THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF BIOBEHAVIORAL HEALTH

EXAMINING THE RELATIONSHIP BETWEEN TECHNOLOGICAL SAVVINESS IN MELANOMA PATIENTS AND SELF EFFICACY IN USING INFORMATION FROM TABLET-BASED INTERVENTIONS FOR SELF-SKIN EXAMINATIONS

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A thesis
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ABSTRACT

Patients who have had melanoma, the deadliest form of skin cancer, are at increased risk of developing it again. Studies have shown technology-based interventions to be as efficacious as traditional interventions in teaching patients to perform self-skin examinations (SSE), in order to increase early detection. The aim of this study is to examine the association between melanoma patients' technological savviness and self-efficacy in performing SSE after a tablet-based intervention. Participants included melanoma patients and their partners from Project Skin Watch, a randomized controlled trial, who were randomly assigned to one of four groups (in-person intervention, workbook intervention, tablet intervention, or control with no intervention). This paper looked solely at the tablet intervention group (N=71). At baseline and 4 months post-intervention, participants were assessed on their internet/mobile usage patterns, confidence in performing SSE, and actual frequency of skin checks. Multiple regression analysis was used to examine the relationship between the technological savviness and self-efficacy in performing SSE, while controlling for baseline values of confidence and skin check frequency, gender and age. Time spent on the Internet was not significantly associated with confidence at 4 months after controlling for age and baseline levels of confidence (B=-.150, SE=1.008, p=0.203). Results were similar when looking at the predictor of Internet activity, which when controlled for gender and baseline levels of confidence, was also not significantly associated with confidence at 4 months (B=.037, SE=.776, p=.740). When assessing the relationship between technological savviness and skin check frequency, the results also demonstrated a weak, insignificant association between the variables (Internet Time: B=0.011, SE=0.156, p=0.942) (Internet Activity: B=-0.031, SE=0.138, p=0.822). Low levels of technological savviness were not

associated with a reduced level of confidence in performing SSE, nor a reduced level of skin check frequency, after receiving a tablet intervention. This demonstrates that patients with less technological experience benefit just as much from the tablet interventions than those with more experience.

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ACKNOWLEDGEMENTS

I would first and foremost like to thank Dr. Robert Turrisi for allowing me to use his Project Skin Watch data as the basis for this thesis and supporting me as my Thesis Supervisor. Dr. June Robinson from Northwestern Medicine was also paramount in bringing Project Skin Watch to fruition. I would also like to thank Brittney Hultgren for her unwavering support and assistance with all matters concerning this thesis. Her generosity in making time to help me with everything from SPSS codes to proofreading was incredibly appreciated. The entirety of the PRO Health Lab faculty and staff was also instrumental in giving me the time and resources to complete this project. Additionally, I would like to thank my Honors Adviser, Dr. Francis, for her supervision of this final product and providing excellent advice. I must also thank the Schreyer Honors College for giving me the opportunity to showcase my work and complete a thesis during my time at Penn State.

Finally, I would like to thank my family and friends for their encouragement and support throughout this arduous, yet worthwhile and meaningful process. For as long as I can remember, these amazing people have inspired me to work hard and achieve great things. This thesis would not have been possible without the fantastic support of these people in my life.

INTRODUCTION

Skin cancer has become an epidemic and is the most common type of cancer affecting the United States. (Skin Cancer Foundation, 2016). With more than two million people diagnosed each year, it is currently the leading cause of cancer in adults (CDC, 2016). Melanoma, the most serious and deadly form of skin cancer, has increasingly become a greater concern. This fatal form of skin cancer, also referred to as malignant melanoma, accounts for approximately 75% of all skin-cancer causing deaths (CDC, 2016). Individuals that have had previous melanomas are part of the "high-risk population" as they have an increased likelihood of developing another melanoma (Fears, Guerry, Pfeiffer, Sagebiel, Elder, 2006). Despite there being more knowledge available about skin cancer risk factors, skin cancer incidence continues to be on the rise. Improvements on strategies for early detection in patients with previous melanoma are crucial for treatment and prevention of early mortality.

As with nearly all types of cancers, early detection and treatment of skin cancer can improve patient prognosis and survival (Jerant, Johnson, Sheridan, Caffrey, 2000). Most skin cancers can be observed on the surface of the skin early on in their growth, and in time every malignant tumor will be visible on the skin surface (Skin Cancer Foundation, 2016). Thus the precancerous and cancerous skin lesions can be detected through a visual skin examination. Because removal of these lesions early on is associated with decreased morbidity and mortality, it stands to reason that routine skin examinations can improve patient outcomes (Robinson, Fisher, Turrisi, 2002). Encouraging skin examinations by physicians and self-skin examinations (SSE) has great potential for early detection.

SSE provides patients with tools to observe on their own moles and lesions on the skin surface and determine if they need additional examination by a physician. Studies have shown that the mortality rate from melanoma can drop by as much as 63% due to regular performance of SSE (Kelly, 1998). Particularly in high-risk populations, the combination of annual skin examinations by physicians and monthly SSE can promote early detection (Robinson, Fisher, Turrisi, 2002). Due to this knowledge of SSE effectiveness, scientists and physicians have been attempting to find ways to encourage SSE and learn about what makes patients more likely to perform SSE. One study discovered that when patients and their partners received an intervention about SSE, they were more likely to engage in SSE and more confident in their SSE skills, than those patients who received the SSE intervention alone (Robinson, Turrisi, Stapleton, 2007). In another study, it was found that patient confidence in their own SSE performance was among one of the strongest predictors of SSE performance in the future (Robinson, Fisher, Turrisi, 2002). Understanding the factors that influence a patient's likelihood of performing SSE in their own time is crucial to developing the most effective SSE-related interventions for skin cancer patients.

Technology in Clinical Research

Computer technology has helped transform healthcare at various levels, and has especially been a valuable tool for communicating health messages to patients (Hornung, Lennon, Garrett, DeVellis, 2000). The growth and convenience of the Internet has made health-related information easily accessible to patients. Technological advancements have brought changes in the way that information, specifically about disease protection and prevention, is provided to patients. Multimedia programs have demonstrated to be successful in a wide variety

of patient care settings, including improving diabetes self-management outcomes for patients and increasing patient understanding of a disease for newly diagnosed patients (Williams, Lynch, Glasgow, 2007). From electronic booklets to cell phone applications and other digital mediums, the use of current technology has demonstrated to be effective and convenient for patient interventions and early detection techniques for cancer (Robert H. Lurie Comprehensive Cancer Center, 2016). One study found that an electronic tablet-based intervention informing patients and their partners about SSE was just as effective as workbook and in-person delivery of the intervention (Robinson, Gaber, Hultgren, Eilers, Blatt, 2014). This last study helped form the basis for this paper, and the decision to examine patients' technological savviness as a potential factor to impact their ability to effectively receive information from a tablet-based intervention.

In this project, technological savviness is defined as the level of sophistication and comfort one has with technology and internet-based applications. Studying technological savviness of patients is one way to better understand whether it interferes as a factor in one's ability to effectively use the tablet-based interventions. There is the concern that people with lower savviness might be at a disadvantage and may not benefit from electronically delivered intervention as those with higher savviness. For example, one study found that among health care professionals, one reason nurses were reluctant to use mobile information computing technologies (MCITs) to improve patient care was because of the "fear" that the new technology is a foreign tool that would hinder their process flow (Junglas, Abraham, Ives, 2009). Age may also influence this concept of technological savviness. Young adults and children make up what is referred to as the "Net Generation" as they have grown up with technology in a way that makes obtaining information from the Internet seemingly effortless (Lorenzo, Oblinger, Dziuban, 2006). While individual differences do exist, this Net Generation does have an

increased comfort and confidence in online environments as they use electronic resources more readily than older populations (Lorenzo, Oblinger, Dziuban, 2006). However, not every young adult fits the profile of this "Net Generation" so while age may indeed be a factor, it is necessary to more broadly define technological savviness according to the amount of time spent on the internet as well as types of internet usage.

This project seeks to improve upon the lack of scientific literature on technological savviness and its impact on an intervention that is delivered using a technological device. A patient's level of technological sophistication may be a confounding variable not yet studied, that may influence how well certain participants are able to gain information from the electronic interventions. This becomes especially relevant for skin cancer patient populations that tend to be older and may be at a disadvantage due to a lower technological savviness. In studying this relationship, the author hopes to determine if an individual's level of technological savviness needs to be taken into account in future electronic-based intervention studies. This paper examines how patients' technological savviness impacts the results of a tablet-based skin cancer intervention in two ways: confidence in SSE skills and directly on patients' frequency of performing SSE. It was hypothesized that patients with lower technological savviness would have reduced levels of SSE confidence and frequency as compared to patients with higher technological savviness, after receiving the tablet intervention.

METHODS

Procedures

The data used for this research was taken from the NIH/NCI funded Project Skin Watch, with permission from the Principal Investigators (Drs. Rob Turrisi and June Robinson). The goal of Project Skin Watch was to teach patients with a history of melanoma and a partner of their choosing about SSE techniques to identify lesions that may result in the recurrence of skin cancer. In 2013, patients with a history of melanoma were recruited from the Midwest region from either the electronic medical records of patients at the Northwestern Medicine health system or through the health section of regional newspapers. Other eligibility requirements for this study included being within the age range of 21-80 years, having acceptable vision, having a partner who was willing and able to participate in the study, and that the patient had a previous diagnosis stage from 0 to IIB melanoma, with at least 6 weeks time elapsed since surgical treatment for the melanoma. The study was approved by the International Review Board (Turrisi et al., 2015).

Patient demographics included 51.2% female patients and a mean age of M=55 years (Standard Deviation of 10 years) which demonstrates a diverse group of participants. The patient sample for this study consisted of 494 dyads (patient-partner pairs) that were randomly assigned to one of three intervention groups: 1) in-person SSE intervention (n=165), 2) workbook SSE intervention (n=159), and 3) tablet-based SSE intervention (n=71), or the control group that received no intervention (n=99). For this paper, only participants assigned to the tablet intervention group (n=71) were included in the data analyses. However, it's important to note that the content of the interventions was identical for each group, with the only difference being

the medium through which the information was transmitted. The interventions specifically taught the dyads about the ABCDE rule of skin check as well as an overall SSE skills training. Dyads answered questionnaires about their confidence in performing SSE and the frequency of SSE with their partners 4 months after receiving the intervention.

Measures

For the purpose of this thesis, only the tablet-based intervention group was analyzed in order to assess whether a patient's technological savviness influences his/her self-efficacy of SSE after receiving a tablet-based intervention. The previously mentioned survey questionnaires were used to assess these predictor and outcome variables. For technological savviness, patients answered questions at baseline about their internet/mobile usage patterns to ascertain the amount of time spent on the internet, and what activities they use the internet for. Thus, "Internet Time" and Internet Activity" were created as two separate predictors of technological savviness. Then, two outcome variables were created to assess the degree to which patients felt confident in their SSE abilities after the tablet-based intervention, as well as their frequency of skin checks. For confidence or self-efficacy, patients were asked to determine whether or not they agreed or disagreed with several statements, one of which was "I am very confident that I know how to check my skin for signs of skin cancer." The response options ranged from strongly disagree to strongly agree on a 5-point Likert scale. For skin check frequency, patients were asked "How many times in the last 4 months have you closely examined your skin in the following areas?" and given 17 different body parts to consider. The response options were given on a 5-point Likert scale with options ranging from 0 times to 4+ times. Both of these outcome variables were assessed at baseline and the following 4-month intervals.

Data Analysis

The statistical software package SPSS was used for all data analyses. Zero order correlations were performed to examine the relationship between each predictor and outcome variable at baseline and 4 months. Multiple regression analysis was conducted between each predictor and outcome variable to assess the relationship between technological savviness and confidence and frequency of SSE. To control for potential confounding variables, baseline patient confidence in SSE, baseline frequency of SSE, age, and gender were included as covariates in the regression analysis.

RESULTS

Zero Order Correlations

From the Zero Order Correlation in Table 1 below, the Pearson's Correlation Coefficients are all very close to zero. This demonstrates that the correlation between time spent on the Internet and SSE confidence and frequency is both weak and insignificant at both baseline and 4 months.

Table 1: Zero Order Correlation Between Internet Time And Outcome Variables of SSE Confidence and Frequency

Table 1 Zero Order Correlation Internet Time

	Baseline Confidence	4 Month Confidence	Baseline SSE Frequency	Month 4 SSE Frequency
Internet Time	r= 0.018 p= 0.879	r= -0.096 p= 0.481	r= 0.078 p= 0.521	r= 0.018 p= 0.891

*r= Pearson's Correlation Coefficient, p= significance value

From the Zero Order Correlation in Table 2 below, the Pearson's Correlation Coefficients are all very close to zero. This demonstrates that the correlation between Internet activity and SSE confidence and frequency is both weak and insignificant at both baseline and 4 months.

Table 2: Zero Order Correlation between Internet Activity and Outcome Variables of SSE Confidence and Frequency

Table 2 Zero Order Correlation Internet Activity

	Baseline Confidence	4 Month Confidence	Baseline SSE Frequency	Month 4 SSE Frequency
Internet Activity	r= 0.140 p= 0.244	r= 0.119 p= 0.384	r= 0.067 p= 0.577	r= -0.004 p= 0.975

*r= Pearson's Correlation Coefficient, p= significance value

Multiple Regression

Regression analysis that examined the relationship between each predictor variable (Internet time and Internet activity) with each outcome variable (SSE confidence and SSE frequency) found there to be no significant association between any of these variables. After controlling for baseline values, age, and gender for each association, it was found that the only significant values ($p<0.05$) were when SSE confidence at baseline was accounted for. This demonstrates that our predictors of technological savviness have no strong or significant association with patient SSE confidence or frequency at 4 months.

Table 3: Association Between Time Spent on the Internet and Confidence at 4 months, while controlling for Baseline Confidence Values

Table 3 Regression of Internet Time and Confidence at 4 months

Predictors	**Un-standardized Beta**	**Standard Error**	**P Value**
Internet Time	**-1.42**	**1.03**	**0.18**
Confidence in SSE at Baseline	**0.61**	**0.10**	**0.00**
Age	**-0.08**	**0.08**	**0.32**
Gender	**-1.31**	**2.05**	**0.53**

Table 4: Association Between Time Spent on the Internet and SSE Frequency at 4 months, while controlling for Baseline Frequency Values

Table 4 Regression of Internet Time and SSE Frequency

Predictors	Un-standardized Beta	Standard Error	P-Value
Internet Time	0.01	0.16	0.94
Frequency of SSE at Baseline	0.63	0.33	0.06
Age	0.16	0.31	0.60
Gender	0.00	0.01	0.92

Regression of Internet Activity and Confidence

Table 5: Association Between Internet Activity and Confidence at 4 months, while controlling for Age, Gender, and Baseline Confidence Value

Table 5 Regression of Internet Activity and Confidence at 4 months

Predictors	Un-standardized Beta	Standard Error	P-Value
Internet Activity	0.09	0.94	0.92
Confidence in SSE at Baseline	0.60	0.11	0.00
Age	-0.03	0.09	0.75
Gender	-0.82	2.06	0.69

Table 6: Association Between Internet Activity and SSE Frequency at 4 months, while controlling for Age, Gender and Baseline Frequency Values

Table 6 Regression of Internet Activity and SSE Frequency

Predictors	Un-standardized Beta	Standard Error	P-Value
Internet Activity	-0.03	0.14	0.82
Frequency of SSE at Baseline	0.63	0.33	0.06
Age	0.16	0.31	0.60
Gender	0.00	0.01	0.95

DISCUSSION

The results from this study provide more insight into the factors that affect one's ability to use technology-based applications in health intervention studies. A patient's confidence in his/her SSE skills is a good metric for understanding their comfort and capability of understanding the information from the intervention. As previous studies have demonstrated, confidence in one's own SSE skills is a strong predictor of future SSE performance to detect skin cancer lesions (Robinson, Fisher, Turrisi, 2002). Both predictors of technological savviness, Internet time and Internet activity, were not associated with patient confidence in SSE. While a patient's SSE confidence was designed to assess his/her perceived self-efficacy in ability to perform SSE after receiving the intervention, SSE frequency was designed to measure the actual number of times patient's examined their skin for lesions. This is a more objective outcome variable that indicates the patient's ability and willingness to perform SSE on their own. Similar to associations with confidence, both Internet time and Internet activity were not associated with skin check frequency at four months. This demonstrates that low levels of technological savviness were not associated with reduced levels of confidence in performance of SSE after receiving a tablet intervention.

The results from both outcome variables suggest that patients with less technological savviness may benefit just as much from the tablet interventions as those who have more technological experience. While technological savviness was not as influential of a factor in the effectiveness of the skin cancer interventions as predicted, this research still provides helpful information for planning future studies that include tablet or internet-based interventions. This suggests that no one on the basis of age, gender or level of experience with technology is at a disadvantage from gaining useful information from this intervention. This also suggests that if

the tablet-based interventions are designed to be as simple and straightforward as possible, any differences in technological savviness between subjects are unlikely to affect the results significantly.

This study did have some limitations worth noting. First, the predictors and outcomes studied were mainly based on survey results that the subjects self-reported. Subjective variables such as time the subject spends on the Internet as well as their confidence in performing SSE are only as accurate as the participant chooses to report them. However, many of these variables can only be assessed in a self-reported survey format, as they cannot be objectively observed in a laboratory setting. Additionally, this study was limited by its small sample size, (N=71). This smaller sample size was reduced even further over time due to attrition at each 4-month interval. Larger sample sizes provide better pictures of analysis and are more representative of the given population. Future studies should seek to replicate these findings in a larger sample.

In conclusion, while the results of this study did not support the initial hypothesis, there was still valuable information to be gained from the study. This research demonstrates that levels of technological savviness are not significantly associated with self-efficacy or frequency of performing SSE. Future studies should use other metrics for assessing technological savviness and self-efficacy, if possible, to either substantiate or reject the results from this study. Additionally, more research should be done on the concept of technological savviness itself, which may be associated with other outcomes in health research that haven’t been previously studied.

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ACADEMIC VITA

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EDUCATION

The Pennsylvania State University, University Park, PA
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Expected graduation: May 2017
Major: Biological Sciences & Health Professions
Minors: Health Policy & Administration and Spanish

RESEARCH EXPERIENCE:

Research Intern - Dept of Surgery
Cedars-Sinai Medical Center, Los Angeles, Ca June 2015 – July 2015

- Analyzed the role of mitochondrial dysfunction in breast cancer etiology, progression and metastasis using advanced imaging tools for early detection of breast cancer.
- Developed a subproject that focused on an oxygen-sensing method for measuring enzyme activity in tissue biopsies, which has significant clinical applicability in diagnosing cancer.
- First author on publication, "Direct measurement of catalase activity in living cells and tissue biopsies", *Biochemical and Biophysical Research Communications* (2016) http://dx.doi.org/10.1016/j.bbrc.2016.01.026.

Undergraduate Research Assistant
PROHealth Lab, Pennsylvania State University Sept 2015 – present
Dr. Rob Turisi, Dr. Racheal Reavy

- Currently performing preliminary research for my honors college thesis which will focus on
  skin cancer and the use of tablet/application based interventions to identify and reduce recurrences in melanoma patients.
- Study college student drinking behaviors and perceived norms. Work in this lab became the basis for a poster presentation in April 2016 which examined the relationship between parental communication and perceived student drinking norms while in college.

Undergraduate Research Assistant
Penn State Breast Cancer Research Lab Jan 2014 – June 2015
Dr. Andrea Mastro Prof: Micro & Cell Biology

- Analyzed the impact of matrix environments on breast cancer cell growth with focus on metastasis prevention. This research provided me with exposure to sophisticated, technical imaging equipment and allowed me to refine my observation and analytical skills.

RESEARCH PUBLICATIONS

- C.N Scaglione, et al., "Direct measurement of catalase activity in living cells and tissue biopsies", *Biochemical and Biophysical Research Communications* (2016), http://dx.doi.org/10.1016/j.bbrc.2016.01.026

HEALTH EXPOSURE:

Free Clinic of Newton
Newton, NJ — May 2014 – present
Dr. Jeffrey Liegner — Medical Director

- Volunteer on a weekly basis during the summers and winter breaks for a free public clinic serving the uninsured and underinsured in Sussex County, NJ.
- Duties included screening patients, taking vitals and inputting patient medical records into the medical system, *Practice Fusion*. Used my Spanish language skills to translate for Spanish-speaking patients.
- At the request of the Medical Director, reviewed the existing Quality Assurance Plan and provided recommendations for the biennial update to improve the document. Recommendations included: the measurement of key medical and administrative indicators, staff training, and confidentiality of patient records.

Global Medical Brigades
Honduras — May 2015

- Volunteer with a 10 Day medical and water brigade in Honduras. The medical brigade focused on implementing sustainable health initiatives and providing relief to rural areas of Honduras with limited access to healthcare. Medical duties included screening patients, triage, medication packaging and health education. Used my fluency in Spanish to instruct the children about proper hygiene.
- Water brigade focused on developing sustainable water systems within rural communities and included digging trenches for water supply.

Atlantic Neurosurgical Specialists
Sparta & Morristown, NJ — June 2014 – Aug 2014; Jan 2015
Neurosurgeon Dr. Charles Stillerman

- Internship with the third largest private neurosurgical practice in the US.
- Duties included screening patients, taking vitals and inputting patient medical records into the electronic medical system, *Centricity.*
- Shadowed Dr. Stillerman on patient office visits and observed 3 spinal surgeries.

Penn State Hershey Medical center
Hershey, PA — May 2014
Dr. Genevieve Andrews — Otolaryngologist

- 2 day externship in the Department of Otolaryngology. Shadowed Dr. Andrews on patient rounds and office visits. Observed 3 surgeries involving the removal of cancerous tumors and surrounding glands of the head and neck.

Sparta Pediatrics
Sparta, NJ Jan 2013
Dr. Catherine McHugh Pediatrician

- 10 hours of shadowing a pediatrician on office appointments including diagnosis, care & treatment of patients, ranging in age from birth to 18 years.

LEADERSHIP & ACTIVITIES

VP- Elect and Fundraising Committee Chair Sept 2014 – present
Ayuda University Park, PA

- Co- direct this student-run organization at Penn State University and coordinate alternative fundraising events to support pediatric cancer research, the patients and their families through the Four Diamonds Fund at Hershey Medical Center.

Scholar Advancement Team Feb 2014 - present
Penn State - Schreyer Honors College University Park, PA

- One of 20 students selected to serve as ambassador for the Schreyer's Honors College at meetings and events for alumni, donors, visitors & prospective students.

Student Orientation Leader March 2014 – Aug 2015
Penn State - Schreyer Honors College University Park, PA

- Leader for the three day orientation to help new scholars transition to college life.
- Preparation for the orientation was over a 6 month period and included a leadership course component.

Philanthropy Committee & General Member Jan 2014 – Dec 2014
Alpha Delta Pi Sorority University Park, PA

- Coordinate events to raise funds and assist the charitable organizations which the sorority supports. This includes the Ronald McDonald House and the Four Diamond's Fund at Hershey Medical Center. In the area of service, each year we visit the local Ronald McDonald House to spend the day cooking & playing with the children and their families.

Alpha Epsilon Delta (AED) Sept 2014 – present
National Health Pre-professional Honor Society University Park, PA

- Assist with the PSU/MSU Blood Donors Challenge, AED Blood Drive, THON, and AED Public Health Fair.

HONORS & AWARDS

- Pennsylvania Space Grant's Undergraduate Research WISER Scholar (2014)
- Phi Beta Kappa Academic Honors Society (2016)
- Dean's List, Penn State University (every semester)
- Valedictorian – Sparta High School Class of 2013; Sparta NJ

SKILLS

- Software: Microsoft Word, Excel & Power Point, SPSS Statistics
- Laboratory : PCR, western blot, gel electrophoresis, pure culture methods, titration, preparation and sterilization of media, alkaline phosphatase enzymatic assay, von Kossa stain for mineralization
- Language: Spanish (Intermediate level); Study Abroad in Madrid, Spain (Summer 2016)