golf per week resulting in sun exposure of about 8 to 10 hours per week. However, 92 of 158 respondents (58.2%) reported that they played golf in the mid morning and/or early afternoon. About 20.5% of the respondents mentioned that they played any time of a day if possible. This finding indicates that respondents in this study are exposed to the sun during peak sun hours, while recommended sun protective action suggests that outdoor activities should be minimized between 10 a.m. and 4 p.m. "when sun's rays are most direct" (Liffring, 2001, p. 197).

Sun protective behaviors. The most reported sun protective behavior taken by respondents was wearing a hat when outdoors. About 47% of the respondents often or all the time wore a hat. Next in frequency were use of sunscreen on the face (31.1%), staying in the shade (26.1%), and use of sunscreen on the body (19.7%). Only 4.4% wore long sleeved shirts or long pants when outdoors. From the results, it was assumed that their bodies were not properly protected from the sun. Based on market research, most golfers wore short-sleeved shirts while playing. However, they reported in the survey questionnaires that they neither use sunscreen on the body nor wear long-sleeved shirts. Findings were consistent with sun protective behaviors of outdoor workers in Stepanski and Mayer's study (1998). From observation data, they found that face and lower arms were the least protected areas of the body. Hence, it would be essential to educate outdoor occupational or recreational groups about appropriate sun protective practices.

Wearing a hat was the most frequently taken action when outdoors in the present study and Stepanski and Mayer's study (1998). However, hats seemed to be worn for reasons other than sun protection. Respondents in the present study were more dependent on using sunscreen than wearing long-sleeved shirts, contrary to the outdoor workers in Stepanski and Mayer's study (1998). Respondents may think wearing long-sleeved shirts as sun protection is not appropriate for golfers if it is comfortable while they are playing.

Research Question 2 for Objective 4

- Which Variables in the Health Belief Model Contribute Most to Explaining their Current Sun Protective Behaviors?

Among eleven variables in the health belief model in regression model A, Table 27, cues to sun protection (CA-SP), susceptibility, marital status, psychological barriers, benefits, and knowing a person who has skin cancer were significant, in that order, in explaining 44.2% of the variance of sun protective behaviors (SPB). CA-SP, friend's sun protective behaviors, contributed most. That is, the more respondents have friends who take sun protective actions, the greater the likelihood that respondents take sun protective behaviors. Psychological barriers (perceived advantages of tanning) and impact of peers' sun protection were also significant predictors of sun protective behaviors in Jackson and Aiken's study (2000).

Susceptibility was the second most important variable in explaining sun protective behaviors. The more respondents perceived they were susceptible to developing skin cancer, the more likely they were to take sun protective behaviors. Severity was not a significant predictor in the present study. This is consistent with the findings of Jackson and Aiken's study (2000). As Janz and Becker (1984) indicated, severity seemed not to be meaningful to subjects in explaining preventive behaviors. If respondents were persons who have been diagnosed with skin cancer, severity might help to explain sun protective behaviors as was true in the studies of compliance with the treatment for the sick.

Behavioral barrier was the most significant variable in predicting the recommended health-related behaviors in the 29 studies (Janz & Becker, 1984), but this factor was not significant in the present study. Rather, the psychological barrier, perceived advantage of tanning, was a significant predictor, indicating that perceived body image was more influential in explaining respondents' sun protective behaviors than behavioral barriers. Educational messages that influence the perception of appearance would be necessary, especially for young adults in order to increase sun protective actions.

Being single is another significant predictor which is in contrast to the finding of Hall, et al. (1997). In the present study, singles are less likely to take sun protective behaviors than married people. It might be because the respondents' marital status was associated with their age or with their lifestyles. Having family members or friends who had skin cancer was a significant predictor of sun protective behaviors, supported by the previous studies. Benefits of taking sun precautions were also significant in explaining the variance of sun protective behaviors, meaning that the more the benefit perceived, the more likely respondents practice sun protective behaviors.

Research Question 1 for Objective 5

- To What Extent and How is Each Attribute of UV Protective Clothing Related to the Intention to Adopt?

Less than 50% of the respondents perceived UV specialized shirts to have a relative advantage (Table 23). Although 69% agreed that they could have better protection with UV specialized shirts, respondents disagreed with the superiority of the image (69%) or fashionability (56%). About 30% of the respondents agreed that the innovation photographed was compatible with their garments and their situation, and that the benefits of UV protection were observable. More than 40% of the respondents perceived that the difficulty of understanding the UV protective function was low, and triability was high. However, about 70% did not intend to purchase UV specialized shirts.

In order to find out the specific association between five attribute variables and the dependent variable, intention to adopt (IA), correlation coefficients were examined (Table26). All variables except complexity were significantly correlated with IA. The ranges of significant coefficients were from .317 (Observability) to .569 (Triability).

Complexity was also an insignificant variable in predicting the likelihood of purchasing India-inspired garments for U.S. female consumers (Littrell & Miller, 2001).

Research Question 2 for Objective 5

- What is the Relative Importance among Attribute Variables in Predicting the Intention to Adopt UV Specialized Shirts for the Potential Adopters?

Although four attribute variables were significantly correlated with the intention to adopt, only two variables were significant in regression model B in Table 28. R^2 indicated that 41% of the variance in the dependent variable, IA, was accounted for by triability and relative advantages, and triability was the most important predictor of the intention to adopt UV specialized shirts. That is, the more respondents perceived that the UV specialized shirt could be tried in the local stores and was better than existing shirts in style, price, or UV protective function, the greater the likelihood that they would intend to wear or purchase it. Since UV specialized shirts represented a preventive innovation and golfers seemed not to be familiar with it, trying it on and advantages of the shirts were directly and significantly associated with their intentions to wear it.

In the study by Agarwal and Prasad (1997), triability was a significant predictor of current usage of World Wide Web, while relative advantage was a predictor of the intention to continue to use it. Their study supported how important it is to emphasize the different attributes of an innovation in accordance with the perceivers' states of the decision-making process. The p-value of compatibility was .075, which was close to the significance level of alpha. Complexity and observability did not contribute significantly to explaining the variance. Since the innovation is relatively new, the effectiveness of UV protection would not yet be apparent to respondents. Complexity may be an inadequate attribute to describe the clothing innovation that is consistent with the study of Littrell and Miller (2001).

Research Question 1 for Objective 6

- How are Beliefs about Skin Cancer Associated with Perceived Attributes of a UV Specialized Shirt as an Innovation and the Intention to Adopt it?

In the Table 26 of correlation coefficients, susceptibility was significantly and positively correlated with triability (r = .241), indicating that individuals who believe they have higher levels of susceptibility to skin cancer than the typical person are more likely to try the UV protective shirt. The perceived benefits of practicing sun protective behaviors were significantly and positively related to relative advantages (r = .175), triability (r = .224), and observability (r = .258). That is, if individuals believe that sun protective behaviors would reduce the chance of getting skin cancer, they perceive the UV specialized garment as more advantageous, more triable, and more observable than individuals who perceive fewer benefits. On the contrary, behavioral barriers were negatively correlated with relative advantages (r = -.208), compatibility (r = -.290), and triability (r = -.207). The more individuals believe that there are barriers to taking sun protective actions, the less likely they are to perceive relative advantages, compatibility, and triability.

Cues to sun protection (CA-SP) were positively and significantly correlated with relative advantage (r = .230), compatibility (r = .217), and triability (r = .238). If individuals have more friends who practice sun protective behaviors, they perceive the innovation as more advantageous, compatible, and triable. However, compatibility was significantly and negatively related with cues to tanning (CA-Tan), indicating that respondents tend to perceive UV specialized shirts negatively and incompatible with their social values, if they have more friends who enjoy a suntan. This is not surprising since significant others' opinions play key roles in sun tanning and sun protective behaviors (Arthey & Clarke, 1995); innovations need to be compatible with what is acceptable to peers. Complexity was significantly and positively related only with cues to tan. That is, if individuals' friends are more likely to enjoy a tan and perceive having a tan positively, they tend to agree that it would be difficult to understand and explain the UV protective function of the innovation. Individuals in this category might not attempt to understand the function of UV protection.

Current sun protective behaviors (SPB) were significantly and positively correlated with relative advantages (r = .234), compatibility (r = .170), triability (r = .270), observability (r = .203), and intention to adopt (r = .384). The positive correlations indicate that the more respondents practice sun protective behaviors, the more likely they perceived UV specialized shirts as advantageous, compatible, triable, and observable, and the more likely they intended to adopt the shirts.

Findings suggest that beliefs or knowledge about a certain condition (skin cancer risks) influence the formation of attitudes toward the related object (UV specialized shirts), affecting their intention to adopt the innovation.

Research Question 2 for Objective 6

- Which Variables in the Final Model Contribute Most to Explaining the Intention to Adopt the UV Specialized Shirt?

About 50% of the variance of the Intention to Adopt (IA) was explained by five variables in the final model in Table 29. Triability contributed most in explaining IA, followed by relative advantages, sun protective behaviors (SPB), behavioral barriers, and being Caucasians (ethnicity). In the first block of the final model, the significant contribution of behavioral barriers was reasonable, since this variable focused on barriers to wearing sun protective clothing. Caucasians would have a lower level of intention to purchase or wear the UV specialized shirts than other ethnic groups. Though outdoor workers were more likely to wear long-sleeved shirts for sun protection than to use sunscreen (Stepanski & Mayer, 1998), Caucasian golfers in this study did not prefer to wear long-sleeved shirts. The differences could be attributed to the activity in which they are engaged. Since golfers' body movements are directly related to their golf scores, uncomfortableness could be a very significant factor to them. This could explain why golfers in the present study are more likely to use sunscreen than to wear long-sleeved shirts in the sun (Table 18).

In the second block, adding one variable, SPB increases the explanatory power of the IA from .232 to .281 of adjusted R^2 in Table 29. This indicates that current sun protective behavior is a significant predictor of the intention to adopt or purchase UV specialized shirts, and implies that promoting sun protective behaviors would be helpful to increase the rate of adoption.

By adding the five attribute variables in the third block, the adjusted R^2 increased to .477. This shows that the attribute variables had some impact on the intention to adopt. In fact, triability and relative advantage contributed the most, leading to a high increase in R^2 value. In comparison with model B in Table 28, model C is improved overall by adding health belief variables, demographic variables, and the variable of sun protective behaviors (SPB).

However, the R^2 indicated that about 50% of the variability in the dependent variable (IA) was explained by five variables, indicating that there are other significant predictors that were not included in explaining the intention to adopt UV specialized shirts. The imbalanced proportion of demographic variables such as age or gender in the present sample would contribute to lack of significance in predicting the dependent variables, reducing the explanatory power.

Summary

The average respondents in this study were not inclined to practice appropriate sun protective behaviors. Many respondents spent more than 10 hours in the week during the summer, and 42% sunbathed one to 10 hours a week in the sun during the summer. The significant relationships in the proposed model are shown in Figure 16. This figure was developed based on Figure 15, and shows only the significant predictors of the dependent variables, sun protective behaviors (SPB) and intention to adopt UV specialized shirts (IA) in three regression models.

In regression model A, six variables among the 11 health belief model variables were significant in explaining 44.2% of the variance of sun protective behaviors: marital status (single), susceptibility, benefits, psychological barriers, friends' sun protective actions (CA-SP), and having family member or friend who has skin cancer. Marital status and perceived psychological barriers had negative impacts on the dependent variable.

In predicting the contributions of five attribute variables on the intention to adopt UV specialized shirts, only relative advantage and triability were significant predictors of IA in regression model B, although relative advantages, compatibility, triability, and observability were significantly correlated with IA. About 41% of the variability in IA was explained by two variables.

Additional variables in regression model C significantly increased the explained variability of IA ($R^2 = .50$). IA was explained by ethnicity, behavioral barriers, sun protective behaviors in the health belief model and relative advantages and triability among five attributes of innovations. Ethnicity and behavioral barriers were negatively associated with IA.

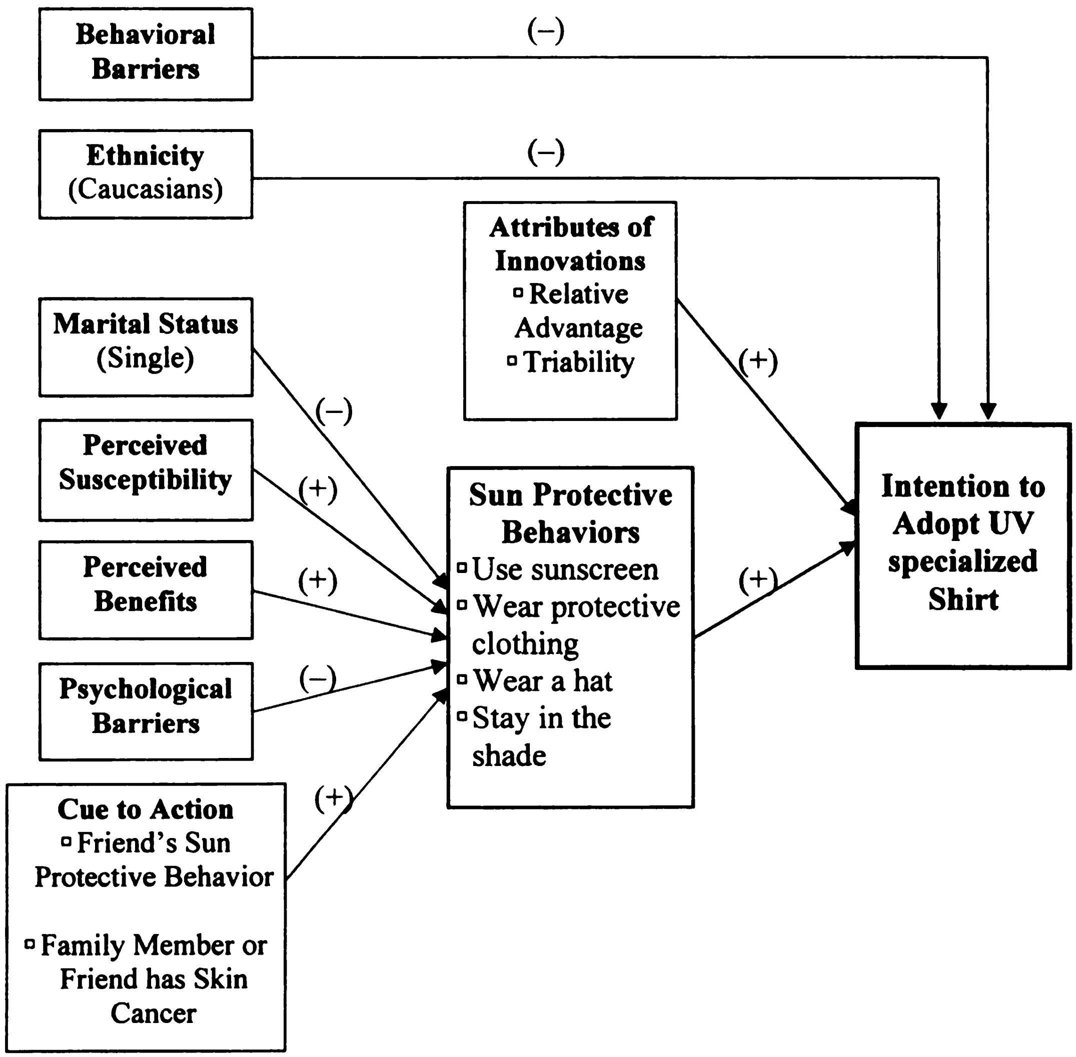

Figure 16. Significant Relationships in the Research Model

The findings support the proposed research model partially, and indicate that variables were excluded from the study that might help to explain the unexplained variance of the intention to purchase or wear UV specialized shirts. In addition, adoption of UV specialized clothing was not described with the five attributes. Only two attributes were influential in predicting IA. Thus, discovering the significant variables for the regression model A, B, or C would be very worthwhile for future studies. For instance, investigating the information sources (media or reference group influences), information process, involvement with the innovation, or motivation toward health behaviors might contribute. In addition, the health belief variables which were significant predictors of sun protective behaviors can be related to IA indirectly, so investigating causal relationships would be useful to understand the directions among these variables in a future study.

CHAPTER FIVE

Summary and Conclusions

This chapter includes a summary of the findings of the study, the limitations of the study, and the implications for future studies and practice.

The primary purposes of this study were to investigate to what extent golfers were exposed to UV radiation while they play and to understand how they perceived the risk of sun exposure and its impact on the intention to wear UV specialized shirts. This study was divided into two phases and used a variety of data collection methods. A brief summary of the findings with respect to the objectives of each phase is presented.

Phase I

Field Experiments

The objectives of the first phase were to investigate the cumulative exposure of different body sites to UV radiation during golf rounds and to evaluate the effects of clothing in reducing UV radiation transmissions. Polysulphone film badges were used to measure personal exposure to UVB. When the film is exposed to UVB, it depolymerizes with a change in its absorbance that is measurable at a wavelength of 330 nm. The absorbance change (ΔA) of each dosimeter was calculated by subtracting the value of the unexposed film from the value of the exposed. The experiments were conducted in August and in October at Forest Akers Golf Course East at Michigan State University.

Seven subjects participated in each experiment. Sixteen bandages were placed on upper body sites over and under the clothing. In Experiment 1, seven subjects wore their own summer golf shirts, while in Experiment 2, four subjects wore UV specialized shirts that were provided by the researcher and three wore their own fall shirts. While subjects were exposed, ambient exposure was also measured with 30 badges that were placed in an open, unshaded area. The absorbance values of the personal dosimeters were standardized to the equivalent absorbance values in the ambient level in order to compare the data between Experiment 1 and Experiment 2.

The results from both experiments indicates that the upper back of golfers, such as the shoulder, back, the back of the neck, and the posterior arms, are more exposed to UV radiation than the front of the body such as the chest. Under clothing, the back neck and front of the neck were the two most exposed areas, which indicated that the badges were exposed directly to the sun even though they were intended to be covered by clothing. The difference between exposure of the neck and other sites may be attributed to golfers' stance during play (bending at the waist) and their clothing habits (unbuttoning the shirts). However, the other body sites under the clothing received a limited amount of UV radiation, suggesting the importance of clothing in reducing UV radiation transmission. In addition, while the shoulder and the back over clothing were exposed to UV radiation the most, these locations were least exposed under clothing, perhaps because two layers of back yoke in UV specialized shirts and corduroy shirts contributed to better protection.

Comparison of exposure under different clothing indicates the summer cotton shirts allowed more UV radiation across most body sites than did the UV specialized shirts or thick fall shirts (Figure 12). Summer golf shirts are less effective in blocking UV radiation than the thicker fall shirts or UV specialized shirts. However, the differences in the absorbance values under the three types of shirts were not statistically significant at each body location, perhaps due to the small absorbance values as measured by films in this study.

Market Research

Market research focused on a survey of standardized images of golfers from photographs in magazines and interviews of golf store personnel to gain general information of golf clothing available. Photographs of golfers in *Golf Digest* in two years indicated standardized images of golfers, wearing short-sleeved polo shirts that included wide width of sleeve hem and collar, matched with long pants. The images reflect professional golfers and may not represent public or amateur norms.

The interviews with four salespeople in local golf stores, however, supported the findings of published images. The most typical styles of golf shirts available and purchased were the short-sleeved cotton polo, in soft colors across seasons. A baseball cap was the most common head covering for customers at local golf stores, which was also consistent with the findings of published images. Few UV specialized products, such as hats, short-sleeved shirts, or sunglasses, were available at local stores, because the majority of customers was not interested in them. Only a small portion of customers, mainly women, looked for these products. Design and price of shirts were more important factors than UV protective functions when golfers made purchasing decisions. It seemed that most customers in the local pro golf shops were aware of UV specialized products, but had not yet formed attitudes toward those products. That is, golfers in the selected market are in the knowledge stage in the innovation-decision process.

Phase II

The purposes of the second phase were to assess golfers' health beliefs and current sun protective behaviors and to examine their attitudes toward a UV specialized shirt with relation to the intention to adopt it. In addition, this study proposed a psychosocial model, based on the health belief model and Rogers' attributes of innovations, to investigate the relationships between the two theoretical frameworks.

A self-administered questionnaire was developed and distributed at public golf courses and golf-related programs in a Midwestern area by convenience sampling intercept method. One-hundred-fifty-eight respondents completed a 58-item questionnaire. Beliefs, sun protective behaviors, and attribute variables were measured using five-point Likert-type scales. Ninety-one percent were male, and their age ranged from 16 to 80 years old (mean age = 30 years). About 74% were Caucasians and 65% were single. Respondents' personal characteristics were comparable with those who were more likely to be exposed to the sun for long periods of time (Robinson, et al., 1997) and to have repeated sunburn experiences (Purdue, et al., 2001).

Health Belief Model

The majority of respondents agreed or strongly agreed on the severity of skin cancer, benefits of taking sun precautions, and barriers to wearing sun protective clothing. With respect to protecting the face, about 50% of the respondents wore a hat, and 30% used sunscreen on the face frequently or all the time when outdoors. With respect to protecting the body, only 20% of the respondents used sunscreen on the body, and 4% wore protective clothing often or all the time when outdoors. The findings indicate that the majority of respondents do not protect themselves adequately, despite being exposed to the sun to a great degree while playing golf.

The health belief variable that contributed most to predicting sun protective behaviors was cue to sun protection (CA-SP), e.g., a friend's sun protective behavior. This finding supports Arthey and Clarke's argument (1995) that the influence of peers on sun protection would make their knowledge and beliefs about sun precautions transfer into actions. Susceptibility, marital status (single), psychological barriers, benefits, and having family members who have skin cancer were also significant predictors of sun protective behaviors in that order (Table 27). The more likely respondents believe they are susceptible to getting skin cancer, believe practicing sun precautions are beneficial, and have family members or friends who have skin cancer, the more likely they are to practice sun protective behaviors. Being single and psychological barriers had negative impacts on sun protective behaviors.

Attributes of a Preventive Innovation

According to Rogers (1995), an innovation can be described by five attributes: relative advantage, compatibility, complexity, triability, and observability. About 70% of the respondents in this study agreed that the photographed UV specialized shirt had superior UV protective qualities, compared to other typical shirts. However, they did not agree with the advantages of style, prestigious image, or economic value of the shirts. Only 30% of the respondents agreed that the innovation was compatible with their garments and that the benefits of UV protection were observable. About 70% reported that they did not intend to purchase or wear a UV specialized shirt.

The intention to adopt UV specialized shirts (IA) was predicted by triability and relative advantages among five attributes of the innovation in the regression model in Table 28. This finding is compatible with market survey results. As salespeople indicated, the important criteria used when purchasing golf clothing in local stores are design and price of a garment. Consequently, the innovation needs to be perceived by consumers as superior in style and price as well as the UV protective function in comparison to other existing garments in order to be adopted. It also needs to be available to try on in the store.

Proposed Research Model

Combining the health belief model with Rogers' attributes of innovations increased the explanatory power of the variance of intention to adopt (IA) in Table 29. Triability and relative advantages among five attributes were the most significant predictors in the proposed model. Current sun protective behaviors were a significant indicator of IA. The behavioral barrier variable in the health belief model was also a significant predictor of IA and was associated negatively. That is, in order to increase the adoption of UV specialized shirts, the shirts should have few barriers to being worn: UV specialized shirts need to be perceived as comfortable, inexpensive, and/or attractive. Caucasians have a lower intention rate to adopt a UV specialized shirt than do other ethnic groups, although they have higher incidence rates of skin cancer than other groups have (Arthey & Clarke, 1995).

Limitations of the Study

Several limitations in this study should be considered when interpreting the research findings.

Phase I

The polysulphone films used as personal dosimeters have limitations. This film reached the saturation point before the maximum length of the golf game, so the researcher generated the total amount of UVB exposure of golfers based on the regression line. In addition, some personal dosimeters were lost, especially in Experiment I, presumably due to the golfers' sweat under the shirts and to their carrying the golf bags on the shoulders over the shirts where the film badges were placed. Field experiments typically involve a small numbers of subjects and data are subject to confounding variables, such as height of the sun in the sky, season, the UV index of the experiment dates, topography of golf course, orientation of golfers to the sun, and subjects' characteristics. Although this study reported the characteristics of clothing worn by the participants while they played golf, the specific factors affecting the sun protectiveness of fabric, such as fabric count (the number of yarns/cm for tightness of the weave or knit), mass per unit area, wetness, stretch effect, color effect, or washing effect, were not controlled or studied. Future studies could examine the contribution of these variables to the effectiveness of golf shirts in blocking UV radiation transmissions.

In the review of published images, the researcher reviewed one publication, *Golf Digest*, which focused on the activities of professional golf players, so the observed appearances represented only formal images of golfers. It would be useful to observe the appearance or look of the typical golfers at public golf courses across different seasons. With respect to personal interviews with the salespeople in the pro shops, the researcher visited four stores in the local area that sold clothing. The interviewees were asked to recall previous sales experiences. They responded based on their knowledge or beliefs about sun protection. Another study could involve interviewing customers or reviewing sales data.

Phase II

There were also limitations in the survey portion of the study. The sample size and sampling methods could be improved. The participants were recruited through a convenience sampling method. Non respondents who refused to fill out the questionnaire or who did not complete the questionnaire might be less likely to be interested in sun protection. The sample was not balanced with respect to age, gender, marital status, or ethnicity and that might influence the results obtained, so caution is necessary in interpreting the findings.

There were few standardized measurements of the health belief model or the attributes of fashion products as innovations. The instrument for the present study was modified and developed based on previous studies. Although the instrument was examined for reliability and validity during a pretest, the reliability scores of some of the variables in the instrument were less than the desired level of .70 (Spector, 1992), which might affect the significances in the regression models.

This study combined the different types of sun protective behaviors as one dimension, and this might produce findings that are different from the literature. Hall, et al. (1997) found that different indicators were associated with the different types of sun protective behaviors: Age and sunburn experience were significantly related to wearing protective clothing, and a history of skin cancer was related with use of sunscreen. Another limitation could be that people adopt health-related actions for non-health reasons. For instance, an individual could wear a hat for social acceptance or for fashion. Thus, it would be interesting to investigate golfers' sun protective behaviors and beliefs with a qualitative research approach.

The male model in the photograph of the questionnaire might influence positive or negative attitudes toward UV specialized clothing. The model's physical characteristics such as body type, facial attractiveness, gender, or age could impact the judgment of attractiveness of the clothing that the model wore.

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Implications for Practice and Further Research

Design Perspective

Data from the experiments indicate which body sites should be more protected to reduce UV radiation transmission for golfers. In addition, summer cotton shirts, typically worn by golfers, were less effective in protecting the human skin from UV radiation than heavier fall shirts or UV specialized shirts. The American Academy of Dermatology (2002c) recommends wearing tightly woven clothing such as a long-sleeved shirt and pants and a wide-brimmed hat (3-inch brim) that covers the face and ears, along with sunglasses with UV protection. Most golf consumers, however, would hesitate to follow these practices, especially during the summer season due to discomfort from heat or restriction of movement to play. In addition, the findings in the market research show the standardized images of golfers: The most general look is to wear a short-sleeved polo knit shirt, and few wear long-sleeved shirts. Hence, promoting long-sleeved golf shirts during the summer season will not be compatible with golfers' social norms.

Cotton, linen, or rayon fabrics are the most popular in the summer, since they are excellent in moisture absorbency, but inferior in sun protection factors to polyester fabrics (Davis, et al., 1997). The most common fabric for golfers is cotton, based on market research and clothing features of subjects in experiments (Table A1 and A2, in Appendix A). Thus, it is crucial to retain cotton fabrics for a golf shirt in order to increase the adoption of sun protective clothing.

The findings in the field experiments can be put into practice in designing an improved golf shirt. Since the two layers of cloth in the back yoke of shirts were more effective in reducing UV radiation than one layer of fabric, this approach can be applied to the excessively exposed body sites such as the shoulder, back, or posterior arm. This will also take care of any differences in the UV exposure to the left and right side of the shoulder (Table 4) and the back (Table 11). Two layers of fabrics in the yoke area can be made up of two layers of cotton fabrics or UV specialized fabric over cotton fabric. Increasing yoke size will provide more protection to the back side of the body. Slightly longer sleeves to cover the elbow would also add protection. In addition, a collar that stands high would reduce the exposure of the back of the neck to the sun. Figure 17 presents the UV protective shirt designed on the basis of the implications of this study.

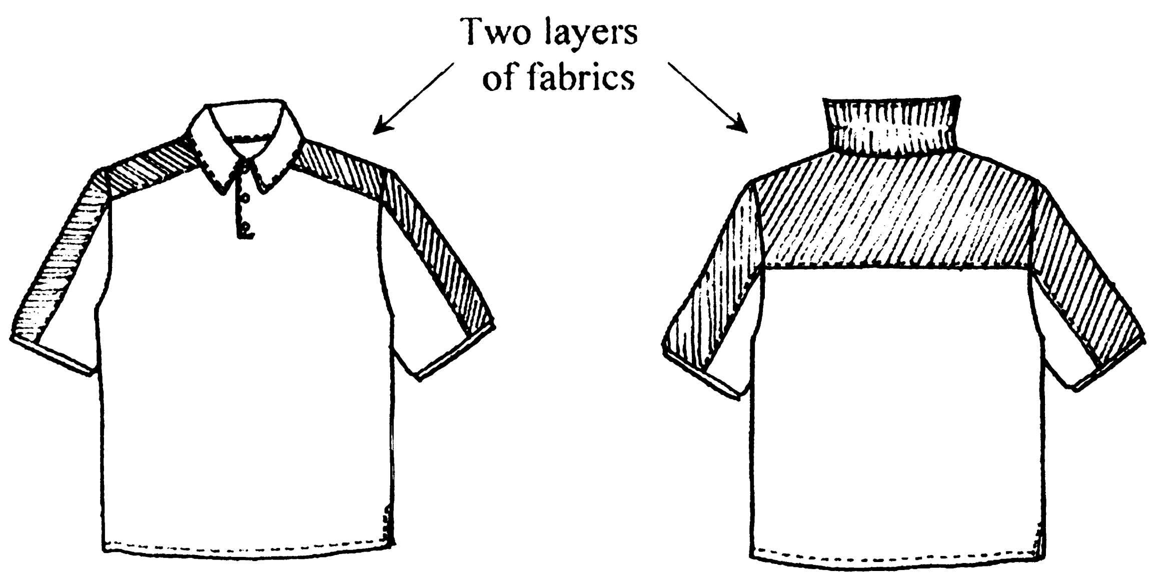

Figure 17. Proposed Design of UV Protective Shirt for Golfers

The front neck is one of the most exposed areas under the clothing, suggesting that different clothing habits, like buttoning the shirt, would reduce the body exposure at this site. Also, the forearm sites were more exposed to the sun than the upper arm sites in Experiment II (Table 15) although the subjects wore long-sleeved shirts, mainly caused by

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by unfastened cuffs of the UV specialized shirt sleeves. Hence, it would be necessary to educate the consumers about appropriate clothing habits for sun protection.

Based on findings in the phase II, behavioral barrier, relative advantage, and triability were significant in predicting the intention to adopt UV specialized shirts. That is, in order to promote sun protective clothing, barriers to wearing clothing, such as discomfort or movement restriction should be considered in designing clothing. In addition, the designers need to pay attention to style, image, and economic values in designing UV specialized shirts and make them available in the local stores in order to increase consumer's intention to adopt. In fact, about 35% to 70 % of the respondents in the second phase reported that they did not notice relative advantages of economic values, prestigious image, or fashionable style of the photographed shirts in the instrument. In order to overcome these limitations of UV specialized shirts, designers need to analyze the target consumers' needs with respect to aesthetic needs (design and color), psychosocial needs (social norm), physical needs (comfort), and technical needs (movement). The designers must reflect on consumers' needs and the standardized images of current golfers. Observation of average golfers at public golf courses during the summer season would be helpful for identifying the standardized images in the process of designing UV protective clothing. Triability was the most important predictor of the intention to adopt UV specialized shirts in regression model B and C. That is, in order to increase the adoption of sun protective clothing, those products should be available in the local store. Market survey in the present study indicated that only a small portion of UV specialized products were available in the selected local store.

A recent study reports that the use of UV absorbers as a new laundry additive during household laundering resulted in a significant improvement of UV protection of fabrics (Osterwalder & Rohwer, 2002). Since summer cotton shirts were less effective in protecting golfers from sunlight than thick fall shirts or UV specialized shirts, based on the field experiments, effective UV absorbers as a laundry additive would be beneficial and feasible for consumers if they work properly. Hence, testing the effects of UV absorbers after laundry process, compared with the normal clothing in terms of the duration and the amount of UV radiation prevention, would be necessary.

Business Perspective

For retailers of golf clothing, UV specialized short-sleeved shirts can be supplied with sunscreen for using it on forearm sites to promote sun protection. As a commercial package, a short-sleeved golf shirt can be purchased only with sunscreen, or sunscreen can be provided as a gift when golfers purchase golf clothing. In addition, educational messages targeting golfers need to be supplied with sunscreen in the pro golf stores. Flyers, including information about the proper sun protective actions and the data regarding UVR exposure at different body sites or the effects of clothing, such as the differences in the absorbance values of UVR between over and under the shirts, could stimulate consumers to comply with the recommended sun protection.

For golf course managers, the UV index card can be provided to golfers, or the UV index of each day can be posted in the golf course, so golfers become aware of the UV index. Also, providing information about the definition of the UV index, the amounts of UV radiation received by golfers during the different seasons, and the risk of developing skin cancer when outdoors will be useful to increase sun protective practices.

Research Perspective

Although increasing attention is being given to golfers regarding sun protective practices due to their prolonged exposure when the sun is the strongest, little is known about golfers' beliefs and prevention practices. This study makes a small contribution to that body of literature. Additional research is necessary to confirm the findings. By using a random or stratified sampling method, examining the general population of golfers without geographic limitation is recommended in order to generalize golfers' beliefs and behaviors regarding sun precautions. A list of public golf course users could be a possible sampling frame. Comparing age or gender differences of golf players would provide specific and appropriate information to the different subpopulation groups. Replication of the instrument across different sample groups could be helpful to establishing a stable instrument.

In addition, researchers in future studies need to explore and test variables to account for the unexplained variance of the final research model, which combined the health belief model with attributes of the preventive innovation. For example, it would be important to examine social influences on sun protection, such as, to what extent, to whom, and in which stage of the decision process significant others influence the potential adopters' practices. Investigating the structure and strength of the potential adopters' social network would be a related study, since an innovation is communicated through social networks (Rogers, 1995). Furthermore, sunbathing and sun protecting behaviors are affected by the perceiver's willingness to belong to his/her social network (Keesling & Friedman, 1987). This would contribute to developing a more complete model. The present study analyzed the data by using multiple regressions. It would be valuable to use path analysis to specify the causal relationship among variables.

In addition, discovering consumers' perceived attributes of an innovation will be useful, before diffusion is attempted. For the clothing innovation, only two attributes contributed to explain 41% of the variances of the intention to adopt it. A number of the clothing studies have provided clothing evaluative criteria with respect to price, quality, performance, usefulness (matching, appropriateness, utility), and aesthetic criteria (color, styling, fabric) (Dickson & Littrell, 1997; Eckman, et al., 1990; Lee & Burns, 1993). Most of these criteria were examined as the relative advantages in the present study, which might lead to a low level of explanation of the variance. It will be worthwhile to attempt to use these criteria as an individual attribute of the clothing innovation. Also, other extrinsic cues, such as brand name or store images, can be examined as additional factors that influence the consumers' intention to adopt clothing. Consumers' fashion or shopping involvement can be associated as well.

A longitudinal study is recommended for future research. Since this study measured the golfer's intention to adopt or purchase UV specialized shirts, it would be important to examine whether the innovation has actually been adopted. Also, it will be useful to compare the outcomes of self-reports with direct observations of respondents' sun protective behaviors.

Conducting market survey of golf clothing in other geographic locations would be necessary. In areas warmer than Michigan, potential adopters might be more knowledgeable about UV specialized shirts since they are exposed to the sun all year round. On the contrary, they might not consider it as sun protection, since wearing a shirt would be uncomfortable due to heat stress. This can be a part of the analysis process in designing functional clothing.

Education Perspective

Findings in the second phase would guide the direction of educational messages to promote skin cancer prevention. Outdoor enthusiasts have a higher risk of skin cancer than the average person since they have been associated with high cumulative UVR exposure. The present study found that the majority of respondents did not protect their body properly while they played golf. However, staying out of the sun during the midday would not be a suitable message for outdoor enthusiasts. Promotion of wearing long-sleeved shirts in the summer as sun precaution would not be appropriate to golfers, as market research described. Golfers would wear short-sleeved shirts if the weather is not cool. Survey data indicate that respondents are more apt to use sunscreen than wear long-sleeved shirts. If so, educating golfers regarding use of sunscreen on the exposed body sites, such as forearm and legs, as well as wearing shirts when outdoors, would be important. Actually, forearm sites of golfers were the least exposed areas directly to the sun based on experiments. Thus, if a golfer feels heat stress in wearing a long-sleeved shirt while playing golf, it will be appropriate to use sunscreen on the forearm sites. Golf course staffs or instructors will take important roles to promote use of sunscreen. They can remind golfers of the importance of using sunscreen before starting the golf games.

The educational messages could be designed differently according to various age groups. As Mahler, Fitzpartick, Parker, and Lapin (1997) found, appearance-based messages, presenting photoaging or skin cancer slides associated with lack of sun protection were more effective with the older age group (26-43 years of age) than with the younger group (18-25 years of age) in increasing the intention to use of sunscreen. For the young adult group, acceptance from their peers is significant, so attractive practice guides that are comparable with their social norms are appropriate. Messages that would influence their basic concepts of beauty or fashion would be necessary. The proper role models or opinion leaders of the young age group will be influential in changing their beliefs, leading to changing their behaviors.

This study shows how each dimension of the health belief model played significant roles in explaining sun protective behaviors. Findings can assist practitioners in designing sun protection programs. Focus on the significant belief variables, such as cues to sun protection, susceptibility, perceived benefits, or psychological barriers (perceived advantages of tanning) in designing messages to golfers is necessary in order to effectively influence or change golfers' sun protective behaviors. For instance, it is necessary to explain the possibility of developing skin cancer especially to young adults in the near future if they do not practice sun protection. According to the American Academy of Dermatology (2002a), melanoma, the most serious type of skin cancer is more common than any other type of cancer among women between 25 and 29 years old. This fact might be associated with women's positive perceptions about tanning. Hence, the educational messages focusing on the association between sunbathing/artificial tanning and the risk of developing skin cancer photoaging of skin are required. In addition, targeting young stars who do not have a tan would be effective in influencing the young adults' perception about beauty.

However, it would be important to control the level of threat of the message for practitioners. Becker and Maiman mentioned that "very low levels of perceived severity are not sufficiently motivating, while very high levels of perceived seriousness are inhibiting" (1975, p. 14). That is, insufficient level of threat would make the audience reluctant to accept the recommendations. Excessive fear would cause negative results, as well, causing avoidance of the recommended sun protective actions and/or denial of the possibility of their developing skin cancer. Therefore, it will be important to analyze the extent to which the targeted group feels susceptible or believes the disease is severe from the educational messages they received in order to enhance compliance.

To increase compliance, campaign designers need to provide specific action guides and encourage self-confidence to perform actions, which is effective in increasing compliant behaviors (Mattson, 1999; Rodrigue, 1996). Those variables would also help to reduce the perceived barriers to taking actions. After designing and implementing the educational messages, it would be necessary to conduct longitudinal studies to find how behavioral changes occur after the target consumers are exposed to the messages.

The findings in this study suggest that golfers are at the knowledge stage in the innovation-decision process, and they have not formed favorable or unfavorable attitudes toward the preventive innovation. Golfers' intention to adopt a preventive innovation is predicted by attributes of the innovation, health beliefs, and their current behaviors. Triability and relative advantages of UV specialized shirts, the barriers to wearing sun protective clothing, and sun protective behaviors are the significant predictors to increase the intention to adopt. This study suggests implications for apparel designers and business practitioners to reduce UV radiation exposure by golfers. However, the skin cancer incidence rates could be reduced by changing the individuals' health-related beliefs and practices of sun precautions.

APPENDICES

APPENDIX A

Experiments and Market Research

Table A1. Record of Clothing Characteristics in Experiment I (August 28, 2002)

		T-SHIRT											Hats				Sun glass		Handed	
Photo	Subject (Name)	Sleeve length		Sleeve Band		Neck collar		Hue	Shade of Color Light Dark ------------------	Fiber Contents	Fabric Structure		Yes			No	Yes	No	R	L
		Long	Short	Yes	No	Yes	No				Knit	Woven	Cap	Brim	Visor					
V	Subject A (Polo shirt)		V	V		V		Navy	V L----------------D	Cotton 100%	V		V					V	V	
V	Subject B (Cotton vest + under knit)		V		V		V	Grey + White	V L----------------D	Cotton 100%	V				V		V			V
V	Subject C (Cotton under shirt)		V		V		V	White	V L----------------D	Cotton 100%	V				V			V	V	
V	Subject D (Cotton knit)		V		V		V	Black	V L----------------D	Wool 50% Nylon 50%	V		V					V	V	
V	Subject E (Polo shirt)		V		V	V		White	V L----------------D	Cotton 100%	V		V				V		V	
V	Subject F (Polo shirt)		V		V	V		White	V L----------------D	Cotton 100%	V		V					V	V	
V	Subject G (Polo shirt)		V	V		V		Navy/ Pink Check	V L----------------D	Cotton 100%	V		V					V	V	
Total	7	0	7/7	2/7	5/7	4/7	3/7				7/7	0	5/7	0	2/7	0	2/7	5/7	6/7	1/7

Table A2. Record of Clothing Characteristics in Experiment II (October 11, 2002)

		T-SHIRT											Hats				Sun glass		Handed	
Photo	Subject (Name)	Sleeve length		Sleeve Band		Neck collar		Hue	Shade of Color Light Dark ------------------	Fiber Contents	Fabric Structure		Yes			No	Yes	No	R	L
		Long	Short	Yes	No	Yes	No				Knit	Woven	Cap	Brim	Visor					
V	Subject A (UV Shirt)	V		V		V		Beige	V L----------------D	Nylon 100%		V	V					V	V	
V	Subject B (UV Shirt)	V		V		V		Beige	V L----------------D	Nylon 100%		V	V					V		V
V	Subject C (Cotton Sweatshirt)	V		V		V		Navy	V L----------------D	Cotton 100%	V		V					V	V	
V	Subject D (UV Shirt)	V		V		V		Beige	V L----------------D	Nylon 100%		V	V					V	V	
V	Subject E (UV Shirt)	V		V		V		Beige	V L----------------D	Nylon 100%		V			V			V	V	
V	Subject F (Sweatshirt lined in fleece)	V		V			V	White	V L----------------D	80%/20% Cotton/ Polyester	V		V					V	V	
V	Subject G (Corduroy Shirt)	V		V		V		Brown	V L----------------D	Cotton 100%		V	V					V	V	
Total	7	7/7	0	7/7	0	6/7	1/7				2/7	5/7	6/7	0	1/7	0	0	7/7	6/7	1/7

Table A3. Frequency of Garment Characteristics Photographed in Golf Digest

2001		T-SHIRT												OUTERWEAR			PANTS			HAT				SUN GLASS		
Month	Total cases	Sleeve Length			Sleeve Band			Neck Collar			Color	Pattern		Y^d		N	L^a	S^b	I^c	Y^d			N^e	Y^d	N^e	I^c
		L^a	S^b	I^c	Y^d	N^e	I^c	Y^d	N^e	I^c		Strip	pattern	Jacket Sweater	Vest					Cap	Visor	Brim				
Jan	22	1	21		14	7	1	19	2	1	17	5			1	21	16	1	5	10	5	1	6	1	21	
Feb	12	1	11		5	7		12			6	6		1	1	10	11		1	5	1		6	1	11	
Mar	16	4	12^f		9	7		10	4	2	14	2		2	4	14	12	4		4	1	1	10	4	10	2
Apr	36	8	28		18	14	4	30	3	3	29	7		6	4	26	30	1	5	21^g	5	4	6	2	34	
May	27	4	23		18	8	1	23	1	3	16	9	2	1		22	23		4	9		1	17	7	20	
June	14	1	13		3	11		14			6	4	4	1	1	13	12	1	1	7	2	1	4	1	12	1
July	29	5	24		14	15		28		1	17	10	2	3	1	25	27	2		16	1	2	10		26	3
Aug	13	2	11		7	6		11	1	1	7	5	1	1	1	11	10	1	2	9			4	2	11	
Sep	34	8	26		22	12		30	2	1	26	7	1	5		28	30		4	24	2		8		30	4
Oct	34	10	23	1	23	10	1	34			26	4	4	8		26	31		3	16	1	4	13	2	32	
Nov	20	1	18	1	10	8	2	18		2	15	3	2	1		19	20			10	1	1	8	2	18	
Dec	13	1	12		6	7		13			11	2		1	1	11	10		3	5			8	1	11	1
Total	270	46	222	2	149	112	9	242	14	14	190	64	16	30	14	226	232	10	28	136	19	15	100	23	236	11
%	**100**	**17**	**82.2**	**0.8**	**55.2**	**41.5**	**3.3**	**89.6**	**5.2**	**5.2**	**70.4**	**23.7**	**5.9**	**11.1**	**5.2**	**83.7**	**85.9**	**3.7**	**10.4**	**50.4**	**7.0**	**5.6**	**37.0**	**8.5**	**87.4**	**4.1**

L^a: Long. S^b: Short. I^c: Invisible. Y^d : Yes. N^e: No. N^f : Include sleeveless (N=2). N^g: Include skullcap (N=1).

Table A3. Frequency of Garment Characteristics Photographed in Golf Digest - Continued

2002		T-SHIRT												OUT- WEAR			PANT			HAT				SUN GLASS		
Month	Total cases	Sleeve length			Sleeve Band			Neck collar			Color	Pattern		Y^d		N^e	L^a	S^b	I^c	Y^d			N^e	Y^d	N^e	I^c
		L^a	S^b	I^c	Y^d	N^e	I^c	Y^d	N^e	I^c		Strip	pattern	Jacket Sweater	Vest					Cap	Visor	Brim				
Jan	12	1	11		5	7		12			7	4	1	1		11	12			7	1		4		12	
Feb	17	1	16		8	9		16	1		9	7	1		1	16	17			8	2		7	1	16	
Mar	10	1	9		7	3		10			6	1	3	1	2	7	9		1	10					10	
Apr	21	4	17		13	7	1	20	1		14	5	2	2	1	18	21			11	5		5	3	16	2
May	8		8		6	1	1	8			6	2				8	8			5			3		7	1
June	15	1	14		10	5		13		2	13	1	1	1	1	13	15			9	1	1	4	1	14	
July	15	3	12		8	5	2	11	1	3	11	4		2		13	14	1		5	2		8		13	2
Aug																										
Sep	20	2	18		13	7		19		1	17	2	1	2	1	17	17		3	10	3	1	6	1	19	
Oct	21	3	18		13	8		20		1	14	5	2	2		19	19		2	14	2		5		21	
Nov	15	2	13		10	5		13	2		15			2	1	12	14	1		10	2	1	2		15	
Dec	16	2	14		8	8		14	1	1	11	4	1	2		14	14	1	1	9	1	1	5		16	
Total	170	20	150	0	101	65	4	156	6	8	123	35	12	15	7	148	160	3	7	98	19	4	49	6	159	5
%	**100**	**11.8**	**88.2**	**0**	**59.4**	**38.2**	**2.4**	**91.8**	**3.5**	**4.7**	**72.3**	**20.6**	**7.1**	**8.8**	**4.1**	**87.1**	**94.1**	**1.8**	**4.1**	**57.6**	**11.2**	**2.4**	**28.8**	**3.5**	**93.5**	**3.0**
Sum %	**100**	**15.0**	**84.5**	**0.5**	**56.8**	**40.2**	**3.0**	**90.5**	**4.5**	**5.0**	**71.1**	**22.5**	**6.4**	**10.2**	**4.8**	**85.0**	**89.1**	**3.0**	**7.9**	**53.2**	**8.6**	**4.3**	**33.9**	**6.6**	**89.8**	**3.6**

Y^d : Yes N^e: No I^c: Invisible L^a: Long S^b: Short $N^{\dagger}$: Include sleeveless (N=2) $N^{\dagger\dagger}$: Include skullcap (N=1)

Table A4. Frequency of Colors of Photographed images in Golf Digest

COLOR	WHITE	BEIGE			RED					Sum
	White	Off-White	Beige	Yellow	Orange	Red	Burgundy	violet	Pink	
Cases	44	9	18	24	5	32	25	3	2	162
Percent	14.1	2.9	5.8	7.7	1.6	10.2	8.0	0.9	0.6	51.8
Percent [a]	14.1		16.4				21.3			51.8

COLOR	GREEN				BLUE			NAVY or BLACK			GREY	Sum	TOTAL
	Light Green	Olive	Green/ Lawn	Pine/ Dark green	Blue/ Sky Blue	Ocean	Indigo	Dark Navy	Black	Navy or Black	Grey/ Charcoal		
Cases	6	1	1	6	29	12	17	16	23	13	27	151	313
Percent	2.0	0.3	0.3	2.0	9.3	3.8	5.4	5.1	7.3	4.1	8.6	48.2	100
Percent [a]		4.6				18.5			16.5		8.6	48.2	100

[a] : Percent of sum of grouped color

Consent Form for Experiment

The purpose of this study is to measure the amount of ultraviolet radiation (UVR) received at different sites of upper body and to identify which areas are exposed the most during play. Golfers tend to be at higher risk of developing skin cancer than the average person due to the extensive exposure during periods of sun peak time since cumulative UV exposure has strongly associated with skin cancer. The ultimate goal will be to develop clothing that offers more UV protection service.

You are invited to play a free game of golf (18 holes) at East course of MSU during a day when you will be asked to wear personal dosimeters at several body locations over or under the golf clothing. The dosimeter (film badge) will be held by adhesive bandage which is unnoticeable by others. Record will be made based on fiber content, fabric structure, hue, shade of color, and style of clothing that you choose on the day of experiment.

During these processes, you have the right to refuse to participate or withdraw this study at any time. Your name or identification will not be associated with results. Your privacy will be protected to the maximum extent allowable by law. All data recorded will be accessible only to a few of permitted researchers. Data will be kept confidential and will be aggregated for any reports. Your participation is entirely voluntary.

If you have any questions about this study, please contact Dr. Ann Slocum (phone: 355-3779, ascolcum@msu.edu). If you have questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact Ashir Kumar, M.D., Chair of the University Committee on Research involving Human Subjects by phone: (517) 355-2180, email: ucrihs@msu.edu, or regular mail: 202 Olds Hall, East Lansing, MI 48824.

Consent for Participants

I have read the above description and voluntarily agree to participate in today's experiment for this study.

Subject's Name: ____

Subject's Signature: ____

Date: _____________

Please indicate whether you consent to following category:

Yes No

___ ___ I consent to having my picture taken for educational and research purposes.

Consent Form for Interview

The purpose of this study is to investigate golf clothing currently available in stores. In order to design clothing that offers more effective UV protection, it is necessary to examine what types and features of golf clothing commercially available and generally worn by players. The data obtained from this study will be helpful to identify the design problems and to appreciate the scope of UV specialized clothing.

Your store was randomly selected from 12 local golf clothing suppliers/retailers listed in 2002 Yellow book in Greater Lansing Area. You will be asked a few questions regarding your products commercially available and your customers' preferences. The interview will be taken approximately 10 minutes and can be tape-recorded. In addition, description of clothing in your store will be recorded, for example, styles, price, fiber content, fabric structure, and color of golf t-shirts.

Your participation is entirely voluntary. You have the right to withdraw from this study at any time. Your name will not be associated with the results. Your privacy will be protected to the maximum extent allowable by law. All data recorded will be accessible only to a few permitted researchers. Data will be kept confidential and will be aggregated for any reports. The audio tape will be destroyed after the data reported.

If you have any questions about this study, please contact Dr. Ann Slocum (phone: 355-3779, ascolcum@msu.edu) or Heewon Sung (phone: 381-1510, sungheew@msu.edu). If you have questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact Ashir Kumar, M.D., Chair of the University Committee on Research involving Human Subjects by phone: (517) 355-2180, email: ucrihs@msu.edu, or regular mail: 202 Olds Hall, East Lansing, MI 48824.

Consent for Participants

I have read the above description and voluntarily agree to interview for this study.

Subject's Name: ____

Subject's Signature: ____

Date: ____________

YES No

____ ____ I consent to be tape-recorded during the interview.

Subject's Signature: ____

APPENDIX B

Questionnaires

Table B1. Items in the Health Belief Model and Attributes of Innovations in Pretest

Variables	Sample Item	Source	Reliability
	Health Belief Model		
Sun-Related Activities	1. In the typical week, approximately how many hours do you spend in the sun? 2. In the typical week, approximately how many hours do you sunbathe?	Jackson, (1997)	n.a.
Current Sun Protective Behavior	3. I use sunscreen with a sun protection factor (SPF) of at least 15 on my face when I am in the sun. 4. I use sunscreen with SPF of at least 15 on my body when I am in the sun. 5. I wear protective clothing to cover my body like a long sleeved shirt and long pants when I am in the sun. 6. I wear a hat when I am in the sun. 7. I try to stay in the shade as much as possible when I am outdoors.	Carmel et al., (1994) Jackson, (1997)	0.82 (5)
Susceptibility	8. I am more likely than the average person to get skin cancer. 9. The possibility of skin cancer worries me. 10. I don't need to worry about getting skin cancer until I am much older. 11. Whenever I hear of a friend/relative (or public figure) getting skin cancer, it makes me realize I could get it too.	Jackson, (1997) Grubbs & Tabano (2000)	0.70 → Item 3 deleted, α = 0.83 (3)
Severity	12. Getting skin cancer would severely affect my life. 13. It would be terrible to have skin cancer. 14. It would be terrible to look older than I really am due to too much sun-exposure. 15. Skin cancer can be taken care of pretty easily with medication in the future.	Jackson, (1997) Jackson & Aiken (2000)	0.80 → Item 8 deleted, α = 0.86 (3)
Benefits	16. Wearing a long-sleeve shirt, a brimmed hat, or sunscreen when I am in the sun would reduce my chances of getting skin cancer. 17. Whether or not a person develops skin cancer is related to how frequently they avoid exposure while spending time in the sun. 18. If more people cover up their bodies when they are in the sun, they would reduce the chances of getting age spots and wrinkles.	Jackson & Aiken (2000) Carmel et al., (1994)	0.78 (3)
Behavioral Barriers	19. Ii is likely that a long-sleeve shirt feels uncomfortable would keep me from wearing it. 20. It is likely that a wide brimmed-hat feels uncomfortable would keep me from wearing it. 21. It is likely that the cost of UV specialized clothing would keep me from using it. 22. It is likely that the style/appearance of UV specialized clothing would keep me from wearing it. 23. Having to reapply sunscreen while spending some time in the sun bothers me. 24. I don't like to use sunscreen because it feels unpleasant.	Jackson, (1997) Vail-Smith & Felts (1993)	0.74 (6) → Items 16 & 17 deleted, α = 0.81 (4)
Psychological Barriers	25. I feel more attractive with a tan. 26. A tan makes me feel better about myself. 27. I feel healthier with a tan. 28. A sun-tanned person looks healthier than someone	Jackson, (1997) Carmel et al., (1994)	0.79 (5)

Variables	Sample Item	Source	Reliability
	without a tan. 29. A sun-tanned person looks more attractive than someone who is not tanned.	Vail-Smith & Felts (1993)	
Cue to Act	30. My friends usually wear protective clothing, like a long-sleeve shirt or hat, when in the sun. 31. My friends always use sunscreen with a sun protection factor (SPF) of at least 15 when they are in the sun. 32. I have family members or friends who have skin cancer. 33. I have noticed more news announcements and articles about risks of sun exposure. 34. Most of my friends are tan. 35. Most of my friends feel that a suntan is a good thing. 36. My friends disapprove of people who have a dark tan.	Jackson, (1997) Arthey & Clarke, (1995)	0.52 (7) → Items 25 & 26 deleted, α = 0.68 (5)
	Attributes of an Innovation		
Relative advantage	[Economic Advantage] 1. I cannot get the best value for the money by using this product. 2. This product would maximize the quality for the money that I spend. [Image] 3. Golfers who have this product would have more prestige than those who do not. 4. Wearing this product would improve my image among my golfing friends. 5. I would be self-conscious about wearing this product. [Overall Usefulness] 6. This product is more fashionable or unique in style than other similar types of shirts. 7. This product would be better in performance (i.e. fit, comfort) than other similar types of shirts. 8. This product would provide better UV protection than the other garments I have.	Moore & Benbasat (1991) Strutton, et al., (1994)	0.78 (8) → Item 1 & 7 deleted, α = 0.83 (6)
Compatibility	9. This product does not differ from what I have worn in the past. 10. This product would be coordinated with the other garments I have. 11. This product would be compatible with my current need of a new shirt. 12. This product would be appropriate for my golf games.	Strutton, et al., (1994) Moore & Benbasat (1991)	0.66 (4) → Item 9 deleted, α = 0.73 (3)
Complexity	13. It would be difficult to understand how this product works to prevent UV radiation. 14. Overall, this product would be easy to use. 15. I believe that this product is cumbersome to use.	Strutton, et al., (1994) Moore & Benbasat (1991)	0.49 → Item 14 & 15 deleted, and add item 20, α = 0.66 (2)
Triability	16. It would be easy to try out this product without a big commitment. 17. Before deciding whether to purchase clothing, I prefer to try it on. 18. If this product, made specially for golfers, is available in stores where I buy my golf clothes, I would try it on.	Strutton, et al., (1994)	0.89 → Item 17 deleted α = 0.83 (2)

Variables	Sample Item	Source	Reliability
Attributes of an Innovation			
Observability	[Visibility] 19. I have seen people wearing this product when I am outdoors. 20. If I use this product, the advantages/disadvantages would be readily apparent to me. [Result Demonstrability] 21. I would have difficulty explaining why wearing this product is beneficial. 22. I would communicate the advantages of wearing this product to others.	Moore & Benbasat (1991) Strutton, et al., (1994)	0.71 → Item 20 deleted, α = 0.82 (3)
Intention to Adopt	23. I plan to wear a UV specialized shirt for most outdoor activities. 24. I intend to wear a long-sleeve shirt while playing golf. 25. I intend to purchase a UV specialized shirt within the next few years. 26. I probably won't purchase a UV specialized shirt.	Jackson & Aiken (2000) Shim & Drake, (1990)	0.86 → Item 26 deleted, α = 0.87 (3)

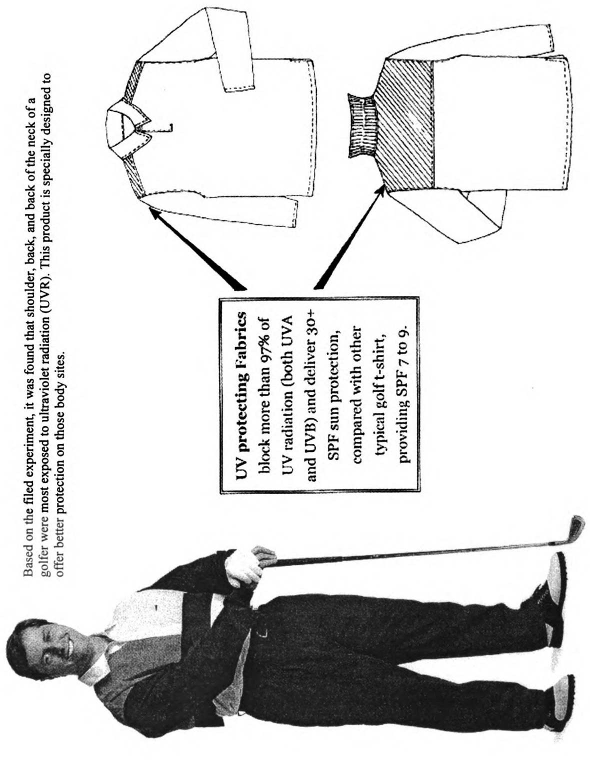

Figure B1. A Black-and-White Photograph for the Pretest

Questionnaire

MICHIGAN STATE
UNIVERSITY

October 2002

Dear Golfer:

Outdoor enthusiasts such as golfers have paid limited attention to sun safety practices, although their activities lead to extensive sun exposure during peak sun hours. You are invited to participate in a survey, conducted by Michigan State University Clothing and Textile researchers. The goal of the project is to design a shirt that offers more effective UV protection than currently available golf shirts.

The purpose of this survey is to learn about your beliefs about sun exposure, and your perceptions of a prototype shirt that offers UV protection. Your answers to the following questions will aid us in designing an acceptable golf shirt.

Please read each question carefully and answer as accurately as possible. The questionnaire has three sections and it will take you approximately 20 minutes to complete. You have the right to refuse to answer or to withdraw from this study at any time. Your responses will be anonymous. Data will be kept confidential and will be aggregated for any reports. All data recorded will be accessible only to the principal investigators, and the data will be destroyed after the findings are reported. By completing and returning this questionnaire, you indicate your voluntary agreement to participate.

If you have any questions about this study, please contact Dr. Ann Slocum (phone: 355-3779, ascolcum@msu.edu) or Heewon Sung (phone: 381-1510, sungheew@msu.edu). If you have questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact Ashir Kumar, M.D., Chair of the University Committee on Research involving Human Subjects by phone: (517) 355-2180, email: ucrihs@msu.edu, or regular mail: 202 Olds Hall, East Lansing, MI 48824.

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Thank you for your time and cooperation in answering our questions. The information will be very helpful.

Sincerely yours,

Ann C Slocum

Ann C. Slocum
Associate Professor
Michigan State University

SungHeewon

Heewon Sung
Doctoral Student
Michigan State University

QUESTIONNAIRE

Section I: This section asks about your health beliefs and your behavior in the sun.

The following questions ask about your current practices when you are outdoors. Please respond to each statement by circling the appropriate number on the scale provided.

1. In the typical week in the summer, approximately how many hours do you spend in the sun?

(1) 0 hrs/week (2) 1-2hrs/week (3) 3-4hrs/week (4) 5-7hrs/week (5) 8-10hrs/week

(6) 11-15hrs/week (7) 16- 20 hrs/week (8) 21-25hrs/week (9) more than 25hrs/week

2. In the typical week in the summer, approximately how many hours do you sunbathe?

(1) 0 hrs/week (2) 1-2hrs/week (3) 3-4hrs/week (4) 5-7hrs/week (5) 8-10hrs/week

(6) 11-15hrs/week (7) 16- 20 hrs/week (8) 21-25hrs/week (9) more than 25hrs/week

	Never		Some times		All the Time
3. I use sunscreen with a sun protection factor (SPF) of at least 15 on my face when I am in the sun.	1	2	3	4	5
4. I use sunscreen with SPF of at least 15 on my body when I am in the sun.	1	2	3	4	5
5. I wear clothing to cover my body like a long sleeved shirt and long pants when I am in the sun.	1	2	3	4	5
6. I wear a hat when I am in the sun.	1	2	3	4	5
7. I try to stay in the shade as much as possible when I am outdoors.	1	2	3	4	5

Below are some beliefs people have about sun protection. Please indicate whether you disagree or agree with each statement by circling the appropriate number on the scale provided.

	Strongly Disagree				Strongly Agree
8. Wearing a long-sleeve shirt, a brimmed hat, or sunscreen when I am in the sun would reduce my chances of getting skin cancer.	1	2	3	4	5
9. Whether or not a person develops skin cancer is related to how frequently they avoid exposure while spending time in the sun.	1	2	3	4	5
10. If more people cover up their bodies when they are in the sun, they would reduce the chances of getting age spots and wrinkles.	1	2	3	4	5

The following questions are regarding your beliefs about tanning. Please indicate whether you disagree or agree with each statement by circling the appropriate number on the scale provided.

	Strongly Disagree				Strongly Agree
11. I feel more attractive with a tan.	1	2	3	4	5
12. A tan makes me feel better about myself.	1	2	3	4	5
13. I feel healthier with a tan.	1	2	3	4	5
14. A sun-tanned person looks healthier than someone without a tan.	1	2	3	4	5
15. A sun-tanned person looks more attractive than someone who is not tanned.	1	2	3	4	5

Please indicate whether you disagree or agree with each statement by circling the appropriate number on the scale provided.

	Strongly Disagree				Strongly Agree
16. People with whom I play outdoor sports usually wear a long-sleeve shirt or hat, when they are in the sun.	1	2	3	4	5
17. People with whom I play outdoor sports usually use sunscreen with an SPF of 15 or more when they are in the sun.	1	2	3	4	5
18. Most of my friends have a suntan.	1	2	3	4	5
19. Most of my friends feel that a suntan is a good thing.	1	2	3	4	5
20. My friends disapprove of people who have a dark tan.	1	2	3	4	5

Below are some factors that may keep you from practicing sun protection. Please indicate whether you disagree or agree with each statement by circling the appropriate number on the scale provided.

	Strongly Disagree				Strongly Agree
21. If a long-sleeve shirt feels uncomfortable, I would not wear it for golf.	1	2	3	4	5
22. If a wide brimmed-hat feels uncomfortable, I would not wear it for golf.	1	2	3	4	5
23. The cost of UV specialized clothing ($ 60.00-$ 80.00) could keep me from purchasing it.	1	2	3	4	5
24. The style/appearance of UV specialized clothing could keep me from wearing it.	1	2	3	4	5
25. Wearing a long-sleeve shirt while playing golf would restrict my movement.	1	2	3	4	5

The following questions are your beliefs about skin cancer risk. Please indicate whether you disagree or agree with each statement by circling the appropriate number on the scale.

	Strongly Disagree				Strongly Agree
26. I am more likely than the average person to get skin cancer.	1	2	3	4	5
27. The possibility of skin cancer worries me.	1	2	3	4	5
28. Whenever I hear of a friend/relative (or public figure) getting skin cancer, it makes me realize I could get it too.	1	2	3	4	5
29. Getting skin cancer would severely affect my life.	1	2	3	4	5
30. It would be terrible to have skin cancer.	1	2	3	4	5
31. It would be terrible to look older than I really am due to too much sun-exposure.	1	2	3	4	5

Section II: This section asks about your perception and opinion about a UV specialized shirt (see attached color picture). This product is designed to offer better UV protection during playing golf. Assume that you can purchase it in the regular golf stores. The price is approximately $60.00-$80.00. Please examine the sample shirt and answer in a way that shows how you feel.

Please indicate whether you disagree or agree with each statement by circling the appropriate number on the scale provided.

	Strongly Disagree				Strongly Agree
1. This product would maximize the quality for the money that I spend.	1	2	3	4	5
2. Golfers who have this product would have more prestige than those who do not.	1	2	3	4	5
3. Wearing this product would improve my image among my golfing friends.	1	2	3	4	5
4. I would be self-conscious about wearing this product.	1	2	3	4	5
5. This product would be more fashionable or unique in style than other similar types of shirts.	1	2	3	4	5
6. This product would provide better UV protection than the other garments I have.	1	2	3	4	5
7. This product would coordinate well with the other garments I have.	1	2	3	4	5
8. This product would be compatible with my current needs for a new shirt.	1	2	3	4	5
9. This product would be appropriate for my golf games.	1	2	3	4	5
10. It would be difficult to understand how this product works t prevent UV radiation.	1	2	3	4	5
11. I would have difficulty explaining why wearing this product is beneficial.	1	2	3	4	5
12. It would be easy to try out this product without a big commitment.	1	2	3	4	5
13. If this product, made specially for golfers, is available in stores where I buy my golf clothes, I would try it on.	1	2	3	4	5
14. I have seen people wearing this product when I am outdoors.	1	2	3	4	5
15. I could communicate the advantages of wearing this product to others.	1	2	3	4	5
16. If I use this product, the advantages/disadvantages would be readily apparent to me.	1	2	3	4	5

Please indicate the likelihood of your future behavior by circling the appropriate number on the scale provided.

	Strongly Disagree				Strongly Agree
17. I plan to wear a UV specialized shirt for most outdoor activities.	1	2	3	4	5
18. I intend to wear a long-sleeve shirt while playing golf.	1	2	3	4	5
19. I intend to purchase a UV specialized shirt within the next few years.	1	2	3	4	5

Section III: This section asks about your demographic information.

Please respond to each statement by marking X next to the most appropriate response or fill in the blank in the space provided.

1. Gender? [ ] Male [ ] Female

2. What is you age? _____________ years old

3. What is the highest level of education you have completed?
   - [ ] Eight Grade
   - [ ] High school degree
   - [ ] 2-year degree, Some college, or Associate degree
   - [ ] 4-year college degree
   - [ ] Graduate School or Advanced degree

4. What is your marital status?
   - [ ] Single
   - [ ] Married → If married, do you have children younger than 18 who live in your
   - [ ] Others ↗ household? [ ] Yes [ ] No

5. What is your race/ethnicity?

[ ] Caucasian	[ ] African American
[ ] Asian	[ ] Hispanic
[ ] Native American	[ ] Others ____________________________

6. How many rounds of golf do you play <u>each month</u> of the golfing season? ____ rounds/month

7. What <u>time of a day</u> do you usually play golf? (Check all that applied)
   - [ ] Early morning
   - [ ] Mid morning
   - [ ] Early afternoon
   - [ ] Mid to late afternoon
   - [ ] Evening

8. Do you have family members or friends who have skin cancer? [ ] Yes [ ] No

Thanks you for your participation!

APPENDIX C

Regression Assumptions

Assumption of Regression Model A

Regression model A: To Examine the contributions of 11 variables in the health belief model to sun protective behaviors (SPB).

X = Age, marital status, ethnicity, susceptibility, severity, benefits, behavioral barriers, advantages of tan, cues to sun protection (CA-SP), cues to tanning (CA-Tan), & cues to family having skin cancer

Y = Sun protective behaviors (SPB)

Figure C1. Partial Regression Scatterplots of 11 Health Belief Variables on Sun Protective Behaviors

Figure C1a. Age and SPB

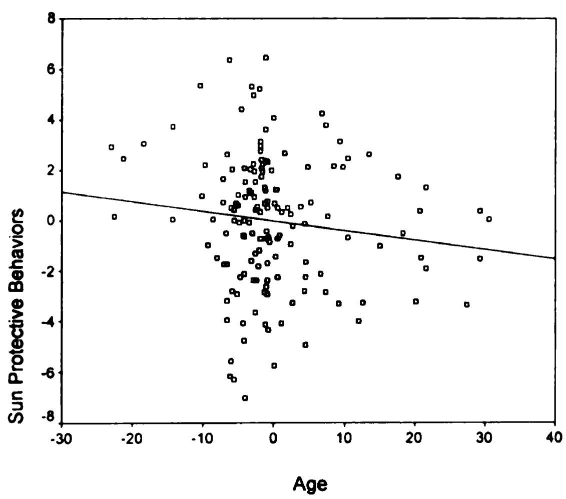


Figure C1b. Marital Status and SPB

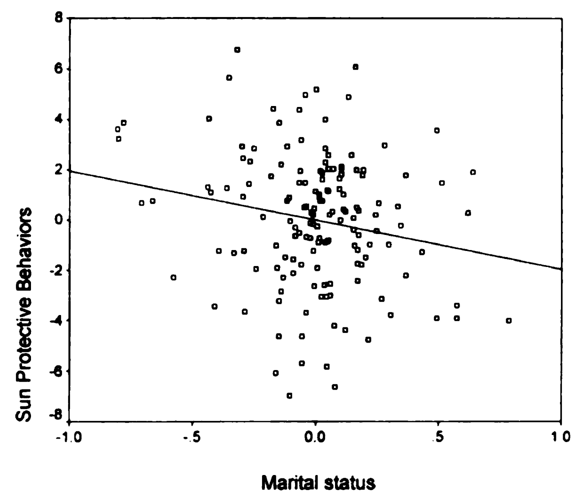


Figure C1c. Ethnicity and SPB

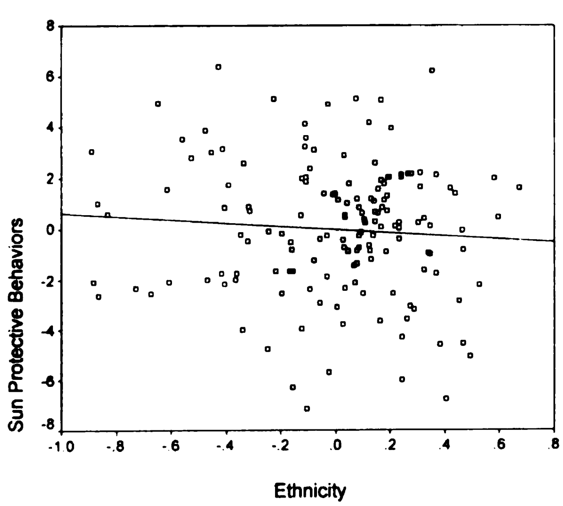


Figure C1d. Susceptibility and SPB

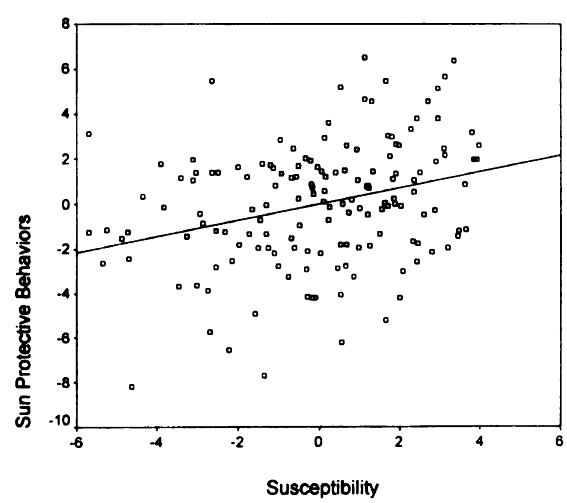


Figure C1e. Severity and SPB

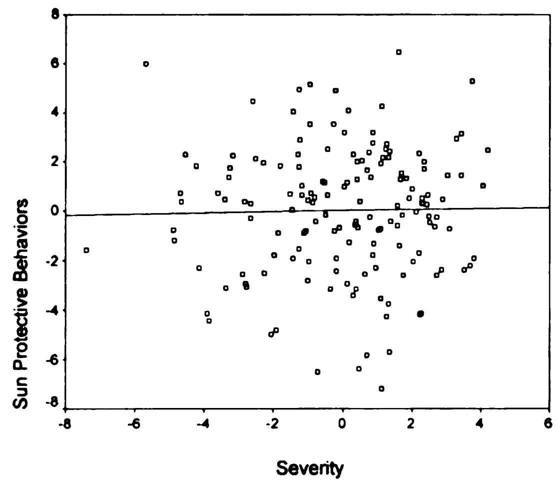


Figure C1f. Perceived Benefits and SPB

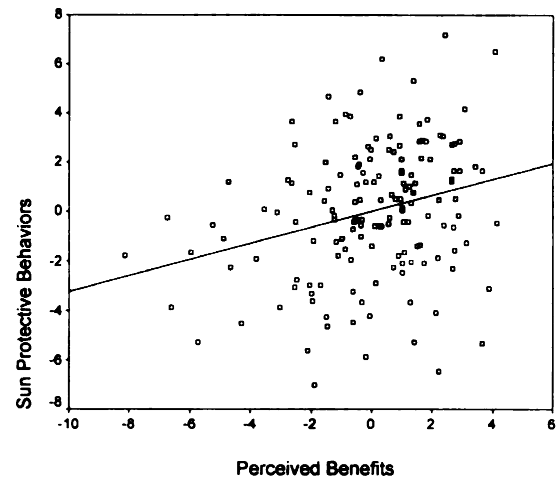


Figure C1g. Behavioral Barriers and SPB

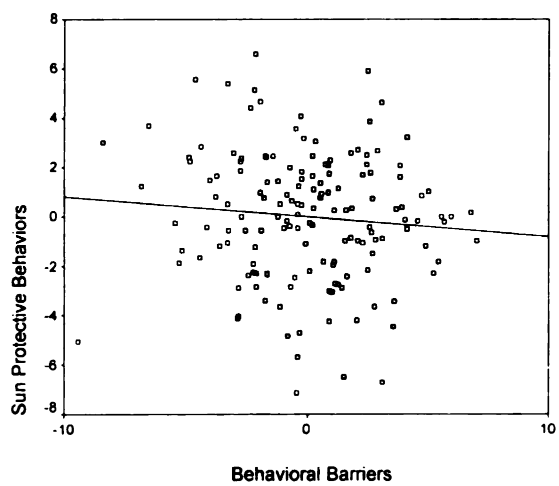


Figure C1h. Psychological Barriers and SPB

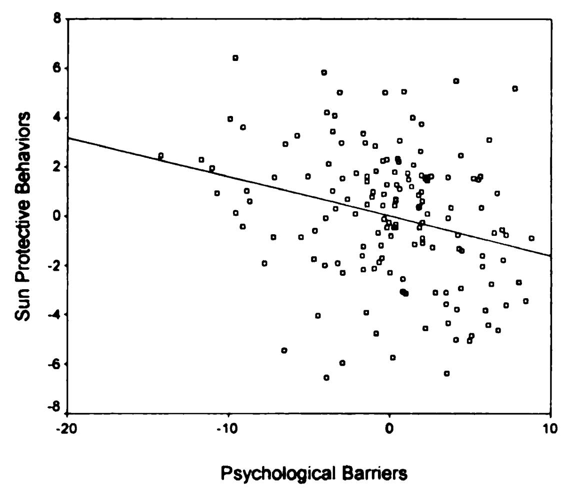


Figure C1i. CA-SP and SPB

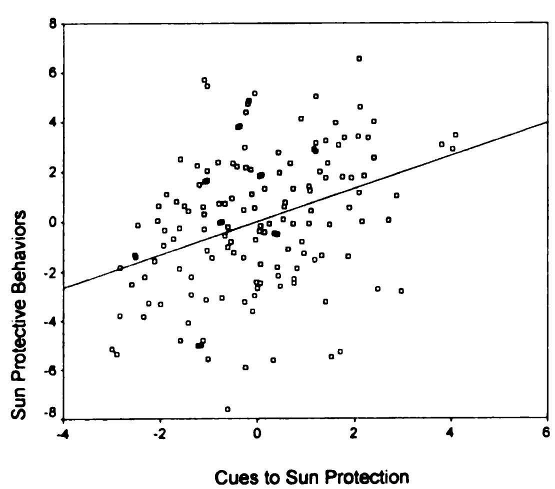


Figure C1j. CA-Tan and SPB

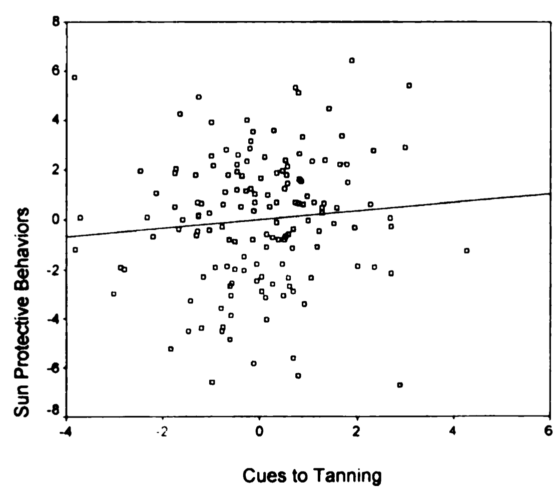


Figure C1k.Family-Skin Cancer and SPB

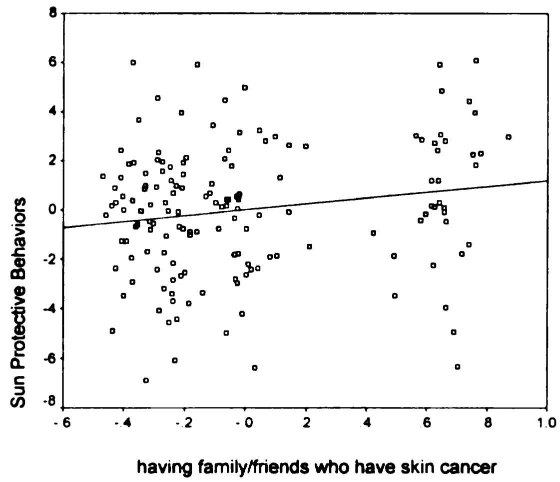


Figure C2. Histogram of the Standardized Residual of Sun Protective Behaviors

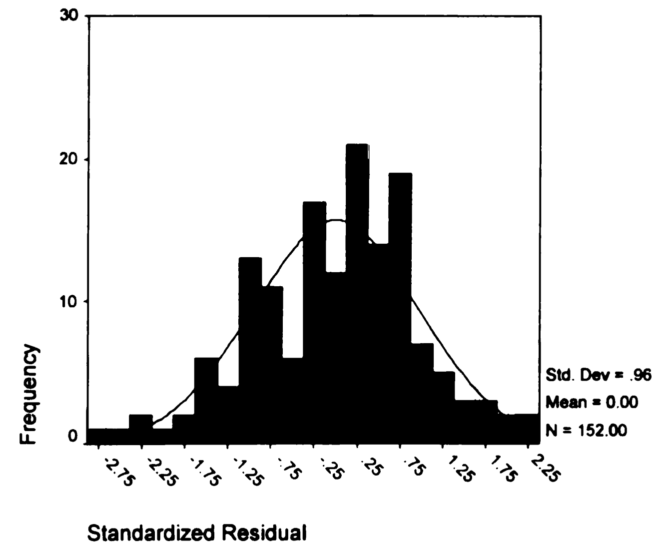
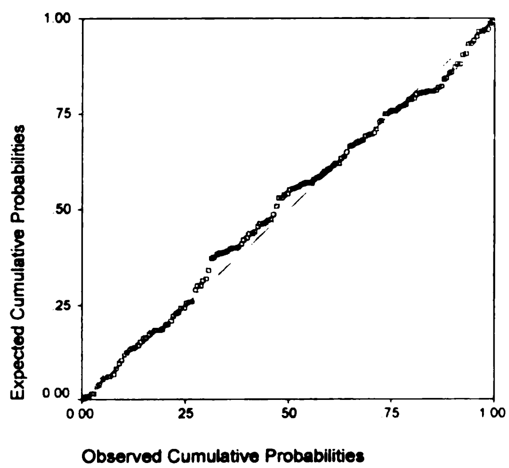


Figure C3. Normal Probability Plot of the Standardized Residual of Sun Protective Behaviors



Kolmogorov-Smirnov Normal Test: z = .057, df = 152, p = .200

Figure C4. Scatterplots between Health Belief Variable and Standardized Residual of Sun Protective Behaviors

Figure C4a. Age and Standardized Residuals

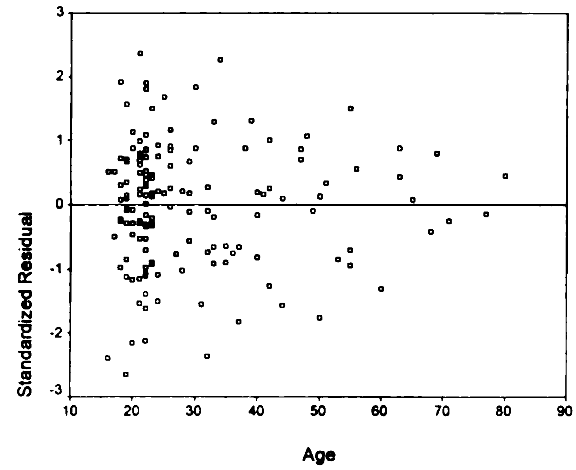


Figure C4b. Marital Status and Standardized Residuals

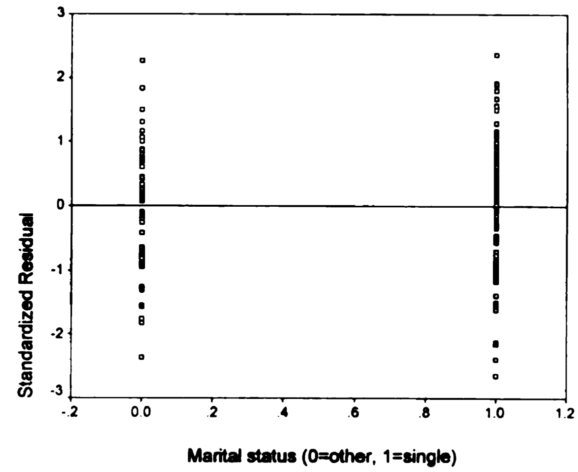


Figure C4c. Ethnicity and Standardized Residuals

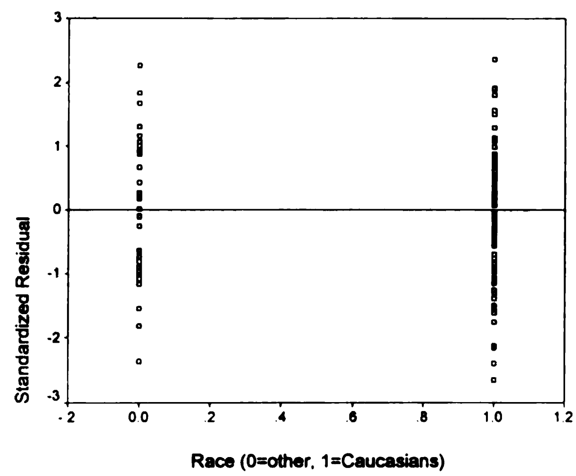


Figure C4d. Susceptibility and Standardized Residuals

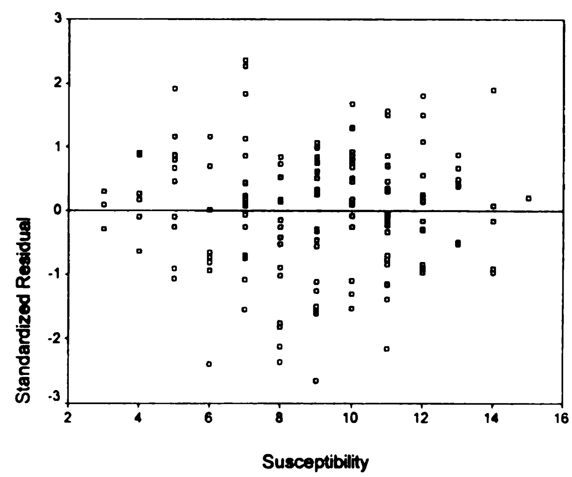


Figure C4e. Severity and Standardized Residuals

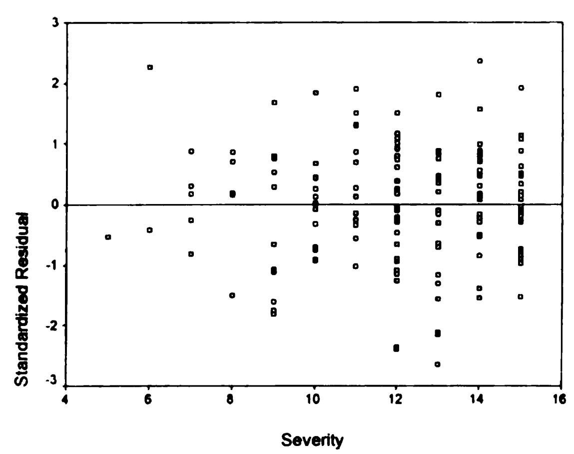


Figure C4f. Perceived Benefits and Standardized Residuals

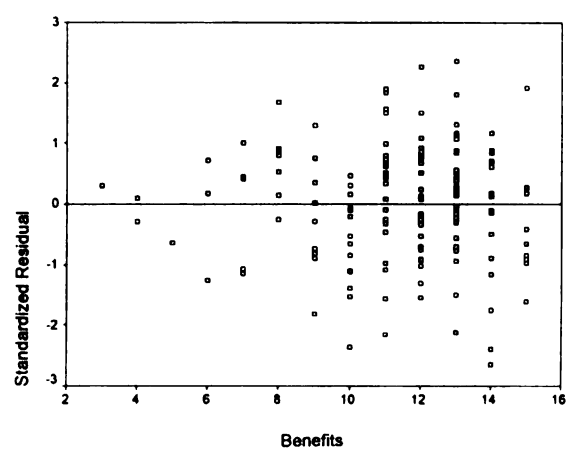


Figure C4g. Behavioral Barriers and Standardized Residuals

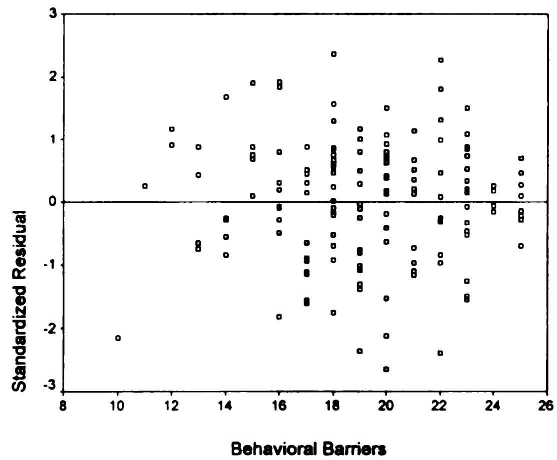


Figure C4h. Psychological barriers and Standardized Residuals

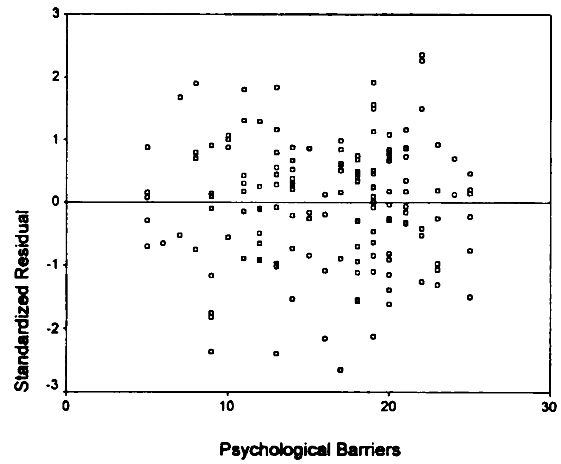


Figure C4i. CA-SP and Standardized Residuals

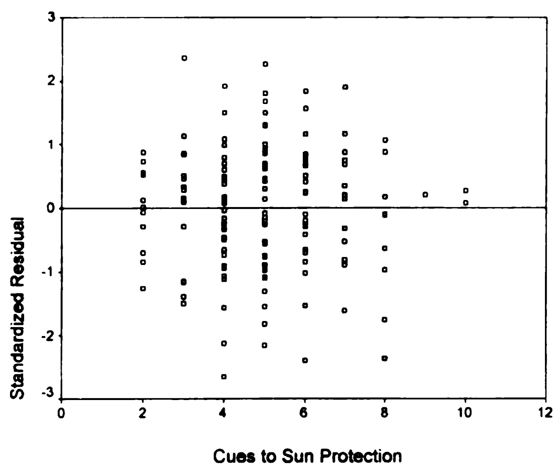


Figure C4j. CA-Tan and Standardized Residuals

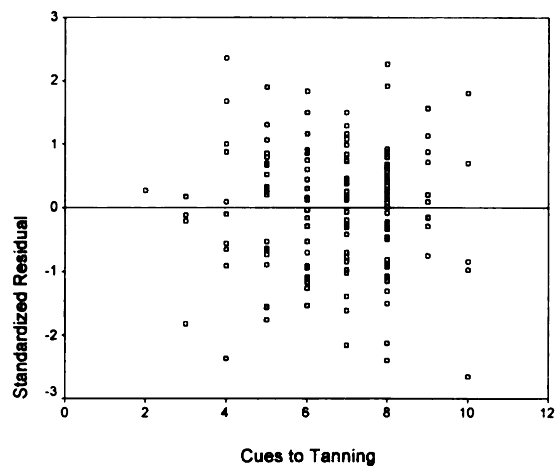
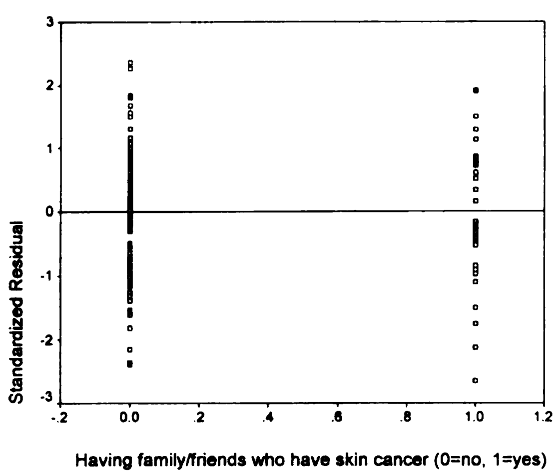


Figure C4k. Family-Skin Cancer and Standardized Residuals



Assumption of Regression Model B

Regression Model B: To Examine the Contributions of Five Attributes Variables to Intention to Adopt UV Specialized Shirts (IA)

X = Relative advantage, compatibility, complexity, triability, observability

Y = Intention to Adopt (IA)

Figure C5. Partial Regression Scatterplots of Five Attributes on Intention to Adopt

Figure C5a. Relative Advantage and IA

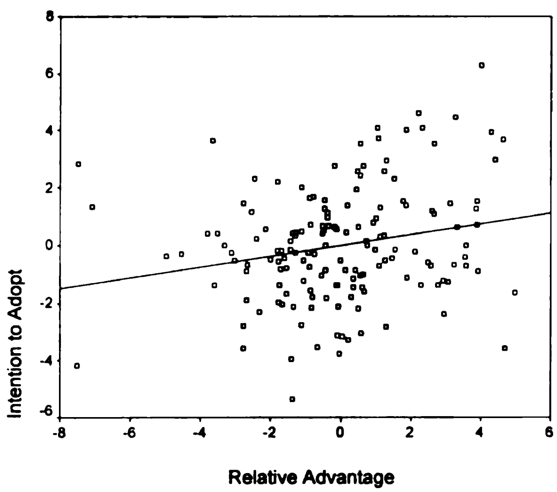


Figure C5b. Compatibility and IA

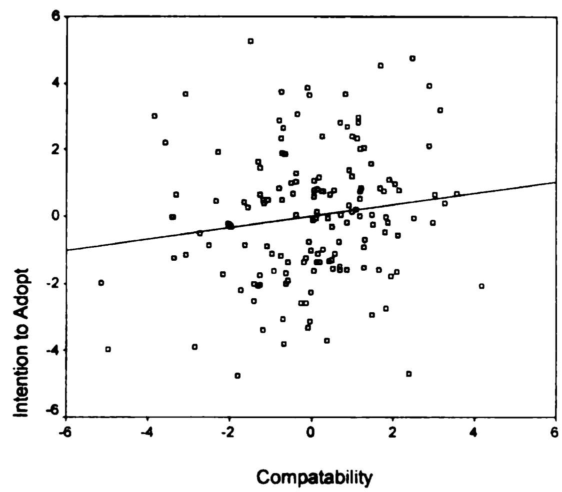


Figure C5c. Complexity and IA

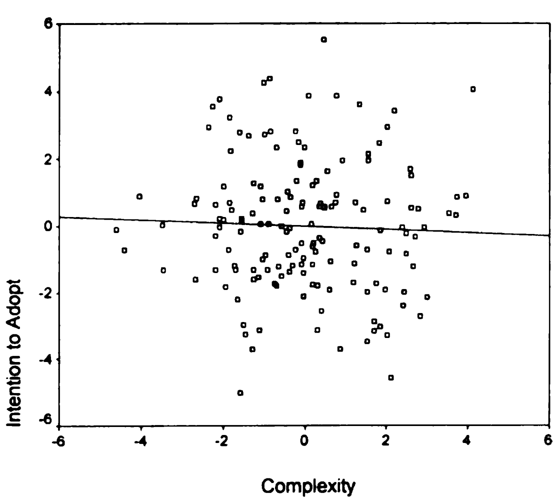


Figure C5d. Triability and IA

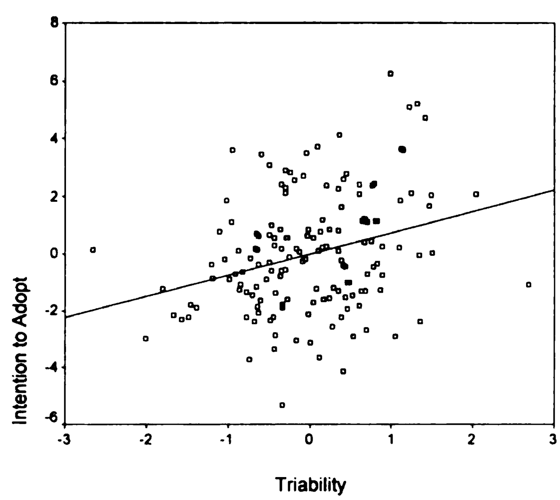


Figure C5e. Observability and IA

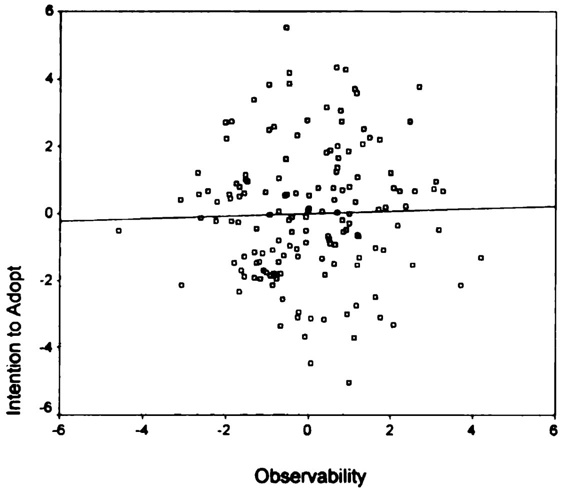


Figure C6. Histogram of the Standardized Residual of Intention to Adopt

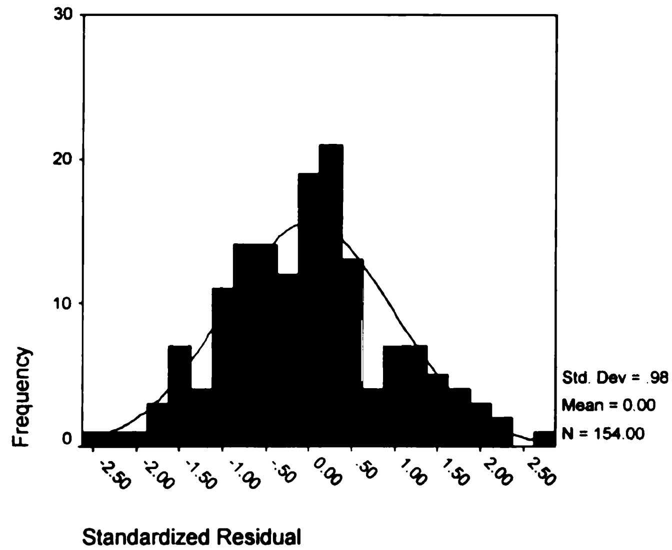
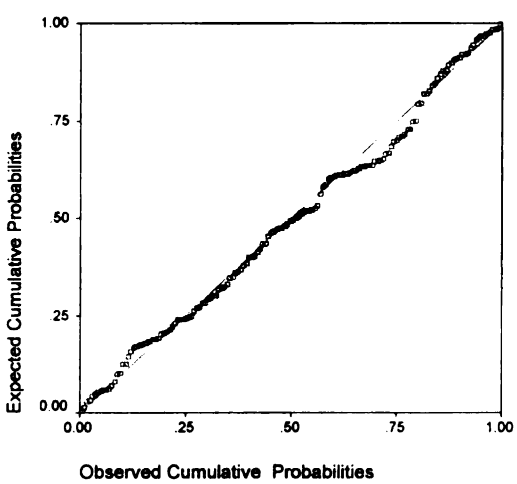


Figure C7. Normal Probability Plot of the Standardized Residual of Intention to Adopt



Kolmogorov-Smirnov Normal Test: $z = .066$, $df = 154$, $p = .097$

Figure C8. Scatterplots between Attribute Variable and Standardized Residual of Intention to Adopt

Figure C8a. Relative Advantage and Standardized Residuals

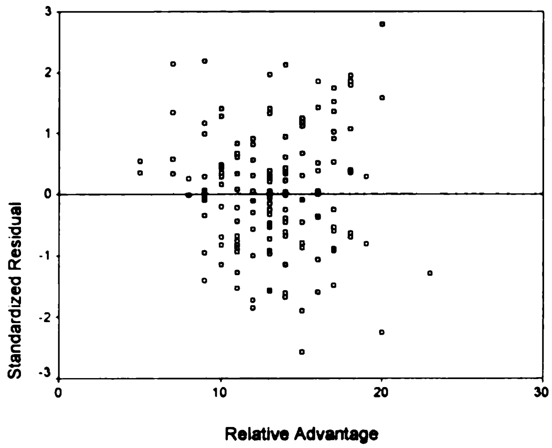


Figure C8b. Compatibility and Standardized Residuals

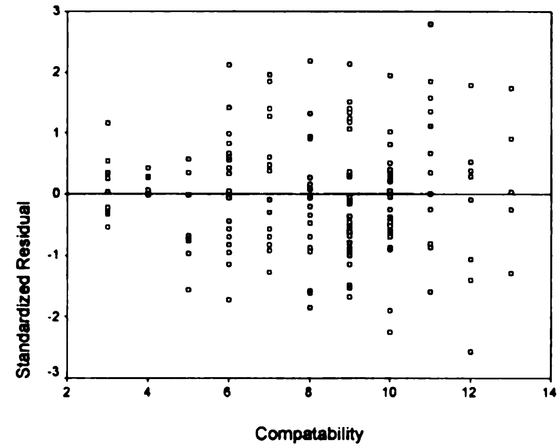


Figure C8c. Complexity and Standardized Residuals

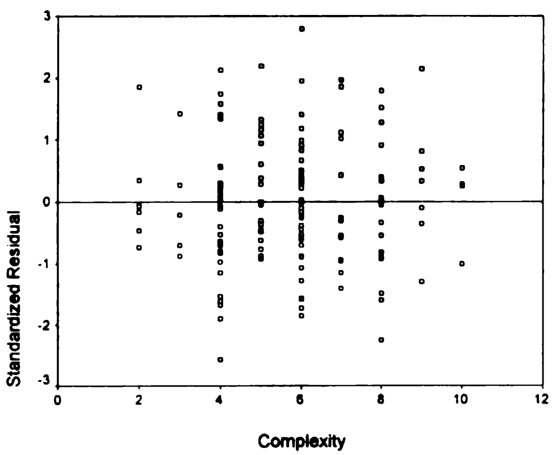


Figure C8d. Triability and Standardized Residuals

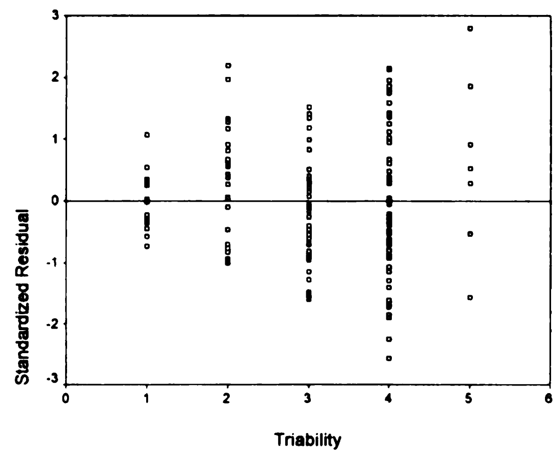
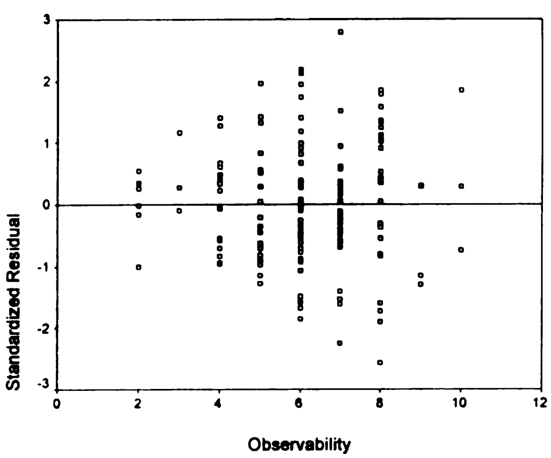


Figure C8e. Observability and Standardized Residuals



Assumption of Regression Model C

Model C: To Examine the Contributions of Variables in the Proposed Model to Intention to Adopt (IA)

X = Age, marital status, ethnicity, susceptibility, severity, benefits, behavioral barriers, advantages of tan, cues to sun protection (CA-SP), cues to tanning (CA-Tan), cues to family having skin cancer; Sun protective behavior; Relative advantage, compatibility, complexity, triability, observability

Y = Intention to Adopt

Figure C9. Partial Correlation Scatterplots between All Independent Variables and IA

Figure C9a. Ethnicity and IA

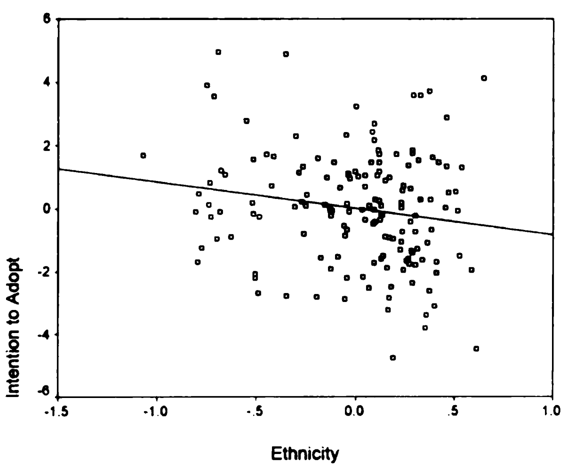


Figure C9b. Perceived Barriers and IA

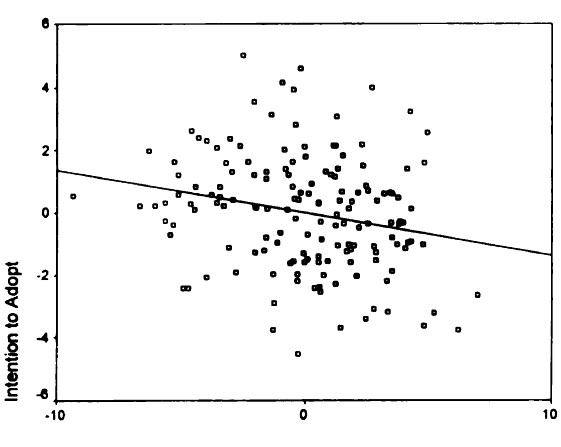


Figure C9c. Sun Protective Behaviors and IA

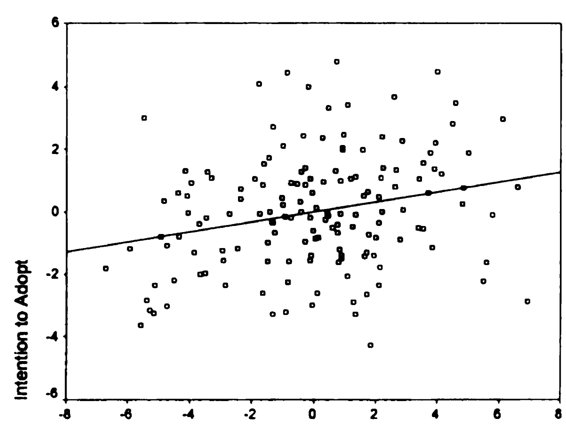


Figure C9d. Relative Advantages and IA

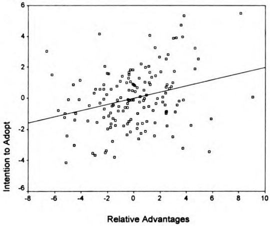


Figure C9e. Triability and IA

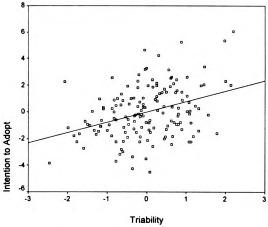


Figure C9f. CA-SP and IA

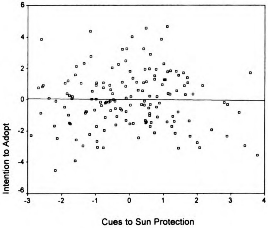


Figure C9g. Susceptibility and SPB

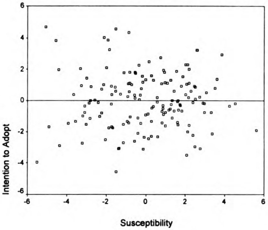


Figure C10. Histogram of the Standardized Residual of IA

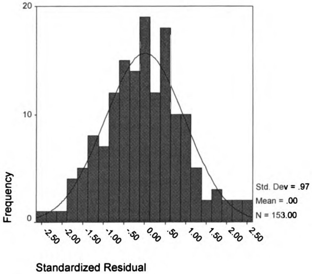
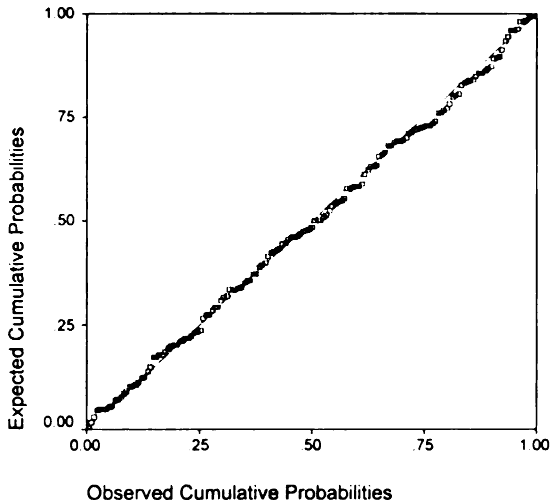


Figure C11. Normal Probability Plot of the Standardized Residual of IA



Kolmogorov-Smirnov Normal Test: z = .033, df = 153, p = .200

Figure C12. Scatterplots between the Significant Independent Variables and Standardized Residual of Intention to Adopt

Figure C12a. Ethnicity and Standardized Residuals

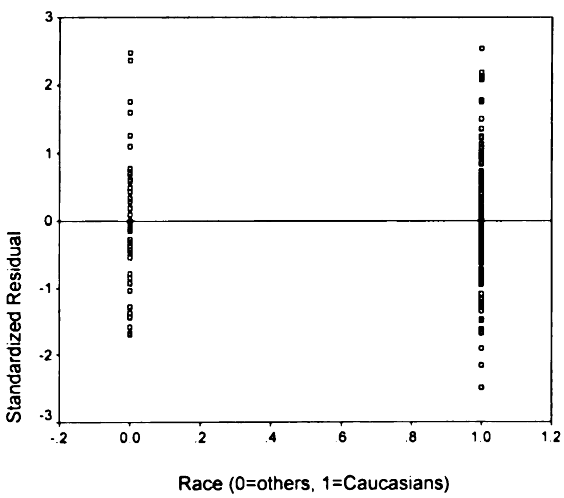


Figure C12b. Behavioral Barriers and Standardized Residuals

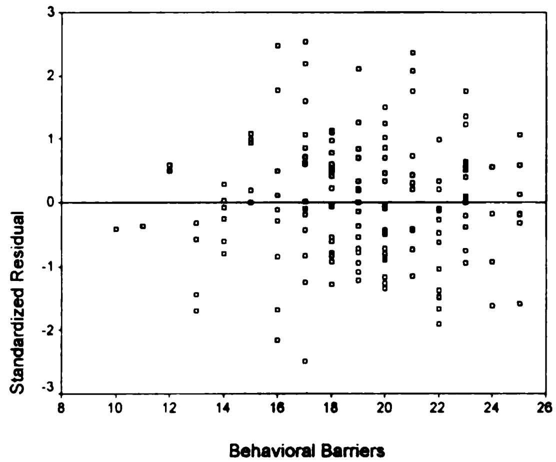


Figure C12c. Sun Protective Behaviors and Standardized Residuals

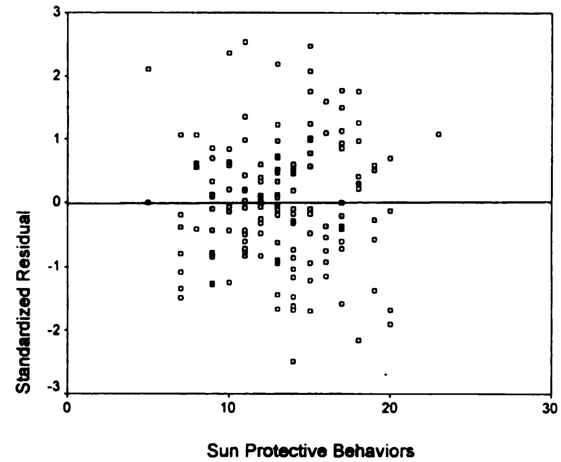


Figure C12d. Relative Advantage and Standardized Residuals

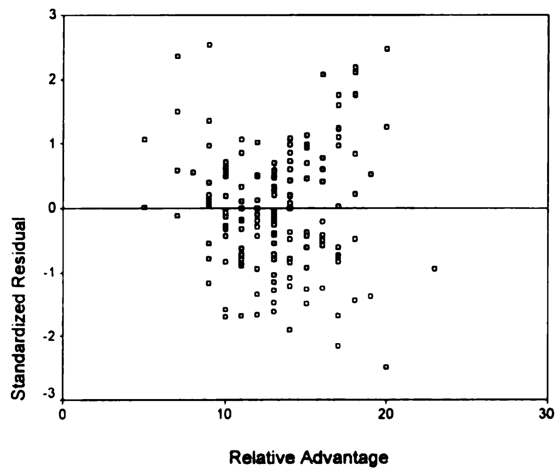


Figure C12e. Triability and Standardized Residuals

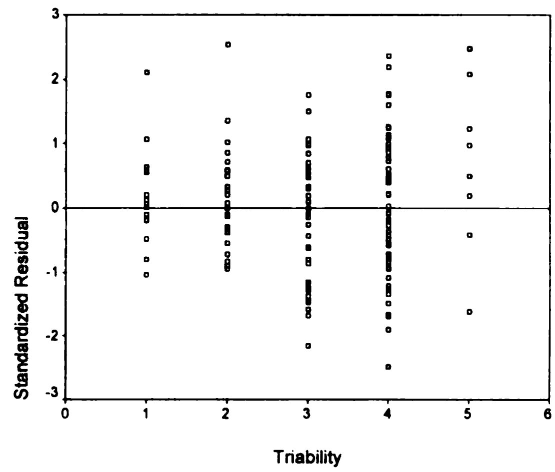


Figure C12f. CA-SP and Standardized Residuals

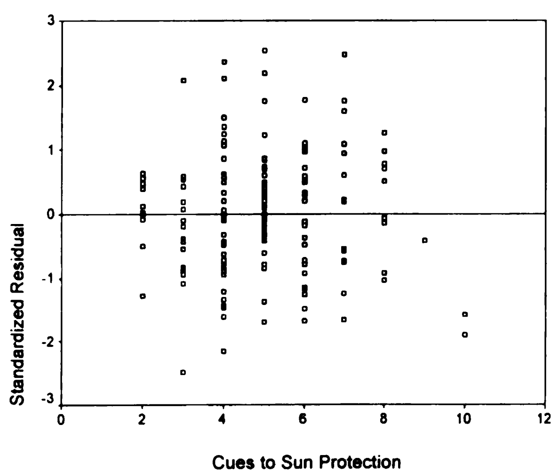
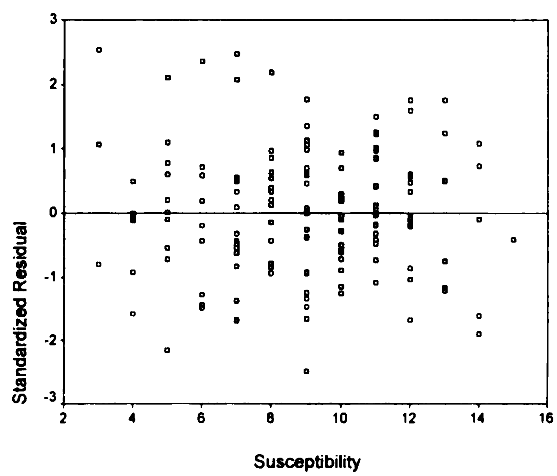


Figure C12g. Susceptibility and Standardized Residuals



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