

https://dspace.org/

South African Consumer Perceptions Of Wearable Technology

Koetsie, Karen Monica

2018
https://hdl.handle.net/10539/26420

Downloaded from a DSpace repository. https://dspace.org/

South African consumer perception of wearable technology

Karen Koetsie

9302483M

A research article submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfillment of the requirements for the degree of Master of Business Administration

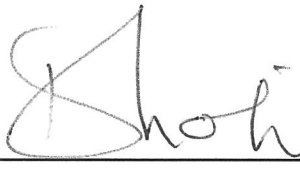
Johannesburg, 2018

Ethics Clearance Number: WBS/BA9302483M/885

Version June 2018

DECLARATION

I, Karen Monica Koetsie, declare that this research article is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfillment of the requirements for the degree of Master of Business Administration in the Graduate School of Business Administration, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Karen Monica Koetsie 

Signed at Parktown

On the 14th day of June 2018

ACKNOWLEDGEMENTS

The author would like to convey her sincerest gratitude to numerous people who have assisted in making this work possible:

To my supervisor, Dr Diran Soumonni, for the pivotal role played in seeing this research project completed. Thank you for your time and effort, looking over every detail to ensure the success of this project.

To my husband for his unwaivering support throughout this entire journey. I am so grateful to have had you at my side.

To my children, Eli and Cara, for your understanding that I was not always able to be there for you.

To my siblings for your immense support and encouragement throughout this process.

SUPPLEMENTARY INFORMATION

Project format:	Research article
Nominated journal:	African Journal of Science, Technology, Innovation & Development
Supervisor/ Co-author:	Dr Diran Soumonni
Word count:	11,782
Supplementary files:	Appendix A: Data collection instrument

Abstract

Purpose of the Study:

The purpose of the study was to provide insight into the South African consumers awareness and perception of wearable devices that monitor health, sports and fitness data. The aim of this research was therefore to investigate and describe the consumers' overall perceived value of wearable technology. It set out to explore how each element of perceived benefit and risk influence the consumers' overall intention to adopt.

Methodology:

The research was a non-experimental cross-sectional study in which quantitative data was collected using an online research survey. The questions included in the questionnaire were devised on the basis of previous published studies with minor amendments in phrasing to adjust to a consumer wearable technology context.

Results

A total of 125 individuals completed the survey. Of the individuals who responded to the survey 67 (53.6%) were male. The majority of respondents (n=67; 56%) were between the ages of 30 and 39 whilst the least number of the respondents (n=3; 2.4%) were above the age of 50 years old. The majority of respondents (n=64; 51.2%) fell into the income bracket of >51K per year. The majority of all the respondents (87.14%) were neither strongly agreed nor strongly disagreed (remained neutral) to the influence design, functionality and ease of operation had on their perception of performance risk. This result was statistically significant (p-value = 0.046). There was a preponderance of individuals across all income ranges that remained neutral when asked about the perceived security and privacy risk of gathered personal health data with the use of wearable devices. The majority of respondents between the ages of 30 and 39 either felt neutral (n=31; 44.29%) or agreed (n= 28; 40%) that their perceived usefulness of wearable devices influenced their intention to adopt or continue to use wearable technology.

Conclusion:

This research makes some empirical contributions that have implications for theory and practice in the wearable technology market. It is among the first to investigate wearable device acceptance from a behavioural perspective in South Africa that is essentially at its infant stage of diffusion into the market. Marketing managers need to consider several strategies geared towards the perceived value as well as the perceived social image of wearable devices to actual and potential users.

INTRODUCTION

1. Introduction

Research and development on wearable technology in healthcare management has been motivated by the challenges facing our health system, namely, rising health care expenditure in both the private and public sectors. The purpose of this research is to investigate the reasons for the increase in demand over the last few years for non-intrusive body-worn sensors for lifestyle and healthcare monitoring. There is the potential financial benefit for many healthcare providers, insurers as well as the consumer when these devices are used as facilitators of health behaviour. Despite the increasing number of devices commercially available to carry out this function, there is little information available on end-user attitude towards these devices.

1.2 Statement of the Problem

The utilitarian, hedonic and social aspects of these devices motivate users of wearable devices, specifically fitness devices, to adopt and adhere to their usage. There are also potential economic benefits for consumers who use these devices to enable healthier behaviour. However, it is not apparent what the factors are that will likely influence the South African consumers decision to initiate the use or to continue the use of wearable technology. Such empirically based insights could improve the ability of healthcare providers and insurers to better understand the consumer behaviour in order to improve healthcare provision

and risk assessment and ultimately benefit in a reduction in both policy and healthcare costs.

1.3 Background

Healthcare is not only one of the most essential aspects of our lives, its also an important aspect of our economy (Safavi and Shukur 2014). There is a health care management evolution underway globally mainly being motivated by an aging population and the rise in chronic diseases. This accompanied by increasing health care costs has fueled the need for consumers to play more of a participatory role in the management of their own healthcare. This cultural change is powered by the extraordinary advancement in innovation and technology in the world of science. South African consumers do not want to be left behind and want to get onto the e-health wagon.

The emergence of wearable technology is appearing at a time when the global population is facing a crisis in obesity-related heart disease, type-2-diabetes, stroke and certain kinds of cancer (Todd, Mills et al. 2016). Wearable devices are used on the external surface of the body; either attached as an accessory or embedded in the users garments. Although there is rapidly growing knowledge of wearable devices, minimal research has been conducted on user acceptance of and user attitudes towards them. This may be because they are still in the very early phase of commercialisation (Yang, Yu et al. 2016).

Gao, Li et al. (2015) define wearable technology as "electronic technology that is incorporated into accessories that can be directly worn on the body" p.1704. These range from smart glasses such as Google glass, to smart watches such as iWatch, Geak Watch and Samsung Galaxy Gear. Smart bracelets such as Fitbit, Jawbone, and Goodon are also categorised as wearable technology (Gao, Li et al. 2015). "Healthcare wearables" are those wearables that measure metrics that are assumed to provide an indication of the users' health and state of wellbeing. Movement trackers and smartwatches are presently the most widespread type of healthcare wearables. More sophisticated wearables have recently emerged

which are able to monitor the wearers more intricate clinical vitals such as heart function, blood pressure, glucose and insulin levels, medication levels, as well blood oxygen saturation levels (Abraham 2016). Wearable technology has the potential to generate a smart environment to assist with remote health care and monitoring (Chan, Estève et al. 2012). Physiological parameters such as blood pressure, heart rate, body temperature, breathing rate, and blood oxygen levels are measured via miniature biosensors within these devices. These aggregated vital signs are then wirelessly transmitted to a medical center (Pantelopoulos and Bourbakis 2008).

1.4 Significance of the Study

The dynamics of corporate-subsidised health plans are presently changing and it is yet to be determined if the use of wearable devices will be a passing trend or a fundamental part of the market place. The last few years have seen a growing use of wearable devices to track fitness and outcomes of healthy lifestyles and so we expect to see them have a bigger influence on health-care costs. As their tracking capabilities evolve and become more sophisticated we expect to see a rise in user acceptance as well as corporate adoption into various health care plans (Todd, Mills et al. 2016). Rising medical costs to manage lifestyle related illnesses means that both the consumer and the various insurance companies assume the costs (Todd, Mills et al. 2016).

The obvious beneficiaries from the implementation of such devices will of course be the health insurers who will likely benefit from the lower health-care costs of a more healthful member profile. Companies that subsidise their employees' health insurance premiums will benefit from a healthier work force. Employers can additionally provide their employees with incentives for participation in wellness programs such as cash rewards on premiums (McFall 2015). Furthermore, data collected by wearable devices can assist consumer companies in understanding their target consumer trends and behaviours. Finally, insurance companies are likely to benefit from the data by an enhanced

understanding of their populations risk profile (Todd, Mills et al. 2016). The ability to improve health by improving the quality and reducing the price of health care can potentially result from the effective use of data and technology. When used appropriately wearable technology can potentially provide consumers with greater control over their health and welfare and significantly reduce the administrative costs by health insurers (McFall 2015).

Healthcare providers including insurers are clearly seeing the numerous benefits of these devices and are encouraging their customers to wear them. Everyone therefore stands to benefit from both a reduction in policy and health care costs to a healthier and more productive workforce. In South Africa wearable technology is still at the infancy stage of adoption and the majority of the insurance segment is moving much slower than the interest suggests.

What follows is an overview of the current literature that debates user preferences of wearable technology as well as the economic implications to corporates.

APPLICATION OF PRIOR RESEARCH

2. Literature review

The Internet is filled with articles on the positive prospects and functionality of wearable technology, however little research has been done on the consumers' perception on the perceived value and benefit of these devices. This review will evaluate the available literature on the value and application of wearable technology. It begins by firstly describing how wearable technology can be used to assist in the scope of healthcare management. It purposely focuses on its financial benefit to the providers and sponsors of health insurance. It will explore how the financial incentives related to health promotion programs offered by health insurers and employers may be a valuable strategy to both enhance member activity as well as lessen long-term health costs. The rising popularity of usage of wearable technology is then described followed by the financial attractiveness of the wearable technology market. Finally a review of the factors related to the adherence to the continuous use of wearable technology by consumers is explored.

2.1 Wearable technology facilitates healthy behaviour

There's no doubt that the world has become more health conscious and people have become "health consumers" searching for better life style and health management options. Wearable technology has the potential to significantly reshape the provision of healthcare management (Lymberis 2003). Wearable technology has the potential to revolutionise health care delivery by affording consumers the ability to take control of their health monitoring (Pantelopoulos and Bourbakis 2008). It is not yet certain whether these devices will ultimately become a fundamental part of our global market or transform the future of corporate-sponsored health insurance (Todd, Mills et al. 2016).

Physical inactivity is a one of the major lifestyle factors that contribute to the increasing disease burden globally. The effect of this sedentary type of lifestyle is

unquestionably resulting in an upsurge of chronic diseases such as hypertension, type 2 diabetes, heart disease and cancer. The benefit of physical activity is compelling and has been shown to mitigate the effects of other risk factors such as obesity. In addition the burden of diseases related to physical inactivity has a direct and indirect effect on the economy. There is an increased financial burden on the economy as a result of lost wages and personal expenses when people live unhealthy lives (Patel, Lambert et al. 2011).

Most industrialised countries are now facing an ever-increasing financial burden from the sedentary and inactive lifestyle of their populations. A systematic review by Müller-Riemenschneider, Reinhold et al. (2009) on the cost-effectiveness of interventions which promote physical activity found that current interventions can result in significant increases in individual physical activity. This can be done at a reasonable cost and these costs are likely to be considerably smaller than many other alternative uses of healthcare resources (Müller-Riemenschneider, Reinhold et al. 2009).

The fields of healthcare and medicine have up till now seen the greatest application of wearable devices. Data is continuously collected and transformed by these devices over a 24 hour period and used for to enhance the quality of patients healthcare management (Gao, Li et al. 2015). Extensive research and development of smart wearable systems for health monitoring have been done in both academic and industrial sectors. This mainly stems from rapidly escalating health care costs and the need for continuous 24 hour health status monitoring of patients activities both indoors and outdoors (Chan, Estève et al. 2012).

2.2 Assisting with healthcare management

The devising of risk in insurance has historically been left to judgment and computed by way of calculating the ways in which the market is likely to respond (McFall 2015). Historically, life insurance was marketed “as a solution to loss and

change, to fortune and accident, to life and death"(McFall 2015, p.24) Actuarial science including statistics and probability were seen and used as both a technical and rhetorical answer to determining risk. References to the "certainties offered by statistical laws" had become customary practice by the middle of the nineteenth century (McFall 2015, p.24). Mortality indicators were used by businesses to calculate their premium prices whilst actuarial statistical calculations were used to predict their likely liability. As the century proceeded, the health of insured populations was progressively being evaluated, measured and appraised by insurance offices. Insurance actuaries later began to work with medical doctors to design new instruments for measuring individual risks. Measures such as the Body Mass Index (BMI), smoking and alcohol consumption measures as well as various medical conditions were developed by insurers working closely with medical doctors (McFall 2015).

Fast-forward to the 21st century and it is clear that the historical calculative basis of insurance premium determination no longer exists. A global climate in which employer-sponsored and insurer-driven "wellness programs" are escalating and being enhanced by digital health monitoring technologies that provide data direct to the insurers calculative equipment has evolved (McFall 2015). The question therefore arises to whether wearable technology can be used to influence people to be healthier? We know that healthcare wearables are able to provide data on an individual's state of health. The question therefore arises as to whether institutions could use data collected to improve the health behaviours of individuals? One way is through self-monitoring. This is when the user engages with their own health data and uses the information as a basis for motivation to improve his health behaviours (Abraham 2016).

Customarily, life insurers gather information on policyholders at a single point in time during the initial process of the underwriting application. Insurers use underwriting to assess and compute the risk presented by potential policyholders. Data provided by healthcare wearables can therefore provide quantified information on policyholders and their relative risk. Rates can appropriately be adjusted to suite policyholders. This can potentially assist

insurers to digitally streamline their underwriting process thereby reducing costs (Abraham 2016). In South Africa, private health insurance is appraised according to the prospective society and illness risk or age cannot be used to decline insurance cover. Data collected from wearable technology can potentially improve the appraisal of the illness risk of the cluster of lives insured (Abraham 2016). This data can provide detailed information on health metrics on a continuous basis thereby providing the insurer the ability to improve their risk measurement through unceasing dynamic underwriting of policyholders. This capability can be used across a spectrum of products such as life insurance and dread-disease cover (Abraham 2016).

All Life in South Africa is an illustration of an insurer who could theoretically offer such a product. All Life provides life and disability cover to individuals with the diagnosis of HIV and diabetes. All Life does not currently feature healthcare wearables into their adherence programmes. These individuals are however expected to participate in their HIV Adherence Programme or Diabetes Control Protocol. Healthcare wearables could provide data on their policyholders programme participation and potentially promote healthier behaviour reducing the mortality and morbidity risk of their policyholders (Abraham 2016).

Healthcare wearables are used to not only add value to policyholders but to assist employees to maximise employee productivity. Havensrock's group income protection plan in the United Kingdom have done this as improved health is perceived to result in better employee productivity by reducing their stress levels, improving their cognitive ability and reducing the degree of absenteeism. The incorporation of healthcare wearables into income protection cover also has the potential to benefit the employer and their employees (Abraham 2016).

The use of particular incentives and rewards for healthy behaviour can be tracked to South African insurance company Discovery Health. Their reward approach to lifestyle began in 1997 and enabled health insurance to be transformed into an efficient and engaging proactive "technology of the self"

(McFall 2015, p.39). Discovery is the country's biggest healthcare funder and was one of the first companies to use wearable technology in their Vitality product offering. Vitality is a lifestyle programme that motivates members to follow healthier lifestyles by enticing them with rewards for reaching stated health targets. Vitality feeds Discovery comprehensive data and better-quality health performance of these policyholders (Abraham 2016).

In 2004, joint ventures between Discovery and Prudential, known as Pruhealth, offered "vitality points" to their members who partook in a range of daily healthy activities. Members who participated in the program could potentially save from 25% to 100% on the renewal of their premiums. This innovative venture has since resulted in the establishment of an array of incentive-driven corporate and insurance-based wellness programs in the United States of America, as well as in Asia and Europe (McFall 2015).

Another use of data from wearable technology is to assist actuaries in the identification of individuals who were originally recognised as standard risk for example, but subsequently have higher than initially calculated mortality and morbidity risk. As soon as these individuals are identified they can be encouraged to partake in programmes to achieve a healthier lifestyle (Abraham 2016).

There clearly is rising relevance of wearable technology in these areas. In October 2014 Humana and Apple announced an agreement that permits for data collected through Apple's health app to be shared by the insurer. Each individual's fitness data from diverse wearable devices and apps are brought together into a single center. The data then allows for existing links between manufacturers of wearable devices and insurers to be amalgamated (McFall 2015). The prospective remunerations of collective partnerships between businesses and insurers are well-defined for companies like Fitbit. Fitbits employer program allows for one company to compete against another company to determine through high-tech tracking software how active their employees

are. Data collected could potentially affect future group pricing negotiations between health care insurers and employers (McFall 2015).

In a retrospective longitudinal study by Patel, Lambert et al. (2011) where they looked at the participation of individuals in fitness-related activities, they found that a comprehensive, reward-based health promotion correlated with improved involvement in physical activity over a certain period of time. They also found that individuals who constantly maintained their level of activity had the most favourable outcomes when it came to in-patient hospital expenses and likelihood of being admitted to hospital. They found that monitored fitness-related activity increases when associated with enticements and rewards. The outcomes of their study furthermore suggest that financial incentives related to health promotion programs offered by health insurers may be a valuable strategy to both enhance member activity as well as lessen long-term health costs (Patel, Lambert et al. 2011).

An empirical study by Gao, Li et al. (2015) looked at the factors related to the consumer's intent to adopt wearable technology in healthcare. They developed an integrated acceptance model and tested 462 respondents using a survey. Their research found that factors related to health, technology and privacy affected consumers decision to accept wearable technology. Medical device users focused more on apparent expectation and severity as well as self-effectiveness and expectation of effort. Fitness device users on the other hand focused more on the utilitarian and apparent privacy risk, and are ultimately motivated by the hedonic aspects and social influence of the device (Gao, Li et al. 2015).

2.3 Prevalence of usage

The most popular application of wearable technology is in the area of health and wellness. This has mainly involved the use of smart watches and fitness trackers. Its popularity is not expected to diminish in the coming years (Abraham 2016). However, as these devices can be quite costly it would appear that the individuals who use these devices are the ones who need them the least. In a

survey of wearable device users, 75% of users described themselves as “early adopters of technology”, 48% were under 35 years, and 29% of users earned more that $100, 000 per year (Patel, Asch et al. 2015). The individuals who need these devices the most and have the most to benefit from their usage are older and less wealthy. It stands to reason that wearables need to be cost effective in order to engage the desired target audience (Patel, Asch et al. 2015). The global wearable device market is projected to grow by 78% each year, from 19 million units sold in 2014 to 112 million units predicted to be sold in 2018 (Yang, Yu et al. 2016).

A systematic review by Bergmann and McGregor (2011) examining wearable device acceptance found that 93% of patients in a geriatric-care facility were accepting of a wearable device. Low-invasiveness and non-interference with their daily activities were the reasons cited for their widespread acceptance. Their review found that geriatric subjects preferred a body-worn system that did not affect their usual daily behaviour, was light and compact and simple to operate and maintain. Study subjects also indicated that they would be prepared to wear the device right through the day and night except in the shower (Bergmann and McGregor 2011).

2.4 Market value of wearable technology

The wearable device market is projected to generate $22.9 billion in revenue by the year 2020. A compound annual growth rate (CAGR) of 50 percent has been predicted for the period between 2014 and 2020 (Gao, Li et al. 2015). According to Patel, Asch et al. (2015) only 1% to 2% of individuals in the United States have used a wearable device. Annual sales, however, are predicted to rise to more than $50 billion by 2018. Research is increasingly showing that the global market for these devices in sports and healthcare is anticipated to reach 170 million units by 2017 (Ramsay 2013). This projected upsurge is due to the increased interest health care organisations, insurers, employers and physicians

show in using these devices to improve physical activity in less driven individuals (Patel, Asch et al. 2015).

2.5 Adherence to usage

Information collected by the device needs to be presented back to the end user in a well-defined and simple fashion. The user is more likely to remain motivated and will continue using the device if the outcomes of their activities are clearly understood (Patel, Asch et al. 2015).

Employers and insurers can potentially pay for these devices if they believe that it will assist their employees and members respectively to adhere to medications and fitness levels. This intervention could potentially result in noteworthy health care savings (Patel, Asch et al. 2015). The high level of discontinuation in the use of wearable devices after initiation is however concerning. Data collected can become scanty if policyholders do not consistently use their wearables. This in turn reduces the credibility and reliability of information collected. Another key operational challenge is that the information provided by wearable technology may not always be accurate. This questionable reliability of data could be due to the quality of the technology itself. Another concern is that the data collected by wearable technology is potentially open to manipulation (Abraham 2016).

Another challenge faced by wearers of these devices is to remember to wear it and to occasionally recharge its battery. These additional behaviours are required from individuals who may already have difficulty with time management (Patel, Asch et al. 2015).

Some healthcare wearables have been known to be uncomfortable to wear all day long and therefore need to be refined and advanced to make them smaller and more wearable. This enhanced wearability will potentially allow these devices to become more user friendly and therefore augment its ability in the detection of the early onset of health conditions (Abraham 2016).

2.6 Conclusion to literature review

Research has continuously shown that reward-based health promotion correlates with improved involvement in physical activity over a certain period of time. Wearable technology when associated with enticements and rewards increases fitness-related activity. Concerns pertaining to ethical and legal issues, that is, the protection of personal medical data, risk exploration as well as measures of user confidentiality is particularly of importance to the consumer (Lymberis and Dittmar 2007). Technology has no doubt improved and reduced the cost of healthcare management by changing the way in which medicine is practiced (Safavi and Shukur 2014). There are still several factors related to health, technology and privacy that affect consumers' decision to accept wearable technology.

2.6.1 Alignment of literature reviewed with the objectives of the study

The use of wearable technology can potentially improve healthcare efficiency and reduce healthcare costs for both the end user and the healthcare provider. In addition, consumer concerns such as privacy and financial costs need to be assessed and addressed in order to comprehend the health economic benefit of wearable devices. Providers of healthcare insurance can be guided by this study to implement better policies and strategies to promote wearable technology amongst their members.

2.7 Aim of the research

The aim of this research was to investigate and describe the consumers' overall perceived value of wearable technology. It set out to explore how each element of perceived benefit and risk influence the consumers' overall intention to adopt these devices. The study assumes consumers are either actual or potential users of wearable technology.

2.8 Research model and hypotheses development

To comprehensively understand the consumer's reasons for acceptance and adoption of wearable technology an integrated model combining 5 of the 11 latent constructs originally developed, tested and validated by Yang, Yu et al. (2016) was used. The 5 selected constructs for the purpose of this study are perceived usefulness, perceived value, perceived social image, perceived privacy and financial risk and perceived performance risk (Yang, Yu et al. 2016). The proposed model is based on the Protection Motivation Theory (PMT) and Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) as the theoretical foundations (Gao, Li et al. 2015). The UTAT2 is an integrated acceptance model and was tested with 462 respondents using a survey. This empirical study of wearable technology acceptance found that consumer's decision to adopt healthcare wearable technology is influenced by factors ranging from technology, privacy as well as health concerns. The UTAUT2 model firstly aims to investigate the use of wearable devices from a behavioural perspective. Secondly it assists in the comprehensive understanding the recent emergence and popularity of health information technology acceptance amongst users (Gao, Li et al. 2015).

UTAUT2 model is the most all-inclusive of all technology acceptance models that sets out to describe the consumer's approval and usage of technology. The model is the most comprehensive technology acceptance model to explain consumer's technology acceptance and use. The theory explains seven factors that impact on the consumer's intent to accept innovation. These include social impact, effort anticipation, hedonic incentive, habit, expenditure value, and functionality (Gao, Li et al. 2015).

Traditionally researchers have adopted the UTAUT model to predict the acceptance of a new technology as the model is viewed as more robust than other models for predicting user acceptance. The influential factors of using

intention and actual using behaviour of wearable technology tests the applicability of the model (Chen and Shih 2014).

The PMT describes the consumer's decision-making stages in two stages. Stage one is seen as the coping evaluation that comprises the response value and response expense and self-efficiency. Stage two is seen as the risk assessment that includes perceived susceptibility and perceived difficulty (Gao, Li et al. 2015).

What ensues is a brief definition of each construct followed by the proposed hypothesis for each construct. To test each hypothesis, a survey questionnaire will be developed which will include items (questions) for all the constructs listed above.

2.8.1 Perceived usefulness

Perceived usefulness is defined as the "the degree to which a person believes that using a particular system would enhance his or her job performance" (Yang, Yu et al. 2016, p.258). A consumer's intention to buy a product is influenced by both intrinsic and extrinsic factors. Intrinsic benefits perceptions are a consequence of fun and playfulness for the self whilst extrinsic benefits are seen as practical and functional.
The main components of these intrinsic and extrinsic benefits have been shown to be the perceived pleasure and perceived utility, respectively, that the product brings about in the user (Yang, Yu et al. 2016).

H_0: The perceived usefulness of wearable technology will not have a positive influence on consumers' intention to adopt.
H_A: The perceived usefulness of wearable technology will have a positive influence on consumers' intention to adopt.

2.8.2 Perceived value

Perceived value suggests the usefulness of wearable devices in terms of benefits and sacrifices. Perceived value is comprised of objective and subjective factors that form part of a buyer's experience. It is made up of both qualitative as well as quantitative elements and is "the ratio of perceived benefit relative to perceived sacrifice" (Yang, Yu et al. 2016, p.257). Perceived value can also be defined as the consumer's general appraisal of the function of a product centered on the view of what is received and what is given (Yang, Yu et al. 2016).

H_0: The perceived value of wearable technology will not have a positive influence on consumers' intention to use.
H_A: The perceived value of wearable technology will have a positive influence on consumers' intention to use.

2.8.3 Perceived social image

Social image is defined as the perceived admiration and esteem wearable technology affords the user amongst peers in their social circles. Social image and status is also an important element of perceived benefit because consumers want to be admired within their social system for their usage of certain innovative products (Yang, Yu et al. 2016)

H_0: The perceived social image of wearable technology will have a positive influence on consumers' perceived value.
H_A: The perceived social image of wearable technology will not have a positive influence on consumers' perceived value.

2.8.4 Perceived privacy and financial risk

Risk may cause consumers to postpone or terminate the acquisition of an innovative product. The likelihood of loss of money is referred to as economic risk (Yang, Yu et al. 2016). Innovation in healthcare presents a concern that health information that is ordinarily protected is not misused. While wearable

healthcare devices provide several benefits, it has the potential to introduce huge issues related to security and privacy. They therefore need to be designed to withstand any breaches in privacy (Safavi and Shukur 2014).

H_0: The perceived privacy and financial risk will not have a negative influence on the consumers' intention to adopt wearable technology.
H_A: The perceived privacy and financial risk will have negative influence on the consumers' intention to adopt wearable technology.

2.8.5 Perceived performance risk

The adoption of a novel product or service entails some risk since all actions have some likely consequences. The inability of the product or service to meet with the consumers' expectations is referred to as performance risk. Consumers see the purchase of innovative products as risky due to uncertainties in the technological market. Perceived performance risk is defined as "the possibility that the wearable devices will not function as expected (Yang, Yu et al. 2016, p.259).

H_0: The perceived performance risk of purchasing wearable technology will not have a negative influence on the consumers' intention to adopt.
H_A: The perceived performance risk of purchasing wearable technology will have a negative influence on the consumers' intention to adopt.

DATA COLLECTION AND ANALYSIS

3. RESEARCH METHODOLOGY

3.1 Research design

The research was a non-experimental cross-sectional study in which quantitative data was collected using an online research survey.

3.2 Research instrument for the study

The selected instrument of measurement for this research was an online survey questionnaire. The questions included in the questionnaire were devised on the basis of previous studies by Gao, Li et al. (2015) and Yang, Yu et al. (2016) as documented in the literature review. All the items (see Appendix A) were adapted from previous published studies with minor amendments in phrasing to adjust to a consumer wearable technology context. Each item was measured on a five-point Likert scale rated from 1 to 5 with 1 being "strongly agree", 2 being "agree", 3 being "neutral, 4 being "disagree" and finally 5 being "strongly disagree". Each construct had 3 questions. A total of 15 questions (3 questions per construct) were presented in the survey. A minimum score of 3 and a maximum score of 15 was therefore assigned to the respondent depending on their response.

3.3 Research sampling

3.3.1 Population

The target population consisted of males and females in the Johannesburg area with a sampling frame of consumers from 18 and above. Johannesburg has long been considered as the continent's economic hub and is essentially important to the economies of South Africa and the continent. Johannesburg is a global city with a population that is rapidly urbanising and embracing technology. It attracts talented and highly skilled individuals who are lured by its physical, social and digital infrastructure (BrandSouthAfrica 2016). According to the 2011

Census, the City of Johannesburg has a population of 4.435 million (StatsSA 2017).

3.3.2 Sample frame

The target population consisted of males and females aged 18 and above who were enrolled in the MBA programme at the University of the Witwatersrand Business School. The Wits Business School is estimated to have a total of 500 MBA part-time and full-time students enrolled in 2017. The Wits Business School is a graduate school of business administration of the University of the Witwatersrand and is ranked as one of the top tertiary institutions in Africa. It is located in Johannesburg and attracts a vast array of multitalented and highly skilled individuals who are enticed by a curriculum theme which is tied to context in South Africa (WBS 2017). The WBS group of students are innovative and keen consumers of technology.

3.3.3 Sample size

To determine the sample size, the MBA student population size of 500 was entered into a software system called Raosoft (Raosoft 2004). The results obtained indicated that the sample size required was 218 individuals using a Margin of Error of 5%, a 95% Confidence level, and a Response Distribution of 50% (Raosoft 2004).

3.5.3 Sampling method

Convenience sampling is said to be used in exploratory research and is classified as a nonprobability sampling method. This sampling method was selected because of the time constraint (StatPac 2017).

3.6 Data management and analysis

Data management and statistical analysis was done using STATA. Detailed descriptive statistics (frequency and percentages) for the respondents' demographic characteristics were described.

Quantitative data for each construct was collected using the Likert scale described above. Each construct had 3 questions posed to the respondent. Based on their response, individuals could obtain a score of 3 to 15 for each construct. A score of 3-6 was regarded as "Low Category", a score of 7-11 was regarded as "Medium Category" and a score of 12-15 was regarded as "High Category". A low score indicated that the respondent strongly agreed whilst a medium score indicated that the respondent neither strongly agreed nor strongly disagreed. This score category was assumed to be a neutral response for all respondents. A high score indicated that the respondent strongly disagreed. In this way quantitative data outcome for each construct was converted into categorical data (Low, Medium and High categories). To examine the relationship of each of the constructs with background characteristics (age, gender, race and income), bivariate Fisher's exact test analysis was done. Fisher's exact test is a statistical analysis method used to assess whether or not there is a relationship between two categorical variables in small samples if the frequency in some of the cells is less than 5, as found in our sample (Freeman and Julious 2007). However, the test is also valid for large sample sizes. Unlike the chi-squared test, Fisher's exact test is an exact test rather than relying on an approximation. Results yielding a p-value of <0.05 was considered to be statistically significant.

Next, the correlation between the outcomes using scores for each of the constructs was analysed. Correlation refers to the linear association between two quantitative variables. This linear association is measured by the correlation coefficient, *r*, which lies between -1 and 1. A negative value of *r* depicts a negative correlation while a positive value means that's there is a positive correlation. The higher the value of *r,* the stronger the association between the two variables. These results were summarised in a correlation matrix.

Since the outcomes (perceived benefits and sacrifices) are ordinal, the multivariate generalised ordered logit procedure was utilised to investigate the relationship between the constructs and background variables. When the outcome is ordinal rather than continuous, linear regression techniques are

inappropriate. Odds ratios were used as a measure of association between the different background characteristics and the respective constructs. Results yielding a p-value of <0.05 was considered to be statistically significant.

3.7 Validity and Reliability

The measurement items in this study survey were developed based on previous studies by Gao, Li et al. (2015) and Yang, Yu et al. (2016). These items have therefore already been checked involving pilot testing for validity and reliability

3.7.1 External validity

The ability to generalise these research findings across the population was limited due to the convenience sample methodology that was be used.

3.7.2 Internal and Construct validity

In their study on user acceptance of wearable devices Yang, Yu et al. (2016) examined the convergent validity of each construct using confirmatory factor analysis. They evaluated convergent validity by investigating the factor loading for each item on the measurement model. In addition they assessed each loadings impact level as well as the reliability and obtained the average variance for all of the constructs (Yang, Yu et al. 2016). The average variance extracted for the 11 constructs in the original model surpassed 0.50 thereby allowing the authors to ascertain convergent validity (Yang, Yu et al. 2016).

3.7.3 Reliability

Cronbach's alpha is a measure of recommended reliability (Cooper, Schindler et al. 2003). The original instrument had eleven constructs all of which had a Cronbach's Alpha of more than 0.70 (Yang, Yu et al. 2016).

3.8 Limitations of the study design

The study was subject to some limitations that are likely to diminish the strength of the results. Convenience sampling was chosen as the preferred sampling method. As this was the chosen sampling method, selection may bias statistical interpretation about empirical relationships (Cooper, Schindler et al. 2003).

3.9 Ethical considerations

The research proposal was formally submitted to the University of the Witwatersrand Human Research Ethics Non-Medical Committee. The research and data collection was only commenced once ethics clearance had been granted. Participation into the study was voluntary and participants were given the promise of anonymity and confidentiality.

4. Results

A total of 125 individuals successfully completed the survey. Table 4.1 below shows the demographic characteristics of South African consumers of wearable technology. Of the individuals who responded to the survey 67 (53.6%) were male. Fifty six percent of the respondents were between the ages of 30 and 39 whilst 2.4% of the respondents were above the age of 50 years old. Black African individuals were amongst the majority of those who responded, representing 50.4% of the total number of respondents. The majority of respondents (51.2%) fell into the income bracket of >51K per month.

Table 4.1 Demographic characteristics of South African consumers of wearable device

Characteristic	*Frequency*	*Percentage*
Sex		
Male	67	53.60
Female	58	46.40
Age		
20 – 29	22	17.60
30 – 39	70	56.00
40 – 49	22	17.60
50 – 59	8	6.40
50+	3	2.40
Race		
Black	63	50.40
White	23	18.40
Coloured	18	14.40
Indian/Asian	21	16.80
Income		
<10k	13	10.40
10 – 20k	9	7.20
21 - 30k	7	5.60
31 – 40k	18	14.40
41 – 50	14	11.20
51+	64	51.20

Table 4.2 below shows the bivariate analysis of the perceived performance risk of purchasing wearable technology. Of the males who responded the majority, (n=55; 82.09%), obtained a medium score with regards to the perceived performance risk construct. This would indicate that they neither strongly agreed nor strongly disagreed that the purchase of innovative products was risky due to uncertainties in the technological market.

The majority of all the respondents aged between 30 and 39 years (n=61; 87.14%) scored in the medium category when it came to the influence design, functionality and ease of operation had on their perception of performance risk. This result was statistically significant (p- value = 0.046) indicating that consumers between the ages of 30 and 39 see the perceived performance risk of

purchasing wearable technology as not having a negative influence on the their intention to adopt wearable technology.

Table 4.2 Bivariate analysis of perceived performance (PP) risk of purchasing wearable technology across gender, age, race and income levels

PP	*Low Category n(%)*	*Medium Category n(%)*	*High Category n(%)*	*Total*	*Fisher's exact p value*
Sex					
Male	9(13.43)	55(82.09)	3(4.48)	67	0.096
Female	14(24.14)	44(75.86)	0	58	
Age					
20 – 29	6(27.27)	16(72.73)	0	22	
30 – 39	8(11.43)	61(87.14)	1(1.43)	70	0.046
40 – 49	7(31.82)	14(63.64)	1(4.55)	22	
50 – 59	2(25)	6(75)	0	8	
50+	0	2(66.67)	1(33.33)	3	
Race					
Black	10(15.87)	52(82.54)	1(1.59)	63	
White	4(17.39)	18(78.26)	1(4.35)	23	
Coloured	6(33.33)	12(66.67)	0	18	0.5
Indian/Asian	3(14.29)	17(80.95)	1(4.76)	21	
Income					
<10k	1(7.69)	12(92.31)	0	13	
10 – 20k	4(44.44)	5(55.56)	0	9	
21 - 30k	1(14.29)	6(85.71)	0	7	
31 – 40k	2(11.11)	16(88.89)	0	18	0.655
41 – 50	2(14.29)	12(85.71)	0	14	
51+	13(20.31)	48(75)	3(4.69)	64	

Table 4.3 below outlines the bivariate analysis carried out to determine the influence the perceived usefulness of wearable technology has on the consumers intention to adopt the technology. The majority of respondents between the ages of 30 and 39 either obtained a medium score, (n=31; 44.29%) or a low score, (n=28; 40%) when it came to the perceived usefulness of wearable devices. The perceived usefulness of wearable devices therefore positively influenced their

intention to adopt or continue to use wearable technology. This result was however not statistically significant (p-value = 0.08).

Table 4.3 Bivariate analysis of the perceived usefulness (PU) of wearable technology across gender, age, race and income levels

PU	*Low Category, n(%)*	*Medium Category, n(%)*	*High Category, n(%)*	*Total*	*Fisher's exact p value*
Sex					
Male	30(44.78)	30(44.78)	7(10.45)	67	0.418
Female	20(34.48)	33(56.9)	5(8.62)	58	
Age					
20 – 29	8(36.36)	14(63.64)	0	22	
30 – 39	28(40)	31(44.29)	11(15.71)	70	
40 – 49	9(40.91)	13(59.09)	0	22	0.082
50 – 59	5(62.5)	2(25)	1(12.5)	8	
50+	0	3(100)	0	3	
Race					
Black	25(39.68)	30(47.62)	8(12.7)	63	
White	11(47.83)	11(47.83)	1(4.35)	23	0.912
Coloured	7(38.89)	10(55.56)	1(5.56)	18	
Indian/Asian	7(33.33)	12(57.14)	2(9.52)	21	
Income					
<10k	6(46.15)	6(46.15)	1(7.69)	13	
10 – 20k	3(33.33)	5(55.56)	1(11.11)	9	
21 - 30k	2(28.57)	5971.43)	0	7	0.431
31 – 40k	3(16.67)	13(72.22)	2(11.11)	18	
41 – 50	8(57.14)	4(28.57)	2(14.29)	14	
51+	28(43.75)	30(46.88)	6(9.38)	64	

In Table 4.4 below the bivariate analysis of the consumers perceived value attached to the use of wearable technology is outlined. Of the 22 respondents in the age range 40 to 49, 11 (50%) agreed that their perceived value of wearable devices would have a positive influence on their decision to either continue using or adopt wearable technology. This result was close to being statistically significant (p-value = 0.06). Likewise the majority of the respondents in the age range 50 to 59 agreed (n=6; 75%) agreed with the perceived value of wearable

devices. Overall the majority of respondents leaned towards either strongly agreeing (low score category) or remained neutral (medium score category) when asked about the perceived benefits relative to the perceived sacrifices that accompany the use of wearable technology.

Table 4.4 Bivariate analysis of the perceived value (PV) of wearable technology across gender, age, race and income levels

PV	*Low Category n(%)*	*Medium Category n(%)*	*High Catergory n(%)*	*Total*	*Fisher's exact p value*
Sex					
Male	25(37.31)	34(50.75)	8(11.94)	67	1
Female	22(37.93)	29(50)	7(12.07)	58	
Age					
20 – 29	5(22.73)	14(63.64)	3(13.64)	22	
30 – 39	25(35.71)	38(54.29)	7(10)	70	
40 – 49	11(50)	7(31.82)	4(18.18)	22	0.063
50 – 59	6(75)	1(12.5)	1(12.5)	8	
50+	0	3(100)	0	3	
Race					
Black	25(39.68)	32(50.79)	6(9.52)	63	
White	7(30.43)	15(65.22)	1(4.35)	23	0.437
Coloured	7(38.89)	7(38.89)	4(22.22)	18	
Indian/Asian	8(38.1)	9(42.86)	4(19.05)	21	
Income					
<10k	5(38.46)	7(53.85)	1(7.69)	13	
10 – 20k	3(33.33)	3(33.33)	3(33.33)	9	
21 - 30k	3(42.86)	4(57.14)	0	7	0.89
31 – 40k	6(33.33)	10(55.56)	2(11.11)	18	
41 – 50	7(50)	6(42.86)	1(7.14)	14	
51+	23(35.94)	33(51.56)	8(12.5)	64	

Table 4.5 below shows that the majority of both males (n=40; 59.7%) and females (n=27; 46.55%) obtained a medium category score when it came to the perceived social image wearable technology offers the user. The majority of respondents therefore neither strongly agreed nor strongly disagreed with the perceived social image presented in the study as the perceived admiration and esteem wearable technology affords the user amongst peers in social circles. The

majority of respondents between the ages of 30 and 39 either felt neutral (n=37; 52.86%) or disagreed (n=21; 30%) that social image and status is an important element of perceived benefit.

Table 4.5 Bivariate analysis of perceived social image (PSI) across gender, age, race and income levels

PSI	*Low Category n(%)*	*Medium Category n(%)*	*High Category n(%)*	*Total*	*Fisher's exact p value*
Sex					
Male	9(13.43)	40(59.7)	18(26.87)	67	0.232
Female	14(24.14)	27(46.55)	17(29.31)	58	
Age				Total	
20 – 29	5(22.73)	10(45.45)	7(31.82)	22	
30 – 39	12(17.14)	37(52.86)	21(30)	70	0.768
40 – 49	4(18.18)	14(63.64)	4(18.18)	22	
50 – 59	2(25)	5(62.5)	1(12.5)	8	
50+	0	1(33.33)	2(66.67)	3	
Race				Total	
Black	13(20.63)	28(44.44)	22(34.92)	63	
White	1(4.35)	17(73.91)	5(21.74)	23	0.174
Coloured	3(16.67)	11(61.11)	4(22.22)	18	
Indian/Asian	6(28.57)	11(52.38)	4(19.05)	21	
Income				Total	
<10k	1(7.69)	8(61.54)	4(30.77)	13	
10 – 20k	1(11.11)	5(55.56)	3(33.33)	9	
21 - 30k	1(14.29)	4(57.14)	2(28.57)	7	0.844
31 – 40k	2(11.11)	10(55.56)	6(33.33)	18	
41 – 50	1(7.14)	8(57.14)	5(35.71)	14	
51+	17(26.56)	32(50)	15(23.44)	64	

Table 4.6 below shows the results for the respondents perceived privacy and financial risk. The majority of both males (n=43; 64.18%) and females (n=38; 65.52%) remained neutral (medium score category) with regards to the likelihood of loss of money and the privacy of health information. Likewise across all age groups the majority of individuals obtained a medium score regarding the intention to postpone or terminate the acquisition of wearable

technology when it came to perceived privacy and financial risk. The majority of individuals across all income ranges remained neutral (medium score category) when asked about the perceived security and privacy risk of gathered personal health data with the use of wearable devices.

Table 4.6 Bivariate analyses of perceived privacy and financial risk (PPFR) across gender, age, race and income levels

PPFR	*Low Category n(%)*	*Medium Category n(%)*	*High Category n(%)*	*Total*	*Fisher's exact p value*
Sex					
Male	9(13.43)	43(64.18)	15(22.39)	67	0.724
Female	10(17.24)	38(65.52)	10(17.24)	58	
Age					
20 – 29	3(13.64)	15(68.18)	4(18.18)	22	
30 – 39	8(11.43)	47(67.14)	15(21.43)	70	0.6
40 – 49	7(31.82)	11(50)	4(18.18)	22	
50 – 59	1(12.5)	6(75)	1(12.5)	8	
50+	0	2(66.67)	1(33.33)	3	
Race					
Black	9(14.29)	43(68.25)	11(17.46)	63	
White	2(8.7)	17(73.91)	4(17.39)	23	0.522
Coloured	5(27.78)	8(44.44)	5(27.78)	18	
Indian/Asian	3(14.29)	13(61.9)	5(23.81)	21	
Income					
<10k	2(15.38)	8(61.54)	3(23.08)	13	
10 – 20k	2(22.22)	6(66.67)	1(11.11)	9	
21 - 30k	1(14.29)	4(57.14)	2(28.57)	7	0.867
31 – 40k	2(11.11)	12(66.67)	4(22.22)	18	
41 – 50	0	10(71.43)	4(28.57)	14	
51+	12(18.75)	41(64.06)	11(17.19)	64	

Table 4.7 below shows the correlation coefficients for each of the five constructs. The combinations of outcomes PSI-PU and PSI-PV indicated a weak positive linear correlation. There was a strong positive linear correlation between PV-PU and a moderate positive correlation between PSI and PV. PU-PPFR and PV-PPFR presented a weak and moderate negative linear correlation.

Table 4.7 Pearson correlation matrix between all five constructs: perceived performance risk (PPR), perceived usefulness (PU), perceived value (PV), perceived social image (PSI), and perceived privacy and financial risk (PPFR)

	PU	PPFR	PSI	PV	PU
PU	1				
PPFR	-0.285	1			
PSI	0.276	0.166	1		
PV	0.717	-0.356	0.333	1	
PU	1	-0.285	0.276	0.717	1

Table 4.8 below compares the odds of agree responses vs neutral and disagree responses across the study population's characteristics, i.e. gender, age, race, and income for each construct, i.e. perceived performance risk (PPR), perceived usefulness (PU), perceived value (PV), perceived social image (PSI), and perceived privacy and financial risk (PPFR).

Table 4.8 Results for the adjusted Odds Ratio across all five constructs: perceived performance risk (PPR), perceived usefulness (PU), perceived value (PV), perceived social image (PSI), and perceived privacy and financial risk (PPFR)

		Adjusted Odds Ratio [Low Category vs Medium & High Category]	*95% CI*	*P value*
Construct	***Characteristic***			
PPR				
	Sex			
	Male	1		0.044
	Female	0.42	0.15-1.16	
	Age			
	20 – 29	1		
	30 – 39	2.98	0.76-11.70	
	40 – 49	1.62	0.32-8.35	
	50 – 59	1.63	0.23-11.88	0.422
	50+	161.65	5.82-4489.58	
	Race			
	Black	1		
	White	0.91	0.22-3.77	0.618
	Coloured	0.48	0.13-1.76	
	Indian/Asian	1.59	0.34-742	
	Income			
	<10k	1		
	10 – 20k	0.07	0.01-0.71	
	21 - 30k	0.35	0.03-4.08	0.608
	31 – 40k	0.42	0.05-3.49	
	41 – 50	0.25	0.02-2.53	
	51+	0.26	0.04-1.77	
PU				
	Sex			0.438
	Male	1		
	Female	1.42	0.66-3.05	
	Age			0.833
	20 – 29	1		
	30 – 39	1.15	0.41-3.22	
	40 – 49	0.82	0.23-2.97	
	50 – 59	0.40	0.07-2.39	
	50+	5.01	0.47-52.93	
	Race			0.859
	Black	1		
	White	0.45	0.15-1.32	
	Coloured	0.92	0.31-2.78	
	Indian/Asian	0.91	0.34-2.48	
	Income			0.853
	<10k	1		
	10 – 20k	1.47	0.25-8.48	

	21 - 30k	1.06	0.17-6.51	
	31 – 40k	3.10	0.70-13.73	
	41 – 50	0.73	0.14-3.86	
	51+	1.08	0.28-4.17	
PV				
	Sex			
	Male	1		0.876
	Female	1.05	0.48-2.26	
	Age			
	20 – 29	1		
	30 – 39	0.51	0.18-1.45	
	40 – 49	0.26	0.07-1.01	
	50 – 59	0.07	0.01-0.47	0.129
	50+	1.16	0.12-11.28	
	Race			
	Black	1		
	White	1.02	0.36-2.90	0.400
	Coloured	2.11	0.65-6.78	
	Indian/Asian	1.07	0.38-2.98	
	Income			
	<10k	1		
	10 – 20k	1.26	0.19-8.31	
	21 - 30k	0.62	0.10-3.96	0.799
	31 – 40k	1.78	0.41-7.79	
	41 – 50	0.96	0.19-4.74	
	51+	1.79	0.48-6.66	
PSI				
	Sex			
	Male	1		0.172
	Female	0.64	0.30-1.37	
	Age			
	20 – 29	1		
	30 – 39	1.17	0.38-3.57	
	40 – 49	0.98	0.25-3.87	
	50 – 59	0.49	0.08-2.87	0.657
	50+	15.98	0.93-275.64	
	Race			
	Black	1		
	White	4.00	0.47-33.78	0.115
	Coloured	0.98	0.35-2.77	
	Indian/Asian	0.42	0.15-1.17	
	Income			
	<10k	1		
	10 – 20k	1.18	0.19-7.31	
	21 - 30k	0.60	0.09-3.91	0.049
	31 – 40k	1.20	0.26-5.57	
	41 – 50	0.94	0.19-4.71	
	51+	0.42	0.11-1.64	
PPFR				

	Sex			
	Male	1		0.357
	Female	0.69	0.31-1.54	
	Age			
	20 – 29	1		
	30 – 39	1.10	0.36-3.41	
	40 – 49	0.58	0.13-2.53	
	50 – 59	0.78	0.14-4.23	0.784
	50+	4.01	0.30-53.49	
	Race			
	Black	1		
	White	1.04	0.34-3.16	0.797
	Coloured	0.61	0.16-2.29	
	Indian/Asian	1.40	0.46-4.21	
	Income			
	<10k	1		
	10 – 20k	0.41	0.06-2.77	
	21 - 30k	0.98	0.13-7.64	0.605
	31 – 40k	0.97	0.20-4.68	
	41 – 50	1.73	0.32-9.43	
	51+	0.68	0.16-2.82	

For the construct of PPR females were 68% less likely to agree that the perceived performance risk of purchasing wearable technology would influence their intention to adopt wearable technology. The odds of strongly agreeing that the wearable device will meet the consumers expectations was higher in the 30 – 39 age group (OR=2.98 CI (0.76-11.70)) compared to age groups 40 – 49(OR=1.62 CI (0.32-8.35)) and 50 – 59 (OR=1.63 CI (0.23-11.88)). This was a statistically significant finding with a p-value of 0.04. The odds of strongly agreeing that the perceived performance risk of purchasing wearable technology will influence the consumers intention to adopt wearable technology was highest in the 50+ age group (OR=161.65 CI (5.82-4489.58)). This was however not statistically significant (p=0.42).

The odds of adopting or continuing the use of wearable technology was 42% higher if you were female when it came to the perceived usefulness of these devices. The odds were 5 times higher in the 50+ age group compared to the 20 – 29 age group when it came to strongly agreeing about the perceived usefulness of wearable technology. The odds of agreeing on the perceived usefulness of wearable technology was 3 times greater (OR=3.10 CI (0.70.13.73)) in the 31-

40k income group compared to the 21-30k income group (OR=1.06 CI (017-6.51)).

Both males (OR=1) and females (OR=1.05) showed similar odds of strongly agreeing with the perceived value in using wearable devices. The odds of agreeing with the perceived value of wearable technology was 1.78 times and 1.79 times in the 31-40k and 51+k income group respectively compared to the <10k income group.

The odds of strongly agreeing with the perceived admiration and esteem wearable technology affords the user was 15 times greater in the 51+ age group than any other age group. This however was not statistically significant (p = 0.657). The odds of agreeing on the perceived social image of wearable devices was 2 times (OR=1.20 CI (0.26-5.57)) greater in the 31-40k income group compared to the 21-30k income group (OR=0.60 CI (0.09-3.91)). This result was statistically significant with a p-value of 0.049. This indicates that consumers who fall into this income bracket would most likely choose to purchase wearable devices purely based on the perceived approval and appreciation wearable technology affords its user.

The odds of agreeing with the perceived privacy and financial risk attached to using wearable devices was 4 times greater in the 50+ age group when compared to the 20-29 age group of respondents.. The odds of agreeing that the perceived privacy and financial risk attached to using wearable devices will influence the consumers intention to adopt wearable technology was highest in the 41-50 age group (OR=1.73 CI (0.32-9.43)).

5. Discussion

The purpose of the study was to provide insight into the South African's consumer awareness and perception of wearable devices that monitor health, sports and fitness data. The aim of this research was therefore to investigate and

describe the consumers' overall perceived value of wearable technology. It set out to explore how each element of perceived benefit and risk influence the consumers' overall intention to adopt or to continue using these devices. This research offers a number of findings.

One hundred and twenty five (125) individuals successfully responded to the survey. Of the individuals who responded to the survey 67 (53.6%) were male. The majority of the respondents (n=70; 56%) were between the ages of 30 and 39 years. Black Africans (n=63; 50.4%) were the majority of respondents. This was followed by White (n=23; 18.4%), Indian (n=21; 16.8%) and finally Coloured (n=18; 14.4%). This compares favourably and is in keeping with the national census 2011 data (StatsSA 2017). The majority of respondents (n=64; 51.2%) were in the 51k+ income bracket. This was followed by respondents in the 31-40k income range (n=18; 14.4%).

The adoption of a novel product or service entails some risk since all actions have some likely consequences. This study found that for the respondents between the ages of 30 and 39 years the perceived performance risk was neither essential nor unimportant. Sixty-one respondents (87.14%) between the ages of 30 and 39 remained neutral (received a medium score) when asked about the perceived performance risk of wearable technology. This result was statistically significant (p-value=0.04). Conversely Yang, Yu et al. (2016) demonstrated that perceived risk was an important factor only for prospective users not for actual users. Consumers in the age range 30-39 years can be seen as the early adopters who are more willing to take risks. In this study the odds of agreeing that the design, functionality and ease of operation influence whether they would adopt or continue using these devices was greater (OR=1) if you were male (p-value = 0.044). In a study on fitness-related activities and medical claims among members of a major insurer, men represented 59% of the highly active group and 46 to 50% of the inactive group (Lambert, da Silva et al. 2009).

Wearable devices are in most instances effortlessly exposed by those wearing them in various social settings and therefore offer the user both visual

attractiveness and a positive social image. Yang, Yu et al. (2016) found that visual desirability was the strongest variable that positively affected perceived social image in their study population. There is undoubtedly a positive relationship between the aesthetic appearance of wearable devices and social image. This study however found that the majority of both men (n=40; 59.7%) and women (n=27; 46.6%) did not strongly agree nor strongly disagree with the perceived social approval that accompanies the using of these devices. The majority of respondents (n=67; 53.6%) across all age ranges neither strongly agreed nor strongly disagreed that wearable technology influenced their perceived social image. Likewise the majority of respondents (n=67; 53.6%) across the entire income range neither strongly agreed nor strongly disagreed that wearable technology influenced their perceived social image. Innovative devices with impressive design allow their users to gain social approval amongst their peers in diverse social circles. Users of wearable devices therefore see themselves as innovators as these products allow them to express or even increase their social image. This study however was unable to demonstrate this observation. This study did however show that consumer's income bracket had a statistically significant impact on whether respondents agreed that wearable technology improved their social image. Respondents whose income was between 31-40k per annum had the greatest odds (OR=1.2, CI 0.26-5.57), of accepting wearable devices based on their perceived social image.

Perceived value of wearable technology was close to being statistically significant (p-value = 0.06) for the age of the respondents. For the age groups 40-49 years (n=11; 50%) agreed that wearable technology was perceived as good value. Likewise in the age groups 30-39 years 25 (36%) and 50-59 years (n=6; 75%) acknowledged and strongly agreed with the value wearable technology affords them. Perceived value therefore had a noteworthy influence on both potential and actual consumers' intention to accept innovation. Similarly, Yang, Yu et al. (2016) found that perceived value is a very important element in consumers' resolution to adopt new products or services. Consumers who perceive value in the use or continued use of wearable devices will demonstrate greater adherence. In a review of wearable devices as facilitators, not drivers, of

health behaviour change, Patel, Asch et al. (2015) found that users are more likely to remain motivated and will continue using the device if the outcomes of their activities are clearly understood. They also found that employers and insurers could potentially pay for these devices if it assists employees and members respectively to adhere to medications and fitness levels. In a 5 year retrospective study on the changes in participation in fitness-related activities and hospital claims Patel, Lambert et al. (2011) found that incentive-driven health promotion packages are correlated with increased physical activity over time. They also found that an increased participation in fitness-related activities was associated with a reduction in the likelihood of hospitalisation as well as lower general health related costs. A survey in nine countries by Accenture found that 63% of executives in insurance companies believed that wearable technologies would soon be adopted widely within the insurance industry. A third of these executives admitted to already using wearable devices to assist in engaging customers, partners as well as employees (Johnson 2015).

In their study of user acceptance of wearable devices, Yang, Yu et al. (2016) found for perceived usefulness actual users received gratification from adopting wearable devices , while potential users want wearable devices more for functional and practical reasons than for pleasure and enjoyment. This study did not distinguish potential users from actual users but found age was an important predictor in whether consumers agreed that wearable technology was perceived as useful. A total of only 12 respondents between the ages of 30-39 (n=11; 15.7%) and 50-59 (n=1; 12.5%) strongly disagreed to the perceived usefulness of wearable devices. The rest of the respondents were either neutral (n=63) or strongly agreed (n=50) with the perceived usefulness of wearable devices. This outcome showed a p-value of 0.08 and therefore demonstrates a certain trend towards significance. Bergmann and McGregor (2011) reviewed the patients and clinicians acceptance of body-worn sensors systems such as wearable devices. They found that 93% of individuals accepted wearable systems because of its low-invasiveness and minimal impact on their normal daily activities. This study however looked at geriatric individuals who lived in a care-facility (Bergmann and McGregor 2011).

For many South African consumers investing in unfamiliar high-tech products involves an obvious financial and privacy risk. The adoption of new and innovative devices may elevate consumers socially but they do carry some unanticipated consequences such as maintenance expenses. The majority of males (n=43; 64.2%) and females (n=32; 65.3%) respondents were neutral and neither strongly agreed nor strongly disagreed with the perceived security and privacy risk of gathered personal health data. Likewise the majority of respondents across all age groups (n=81; 64.8%), race groups (n=81; 64.8%), and income groups (n=81; 64.8%) neither strongly agreed nor strongly disagreed with the perceived security and privacy risk of gathered personal health data. This either implies that the majority of respondents do not consider the potential security and financial risk attached to the use of wearable technology as concerning or that the benefit outweighs this particular risk. Health information privacy concerns was cited by Becker (2018) as a barrier to the current growth in the adoption of wearable devices. They argued that privacy concerns were more important in the context of health-related technologies than non health-related devices (Becker 2018).

Li, Wu et al. (2016) examined the predictors of an individual's adoption of wearable devices and found that individuals perceived privacy risk is determined by the sensitivity of the health information gathered by the device. Factors such as personal innovativeness, legislative protection and perceived prestige also influenced these individuals intention to adopt wearable devices (Li, Wu et al. 2016).

A report by PWC showed that 82% of consumers purchasing devices were worried about the potential invasion of privacy while 86% were fearful of potential security breaches (Johnson 2015). In a case study on a conceptual privacy framework for health information on wearable devices, Safavi and Shukur (2014) proposed a comprehensive checklist that could help both developers and manufacturers to improve the quality of privacy defenses in their devices. Combining the security and privacy needs with regulation will have to

be done in partnership between service providers, device developers, and law officials (Safavi and Shukur 2014).

There are a few limitations to this study. The first is that convenience sampling of the target population was used in order to collect data. This sample method was selected because of the time constraint. The results are therefore an approximation of the truth and have limited generalizability. Furthermore the study had a relatively small number of respondents and therefore provided a limited amount of data that again cannot be freely generalised.

6. Conclusion

This research identifies meaningful insights into South African consumers attitude towards wearable device adoption. It is among the first to investigate wearable device acceptance from a behavioural perspective in South Africa that is essentially at its infant stage of diffusion into the market. It has contributed by providing the groundwork for future research on interrelated topics. Marketing managers need to consider several strategies geared towards actual and potential users perceived value as well as their perceived social image of wearable devices.

It's concerning that the majority of South African consumers in this study were not troubled by the perceived security and privacy risk of gathered personal health data in these devices. The purchasing and adopting of new products always involves some risk and often with unsuspected consequences. Some of these consequences may be undesirable to some South African consumers but for the vast majority of the respondents in this study, the health and financial benefits, improved social image, visual attractiveness and enjoyment that comes with the use of these products by far outweigh the risks. These wearable devices not only allow consumers to show off themselves as innovators but also potentially can provide their users with enhanced financial returns from providers of life insurance, healthcare insurance, as well as from actuaries and employers. These providers in turn benefit from a strategy that both enhances their member activity as well as lessen long-term health and insurance payouts.

Wearable devices linked to health promotion programs potentially offer heath care providers strategies to increase member physical activity and in the long term lessen health costs for all involved. More research in the South African context is needed to demonstrate how wearable devices are growing into a cost reduction permitting technology with the remarkable ability to change behaviour.

References

Abraham, M. (2016). "Wearable technology: A health-and-care actuarysvperspective." Institute and Faculty of Actuaries. Retrieved 12 December, 2016, from http://www.actuaries.org.uk.

Becker, M. (2018). Understanding users' health information privacy concerns for health wearables. 51st Hawaii International Conference on System Sciences 2018. Hawaii**:** 3261-3270.

Bergmann, J. and A. McGregor (2011). "Body-worn sensor design: what do patients and clinicians want?" Annals of biomedical engineering **39**(9): 2299-2314.

BrandSouthAfrica (2016). "SA citrus exporters looks to BRICS." Investement & Immigration: Econonmy and Business. Retrieved 18 April 2017, from http://www.brandsouthafrica.com.

Chan, M., et al. (2012). "Smart wearable systems: Current status and future challenges." Artificial intelligence in medicine **56**(3): 137-156.

Chen, C.-C. and H.-S. Shih (2014). "A study of the acceptance of wearable technology for consumers: an analytical network process perspective." Int J Anal Hierarchy Process: 1-5.

Cooper, D. R., et al. (2003). Business research methods. London, McGraw Hill

Freeman, J. V. and S. A. Julious (2007). "The analysis of categorical data." Scope **16**(1): 18-21.

Gao, Y., et al. (2015). "An empirical study of wearable technology acceptance in healthcare." Industrial Management & Data Systems **115**(9): 1704-1723.

Johnson, D. (2015). "How Wearable Devices Could Disrupt the Insurance Industry." Retrieved 18 April, 2017, from http://www.insurancejournal.com.

Lambert, E. V., et al. (2009). "Peer Reviewed: Fitness-Related Activities and Medical Claims Related to Hospital Admissions—South Africa, 2006." Preventing chronic disease **6**(4).

Li, H., et al. (2016). "Examining individuals' adoption of healthcare wearable devices: An empirical study from privacy calculus perspective." International journal of medical informatics **88**: 8-17.

Lymberis, A. (2003). Smart wearable systems for personalised health management: current R&D and future challenges. Engineering in Medicine and

Biology Society, 2003. Proceedings of the 25th Annual International Conference of the IEEE, IEEE.

Lymberis, A. and A. Dittmar (2007). "Advanced wearable health systems and applications-Research and development efforts in the European Union (vol 26, pg 29, 2007)." IEEE ENGINEERING IN MEDICINE AND BIOLOGY MAGAZINE **26**(5): 9-9.

McFall, L. (2015). "Is Digital Disruption the End of Health Insurance? Some Thoughts on the Devising of Risk." Economic Sociology_the European Electronic Newsletter **17**(1): 32-44.

Müller-Riemenschneider, F., et al. (2009). "Cost-effectiveness of interventions promoting physical activity." British journal of sports medicine **43**(1): 70-76.

Pantelopoulos, A. and N. Bourbakis (2008). A survey on wearable biosensor systems for health monitoring. Engineering in Medicine and Biology Society, 2008. EMBS 2008. 30th Annual International Conference of the IEEE, IEEE.

Patel, D., et al. (2011). "Participation in fitness-related activities of an incentive-based health promotion program and hospital costs: a retrospective longitudinal study." American Journal of Health Promotion **25**(5): 341-348.

Patel, M. S., et al. (2015). "Wearable devices as facilitators, not drivers, of health behavior change." Jama **313**(5): 459-460.

Ramsay, R. (2013). "The Impact of Wearable Technology in Healthcare." Retrieved 10 March, 2017, from http://www.wearabletechworld.com/topics/wearable-tech/articles.

Raosoft (2004). "Raosoft." Sample Size Calculator. Retrieved 18 April, 2017, from http://www.raosoft.com.

Safavi, S. and Z. Shukur (2014). "Conceptual privacy framework for health information on wearable device." PloS one **9**(12): e114306.

StatPac (2017). "Survey Sampling Methods." Survey Sampling Methods. Retrieved 18 April, 2017, from http://www.statpac.com.

StatsSA (2017). "Statistics South Africa: 2011 Census." Retrieved 21 April, 2017, from http://www.statssa.gov.za.

Todd, L., et al. (2016). "Wearable technology: The future of fit." Retrieved 10 April 2017, from http://www.thebostoncompany.com.

WBS (2017). "Wits University: Wits Business School." WBS Overview. Retrieved 18 April, 2017, from http://www.wbs.ac.za.

Yang, H., et al. (2016). "User acceptance of wearable devices: An extended perspective of perceived value." Telematics and Informatics **33**(2): 256-269.

Appendix A: Survey Questionnaire

Adapted from the models used by Gao, Li et al. (2015) and Yang, Yu et al. (2016)

Construct	Item	Measurement Items
Demographic Profile	DP	Gender: Male I Female Age: 20-29 I 30-39 I 40-49 I 50-59 I 60+ Racial group: Black I White I Coloured I Indian/Asian Gross Monthly Income: <10k I 10k-20k I 20k-30k 30k-40k I 40k-50k I 50k+
Perceived Usefulness (PU)	PU1	Wearable devices are very useful to my life in general
	PU2	Wearable devices provides very useful service by improving the quality of my daily health activities
	PU3	Using wearable devices increase my productivity
Perceived Value (PV)	PV1	Using wearable devices offers value for money
	PV2	Wearable devices are beneficial to me when compared to the effort I put in
	PV3	Wearable devices deliver good value overall
Perceived Social Image (PSI)	PSI1	The fact that I use wearable devices makes a good impression on other people
	PSI2	Using wearable devices improves my image within my work environment
	PS3	The use of wearable devices gives me social approval
Perceived Privacy and Financial Risk (PPFR)	PPFR1	Using wearable devices would lead to financial risk for me because of the possibility maintenance costs and repair costs
	PPFR2	It would be risky to disclose my personal health information to vendors providing wearable devices
	PPFR3	Considering the potential investment involved, purchasing and using wearable devices is risky

Perceived Performance Risk (PPR)	PPR1	I worry about whether wearable devices will provide the level of benefits I expect
	PPR2	Wearable devices are able to self-monitor my physical activity without much effort
	PPR3	It is uncertain that wearable devices will perform the functions that are described in their advertisements