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MEASURING SMARTWATCH FEATURE PREFERENCES IN COLLEGE STUDENTS USING CONJOINT ANALYSIS AND EYE-TRACKING

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MEASURING SMARTWATCH FEATURE PREFERENCES IN COLLEGE STUDENTS

USING CONJOINT ANALYSIS AND EYE-TRACKING

A THESIS APPROVED FOR THE DEPARTMENT OF HEALTH AND EXERCISE SCIENCE

BY THE COMMITTEE CONSISTING OF

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Table of Contents

List of Tables

List of Figures

Abstract

Objective: The primary purpose of the study is to investigate the relationship between the conjoint survey outcome and eye-tracking study outcome and secondary purpose is to investigate the gender differences in visual attention and survey results on smartwatch feature preferences in college students.

Methods: The sample of the study was college students aged 18-64. This study was cross-sectional, and data were collected in three phases at the University of Oklahoma, Norman, OK. First, the elicitation phase gathered the top five features of a smartwatch. Then for the conjoint survey, 101 college students took the survey. Finally, 35 randomly selected volunteers who also took the conjoint survey took part in the eye-tracking study.

Results: The study found that eye-tracking-based outcomes are not significantly correlated to survey-based outcomes. There was a significant gender difference in visual attention but not in the conjoint survey. Eye-tracking identified differences in visual attention by product attributes. Male college students have higher visual attention than female college students.

Conclusions: Conjoint analysis and eye-tracking are two different measurement methods that do not agree with each other. This study provides some evidence that eye-tracking might be a better way to understand human behavior like purchasing decisions.

Chapter 1

Introduction

With advances in technology, wearable devices have quickly become one of the main segments of the global consumer electronic device industry. Among wearable devices, the smartwatch is the fastest growing and most popular wearable device globally. A survey and report compiled by Statista from 2015 to 2019, found global purchasing intention of fitness trackers has declined by 6% whereas smartwatch purchasing intention has increased by 1% ("Buying Intention", 2019). According to Statista in a single year in 2019, it estimated 20.1 million smartwatches were sold in the United States. Apple and Samsung combined control over 60% of the market share (Laricchia, F, 2022). It is estimated that over 130 million will be shipped around the world by 2023(Laricchia, F, 2022). Smartwatches are used in different fields from sports, healthcare, and personal communication, and some studies showed it is seen as a luxury item and part of fashion (Choi & Kim, 2016). However, it is hard to tell which features of the smartwatch are more important than others. This study focuses on the importance of smartwatch features and purchasing preferences in college male and female students using conjoint analysis and eye-tracking. While the feature configurations themselves have clear importance to product designers and marketers, the impact this mix has on activity tracker use is unclear, and the relative weight the activity tracker features have on smartwatch purchases is yet unquantified.

Furthermore, based on gender, females wear smartwatches or fitness trackers more regularly than males, 25% and 18% respectively, with one in every 5 Americans (21%) wearing a smartwatch regularly (Vogels, 2020). According to National Center for Health Statistics, for the years 2017-18, the age-adjusted prevalence of obesity among American adults was 42.4%, and no difference in gender (Craig Hales et al, 2020). However, the age-adjusted prevalence of severe obesity is more in females than males. Twenty-five percent of college students reported that they wear smartwatches or fitness trackers regularly (Pew Research, 2019). Still, the obesity rate is higher in females than in males, and females tend to wear smartwatches regularly. Understanding the differential preferences in watch features may help mitigate this gender disparity for a smartwatch, and therefore activity tracker utilization.

The best way to fight against obesity is through physical exercise and a daily balanced diet (ObesityCampaign.org). According to Heart Disease and Stroke, Statistics 2014 update reported that 50% of US adults and 65% of adults do not meet the recommended amount of daily physical activity. Similarly, the Department of Agriculture suggested that healthier diets could prevent at least $71 billion (about $220 per person in the US) per year on medical bills, loss of productivity of labor, and save lives. If the obesity prevalence rate remains consistent, it is estimated that the obesity prevalence rate will reach 51% by 2030 (Levi et al, 2012). Obesity is also the precursor for many other diseases such as Type 2 diabetes, coronary heart disease, stroke, hypertension, and arthritis. If the obesity rate continues, it will also double the rate of these above diseases. This means that it will cost more money in the health sector and services in the US. It is estimated medical costs associated with the preventable obesity-related disease will increase from $48 billion (about $150 per person in the US) (about $150 per person in the US) to $66 billion (about $200 per person in the US) (about $200 per person in the US) per year in the United States. If the obesity rate remains consistent, it is estimated to lose from $390 billion (about $1,200 per person in the US) (about $1,200 per person in the US) to $580billion (about $1,800 per person in the US) (about $1,800 per person in the US) annually by 2030 (Levi et al, 2012). Thus, if the obesity rate remains consistent then it will impact Americans' health, the cost of health care, and impact the economy of that nation.

One motivation for this study is that the prevalence of obesity among young adults can be reduced by meeting the recommended time of physical activity and eating a proper healthy diet. Interventions to fight against obesity by educating young adults like college students on the risk of obesity and using a smartwatch to meet their daily recommended physical activity. Smartwatches and fitness trackers have become extremely popular among college students (Phoenix, 2017). The main reason to choose the smartwatch over the activity tracker was that most smartwatch has all the capabilities/features that the activity tracker can do. There is a sharp decline in activity tracker sales and the opposite is true for a smartwatch (Laricchia,2019).

The primary motivation for this study is to investigate whether there is consistency between the outcomes of conjoint analysis and eye-tracking methodology. These methodologies are used heavily in market research for products and services. These methodologies may reveal different gender preferences in the features of a smartwatch. The third motivation is that this study's result could provide valuable insight to smartwatch manufacturers, especially the newcomers that might want to compete with existing smartwatch companies.

1.1 Purpose of Study

The purpose of the study is to investigate the relationship between different measurement methods available to evaluate differences in smartwatch feature preferences for male and female college students; specifically, comparing the use of conjoint analysis and laboratory eye-tracking study of visual attention.

1.2 Research Questions

I. Are eye-tracking-based outcomes closely related to conjoint analysis survey outcomes?

II. Are there gender differences in visual attention and conjoint analysis outcomes?

1.3 Hypotheses

1.3.1 Research Hypothesis

H_1: The eye-tracking-based outcomes are significantly related to the survey-based feature preference outcomes.

H_2: There is a significant difference in gender in visual attention outcomes and con-joint analysis feature preference outcomes.

1.3.2 Null Hypothesis

H_0: The eye-tracking-based outcomes are not significantly correlated to the survey-based feature preference outcomes.

H_0: There is no significant difference in gender in visual attention outcomes and conjoint analysis feature preference outcomes of the smartwatch.

1.4 Significance

Most of the previous studies have investigated how people perceived and use smartwatches based on the TAM (technology acceptance model). Another study researched the use of trackers through the SCT (Social Cognitive Theory) among young adults: college students and straight-to-work students. They reported a high expectation of how the tracker would assist them in developing\maintaining health behavior. Gowin et al (2015) reported that the effective use of health or fitness applications on a smartphone can promote a healthy behavior lifestyle in college students. Hsiao and Chen (2017) conducted a study only on Apple watch users in Taiwan on purchasing decisions based on hardware, software, design, and value. They found design was the most crucial factor when it comes to purchasing decisions.

However, there is still a gap to fill in terms of fully understanding what combination of features of a smartwatch influences college student smartwatch purchase preference. More specifically, there is little understanding of gender differences in terms of the combination of unique features impacting their preferences decisions.

This study is significant because first, it covers a large group of diverse students with diverse backgrounds ranging from domestic to international students. Secondly, this study can help the existing smartwatch companies and upcoming companies focus more on the more notable features of smartwatches, which may help companies to design better features for future smartwatches to fulfill the customer demand. Finally, this will be the first study that will combine both conjoint analysis and eye-tracking to study the features of a smartwatch.

1.5 Delimitations

The delimitations of this study include:

1. This study chose only 5 core features of the smartwatch via an elicitation phase.
2. This study is a cross-sectional research design study.

1.6 Limitations

The limitations of this study include:

1. Most of the participants were from the University of Oklahoma.

2. This study used the purposive sampling method due to the nature of the study.
3. This study is not generalizable to other populations.
4. This study investigated only 5 features of the smartwatch.

1.7 Assumptions

The assumptions of this study include:

1. The participants answered the questionnaire honestly and accurately.
2. For this study activity tracker and sleep tracker also falls under the smartwatch.

1.8 Operational Definitions

The operational definitions of this study include:

Area of Interest (AOI): Boundary drawn around the feature of the smartwatch which allows quantitative analysis**.** (Tobii Pro Lab User Manual V1.181, 2021).

AOI aggregated tags: Features of AOI which allows the several AOIs data to aggregate. (Tobii Pro Lab User Manual V1.181)

Battery capacity: It is the measure of the charge stored by the battery and it represents the maximum amount of energy that can be extracted from the battery under certain specified conditions (PVEducation, 2022)

Conjoint analysis: It is a form of data analytical approach, mostly used by market researcher to understand how customers value different components or features of their products or services.

Eye-tracking device: A device that measures a point of gaze and eye movement.

GPS + Cellular: It gives the user the freedom to send and receive text messages, answer phone calls, receive notifications, stream music, and podcasts even the users do not have a smartphone with them (Apple Inc)

Price: The amount of money that has been paid to acquire the given product. It is also a measure of value because people prepare to pay for a product to represent its value (Encyclopedia, Britannica)

Smartwatch: A small smartphone like a device worn on the wrist. Most of it is connected to the smartphone which will notify the user of incoming calls, email messages, and notifications from the application and some come with pedometers and heart rate monitors to help users to track their health (Gregersen, 2021).

Chapter 2

Literature Review

The research question being investigated is whether eye-tracking-based outcomes are related to survey-based conjoint analysis outcomes. This chapter will review findings from previous literature. The first part of this chapter will cover the background on smartwatch features and purchasing decisions/ intentions of the smartwatch. The last part of this chapter will cover the application of the conjoint and eye-tracking method.

The literature review process started with finding scholarly articles published regarding the smartwatch features and purchasing intention, what kinds of behavior model was used, their research design and data collection method focused on conjoint analysis and eye-tracking, and the statistical method for data analysis. We will discuss the application of conjoint analysis methodology and eye-tracking methodology in different settings like marketing, sales promotion, and research and development.

Several scholarly archives were used such as Sport Discus, MEDLINE, and Google Scholar. The inclusion criteria for this study are college students and the exclusion criteria are non-college students. The above databases were used to search keywords such as “smartwatch features,” “purchase intention,” “college student” and a combination of these keywords. The research result regarding the number of screen sources and the number of sources that were used in the full review is displayed in Appendix A& B.

2.1 Background on Smartwatch Features

The first digital watch was called Pulsar. It debuted in 1972 by Hamilton watch company which was later acquired by Seiko in 1978. In the 1980s, when the personal computer was introduced to the market, Seiko began to develop a computer in the form of a watch. Their first wrist computer was called data 2000 because it can store 2000 characters into the watch by typing on the keyboard (pocketcalculatorshow, 2005). During the 1980s, Casio successfully markets their computer watch and calculator watches. In 1994, Timex and Microsoft partnered and introduced Timex Datalink where data from the computer can be transferred to a watch wirelessly. This helped people transfer their appointments and schedule to their watch. In 1999, Samsung launched the first world's watch phone capability which includes a monochrome LCD screen and 90 minutes (about 1 and a half hours) to talk. Many watches were introduced in the 2000s like SPOT (smart personal objects technology) by Microsoft, but it has a standalone system and relay on FM waves to transmit the data and was based on the subscription (Tofel, 2013).

In 2010, Sony Ericsson Live view was launched by Sony Ericsson where the watch can display via Bluetooth from an Android smartphone. Pebble watch was the most innovative watch at that time can communicate both with Android and iOS, has a water-resistant capability, and the battery lasts for seven days. By 2013, True Smart had the full capability of a smartphone. In 2015, Apple launched its first smartwatch with a different appearance and design compared to the traditional watch and it looked notably more fashionable. In 2018, apple launched its series 4, with a larger display and EKG feature which can detect abnormal heart function (Apple Inc, 2018). In the 2020's FDA (Food and Drug Administration) granted market approval to Apple to launch an app called "NightWare" which improves sleep, especially for people who suffer from PTSD-related nightmares by detecting nightmares via heart rate and body movement (Newland, 2020).

In this study, the primary features of the smartwatch included are the price, physical activity tracker, battery capacity, brand, and Wi-Fi/Cellular. One of the features of the smartwatch is the physical activity tracker and it will have various levels of activity tracker such only step count, step count, total calorie burned, and all the above plus the heart rate features. By conducting the conjoint analysis and eye-tracking, the researcher can find the gender difference in preferences of smartwatch features. More specifically, it will reveal gender differences in terms of physical activity trackers at distinct levels and which gender gives more priority/preferences on what level of physical activity trackers features to meet their health goals. While several primary features of smartwatches have been identified in past literature, it will be important to confirm the representation of key features to include in this study (esp. conjoint analysis), so an elicitation phase will be included as a preliminary step of the data collection.

2.2 Literature Review on Smartwatch features

The previous study on features of the apple watches on intention to purchase revealed that by using the theory of reason and perceived value (Hsiao and Chen, 2018). In their model, the perceived value and attitude were the mediating variables that transmit the features of the apple watch to purchase intention. This study found that the interface convenience, perceived content, perceived infrastructure, and design have a strong effect on the attitude but among all the features the design has a stronger effect on attitude. This study revealed that a positive attitude not only has a strong effect on purchasing intention, but it also enhances the purchasing likelihood. Additionally, they found that social value and performance value do not affect purchasing intention to buy an apple watch. The model explains the 54.5% variance of purchasing intention and 40.5% variance in purchasing intention is explained by attitude ((K.-L. Hsiao & Chen, 2018). The limitation of the study was that it is not generalizable to other smartwatches because the study was only conducted on the Apple watch and took place in Taiwan. The recommendation for future study is to include more variety of features of a smartwatch and could implement the expectation-confirmation model (Hasio,2017).

Another study investigated factors that influence the customers to accept smartwatches (Wu et al., 2016). The study was twofold. First, whether perceived relative advantage (RA), perceived ease of use, the perceived result of demonstrability, or perceived enjoyment has a significant impact on the usage of the smartwatch. Secondly, whether perceived RA, social influence, or attitude toward a smartwatch has a notable change in intention to use a smartwatch. The study found no significant effect based on gender for all factors. The demonstrability has the strongest effect on the attitude towards the use of the smartwatch but does not influence the purchasing intention which is a different result from previous studies. This could be because the study explored the customer belief and belief in a product varies from person to person. The researcher suggested investigating several other factors such as perceived price, brand value, and lifestyle cross-culture to better understand the acceptance of smartwatch usage acceptance and intention to buy the smartwatch.

In Bangladesh, a similar study on smartwatch features on customer intention to use was conducted (Sabbir et al., 2020). They found that perceived enjoyment, perceived usefulness, perceived convenience to use, and health have an indirect effect on the intention to use the smartwatch. However, fashion innovativeness and fashion involvement are not significant intentions to use the smartwatch among the customers in Bangladesh. Like the above study, this study concluded that the design of the smart has a positive relationship with the intention to use the smartwatch plus using the smartwatch as their health goals tracker increase the intention to use a smartwatch. They suggest that to test their model to their devices other than a smartwatch and actual smartwatch usage is hard to guarantee by just looking at the intention to use behavior and suggest looking into the high behavioral intention.

Another interesting study on smartwatches was conducted viewing through the lens of social cognitive theory (Gowin et al., 2018). They conducted a study into two groups, one college student and the other straight to work (STW) and collected data via an interview. They found no significant difference between the two groups. The study found that these young adults have a high expectation of activity trackers and showed an increase in self-efficacy and self-regulatory but little knowledge about benefits and risks. There is a mixed report on the benefit of the fitness tracker, some young adults reported that fitness tracker helps them to meet their health goals – by setting goals on it, tracking, and receiving feedback. On the other hand, some young adults reported it did not make any difference in meeting their health goals. They concluded that health educators and parents have a huge responsibility to educate young adults on the use of the fitness tracker and get the best use of the fitness tracker to meet their health goals. The limitation of the study was that the majority of the participants were white and including the more diverse population soon study will give a more meaningful understanding of activity tracker usage and its benefit among young adults.

Hsiao studied the adoption of smartwatch intention between Apple and non-apple smartwatch users (Hsiao, 2017). They found that there is a difference in antecedent which led Apple and non-Apple intention to adopt the smartwatch. They found that perceived product has a strong influence in adopting smartwatch and relative advantage has the strongest effect. The study also revealed that online words of mouth have more significant adoption of a smartwatch than social conformity and individuals who are more open are more likely to adopt a non-apple smartwatch than an Apple smartwatch. The research model explains 50% of the variance in the adoption intention between the apple and non-apple smartwatch users. The study suggested investigating more brands of smartwatches and comparing the non-smartphone and smartphone users in future studies.

Gender socialization plays a vital role in building confidence toward technology. A study found that fathers are more likely to share their personal computers with their sons than daughters. Additionally, also fathers talk more about technology and its field with sons than their daughters. When it comes to product evaluation, female tend to give more priority to price and ease of use of the product and male gives more priority to their own prior experiences, software reputation, and recommendation. This study found that males have higher self-efficacy and a more positive attitude towards high technology (Rudell,1991). Another study found that females are less involved with technology which results in a lower satisfaction rate (Keister et al, 1985).

2.3 Conjoint Analysis Application

Conjoint analysis is a survey-based statistical method used in market research that helps researchers to determine how different combination features of product/ services make the individual decide to purchase or preferences. It can be conducted before the launch of any products or services. Conjoint analysis is used in applied sciences like marketing, product management, and operation research. The conjoint design has four major steps. First, to determine the type of study for this study will be rating-based conjoint, then the second step will be identifying the relevant attribute which we will collect the features of the smartwatch in the elicitation phase. The third step will be the specification of the attributes level and the last step will be to design the questionnaire. Some of the applications of conjoint analysis are pricing strategy, sales, marketing research, and research and development (Stobierski, 2020).

Conjoint analysis is an excellent way to understand the users' willingness to pay for the features of the product/services. This helps the company to develop its pricing for its products and services. Other applications will be sales and marketing. Once the company knows which features are important for their customer, they can use those features in marketing campaigns and promotion of their products. Conjoint analysis is used to target the segment of the population based on their interest like apartment unit pricing for college students vs the non-college students. Finally, conjoint analysis is used in the research and development pipeline. For instance, in 2016 Apple decided to remove the headphone jack from their returning iPhones to free space for their customer-preferred components (Chamary,2016).

2.4 Eye-tracking Application

Eye-tracking is a technique that captures what users are looking at given stimulus. Eye-tracking is not a new method to understand human behaviors. It started early as the 1800s – in 1879 Louis Emile Javal revealed that reading involves a series of short stops called fixation and quick saccades. In the 1900s the research on eye-tracking was more into reading like on which words user's eyes stop and for how long, and when regression happens when seen words encountered. Edmund Huey was the one who built the first eye tracker and his studies revealed that some of the words are fixed and the small number of the saccades regress. (1968 reprint). Then Guy Thomas Buswell build an eye-tacker that records picture viewing then he wrote about the relationship between the fixation and interest of the person. In 1970 research was still on reading, then in 1980 Just and Carpenter formulated the eye-mind hypothesis which says there is no lag between the fixation point and what is processed. In the following years of the 1980s human-computer interaction eye-tracking was born. This allowed us to get real-time eye-tracking results – especially helping the physically and mentally challenged users (*The Mind's Eye, 2003*).

For instance, the application of eye-tracking is used as an assistive technology for people with motor impairment, especially caused by cerebral palsy. Cerebral palsy affects the speech and motor function of the person. So, the users use augmentative and alternative communication (AAC) aid which displays pictures, words, and letters on the screen then software translates text to speech for the output for better communication with health professionals, family members, and friends. Other applications in health settings like the control of robotic arms and wheelchairs (Sharma et al, 2020). Eye-tracking is also used in detecting the presence of Nystagmus (the eyeball moves involuntarily itself) and early signs of learning disability (Jeevithashree et al.& Jones et al, 2008)

Eye-tracking is used in commercial/marketing applications the most. Some of the common applications include advertisement, sponsorship, website usability, product, and shelf design (Horsley, M. (2014). In all these applications, the researcher provides stimulus to the participants, and with the help of an eye-tracker, all the activity of eye movement will be recorded. For instance, website usability for a company can be evaluated with eye-tracking. The researcher can track their clicking or scrolling pattern and the interaction between the clicks. Eye-tracking provides insight into which features of the website are working best, which features grab the user's attention the most, which features create confusion for users, and which features are ignored by the users. The company then can target their customers easily, and effectively and assure customer retention. Eye-tracking is also used in advertising media. One study conducted by yellow pages (telephone directories of businesses where advertisements are sold) on the advertisement focus was what features of advertisement grab user's first attention, is there a pattern in viewing the ads, and how much times users spend on unique features of advertisement. The study revealed that advertisement size, graphics, color, and repetition of ads influence the attention to the advertisement (Percy & Rossiter,1983).

Summary

There is still a gap in understanding the features of a smartwatch and features preferences in college male and female students. This will be the first study that will incorporate both the conjoint analysis and eye-tracking method to investigate the relationship between features of smartwatches and preferences in college male and female students. The next chapter will outline the overall methodological approach of this study.

Chapter 3

Methodology

The research question being investigated in this study is whether the outcomes of conjoint analysis are related to the eye-tracking outcomes, especially concerning gender differences in visual attention and survey outcomes on smartwatch features.

This chapter will focus on the data collection procedure and data analysis used in this study. The first section will discuss the sample and the sampling techniques used to recruit college students. The second section will explain the instrumentation and protocols used in this study. The third section will explain the research design. Finally, the last section will outline the data management and data analysis approaches. All the recruitment materials and data collection protocols were reviewed and approved by the University of Oklahoma Institutional Review Board for the safety of human subjects in this research (See Appendix C-K).

3.1 Sample

The subjects of this study were college students, aged 18-64, completing at least one of three activities: 1) an elicitation phase to facilitate instrument design (20 participants), 2) a main online survey (175 participants), or 3) a laboratory-based eye-tracking protocol (35 participants). For the elicitation, subjects were recruited by convenience sampling. Twenty students were recruited from several social science classes, technology classes, and first-year university classes to have a substantial representation of the college students. Overall, the final sample size for the conjoint study analysis was 101 college students (63 Females, 38 males) because 74 respondents did not complete the whole survey. For the eye-tracking study, 35 college students completed the laboratory part of the study (21 Females, 14 Males).

The potential participants were reached in three forms of recruitment: Mass email (two follow-up emails), flyers, and verbal recruitment from the classes at the University of Oklahoma. Flyers were posted around the University of Oklahoma campus, including the recreation and fitness center, bathrooms, and notice boards with a QR code to access the study who might have missed the mass emails. A similar participant recruitment technique was used in an earlier study (Sabbir et al., 2020). They were able to recruit 300 participants in their study from three universities in Bangladesh. To screen only eligible participants, the questionnaire included an exclusion question that screen out the non-college students. If the college students took part in both studies, their names were entered into a drawing to receive one of the five $20 gift cards given out.

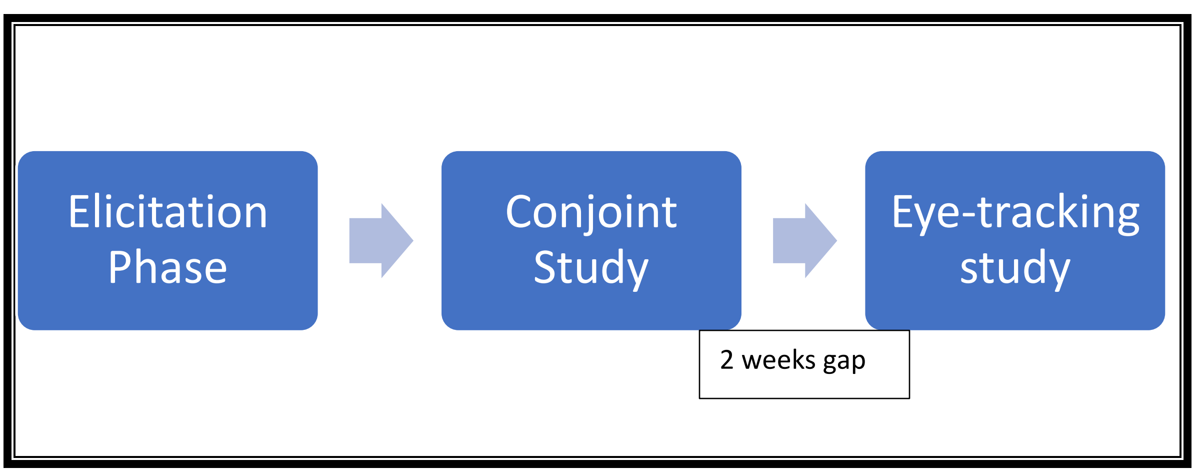
The sampling type used in this study is the non-probability sampling method called convenience sampling. The sampling method should be adequate to examine the association between the features of the smartwatch and purchasing preferences of male and female college students. A similar sampling technique was used by (Gowin et al., 2019) and (Sabbir et al., 2020). Gowin's study was able to recruit 57 participants who meet the criteria, but the majority were female, and Sabbir was able to recruit 300 subjects, among whom 178 were males and 112 were females.

3.2 Research Design

The research design of this study was cross-sectional. This study had three stages as shown in Figure 1. In the first stage, the elicitation phase where 20 students took a one-time online survey. From this stage, the researcher collected the top five most notable features of smartwatches for college students. This process was necessary to avoid researcher bias in selecting features for this study. In the second stage, the conjoint study was built from the features which were selected from the elicitation phase and added levels to the features. Twenty-five fictional smartwatch scenarios were generated by using Orthogonal design from SPSS. The third stage, eye-tracking took place after two weeks of the conjoint analysis study at the University of Oklahoma. The independent variables for this study were also the top five features of the smartwatch which were picked from the elicitation phase: battery capacity (hrs) with 5 levels, price in USD with 5 levels, physical activity with 5 levels, Wifi/Cellular with 2 levels and 5 distinct brands (Apple, Fitbit, Samsung, Fossil, and Xiaomi).

To minimize the threats to internal validity: First, in the consent form, there was a note urging the participants to give an honest answer. Secondly, in the conjoint study, 25 scenarios for the conjoint were generated by SPSS using the full-fractional function which was completely randomized in the level of features in each scenario. In the eye-tracking study, the white dot at the center of the black background was presented after each stimulus to control initial visual attention – as each stimulus presentation begins from the center of stimuli. The features presented in each scenario were also randomized.

Figure 1. The process of data collection.



3.3 Instrumentation

Qualtrics was used to create the conjoint questionnaire. The questionnaire began with a consent form that provides the purpose of the study, what participants will need to do, and how long it will take to complete the survey. Then exclusion questions whether the participants are college students or not. Then 25 profiles of smartwatches were presented to the participants and asked them to rate the individual profile on a scale of 0 to 100 identify as the dependent variable. The 25 profiles of the smartwatch were generated from the SPSS. In SPSS, there is a statistical testing function called orthogonal design which allows the researcher to put an attribute and its level to generate a profile combination of features and their levels. The five features were battery capacity, brand, price, Wi-Fi/Cellular, and physical activity tracker. The battery capacity, brand, price, and physical activity tracker had five levels each, and Wi-Fi/Cellular had two levels. Finally, the participants were asked to provide their email addresses if they were interested in the eye-tracking study.

A questionnaire with conjoint analysis is widely used in market research to understand better understand the consumer's behavior towards the products and services (Stobierski, 2020). Forty-item questionnaires with a Likert scale of 5 have been used in 2 previous studies (Wu et al.) and (Sabbir et al.) in exploring the features of a smartwatch and intention to purchase.

The eye-tracking study was conducted two weeks after the conjoint study. Five profiles of the smartwatch were created with all five features and levels. These five profiles were made of five distinct brands with yes or no Wi-Fi/Cellular features with mid-level battery capacity, price, and physical activity tracker as shown in Appendix G. The eye-tracking study was done at the University of Oklahoma. The eye-tracking device was used to track the visual attention of participants when the five-smartwatch stimuli were presented. For eye-tracking, a Tobi X3-120 screen-based eye-tracking device was used. It has an accuracy of 0.4 degrees of visual eye movement under ideal conditions, and a minimum of 0.9 degrees (suboptimal) was used for acceptable measurements in this study (Tobii AB, 2015).

The participants were randomly selected from volunteers who signed up for the eye-tracking study. Once a participant was in the lab, they were provided and signed the consent form. Then participants were asked to sit in front of a computer screen for the calibration. Once the calibration was valid then the participants were given stimuli. Each of the five stimuli was presented for 15 seconds on the screen. There was a white dot with a black background presented after each stimulus such that every participant would start their stimulus from the center of the screen. The features of the smartwatch were also randomized in each stimulus. Once the presentation was complete, then the researcher provided the sheet of paper which all the five profiles which were presented to participants and told the participants to rank the order of their preferences from 1 to 5, 1 being the most preferred and 5 being the least preferred.

Pilot testing was conducted for both studies, conjoint and eye-tracking studies. Ten students took the conjoint study, and five students took the eye-tracking study. The pilot test was conducted to verify all the items in the survey were clear to the participants and to see if the instructions on the survey were clear and simple. A pilot test for eye-tracking was important to see if the presented time for each stimulus is adequate. The items of the conjoint survey were reviewed by an expert in health promotion.

3.4 Data Collection Procedures

The data collection was approved by the University of Oklahoma Institutional Review Board (IRB) in Norman Campus on February 20, 2022. The primary investigator conducted both conjoint study and eye-tracking study data collection.

For a conjoint study, the participants filled in a one-time online questionnaire on Qualtrics which has 25 scenarios of the smartwatch and participants had to rate each of the scenarios. At the end of the survey, if the participants are interested in the eye-tracking study, they were asked to provide their email addresses. After 4 weeks the online questionnaire was closed.

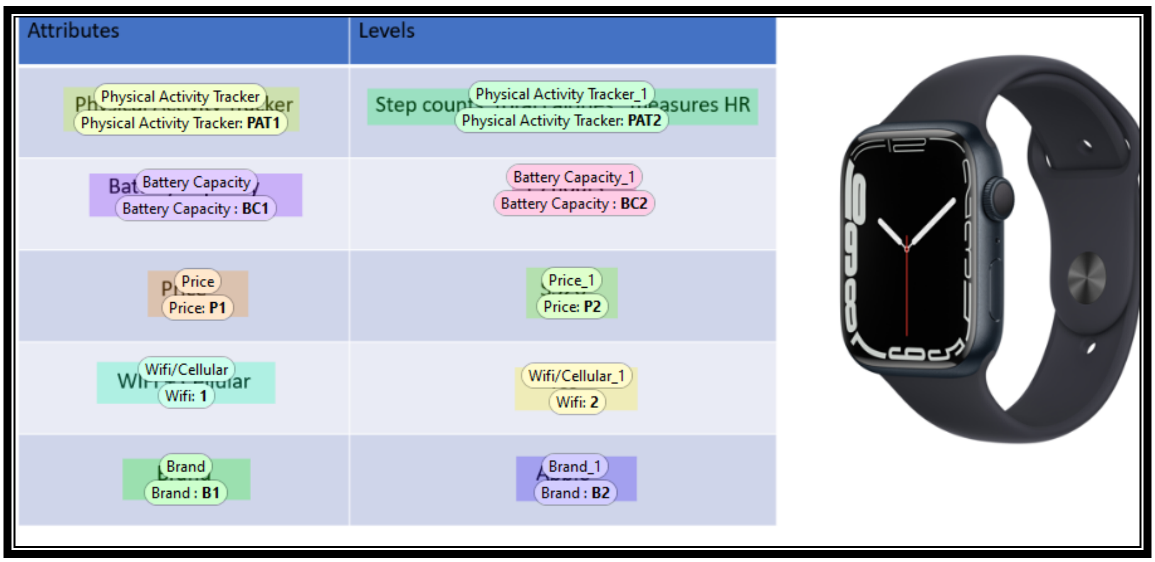
For the eye-tracking study: two weeks after the conjoint study, the participants visited the Sports Performance laboratory once for 30 minutes. The participants were given the consent form to sign, and data were collected after calibration was validated. Five stimuli were presented to participants and their eye movements were tracked by the Tobii Pro (Screen-based) equipment.

3.5 Data Management and Analysis

For the conjoint study, the collected data was exported from Qualtrics to the researcher's laptop with a secured password. Then in MS-Excel the data was cleaned and prepared for analysis. All the categorical data were converted into dummy variables (1 or 0) for each twenty-five scenarios.

For the eye-tracking study, the data was collected in Tobii Pro Lab (Version 1.811). Then within the Tobii Pro Lab – the five stimuli were coded with Aera of Interest (AOI) and tag name. In other words, all the features of the smartwatch and levels were coded with AOI and tagged with appropriate names as shown in below Figure 2. Thus, the researcher can only look at the visual attention of participants on AOIs and later aggregate all the AOIs of each feature to get their overall visual attention on a feature like a brand by using this formula: *(Brand: B1 OR Brand: B2 OR Brand: B3 OR Brand: B4 OR Brand: B5 OR Brand: B6 OR Brand: B7 OR Brand: B8 OR Brand: B9 OR Brand: B10).* Then data was exported to the researcher's laptop with a secured password, then cleaned and prepared the data for analysis in Microsoft Excel.

Figure 2. The AOI and tag in Tobii Pro Lab.



Note: AOI is the border around the attributes in rectangle shape with name and tag are elliptical with name.

3.5.1 Statistical test and Appropriateness

A panel regression in Stata was used to test the overall regression of the Conjoint analysis study. The reason to choose the panel regression was that individual subject has repeated measures. This formula was used:

$$Y(Score) = B0 + B1 * Battery\ Capacity + B2 * Brand + B3 * Price + B4 * Physical\ Activity\ Tracker + B5 * WiFi + Error.$$

Within the Panel regression, the random effects approach was chosen because the Hausman test was statistically significant which accounts for individual effects. Then for individual regression of conjoint analysis study, an R^2 change value of each participant was generated from R^2 values per scenario.

To test the H_1, linear bivariate Pearson correlations were calculated between the R^2 change metrics from the conjoint study and the percentage of time a participant looks at each feature in an eye-tracking study in Statistical Package for Social Sciences (SPSS- Version 28)

To test the H_2: For the conjoint study, the gender factor was input as an independent variable in the panel regression using Stata, and Analysis of Variance (ANOVA) was run to find the gender difference in visual attention in SPSS for the eye-tracking data. For all analyses, an alpha (α) level of 0.05 was used.

Chapter 4

Results

This chapter will cover the results from the conjoint study and the eye-tracking study. The chapter begins with the descriptive result of both studies, followed by the conjoint study result which includes the overall regression and individual regression results. Then the result about the correlation between conjoint study outcome and visual attention outcome of the eye-tracking study. Finally, the results of the gender differences in the eye-tracking study and conjoint study are presented.

4.1 Descriptive Results

4.1.1 Descriptive Result of Conjoint Study

The conjoint survey was completed by 101 subjects. Due to repeated measures, there were 2525 data points were yielded. The product score was the dependent variable, and five attributes were the independent variables. There were 63 female and 38 male participants. The mean price of the smartwatch was $166, and the mean battery capacity was 66 hours as shown in Table 1. The college students (64.3%) meet the ACSM guideline of physical exercise (moderate or vigorous intensity) as shown in Table 2.

Table 1. Mean Price and Battery Capacity

Attributes	Mean	Std. Deviation
Price (USD)	166.00	80.519
Battery Capacity (hrs.)	66.00	61.482

Table 2. Frequencies of variables for the conjoint study

Brand	Frequency (%)
Fitbit	20
Apple	20
Samsung	20
Fossil	20
Xiaomi	20
Physical Activity	
Only count steps & calories	20
Counts steps, calories, and HR	20
ECG + HR	20
HR+ ECG+ 02	20
HR+ECG+02+V02 max	20
Wi-Fi/Cellular	
Yes	50
No	50
Gender	
Male	38
Female	63
ACSM (Moderate or Vigorous Intensity) Meet	
Yes	64.3
No	35.7

4.1.2 Descriptive Result of Eye-tracking Study

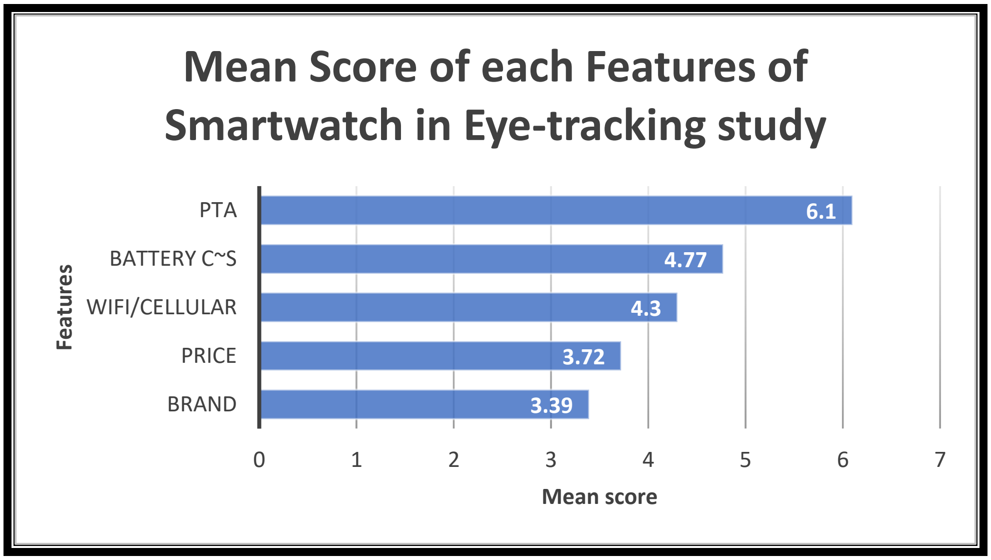
Thirty-five college students took the eye-tracking study (21 Females and 14 Males). The highest average time spent among the five features was the physical activity tracker (6.10 seconds), followed by battery capacity (4.77 seconds), Wi-Fi/Cellular (4.30 seconds), Price (3.72

seconds), and the lowest mean time spent by the college students was the brand (3.39 seconds) as shown in Table 3 and Figure 3.

Table 3. Descriptive Statistics of the eye-tracking study

% Time Spent on features	N	Minimum	Maximum	Mean	Std. Deviation
Physical Activity Tracker (PAT)	35	.36	13.97	6.10	4.11
Battery Capacity (hrs.)	35	.23	10.93	4.77	2.99
Wi-Fi/Cellular	35	.24	14.51	4.30	2.93
Price (USD)	35	.00	10.47	3.72	2.84
Brand	35	.09	10.13	3.39	2.41

Figure 3. Mean score of each feature of the smartwatch in the eye-tracking study.



4.2. Conjoint Result

4.2.1 Overall Regression

The conjoint study was taken by 101 college students. An overall regression was run in Stata. The dependent variable was the product score that participants assigned to the 25 profiles of smartwatches. The independent variables were the brand, physical activity tracker, battery capacity, price, and Wi-Fi/cellular features. For brand and physical activity tracker, it had a reference level. For brands, Apple was compared to other brands, and for physical activity tracker features, only counts steps and calories features as compared to other physical activity tracker features. Ordinary Least Square (OLS) Regression was not used due to the violation of the independence of observations. Before the panel regression was computed, a Hausman test was run to see if the fixed or random effect is suitable to run in the panel regression. The Hausman test rejected the null hypothesis which means the random effect is suitable to run the panel regression for a conjoint study (See the Hausman test results in Appendix M).

The random effect GLS regression number of observations was 2525, and the number of groups was 101. An R^2 value of the overall regression was 0.1326 ($P<0.001$, $\chi^2 = 543.7$) which means that only 13% of the variance in the score is explained by this study's independent variables. The detailed coefficient and p-value of each independent variable are shown in Table 4. All the brand coefficients were statistically significant. The smartwatch profile has Samsung decreased the score by 10.64 points compared to an apple, decreased by 11 points for Fossil, decreased by 12.7 points for Fitbit, and decrease by 5 points by Xiaomi, respectively. While the college students like the Apple brand more than Xiaomi then there is not much difference in Samsung, Fossil, and Fitbit preferences.

For the physical activity tracker features' effect on the score of the smartwatch preference, the base feature was the only count step and calories. All the increasing levels of physical activity tracker features were significant except for the initial addition of heart rate. As the physical activity features level increases, the score of the preference score increases as well. There was only a 0.5 score difference between based and count steps, calories, and measured heart rate level. There is a 4.44 score increase for a feature that counts steps, and calories and measures heart rate and ECG(Electrocardiogram). Then the score jumps to 11.3 points and 15.05 points respectively if the profile has the counts steps, calories, measure heart rate, ECG, and Blood 02, and the steps, calories, measure heart rate, ECG, and Blood 02 and V02 max respectively. The battery capacity feature was significant, but it does not change the preference score much. It only increases by 0.022 points per hour. The price feature was significant, and it makes sense as the price of the smartwatch goes up the score of preference decrease by 0.06. The final feature is the Wi-Fi/cellular feature of the smartwatch, it was significant, and having the Wi-Fi/cellular features in the smartwatch will decrease the preference score by 2.14 points.

Table 4. Linear regression of conjoint analysis study.

Score	Coefficient	St. Error	Z-value	P-value
Apple (reference)				
Samsung	-10.64	1.25	-8.48	0.00
Fossil	-11.11	1.25	-8.86	0.00
Fitbit	-12.74	1.25	-10.16	0.00
Xiaomi	-5.78	1.25	-4.61	0.00
Only counts steps &calories (reference)				
Counts steps, calories, and Measures HR	0.54	1.25	0.43	0.668
Measure HR + ECG	4.45	1.25	3.55	0.00
Measure HR + ECG+ Blood 02	11.37	1.25	9.07	0.00
Measure HR + ECG+ Blood 02+ V02 max	15.05	1.25	12	0.00
Battery Capacity (hrs.)	0.02	0.01	3.37	0.001
Price (USD)	-0.06	0.01	-12.67	0.00
2.Wifi/Cellular	-2.14	0.81	-2.65	0.008
Cons	63.84	2.01	31.74	0.00
R^2 = 0.13256				
Chi2 = 543.7				
P-value <0.001				

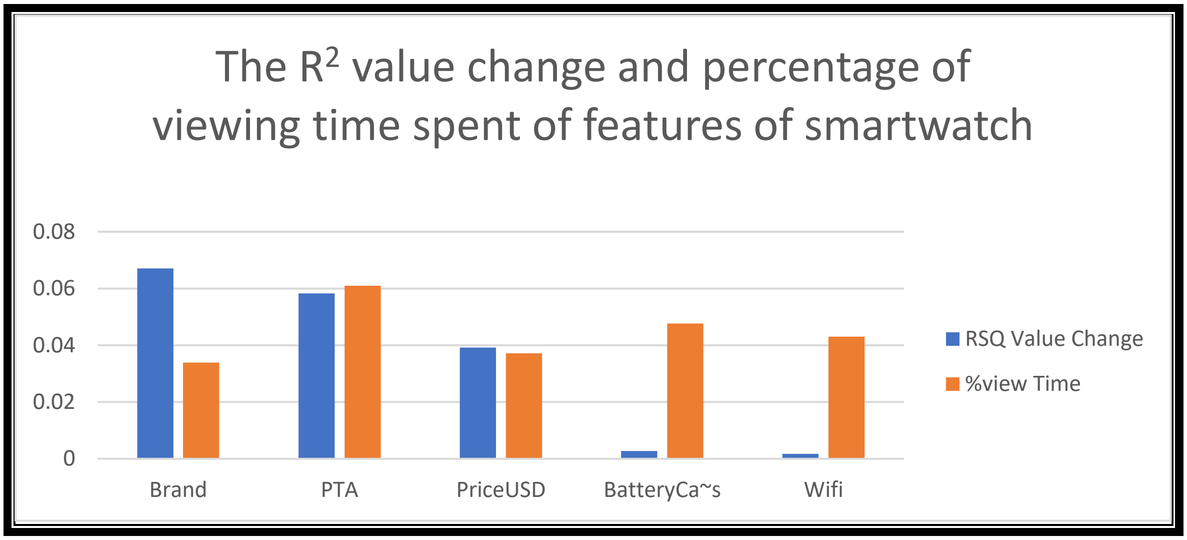
The panel regression only predicts the score based on the features of a smartwatch. However, it does not tell the relative importance of each feature of the smartwatch on the preference rating. Thus, it was important to run the R^2 value change of each feature using the sum of semi-partial values. By calculating the R^2 change, the brand was found to be the most relative key feature among other features. Then followed by physical activity tracker and price then battery capacity was not that important, and the least relative important feature was Wi-Fi/Cellular feature as shown in Table 5, alongside the eye-tracking viewing statistics.

Table 5. Outcomes by feature

Features	R^2 Value Change	% View Time
Brand	0.0671	0.034
Physical Activity Tracker	0.0583	0.061
Price (USD)	0.0392	0.037
Battery Capacity	0.0028	0.048
Wi-Fi/Cellular	0.0017	0.043

As you can see below, in Figure 4, there is no obvious relationship between features of R^2 value change and the percentage of time that college students look at each feature. However, we can say the relative importance of the features of the smartwatch in each study. In the conjoint study, the most notable features of college students are brand, then physical activity trackers, price, battery capacity, and Wi-Fi/Cellular, respectively. On the other hand, the same is not true in the eye-tracking study. The most attention that college students gave was physical activity tracker, battery capacity, Wi-Fi/Cellular, price, and then the brand was the least viewed by the college students.

Figure 4. Bar graph showing R^2 change and % view time on each attribute of the smartwatch.



4.2.2 Individual Regression

Hierarchical Ordinary regression square (OLS) regression was run by adding each of the feature's variables in blocks to see how the factor fit in the overall model. After that, the semi-partial was summed to get the R^2 for each of the individual participants (See Appendix M).

4.2.3 Conjoint Gender Difference.

The researcher computed gender in the overall regression using the panel regression and the gender coefficient was not significant and ASCM meet coefficient was also not significant (>0.05).

4.3. Eye tracking and Conjoint Correlation

4.3.1 Overall correlation

The correlation between the conjoint study outcomes and the eye-tracking study outcomes was 0.022 which was a positive correlation but not a strong correlation. The correlation was not significant (0.787> 0.05). as shown in Table 6.

Table 6. Correlations between the conjoint study and eye-tracking study.

		Visual Attention (%)	RSQ change
Visual Attention (%)	Pearson Correlation	1	0.022
	Sig. (2-tailed)		0.787
	N	155	155
RSQ change/Conjoint survey	Pearson Correlation	0.022	1
	Sig. (2-tailed)	0.787	
	N	155	155

4.3.2 Individual correlation

The researcher ran a bivariate Pearson correlation for each feature between the conjoint study and the eye-tracking study. The p-values of all features of the smartwatch were not significant. Four out of five features had a weak positive correlation, and the physical activity tracker had a weak negative correlation as shown in Table 7.

Table 7. Correlation between conjoint study and eye-tracking study of each feature.

Features	Correlation	p-value
Battery Capacity (Hrs.)	0.192	0.301
Brand	0.012	0.951
Physical Activity Tracker	-0.079	0.674
Price (USD)	0.054	0.771
Wi-Fi/Cellular	0.255	0.167

4.4 Eye-Tracking Gender Difference (ANOVA)

A general linear model repeated measures two-way ANOVA was run to find the gender difference in visual attention and difference within the attributes.

4.4.1 Attribute and Gender

The box's equality of covariance matrices p-value was 0.008<0.05 which indicates the violation of the homogeneity of covariance matrices as shown in Table 8. However, the multivariate test is robust if the ratio of a large to a small group is less than or equal to 1.5 (Pituch & Stevens,2016). Our large to the small ratio between the females and males was (21/14=1.5).

Then in the multivariate test result, Wilk's lambda test suggested that the attributes of the college students are statistically significant (0.002<0.05). On the other hand, the attributes and gender interaction were not statistically significant (0.805<0.05) as shown in Table 11.

Table 8. Box's Test of Equality of Covariance Matrices

Box's M	**F**	**DFL**	**Df2**	**Sig**
37.90	2.08	15	3096.41	0.008

Table 9. Multivariate test: Wilk's Lambda.

Effect	Test	Value	F	Hypothesis df	Error df	p-value
Attributes	Wilk's Lambda	0.57	5.632[b]	4	30	0.002
Attributes * Gender	Wilk's Lambda	0.95	.403[b]	4	30	0.805

4.4.2 Gender

A total of 35 college students took the conjoint study: 21 were female and 14 were male. The mean score of every attribute was higher in males than females as shown in Figure 5. The gender was statistically significant (0.007<0.05) as shown in Table 12.

Table 10. Mean time that gender gave attention to each attribute.

	Gender	Mean(sec)	Std. Deviation
% Time Spent on Battery Capacity	Female	2.95	2.00
	Male	**4.52**	2.32
	Total	3.57	2.24
% Time Spent on Brand	Female	2.00	1.26
	Male	**3.35**	2.20
	Total	2.54	1.8
% Time Spent on Physical Activity Tracker	Female	3.64	2.82
	Male	**5.98**	3.06
	Total	4.56	3.08
% Time Spent on Price	Female	2.07	1.40
	Male	**3.86**	2.58
	Total	2.79	2.13
% Time Spent on Wi-Fi/Cellular	Female	2.63	1.59
	Male	**4.11**	2.70
	Total	3.22	2.19

Gender

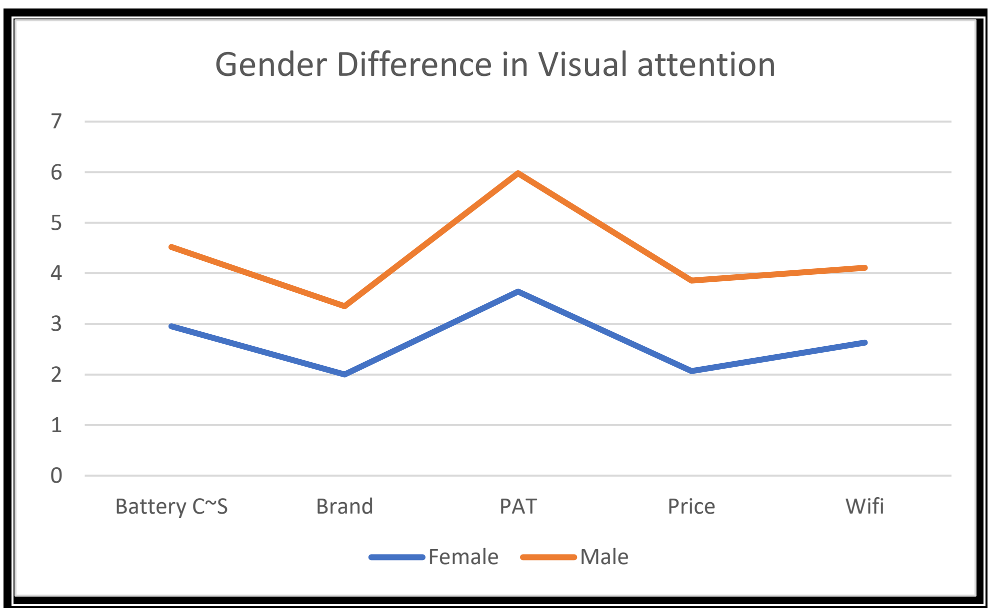
Table 11. Mean score of gender

Gender	Mean(sec)	Std. Error
Female	2.66	0.38
Male	4.365	0.45

Table 12. Showing the mean difference between gender.

(I) Gender	(J) Gender	Mean Difference (I-J) sec	Std. Error	Sig.
Female	Male	-1.71*	0.60	0.007
Male	Female	1.71*	0.60	0.007

Figure 5. Showing gender differences in visual attention.



4.4.3: Attributes

The highest mean time college student spent on the physical activity tracker feature and the least time spent was on the brand. Wi-Fi/Cellular and battery capacity had roughly similar means and brand and price had also a similar mean as shown in Table 13. Pairwise comparison of the battery capacity to brand, brand to physical activity tracker, price to physical activity tracker, and finally Wi-Fi/Cellular to physical activity tracker was statistically significant.

Table 13. Meantime spent on each attribute.

factor1	Mean(sec)	Std. Error
Battery Capacity (hrs.)	3.73	0.37
Brand	2.68	0.29
Physical Activity Tracker	4.81	0.50
Price (USD)	2.97	0.39
Wi-Fi/Cellular	3.37	0.36

Table 14. Showing the pairwise comparison of smartwatch attributes.

Pairwise Comparisons

Measure: Attribute

(I) factor1	(J) factor1	Mean Difference (I-J) sec	Std. Error	Sig.[b]
Battery Capacity	Brand	1.05*	0.35	0.027
	PAT	-1.08	0.37	0.059
	Price (USD)	0.76	0.26	0.065
	Wi-Fi/Cellular	0.36	0.34	1.000
Brand	Battery Capacity	-1.05*	0.32	0.027
	PAT	-2.133*	0.46	<.001
	Price (USD)	-0.29	0.31	1.000
	Wi-Fi/Cellular	-0.69	0.30	0.256
Physical Activity	Battery Capacity	1.08	0.37	0.059

Tracker				
	Brand	2.13*	0.46	<.001
	Price (USD)	1.84*	0.44	0.002
	Wi-Fi/Cellular	1.44*	0.46	0.038
Price (USD)	Battery Capacity	-0.76	0.26	0.065
	Brand	0.29	0.31	1.000
	PAT	-1.84*	0.44	0.002
	Wi-Fi/Cellular	-0.4	0.35	1.000
Wi-Fi/Cellular	Battery Capacity	-0.36	0.34	1.000
	Brand	0.69	0.29	0.256
	PAT	-1.44*	0.46	0.038
	Price (USD)	0.40	0.35	1.000

Based on estimated marginal means

**. The mean difference is significant at the .05 level. b. Adjustment for multiple comparisons: Bonferroni.*

4.5 Summary of results

From the conjoint study, the researcher found that college students gave the brand the highest priority features in their purchasing preference of smartwatch, then physical activity tracker features, price, battery capacity then wifi/cellular features. On the other hand, in the eye-tracking study, the college student spent the least amount of time on brand, and the most time spent was on a physical activity tracker, then batter capacity, wifi/cellular, and price respectively. The correlation between the conjoint study and eye-tracking was not statistically significant.

Regarding gender difference: in the conjoint study, there was no significant difference in smartwatch features preference in college students and whereas in the eye-tracking study there was a significant difference in males and females on how much time they spent on each feature of a smartwatch.

Chapter 5

Discussion and Conclusion

This will cover the discussion and conclusion of this study. The first section will cover on discussion, and hypothesis test results of this study, followed by the limitation of the conjoint study and eye-tracking study than the recommendations for future studies. The last section will be the conclusion of this study.

Discussion

Our research hypotheses were H_1: The eye-tracking-based outcomes are significantly related to the survey-based feature preference outcomes. H_2: There is a significant difference in gender in visual attention outcomes and con-joint analysis feature preference outcomes. Our null hypotheses were H_0: The eye-tracking-based outcomes are not significantly correlated to the survey-based feature preference outcomes. H_0: There is no significant gender difference in visual attention outcomes and conjoint analysis feature preference outcomes of the smartwatch.

Based on our study result, we failed to reject the H_0: The eye-tracking-based outcomes are not significantly correlated to the survey-based feature preference outcomes. Our second hypothesis, for the eye-tracking study: we failed to reject the H_0: There is no significant gender difference in visual attention outcomes. However, we rejected the H_0: There is no significant gender difference in conjoint survey outcomes.

This study found, no significant gender difference in conjoint analysis for all the features of a smartwatch. A similar study on the usage of smartwatches found that there are no significant gender differences in all the factors using the survey method (Wu et al., 2016). However, gender differences were found in the eye-tracking study. This could be true because our literature review says that males have greater self-efficacy and a more positive attitude toward high-tech products and females are less involved with technology (Rudell, 1991, Kiestler et al, 1985).

We also found that things that were not captured in the survey, we were able to capture in the eye-tracking study. Like significant gender differences were found in visual attention and not in the conjoint survey. That could be a reason that the result of these two measurements is not correlated with each other. But the bigger question for the marketer is if they want to use the eye-tracking method over a conjoint study to collect their data in marketing their products. The eye-tracking provides the sub-conscious insights of customers which conjoint surveys cannot provide. However, the eye-tracking system is more expensive than the survey method, and the eye-tracking method needs well-trained individuals for the experiment. So, for the product marketer trade-off between the cost of the eye-tracking device, training cost, and insight that they get from eye-tracking might not be found in the survey results.

An interesting finding of this study was that elicitation phase, which is conscious decision making, the top five features of the smartwatch (as shown in figure 7) were very similar to the eye-tracking study result which was unconscious decision making (as shown in Figure 8). As you can see the physical activity tracker and brand were in the same position in both methods and the only feature flipped was the battery capacity and price. However, the conjoin survey, conscious making, result which gives the relative importance of features was not in similar rank or order like elicitation method and eye-tracking study. However, the standard deviation could be looked at in future studies.

For the eye-tracking study, we could have chosen a website of a smartwatch to browse and study the features preferences of college students which would increase the ecological validity. However, it will decrease the internal validity of the study. Thus, we chose the image stimuli.

Figure 6. The top 5 features of a smartwatch in the elicitation Phase

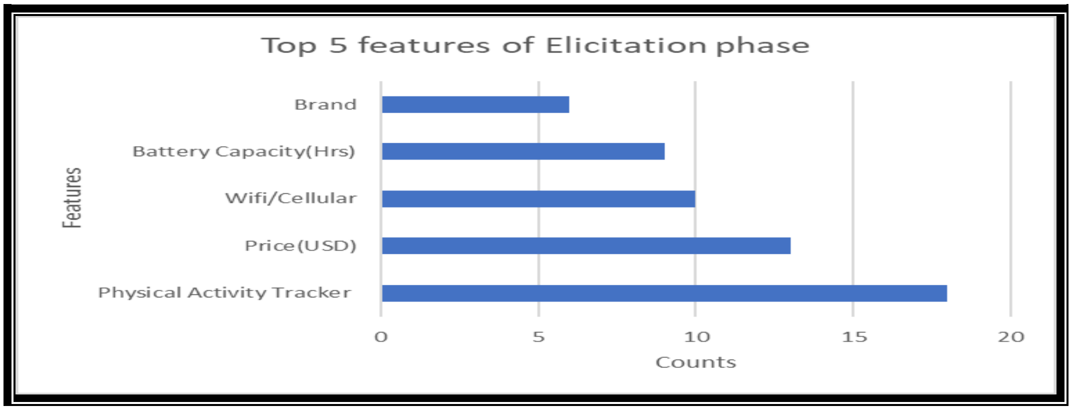


Figure 7. The visual attention on each feature of the smartwatch.

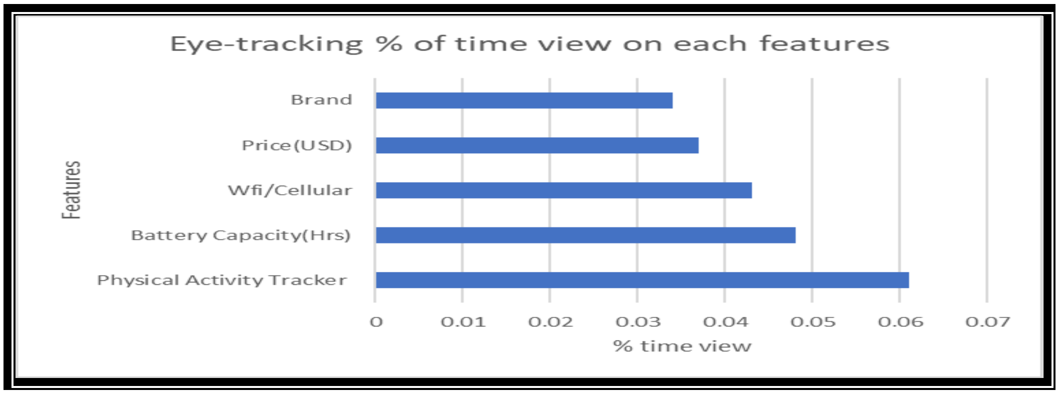
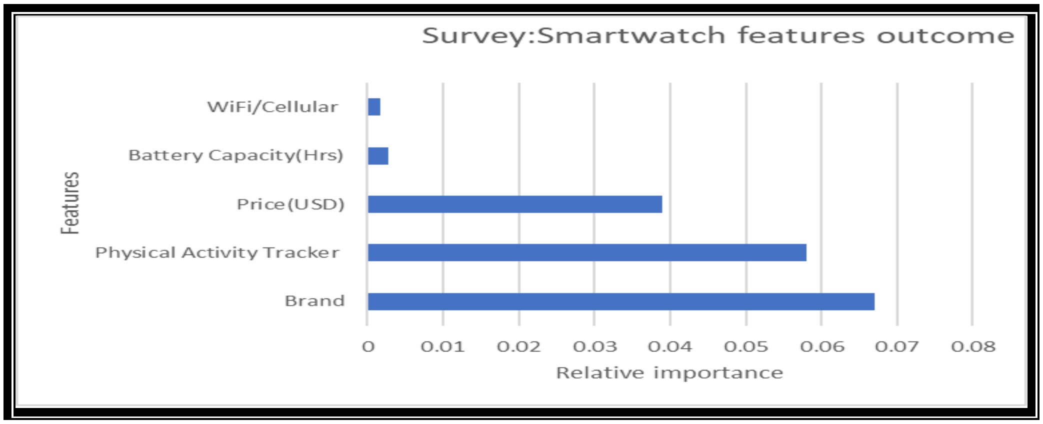


Figure 8. The conjoint survey result on the relative importance of features.



5.1 Conjoint survey study

The strength of the conjoint study is that the five features were selected from the elicitation phase then 25 cards were generated using orthogonal design in SPSS which yielded 2525 data points. The limitations of this conjoint study: The sample size was 101 college students which is much smaller than a normal conjoint study normally has 300 or more participants. However, the researcher believes 101 is still enough sample size because the conjoint study is measuring repeated measures of smartwatch features. Other limitations were items related to Wi-Fi/Cellular and meeting the ACSM guideline. The item about Wi-Fi/Cellular may not have been well understood by the college student as result the smartwatch profile with Wi-Fi/Cellular coefficient was negative. The students might misinterpret the choice “connect only Wi-Fi” and “Connect to Wi-Fi and Cellular.” The researcher assumes that the negative coefficient of having Wi-Fi/Cellular with a smartwatch is that the students might have thought that the smartwatch needs Wi-Fi and Cellular to work. Thus, the college students might have given the lower score. Meeting the ACSM guideline for either moderate or vigorous physical activity is over 60 minutes per week. The number of students meeting either one of them was 64.3%, 65 students out of 101, which is extremely high. This high percentage of college students meeting the ACSM guideline could be because, on both questions, the first choice was meeting the ASCM guideline. This could have randomized response choices in a better way. Most college students were recruited from the University of Oklahoma. It is not generalizable to other populations.

5.2 Eye-tracking study

One of the limitations of the eye-tracking study is that the number of characters per attribute in presented stimuli was not equal or similar in size. Thus, the physical activity tracker level had more characters, thus more time spent on it compared to other features of a smartwatch. It does not measure the preferences. The second limitation is the presented design of the smartwatch overshadowed the independent variables of this study. The area of interest in the design of smartwatches analyzed on follow-up, and the average time spent is much higher than other features. The researcher put the design of the smartwatch in stimuli to give some real sense of purchase feeling. However, the design overshadowed the independent variables (features) of the smartwatch. Another limitation of this study is that the multivariate test for the eye-tracking study (large to the small size of gender group was 1.5) which was on the border of the cutoff point.

5.3 Recommendation for future study.

The first recommendation is to have a larger sample size for the conjoint survey to measure the student preference for features of the smartwatch. Similarly, the ratio of males and females should be similar or equal to run the multivariate test. The future study could include more than 5 features of the smartwatch. For the eye-tracking study, one should have an equal or similar number of characters in the attribute of the smartwatch for the stimuli, each attribute gets an equal or similar amount of time to watch. It will be also interesting to investigate why college females' visual attention is lower than males in visual presentation.

5.4 Conclusion

The purpose of the study was to investigate whether conjoint study outcomes are correlated with eye-tracking study outcomes and whether there are gender differences in visual attention and conjoint survey of smartwatch features preferences in college students. The study found that eye-tracking-based outcomes are not significantly correlated to the survey-based feature preference outcomes. There was a significant difference in gender on visual attention outcomes but not in con-joint analysis on feature preference outcomes. The study found that on average, college male students have higher visual attention than female college students.

Conjoint analysis and eye-tracking are two different measurement methods that do not agree with each other. This study provides some evidence that eye-tracking might be a better way to understand human behavior like purchasing decisions. The unconscious decision is the only step toward the door, but the ultimate decision is based on the conscious decision.

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Appendix

Appendix A: Literature Review Search Results

Search Engine	Search Terms	# Retrieved	# Met inclusion criteria	Table 2 ID#
Google Scholar	Smartwatch features	14,000	2	2,1
Google Scholar	Smartwatch features + purchasing intention	2,650	4	2,1,4,5
Google Scholar	Smartwatch features + college students	1,920	1	2
Google Scholar	smartwatch features + purchasing intention + college students	1,000	1	2
Google Scholar	Eye tracking	386,000		
Total				
MEDLINE	Smartwatch features	8	0	
	Smartwatch features + purchasing intention	46	0	
Total		**54**	**0**	
Sport Discus	smartwatch features +purchasing intention	5	1	5
	smartwatch features +purchasing intention +college students	9	1	1
Total		**14**	**2**	

Table 1: Showing the search result found for literature review of chapter 2.

Appendix B: Literature Review Table

	Authors (Year)	Study Design/ Instrumentation	Sample Size/ Statistical analysis	Key Findings	Inclusion/Exclusion
1	Hsiao, K.-L., & Chen, C.-C. (2018). What drives smartwatch purchase intention? Perspectives from hardware, software, design, and value. *Telematics and Informatics*, *35*(1), 103–113	Cross-sectional design, Used the theory of Reasoned and perceived to study the purchase intention, Online survey, Measure- Likert scale (1-5)	N= 260 PLS regression	Design aesthetic has strong effect on attitude to use smartwatch & attitude have significant affected to purchasing intention of apple watches. Research model explains the 40.5% variance towards attitude to use smart watches and 54.5% in intention to use purchase apple watch(pg-109)	Include
2	Gowin, M., Wilkerson, A., Maness, S., Larson, D. J., Crowson, H. M., Smith, M., & Cheney, M. K. (2019). Wearable Activity Tracker Use in Young Adults Through the Lens of Social Cognitive Theory. *American Journal of Health Education*, *50*(1), 40–51.	Explore the activity tracker via Social Cognitive Theory on college student and straight to work Interview in-person and online	N= 57 Transcribed and analyzed via NVivo	There was little difference between the two group -young adults see the fitness tracker as their guide, goal setter, feedback giver and to facilitators to meet healthy goals but some reported did not make any difference in meeting their health goals. (pg. 6-9)	Include
3	Sabbir, M. M., Akter, S., Khan, T. T., & Das, A. (2020). *Exploring Factors Affecting Consumers' Intention to Use Smartwatch in Bangladesh: An Empirical Study*. https://doi.org/10.14329/apj	Cross-sectional Online survey of 40 items and measure in Likert scale	N= 300 Exploratory factor analysis and Confirmatory factor analysis and - 2 stage of maximum likelihood estimation (pg. 647)	Aesthetic and health ology have Positive impact on behavior intension to use	Include

	is.2020.30.3.636				
4	Hsiao, K.-L. (2017). What drives smartwatch adoption intention? Comparing Apple and non-Apple watches. *Library Hi Tech*, *35*(1), 186–206. https://doi.org/10.1108/LHT-09-2016-0105	Cross-sectional Online survey	N= 341 Casual model using PLS regression	Individual with high level of openness more likely to adopt non- apple watch Online words of mouth have more positive significant on adoption intention than social conformity ((pg.199)	Include
5	Wu, L.-H., Wu, L.-C., & Chang, S.-C. (2016). Exploring consumers' intention to accept smartwatch. *Computers in Human Behavior*, *64*, 383–392. https://doi.org/10.1016/j.chb.2016.07.005	Cross-sectional Online questionnaire with 40 items	N= 212 PLS regression	Gender has no significant moderation effect on each factor (pg. 388) Demonstrability significant effect on attitude	Include

Appendix C: Study Approval

The UNIVERSITY of OKLAHOMA

Institutional Review Board for the Protection of Human Subjects

Approval of Initial Submission – Exempt from IRB Review – AP01

Date: February 03, 2022 **IRB#:** 14205

Principal Investigator: Daniel J Larson

Approval Date: 02/03/2022

Exempt Category: 2

Study Title: Measuring smartwatch features preferences in college students using conjoint analysis and eye-tracking.

On behalf of the Institutional Review Board (IRB), I have reviewed the above-referenced research study and determined that it meets the criteria for exemption from IRB review. To view the documents approved

for this submission, open this study from the *My Studies* option, go to *Submission History*, go to *Completed Submissions* tab and then click the *Details* icon.

As principal investigator of this research study, you are responsible to:

- Conduct the research study in a manner consistent with the requirements of the IRB and federal regulations 45 CFR 46.
- Request approval from the IRB prior to implementing any/all modifications as changes could affect the exempt status determination.
- Maintain accurate and complete study records for evaluation by the HRPP Quality Improvement Program and, if applicable, inspection by regulatory agencies and/or the study sponsor. Notify the IRB at the completion of the project.

If you have questions about this notification or using iRIS, contact the IRB @ 405-325-8110 or irb@ou.edu.

Cordially,

Ioana Cionea, Ph.D.

Vice Chair, Institutional Review Board

Appendix D: Study Flyer Approval

<u>Participants needed for a research study</u>

Measuring smartwatch feature preferences in college students using conjoint analysis and eye-tracking.

IRB Approved number# 14205

Compensation: When Steps 1&2 are completed your name will be entered into a drawing for one of five gift cards each worth $20

Participant needed:

- ❖ **College students**
- ❖ **Age 18 to 64**
  (one visit)

Estimated time commitment:

Step 1: Survey: 10-15 minutes (one time)
Step 2: Eye-tracking visit: 20 minutes

Begin study by scanning the QR code (Step 1)

Contact researchers:

Study Contact: Karma Gurung | karmagurung384@ou.edu | 425-3948629.
Principal Investigator: Dr. Daniel Larson | larsonjd@ou.edu | 405-325-5211.

IRB NUMBER: 14205
IRB APPROVAL DATE: 02/17/2022

Appendix E: Mass Email Recruitment Approval

I am Karma Gurung, a Masters student form the Health and Exercise Science Department and I invite you to participate in my thesis research project entitled "**Measuring smartwatch feature preferences in college students using conjoint analysis and eye-tracking**". This research is being conducted at the University of Oklahoma. I am seeking college students (at OU or any other institutions) who may own a smartwatch (don't need to own one) and who is not enrolled in HES 4953-001 taught by Dr. Daniel Larson or/and HES 2131 taught by Karma Gurung (GTA). You must be at least 18 years of age to participate in this study. The purpose of this research is to investigate the relationship between the features of a smartwatch and purchasing decisions in male and female college students.

What is the procedure in the study?

Step 1: You will ask to fill in online survey of 10-15 minutes one time after you agreed to participate. After the completion of online survey, you will ask to enter your email address if you want to volunteer for the eye-tracking study (second step). No risks and benefit for first step.

Step 2: If you volunteer to participate in 20 minutes eye-tracking study, you will be asked to visit the Sport, Health, and Exercise Data Analytics Laboratory to observe 5 products stimuli presented by a researcher and rank the order of preferences (mostly likely to least likely to purchase) at the end of the study. "Participation in this research may include close social contact with the researcher

. According to the CDC (www.cdc.gov), the virus that causes COVID-19 is spreading very easily and sustainably between people. Our research protocol includes precautions that follow the CDC guidelines and comply with the current state and/or local restrictions on allowable personal interactions." No benefits.

Will I be compensated for participating? If you participate in both steps, you will enter a drawing to receive a $20 gift card.

If you are interested in this research study, please use this below link to begin the first step (Step1):

https://ousurvey.qualtrics.com/jfe/form/SV_9SPuymUZ3Paawia
https://ousurvey.qualtrics.com/jfe/form/SV_bydpzVTvbylXG4e

If you have questions, concerns, or complaints about the research or have experienced a research-related injury, contact me at **karmagurung384@ou.edu or 425-3948629 or Principal investigator Dr. Daniel Larson at larsondj@ou.edu or 405-325-5211**.

Appendix F: Verbal Recruitment Approval

I am Karma Gurung, a master's student from the Health and Exercise Science Department and I invite you to participate in my thesis research project entitled "**Measuring smartwatch feature preferences in college students using conjoint analysis and eye-tracking".** I am seeking college students (at OU or any other institutions) who may own a smartwatch (don't need to own one) and who are not enrolled in HES 4953-001 taught by Dr. Daniel Larson or/and HES 2131taught by Karma Gurung (GTA). You must be at least 18 years of age to participate in this study. The purpose of this research is to investigate the relationship between the features of a smartwatch and purchasing decisions in male and female college students.

What is the procedure in the study?
Step 1: You will ask to fill in an online survey of 10-15 minutes one time.

Step 2: You will be asked to visit the Sport, Health, and Exercise Data Analytics Laboratory to observe 5 products stimuli presented by a researcher and rank the order of preferences. It will take 20 minutes. Your visit will follow the CDC guidelines and comply with state and/or local rules regarding COVID-19.

Will you be compensated for participating? If you participate in both steps, you will be entered into a drawing to receive one of the five $20 gift cards given out.

I will leave my study flyer here and interested participants can begin the study by scanning the QR code.

If you have questions, concerns, or complaints about the research or have experienced a research-related injury, contact me at **karmagurung384@ou.edu or 425-3948629 or Principal investigator Dr. Daniel Larson at larsondj@ou.edu or 405-325-5211**.

IRB NUMBER: 14205
IRB APPROVAL DATE: 02/17/2022

Appendix G: Eye-tracking Study Protocol Approval

Protocol for eye-tracking study:

This study will last 20 minutes. Once the participants come to the lab (at Health and Exercise Department) at the University of Oklahoma. In the first step, the participant will be given a consent form to sign in. Once they agree to participate, participants will sit in front of the monitor where stimulus will be presented. Secondly, researchers will start eye-tracker calibration. Once its calibration is validated. Thirdly, researchers will present the stimulus. The researcher will be 6 feet aways from the participants. At the end of the study, the participants will give a piece of paper with all the stimulus (5 profiles of smartwatch) and pencil, and the participants will rank the order of their preferences smartwatch (most to least =1 to 5 order). All relevant COVID precautions will be in place, e.g., masking, distancing. All equipment will be sanitized before the next participants come in.

Please, rank the below products (1-5 order = 1 being most preferred and 5 being least preferred)

<table>
<tr><th>Product</th><th>Rank</th></tr>
<tr><td>
<table>
<tr><th>Attributes</th><th>Levels</th></tr>
<tr><td>Physical Activity Tracker</td><td>Step counts, calories count and Heart Rate</td></tr>
<tr><td>Battery Capacity</td><td>12 hours</td></tr>
<tr><td>Price</td><td>$300</td></tr>
<tr><td>Notification/ connection with phone</td><td>Information(weather, calendar, text, call), Apple pay</td></tr>
<tr><td>Brand</td><td>Apple</td></tr>
</table>

</td><td></td></tr>
<tr><td>
<table>
<tr><th>Attributes</th><th>Levels</th></tr>
<tr><td>Physical Activity tracker</td><td>Step count, calories count, monitor HR</td></tr>
<tr><td>Price</td><td>$250</td></tr>
<tr><td>Notification/connection with phone</td><td>Information(weather, calendar, text, AI assistant) Samsung pay</td></tr>
<tr><td>Battery Capacity</td><td>2 days</td></tr>
<tr><td>Brand</td><td>Samsung</td></tr>
</table>

</td><td></td></tr>
<tr><td>
<table>
<tr><th>Attributes</th><th>Levels</th></tr>
<tr><td>Brand</td><td>Fitbit</td></tr>
<tr><td>Battery Capacity</td><td>8 days</td></tr>
<tr><td>Price</td><td>$150</td></tr>
<tr><td>Notification/Connection to phone</td><td>Information(weather, calendar, text),Fitbit Pay</td></tr>
<tr><td>Physical Activity tracker</td><td>Step count, calories count, monitor HR</td></tr>
</table>


</td><td></td></tr>
</table>

Attributes	Levels
Brand	Xiaomi
Physical Activity tracker	Step count, calorie count, monitor HR
Notification/connected to phone	Information(weather, calendar, text, AI assistant) no payment system
Battery Capacity	10 days
Price	$100

Attributes	Levels
Brand	Fossil
Physical Activity tracker	Step count, calorie count, monitor HR
Notification/connected to phone	Information(weather, calendar, text), Google pay
Battery Capacity	10 hours
Price	$200

Human Research Participant Protection
The University of Oklahoma
IRB APPROVED
AAHRPP

IRB NUMBER: 14205
IRB APPROVAL DATE: 02/20/2022

Appendix H: Eye-tracking Recruitment Approval

I am Karma Gurung, a Masters student form the Health and Exercise Science Department and I invite you to participate in my thesis research project entitled "**Measuring smartwatch feature preferences in college students using conjoint analysis and eye-tracking**". This research is being conducted at the University of Oklahoma. I am seeking college students (at OU or any other institutions) who may own a smartwatch (don't need to own one) and must have completed the conjoint study. You must be at least 18 years of age to participate in this study. The purpose of this research is to investigate the relationship between the features of a smartwatch and purchasing decisions in male and female college students.

What will I be asked to do? If you agree to participate in this study, you will be asked to visit the Sport, Health, and Exercise Data Analytics Laboratory. ***You will need to wear eye-tracking device*****,** calibration will take place once the eye-tracking device is fitted on your eyes. Then you will observe 5 smartwatch profile stimuli presented by a researcher via eye tracking device on a desktop monitor. At the end of the study, the researcher will give you a piece of paper which has all the profile of smartwatch, and you will rank the order of preferences of smartwatch (most likely to least likely to purchase).

Will I be compensated for participating? ***If you participate in both studies (conjoint study and this study)****, you will* enter a drawing to receive a $20 gift card.

What preparation needed before coming to lab?
Please wear contact lenses (if you have one). Please remove long lashes which might block the eye-tracking vision. Must wear mask during the study.

If you have questions, concerns, or complaints about the research or have experienced a research-related injury, contact me at **karmagurung384@ou.edu or 425-3948629 or Principal investigator Dr. Daniel Larson at larsondj@ou.edu or 405-325-5211**.

IRB
NUMBER:14205
IRB APPROVAL DATE:
02/03/2022

Appendix I: Consent form for Eye-tracking study

Signed Consent to Participate in Research

Would you like to be involved in research at the University of Oklahoma? I am Karma Gurung, a Masters student from the Health and Exercise Science Department and I invite you to participate in my thesis research project entitled "***Measuring smartwatch feature preferences in college students using conjoint analysis and eye-tracking***". This research is being conducted at the University of Oklahoma. You were selected as a possible participant because you are a college student (at OU or any other institutions) who may own a smartwatch (don't need to own one) and ***have completed the conjoint study***. You must be at least 18 years of age to participate in this study.

<u>Please read this document and contact me to ask any questions that you may have BEFORE agreeing to take part in my research.</u>

What is the purpose of this research? The purpose of this research is to investigate the relationship between the features of a smartwatch and purchasing decisions in male and female college students using conjoint analysis and eye-tracking.

How many participants will be in this research? About 50 people will take part in this research.

What will I be asked to do? If you agree to participate in this study, you will be asked to visit the Sport, Health, and Exercise Data Analytics Laboratory. *You will need to wear eye-tracking device*, calibration will take place once the eye-tracking device is fitted on your eyes. Then you will observe 5 smartwatch profile stimuli presented by a researcher via eye tracking device on a desktop monitor. At the end of the study, the researcher will give you a piece of paper which has all the profile of smartwatch, and you will rank the order of preferences of smartwatch (mostly likely to least likely to purchase).

How long will this take? Your participation will take 20 minutes.

What are the risks and/or benefits if I participate? Risk: If you participate in this study no risk using the eye-tracking device. However, "***Participation in this research may include close social contact with the researcher. According to the CDC (www.cdc.gov), the virus that causes COVID-19 is spreading very easily and sustainably between people. Our research protocol includes precautions that follow the CDC guidelines and comply with the current state and/or local restrictions on allowable personal interactions***." No benefits.

Will I be compensated for participating? The participants are entered into a drawing to receive a $20 gift card.

Who will see my information? In research reports, there will be no information that will make it possible to identify you. Research records will be stored securely, and only approved researchers and the OU Institution Review Board will have access to the records.

What will happen to your data in the future? After removing all identifiers, we might share your data with other researchers or use it in future research without obtaining additional consent from you.

Do I have to participate? No. If you do not participate, you will not be penalized or lose benefits or services unrelated to the research. If you decide to participate, you don't have to answer any questions and can stop participating at any time.

Who do I contact with questions, concerns, or complaints? If you have questions, concerns, or complaints about the research or have experienced a research-related injury, contact me at **karmagurung384@ou.edu or 425-3948629 or Principal investigator Dr. Daniel Larson at larsondj@ou.edu or 405-325-5211**. You can also contact the University of Oklahoma – Norman Campus Institutional Review Board (OU-NC IRB) at **405-325-8110 or irb@ou.edu** if you have questions about your rights as a research participant, concerns, or complaints about the research and wish to talk to someone other than the researcher(s) or if you cannot reach the researcher(s).

You will be given a copy of this document for your records. By providing information to the researcher(s), I am agreeing to participate in this research.

Participant Signature	Print Name	Date
Signature of Researcher Obtaining Consent	Print Name	Date

IRB NUMBER:
14205
IRB APPROVAL DATE:
02/03/2022

Appendix J: Eye-tracking Stimulus