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Using Choice-Based Conjoint Analysis to Determine Smartphone Choice - a Student's Perspective

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Abstract

The ability of smartphones to facilitate various services like mobile banking, e-commerce and mobile payments has made them part of consumers' lives. Conjoint analysis (CA) is a marketing research approach used to assess how consumers' preferences for products or services develop. The potential applications of CA are numerous in consumer electronics, banking and insurance services, job selection and workplace loyalty, consumer packaged goods, and travel and tourism. Choice-Based Conjoint (CBC) analysis is the most commonly used CA approach in marketing research. The purpose of this study is to utilise CBC analysis to investigate the relative importance of smartphone attributes that influence consumer smartphone preference. An experiment was designed using Sawtooth CBC Software. 326 students attempted the online survey. Utility values were derived by Hierarchical Bayes (HB) estimation and used to explain consumers' smartphone preferences. All the six attributes used for the study were found to significantly influence smartphone preference. Smartphone brand was the most important, followed by the price, camera, RAM, battery life, and storage. This study is one of the first to use Sawtooth CBC analysis to assess consumer smartphone preference based on the six attributes. We provide implications for the development of new smartphones based on attributes.

Keywords : Conjoint Analysis, Consumer Preference, Hierarchical Bayes Model, Part-worth Utility, Smartphones

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1. Introduction

The history of Conjoint Analysis (CA) dates way back when Luce and Tukey [1964] wrote a paper on conjoint measurement [Wang et al., 2016; Wang, 2014]. Then other scholars used the approach for marketing research [Green and Rao, 1971] and transportation [McFadden, 1974]. Since then, the CA concept has become increasingly popular for studying choice and decision making [Green and Srinivasan, 1990; Vriens, 1994; Halme and Kallio, 2011; Wang et al., 2016; Jung and Kim, 2014; Lee, 2016; Burda and Teuteberg, 2016; Menon and Sigurdsson, 2016; Luo et al., 2013; Ida, 2012; Head and Ziolkowski, 2012; Walters, 2015; Braun et al., 2016; Muggah and McSweeney, 2017; Spralls et al., 2016; Lee et al., 2015; Kim, 2016]. CA is a marketing insight technique for predicting how products you create or redesign should perform when taken to the market [Head and Ziolkowski, 2012; Sawtooth Software, 2013].

Companies win over consumers by putting in right features and charging the right price. Smartphone manufacturers are packing more capabilities into these tiny devices, with billions of dollars at stake if they don't get the right combinations of features and price [Sawtooth Software, 2013]. In 2016, Samsung electronics lost billions of dollars due to battery explosion of its Galaxy Note 7 smartphone [Gibbs and Yuhas, 2016]. A smartphone is a technology product with integrated components like a processor, camera, memory/storage capacity and battery all in a handheld device [Yeh et al., 2016]. It is a telecommunications tool that can be used to edit documents, listen to music, and take pictures, among many other purposes [Pandey and Nakra, 2014]. Its ability to connect to the Internet enables access to online services such as information searches, emails, and maps [Okazaki and Mendez, 2013]. Due to the various purposes, smartphones have become part of consumers' lives [Persaud and Azhar, 2012]. The use of smartphones for mobility and connectivity has increased over the years, especially among millennial consumers (e.g. students) who are addicted to them [Garver et al., 2014]. Young consumers have been found to be more enthusiastic users of smartphones as compared to elder consumers [Sayassatov and Cho, 2016], they actively use more smartphone phone functionalities, such as photo editing, satellite navigation, and texting, whereas elder consumers mainly use them for communication [Yeh et al., 2016]. Smartphones facilitate mobile banking, e-commerce, and mobile payments [Baganzi and Lau, 2017; Okazaki and Mendez, 2013]. They have played a big role in enabling the financial inclusion of the unbanked and underbanked poor population in Africa, Asia and South America [Baganzi and Lau, 2017]. However, a few studies have used CA to research on smartphone attributes within the mobile industry [Head and Ziolkowski, 2012; Nikou et al., 2014; Sayassatov and Cho, 2016]. A study on how to use CA for smartphone attribute choices is therefore worthwhile.

To understand how smartphone choices are made, we consider a smartphone company producing models of smartphones with many combinations of attributes, and needs to come up with the right combination at the right price to regain market share [Sawtooth Software, 2013].

Traditionally, the sales team could concept test among potential customers by coming up with potential smartphones and finding out how much they would buy each one [Sawtooth Software, 2013]. But the sales team may not have enough time, money or customers to do enough of these concept tests. Therefore, they need a smarter, more scientific way to test thousands of possible smartphones to find the optimal one [Sawtooth Software, 2013]. That is where CA comes in. It involves doing some research to be able to list key smartphone attributes and levels of competitors' smartphones [Sawtooth Software, 2013]. CA software systematically combines the attributes from the list of competing smartphones at different prices [Walters, 2015]. Consumers simply pick one from each scenario, much like they do in the real world [Walters, 2015]. This is why it is called discrete choice analysis [Wang et al., 2016]. Across a sample of respondents, numerous combinations are shown and the software keeps track of how often different attributes were chosen at different prices when offered on different smartphones [Sawtooth Software, 2013; Walters, 2015]. Using statistical analysis, the software estimates preference scores for each consumer in the sample [Braun et al., 2016]. Combinations of attributes that are chosen a lot get high utility scores [Jung and Kim, 2014; Walters, 2015]. Highest utilities imply the most preferred levels while lowest utilities imply the least preferred levels [Jung and Kim, 2014]. In essence, CA takes a snapshot of each consumer's brain and derives a statistical model that quantifies the preferences that lead them to choose different smartphones and pay for them the way they do [Sawtooth Software, 2013]. It's like capturing many virtual consumers with their decision-making rules within the software on a computer. The sales team now has a what-if simulator that acts like a voting machine for smartphones [Sawtooth Software, 2013]. They can specify thousands of potential smartphones in the CA software, and the virtual customers will vote on those potential smartphones versus competitors' smartphones [Sawtooth Software, 2013]. If the sales team knew something about the cost of manufacturing the attributes, the software could search all potential smartphones to find the one that is likely to better the competition and maximize profit [Sawtooth Software, 2013]. The most commonly used CA approach today is Choice-Based Conjoint (CBC) analysis [Halme and Kallio, 2011]. It is based on same theories that won Dr Dan McFadden the Nobel Prize in Economics [Sawtooth Software, 2013].

There exists a research gap in CA of smartphones attributes in South Korea. Therefore, this research is motivated to use CA for examining consumers' smartphone preference based on smartphone attributes. We identify six important smartphone attributes : Brand, Price, Camera, Memory (RAM), Battery life, and Storage. We collect data using CBC analysis, a preference elicitation method used in random utility theory. The method is an accepted way for measuring consumer preferences based on relative importance of product attributes [Braun et al., 2016; Burda and Teuteberg, 2016; Green and Srinivasan, 1990; Vriens, 1994]. We are guided by the following research question : which attributes are the most important in influencing

consumer preference towards purchasing smartphones based on utility scores? The findings from this research will give a better perspective of the smartphone attributes that influence consumer smartphone choice. This will help smartphone manufacturers to redesign and better position new smartphone models with customers' motivations and preferences in mind. They will know which smartphone attributes to place particular focus on when devising marketing campaigns.

In the next sections, the theoretical background is discussed that reviews previous research on CA, primarily in the fields of technology, business and economics with a specific focus on CBC analysis. In section 3, we provide the research methodology. In section 4, we provide the data processing and analysis. Section 5 provides the findings. These are followed by discussions, implications, and conclusions.

2. Literature Review

2.1 Conjoint Analysis and Smartphone Attributes

Conjoint Analysis (CA) is a marketing research approach used to assess how consumers' preferences for products or services develop [Hair et al., 2014; Head and Ziolkowski, 2012; Lee et al., 2015]. It is one of the most frequently used approaches in consumer behaviour for measuring consumer preference for products or services based on attributes [Menon and Sigurdsson, 2016]. While purchasing products or services, consumers give better preferences for options appraised conjointly as compared to the ones evaluated individually [Braun et al., 2016]. CA requires respondents to examine the importance of attributes in order to make a purchase decision [Green and Rao, 1971].

CA has been employed to study consumer preference for mobile technologies based on attributes. Jung and Kim [2014] used CA to explore how much mobile phone users in South Korea tolerate Electro-Magnetic Field (EMF) risk by studying their preference structure. They used the brand and price to study how risk influences mobile phone device choice. Brucks et al. [2000] also used brand and price to study consumers' choice for products or services. Brand affects consumer choices, especially where products have uncertain qualities [Jung and Kim, 2014; Erdem and Keane, 1996]. The amount of sacrifice to buy a product is indicated by the price [Dodds et al., 1991; Jung and Kim, 2014]. High prices reduce willingness to buy smartphones [Jung and Kim, 2014]. Karjaluoto et al. [2005] researched among students and found that price, interface, brand, and properties (features) are the most important factors influencing mobile phone choice. Head and Ziolkowski [2012] used applications and tools as attributes for CA to study how attributes influence students' choice of mobile phones. They used Sawtooth software to generate a survey for CA based on the mobile phone attributes. From their research, an attribute can be defined as a smartphone application that focuses on the performed functions and tools that focus on features that can be used. Yeh et al. [2016] found that complex functions, unclear usage instructions, and user-unfriendly menus hinder consumers from exploring smartphone applications. Pandey and Nakra [2014] found Samsung the most preferred smartphone

brand. Other important smartphone attributes from their research include; price, Random Access Memory (RAM), and screen size. Wang and Wu [2014] combined CA with Kano model to study varieties of smartphones. CA was used to obtain customer utilities for smartphone attributes. Nikou et al. [2014] researched on the characteristics of digital platforms mostly preferred by consumers. With 166 consumers, they conducted CA to determine the most important mobile platform characteristics. They found that application related characteristics were most preferred, especially the number of applications available. Lee et al. [2015] used CA to assess the preferences of employees and Human Resource managers for mobile learning at the workplace. Their results indicated that both groups preferred smartphone devices over laptops and tablets for learning. Sayassatov and Cho [2016] researched on the use of smartphones in education using CA. Their analysis with 30 respondents used full profile CA with price, operating system, memory, battery type, and screen size as attributes for CA. Kim [2016] used Kano model and an Integrated Hierarchical Survey Design (IHSD) for large CA. He compared mobile phone attributes utilities for three markets by analysing data obtained from respondents in the United Kingdom (UK), Saudi Arabia, and the Philippines. He found the following smartphone attribute preferences by country : UK consumers showed importance mainly towards the camera, memory (RAM), LTE, brand, FM transmitter; Philippines consumers revealed preference towards the camera, brand, external memory (storage), mobile TV, and NFC; and Saudi Arabian consumers preferred the brand, camera, external memory (storage), 3G, and GPS.

However, Halme and Kallio [2011] investigated on the estimation methods used for Choice-Based Conjoint (CBC) analysis of consumers' preference. They concluded that CBC is the most popular CA method and few alternative estimation methods have been recommended since the introduction of the Hierarchical Bayes (HB) for estimating CBC utility functions. CBC/HB provided by the Sawtooth software has been used by several researchers [Lee, 2016; Walters, 2015; Braun et al., 2016; Muggah and McSweeney, 2017; Spralls et al., 2016], but none of these studies focused on using CBC analysis for smartphones. Therefore, our study was motivated to fill this research gap by using Sawtooth CBC/HB to study smartphones.

2.2 South Korea Smartphone Market

South Korea's smartphone market started with the launch of the iPhone in 2009 [Kim et al., 2014; Kim et al., 2016] and expanded at a very fast rate [Li and Shuai, 2013]. The smartphone penetration rate increased from 1.7% in 2009 to 70.9% in 2014 [Kim et al., 2016]. By 2015, South Korea was ranked the world fourth highest in smartphone penetration as four out of five people owned a smartphone [Kim et al., 2016; Yonhap, 2015]. The smartphone penetration rate is forecasted to increase from 82.3% in 2015 to 88.4% in 2019 [Statistica, 2017].

A chaebol is the prevalent form of business organisation in South Korea [Park et al., 2016]. South Korea's smartphone market is dominated

by two chaebols : Samsung Electronics Co. at 63.4%, trailed by LG Electronics Inc. at 20.9%. These are followed by Apple Inc. which has 13.1% of the market [Yonhap, 2015]. Kim et al. [2016] argue that the South Korean smartphone market reached a saturation point which has caused an overall slow market growth, making existing smartphone users to be dependent on replacements or upgrades of devices. Smartphone consumers in Korea are tech-savvy, highly educated and receptive to new innovations [Kim et al., 2016]. Smartphone replacement has an average life cycle of about 20 months [Kim et al., 2016]. Dominant smartphone manufacturers are therefore changing their marketing strategies in order to maintain their market share and ensure smartphone repurchase by consumers [Kim et al., 2016]. Other smartphone companies are also setting strategies for winning customers from the dominant manufacturers while protecting their market share [Kim et al., 2016]. This has resulted in a fierce competition among smartphone manufacturers which lowers prices and benefits the consumers [Kim et al., 2016]. Under this situation, we argue that smartphone attributes can be used as a source of competitive advantage. Smartphone manufacturers with the best and most reliable smartphone attributes are more likely to retain existing customers and to attract dissatisfied customers of their competitors.

The most prevalent smartphone brands on the market include; Galaxy (Samsung), iPhone (Apple), and Optimus (LG) [Jung and Kim, 2014]. Other brands include; Huawei, Oppo and Vivo [International Data Corporation, 2017]. However, in September 2016, sales of the Galaxy Note 7 were suspended by Samsung and all customers who had purchased this product were refunded [Gibbs and Yuhas, 2016]. There had been several cases of battery explosions reported globally. In the last quarter of 2016, the following changes took place in the global smartphone market share; Apple significantly increased from 12.5% to 18.2%, Samsung decreased from 20.9% to 18%, Huawei increased from 9.3% to 10.5%, Oppo increased from 7.1% to 7.3%, Vivo decreased from 5.9% to 5.7% while other smartphones accounted for 40.2% [International Data Corporation, 2017]. The share price of Samsung Electronics fell more than 6% to a two-month low on the Korean Stock Exchange [Reuters, 2016]. This was a big embarrassment for the Samsung smartphone brand, which resulted from a fault in the battery-one of the attributes considered in our study. However, in 2017, Samsung regained control as the world smartphone leader. The global smartphone market share were as follows; Samsung 23.3%, Apple 14.7%, Huawei 10%, Oppo 7.5%, Vivo 5.5% and others 39% [International Data Corporation, 2017].

3. Research Methodology

3.1 Smartphone Attributes and Attribute Levels Identification

Product attribute selection is a critical aspect of Conjoint Analysis (CA) [Lee et al., 2015]. Where selected attributes do not project the attributes that are of importance to consumers, the CA results may not be relevant [Menon and

Sigurdsson, 2016]. To identify the relevant smartphone attributes we reviewed extant research on mobile phones [Jung and Kim, 2014; Nikou et al., 2014; Kim, 2016; Yeh et al., 2016; Pandey and Nakra, 2014; Karjaluoto et al., 2005; Head and Ziolkowski, 2012; Sayassatov and Cho, 2016]. Also, prior to designing the study, we carried out 2 groups discussions on smartphone attribute choices with 20 graduate students who use smartphones. Each group consisted of 10 students of equal gender. As a result of the discussions with groups, eight attributes and their related levels were identified as follow: Brand (Samsung, iPhone, LG and Huawei); Price ($200, $500, $1,000); Screen size (4.5 inches, 5 inches); Camera (6 megapixel, 12 megapixel, 16 megapixel); RAM (1GB, 2GB, 4GB); Battery life (12 hours, 24 hours, 48 hours); Purpose (communication, social media, entertainment); and Storage (16GB, 32GB, 64GB). However, using many attributes would be too confusing for respondents [Kim, 2016], therefore we scaled down to six attributes for CA experiment. It is acceptable to use fewer attributes and other scholars like Jung and Kim [2014] used only three attributes for CA.

3.2 Experimental Design

In order to determine how consumers purchase particular smartphones, we used a Choice-Based Conjoint (CBC) analysis experiment to assess the significance of six smartphone attributes on consumer preference. The steps involved in CBC experiments are : correcting trade-offs; making choice predictions; and estimating buyer value systems [Curry, 1996; Braun et al., 2016]. We were interested in finding out how consumers trade-off different attributes of a smartphone when deciding which one to purchase. To make this determination, the six attributes for this study and their associated levels were: brand (four levels : Huawei, iPhone, LG, Samsung), price (three levels : $200, $500, $1000), camera (three levels : 6 megapixel, 12 megapixel, 16 megapixel), memory (RAM) (three levels : 1GB, 2GB, 4GB), storage (three levels : 16GB, 32GB, 64GB), and battery life (three levels : 12 hours, 24 hours, 48 hours). In the study questionnaire developed for CBC analysis, the combinations were : 4 (Brand) by 3 (Price) by 3 (Camera) by 3 (RAM) by 3 (Storage) by 3 (Battery life) = 972. It was not possible to show each participant all 972 different smartphone choices [Zwerina et al., 1996]; however, it was possible to use a study design plan, which is an abbreviated plan that focuses on subsets of all possible combinations of attributes, ensuring that all levels are equally represented [Dey, 1985]. This type of study design plan is generated using specialised computer software programs such as Sawtooth Software's CBC, which was used in our study [Spralls et al., 2016; Orme, 2013].

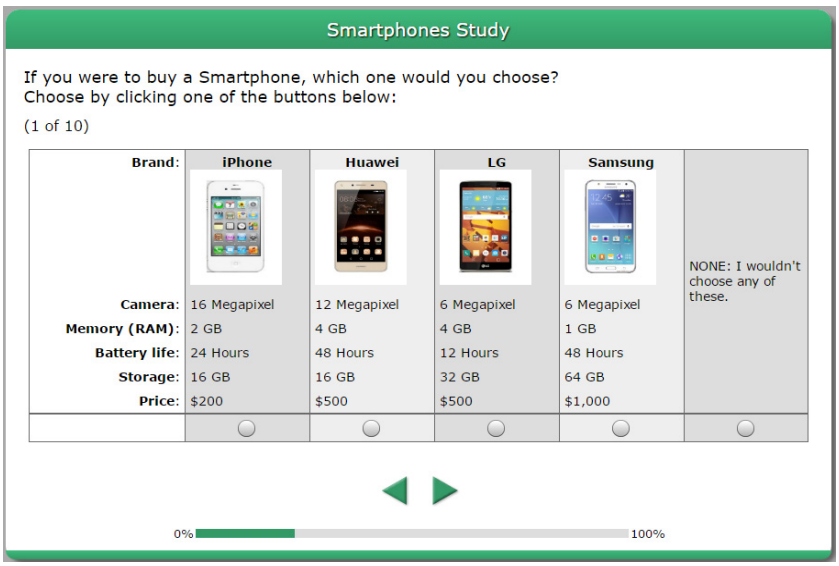
Determining the appropriate number of attribute levels for each attribute is essential. If there are too many, the questions will become difficult for the respondents to answer [Kim, 2016]. If there are too few, the description of the choices may not be adequate [Ida, 2012]. As such, the experiment was created so that each attribute had five levels or fewer [Hair et al., 2014]. Further, the experiment included 15 questions and participation was on a voluntary basis. The

reason for doing so was that CBC questions are more involving than typical survey questions [Orme, 2013]. It was, therefore, beneficial to keep the number low to prevent participants from losing interest in the study [Brenner et al., 2012].

We recruited participants using a convenience sampling approach, by inviting our University students through emails to participate in our study. Students from other Universities were invited to participate via social media sites like Kakao, WhatsApp, or Facebook. In the online questionnaire developed using Sawtooth's CBC analysis software, participants were given 10 random CBC analysis questions (or tasks), supplementary questions about demographics, and an open-ended question. An example of the random CBC tasks used in the online experiment is shown in <Figure 1>. We collected 380 responses in total. 326 usable responses remained after excluding incomplete responses.

When participants began the online experiment, the software randomly created hypothetical smartphone choices, which consisted of various combinations of six attribute levels (one level per attribute) as shown in <Figure 1>. The participant was given a purchasing task and then asked to choose between sets of four different smartphone concepts including a no-choice option [Desarbo et al., 1995], simulating the exact way a consumer would make a purchase decision in real life. This is supported by random utility theory [Louviere et al., 2000; Lee, 2016]. Based on the respondents' choices, it becomes clear which combination of attributes are most important to the respondents. Since CBC analysis is carried out at the individual level, we were able to ascertain the relationship between the six attributes and the consumer preference for all respondents.

Previous studies have indicated that each of these attributes have an influence on smartphone preference [Kim, 2016; Jung and Kim,



〈Figure 1〉 A Sample of Choice-Based Conjoint Scenario

2014; Yeh et al., 2016; Karjaluoto et al., 2005; Pandey and Nakra, 2014]; however, there has yet to be a CBC analysis study that analyzes the combination of six attributes in South Korea. This research study sought to fill this gap. We considered the Internet as a channel for quantitative consumer research because data is collected in an environment in which consumers interact with an electronic presentation of a real product that leads to purchasing intention [Payne and Wansink, 2011]. Also, modern research software can reach a large number of consumers and collect their responses automatically, while coding them for analysis [Walters, 2015].

Using student samples for CA is not without criticism, however, based on some reasons, we were motivated that they are an appropriate target sample for this research. Firstly, previous studies found that young consumers are more enthusiastic users of smartphones [Yeh et al., 2016]. Thus, it is reasonable for students to constitute the target population. Secondly, prior research found student samples to be representative of the direction the general population is moving since they represent early adopters and experienced users of innovations [Burda and Teuteberg, 2016].

The experiment using CBC analysis for predicting consumer preference produces useful results that can be easily interpreted [Spralls et al., 2016]. Although CBC analysis experiments are more sophisticated and demand more effort from the respondents, their results are more realistic [Jervis et al., 2012]. CBC analysis grounds attributes in concrete descriptions and makes a better distinction between attributes' importance [Orme, 2013]. It uses utility theory to analyse consumer buying behaviour. Therefore, it is possible to estimate attribute level utilities and to calculate an importance score for each attribute [Braun et al., 2016]. An importance score shows the effect each attribute has on the smartphone choice [Kabadayi et al., 2013]. For this experiment, we asked respondents the smartphone they wanted to buy. This measured their smartphone preferences.

3.3 Validity and Reliability

We asked academic and smartphone industry experts to check the validity of the smartphone purchase scenarios. When conducting the Choice-Based Conjoint (CBC) analysis experiment, we chose a minimal choice count or a number of times each smartphone attribute level was shown to participants to make a statistically valid sampling. The appropriate minimal choice count for this study was determined by the CBC analysis software and was utilised to ensure validity.

The validity of measurement may be increased by including more CBC questions to reduce measurement error [Braun et al., 2016]. Accordingly, there were 10 choice-based questions. Validity was further accomplished by choosing attributes after an extensive literature review, through the inclusion of hold-out tasks, and by pre-testing the experiment scale measures prior to the study through test-retest reliability (using fixed tasks), which was completed before the launch of the full online experiment [McDaniel and Gates, 2011]. The experiment

met the requirement of internal validity as we assigned respondents randomly, and obtained a sufficient number of respondents to achieve the desired probabilistic equivalence [Campbell, 1986; Lee, 2016].

4. Processing and Analysing Data

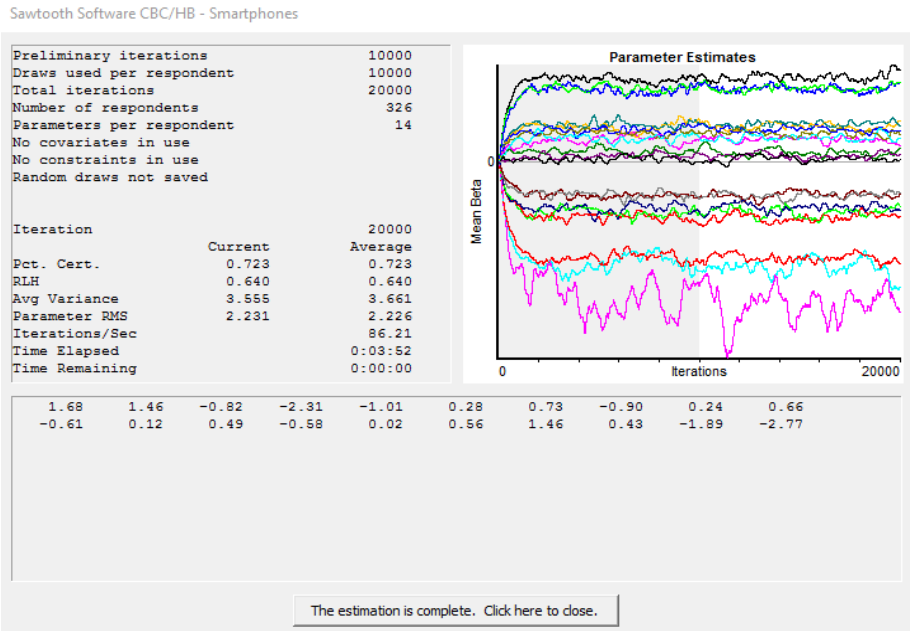
4.1 Processing Data

We employed utility theory to evaluate consumers' smartphone preference. The Choice-Based Conjoint (CBC) analysis questions helped us to estimate part-worth utilities, where importance scores are measured on an index for each of the different attributes [Curry, 1996]. Conjoint importances describe the impact of each smartphone attribute on consumer preference, given the range of levels that were specified for each attribute [Manerikar and Manerikar, 2011]. Attribute importance is calculated as a percentage of the differences between the best smartphone attribute level and the worst smartphone attribute level [Curry, 1996].

CBC analysis was chosen instead of other methods because its results are more realistic and respondents can answer questions faster, with an average response time of only five seconds [Orme, 2013]. In addition, CBC analysis experiments are more accurate. In traditional Q&A survey designs, stated importances often do not reflect true attribute importance, which can lead to inaccurate and skewed results [Kuzmanovic et al., 2012]. CBC analysis experiments allow for acute differentiation of attribute importance, which was necessary for this study [Orme, 2013].

4.2 Data Analysis

For each of the six smartphone attributes, a



〈Figure 2〉 CBC/HB Analysis Run Summary

utility score was determined. Data were analysed using Sawtooth's CBC analysis software that is able to generate count proportions [Orme, 2013]. Counts proportions are closely related to conjoint utilities. Utility scores were used to answer the research question under study. When determining importance scores from CBC data, Orme [2013] recommends the use of part-worth utilities that result from the latent class with multiple segments and Hierarchical Bayes (HB) estimation. HB estimation is a highly effective method for borrowing information from every respondent in the data set to produce more accurate accounts of individual's part-worth estimates [Spralls et al., 2016; Orme, 2013]; this was utilised in our study as shown in <Figure 2>.

5. Findings

5.1 Demographics of Participants

From the Hierarchical Bayes (HB) analysis, a total of 326 respondents attempted the conjoint tasks and completed all the survey questions until the end of the survey. The relevant demographic details were extracted, as shown in <Table 1>. Fifty-three percent of the respondents were male while 47% were female. Twenty-eight percent were aged 18 to 25 years, 46% were 26 to 34 years, 23% were 35 to 45 years, 2% were 46 to 54 years, and 0.6% were 55 to 64 years. About 4.6% of the respondents were at a high school education, 34% were at a bachelor's degree, 57% were at a master's degree and 4.6% were at a doctoral degree. Analysis of household income per year shows that, 50% earned less than $10,000, 33% earned $10,000 to $50,000, 7.98% earned $50,001 to $100,000, and 8.59% earned over $100,000.

〈Table 1〉 Demographic Characteristics

Measure	Items	Frequency	Percentage (%)
Gender	Male	172	52.76
	Female	154	47.24
Age	18~25	92	28.22
	26~34	150	46.01
	35~45	74	22.70
	46~54	8	2.45
	55~64	2	0.61
Household Income in last Financial Year	Less than $10,000	163	50.00
	$10,000~$50,000	109	33.44
	$50,001~$100,000	26	7.98
	Greater than $100,000	28	8.59
Level of Education	High School	15	4.60
	Bachelor's Degree	111	34.05
	Master's Degree	185	56.75
	Ph.D. Degree	15	4.60

5.2 Conjoint Analysis Results

Conjoint Analysis (CA) shows experimentally controlled combinations of attribute levels. Results were compiled and analysed using utility scores, smartphone choice counts, importance, and impact scores. Attribute level utilities were generated for each of the six attributes through HB estimation. These scores demonstrate the effect that each attribute has on smartphone choice based on utility theory.

Data findings are presented in <Table 2> and <Table 3>. <Table 2> shows average importance scores of attributes which represent their importance to respondents in making their smartphone choices [Jung and Kim, 2014]. Using Chi-Square statistics, we tested further and found that all attributes are significant in influencing

〈Table 2〉 Attribute Importance

Attributes	Average Importance (%)	Chi Square Value	P-Value	Conclusion
Brand	38.02	618.22	< 0.0001	Significant
Price	21.92	355.08	< 0.0001	Significant
Camera	12.01	115.63	< 0.001	Significant
Memory (RAM)	10.57	126.43	< 0.001	Significant
Battery	8.76	96.27	< 0.05	Significant
Storage	8.72	87.92	< 0.05	Significant

〈Table 3〉 Attribute Level Utilities

Label	Average Utilities	Effect	Standard Error	t Ratio	P-Value	Conclusion
Samsung	59.25	0.52	0.03	15.85	< 0.0001	Significant
iPhone	47.66	0.51	0.03	15.48	< 0.0001	Significant
LG	-35.25	-0.49	0.04	-11.83	> 0.05	Not significant
Huawei	-71.67	-0.54	0.04	-12.96	> 0.05	Not significant
6 Megapixel	-36.28	-0.32	0.03	-10.39	> 0.05	Not significant
12 Megapixel	14.10	0.12	0.03	4.04	< 0.05	Significant
16 Megapixel	22.18	0.20	0.03	7.23	< 0.001	Significant
1 GB	-31.39	-0.31	0.03	-10.01	> 0.05	Not significant
2 GB	6.15	0.05	0.03	1.73	> 0.05	Not significant
4 GB	25.25	0.26	0.03	9.20	< 0.001	Significant
12 Hours	-23.17	-0.27	0.03	-8.78	> 0.05	Not significant
24 Hours	2.75	0.05	0.03	1.79	> 0.05	Not significant
48 Hours	20.42	0.22	0.03	7.69	< 0.001	Significant
16 GB	-23.29	-0.23	0.03	-7.44	> 0.05	Not significant
32 GB	1.08	-0.02	0.03	-0.53	> 0.05	Not significant
64 GB	22.20	0.24	0.03	8.56	< 0.001	Significant
$200	45.05	0.44	0.03	15.95	< 0.0001	Significant
$500	14.88	0.07	0.03	2.25	< 0.05	Significant
$1,000	-59.93	-0.51	0.03	-15.55	> 0.05	Not significant
NONE	-105.85	-1.03	0.07	-14.50	> 0.05	Not significant

smartphone choice. An attribute is considered significant when its selection frequency for different levels deviates significantly from that of random selection [Luo et al., 2013]. When indicating their preferences, consumers in South Korea placed an average importance of 38.02% on brand, 21.92% on price, 12.01% on camera, 10.57% on memory, 8.76% on battery, and 8.72% on storage. Therefore, it can be deduced that brand is the most important significant attribute, followed by the price, camera, memory (RAM), battery, and storage. This answers the research question that the brand is the most important attribute that influences consumers in South Korea towards purchasing smartphones. Other scholars came to a similar conclusion that brand is the most important attribute [Jung and Kim, 2014; Karjaluoto et al., 2005].

<Table 3> outlines the CBC/HB report summary for all respondents, summarising average utilities within each attribute level. A part-worth utility measures the relative desirability of respondents' choices [Lee, 2016]. Higher utilities indicate that the level was more preferred in respondents' selection [Jung and Kim, 2014; Orme, 2013].

First, for the brand attribute, the measures of the Samsung level and iPhone level contributed more to total utility (59.25 and 47.66, respectively) and were more significant than other levels ($p < 0.0001$), indicating that these smartphones were the more preferred brands. This offers further support to other scholars whose research found similar findings [Jung and Kim, 2014; Pandey and Nakra, 2014]. The utilities for the LG level and the Huawei level were negative (-35.25 and -71.67, respectively) and were not significant in influencing brand choice ($p > 0.05$), showing that the two brands were less preferred.

Second, for the price attribute, the measure of the $200 level contributed more to the total utility (45.05) and was the most significant level ($p < 0.0001$). The utility for the $1,000 level was negative (-59.93) and not significant ($p > 0.05$), showing that it was a less preferred price level. Thus, consumers in South Korea are rational in their smartphone purchase decisions. They prefer smartphones with the lowest prices and the best brands. Jung and Kim [2014] also found that consumers in South Korea prefer lower prices and that high prices reduce their willingness to buy smartphones.

Third, for the camera attribute, the measure of the 16-megapixel level contributed more to total utility (22.18) and was most significant ($p < 0.001$). The utility for the 6-megapixel level was negative (-36.28) and not significant ($p > 0.05$), showing that it was a less preferred camera level.

Fourth, for the memory (RAM) attribute, the 4GB level contributed most to total utility (25.25) and was more significant ($p < 0.001$) than other levels. The utility for the 1GB level was negative (-31.39) and not significant ($p > 0.05$), showing that it was a less preferred level of RAM.

Fifth, for the battery attribute, the measure of the 48 hours level contributed most to total utility (20.42) and was most significant ($p < 0.001$). The utility for the 12 hours level was negative (-23.17) and not significant ($p > 0.05$), showing that it was a less preferred battery life.

Sixth, for the storage attribute, the measure of the 64 GB level contributed more to total utility (22.20) and was the most significant ($p < 0.001$) of all storage levels. The utility for the 16 GB level was negative (-23.29) and not significant ($p > 0.05$), showing that it was a less preferred storage level.

Finally, the most preferred smartphone has the following attributes : Samsung brand, $200 price point, 16-megapixel camera, 4GB of memory (RAM), 48 hours of battery life, and 64GB of storage space. This is in agreement with Jung and Kim (2014), whose research found Samsung brand having the highest preference.

5.3 Analysis of Open-Ended Question

We included the following open-ended ques-

tion : which smartphone model in South Korea do you prefer and why? The purposes of the open-ended question were : to allow an infinite number of possible answers, to learn something we did not expect, and to understand how respondents think. Of the 326 respondents, we obtained 313 responses applicable to the question.

Of the respondents, 57.51% preferred Samsung models. The major reasons for their preferences were : lasts longer and convenient to use in South Korea; works well in places with weak Wi-Fi; beautiful design, user-friendly features, and best specs; from a reliable and competitive firm; reliable and dependable brand; tested quality with common accessories.

Of the respondents, 29.07% preferred iPhone models. The reasons for their preferences were: many applications; no risk of viruses; Android systems are slow; I like the camera and applications; no battery explosions like Samsung; excellent quality, though expensive.

Of the respondents, 8.63% preferred LG models. The reasons for their preferences were : large storage, good battery, and lower price; the best camera; cheaper and has the best processor; reliable and safe brand.

Of the respondents, 3.51% preferred Huawei models for the following reasons : good camera, big memory, light, and user-friendly; very reliable phone; very good quality from China; no battery explosions like Samsung.

Of the respondents, 0.32% preferred each of the following inferior brands in South Korea: Vega, Motorola, Luna, and Sky.

Results from the open-ended question confirmed our findings that the Samsung brand is the most preferred smartphone brand in South Korea.

6. Discussion

This research investigated the aspects on how the decision to purchase smartphones is made by consumers in South Korea and examined the influence of smartphone attributes on smartphone choices. Smartphone choice involves consumers using their judgment to decide the best option. Consumers have the ability to choose among the many smartphone models on the market based on their judgement of attributes.

In the smartphone purchase process, the brand is the most significant attribute that leads consumers to make smartphone choices. Consumers analyse information concerning the brand more than any other smartphone attributes. The numbers of smartphone brands available for consumers to choose from influences their purchase decisions. Consumers in South Korea particularly prefer the Samsung brand relative to other brands on the market. Although the Samsung brand faced the issue of battery explosion of its Samsung Galaxy Note 7 smartphone, the company reacted very well by stopping further sales, recalling products, and refunding affected customers. This further strengthened the Samsung brand name on the Korean market. The critical role of brand gives more strength to the objective of this research in relation to consumer preference. The importance of brand stems from the familiarity the consumers have with the brand in the form of past experiences associated with the use of the brand.

The price of smartphones influences consumer preference in the South Korean market, with lower prices being perceived more favourably than higher prices. Consumers are concerned about the prices they have to pay, given the variety of cheap substitute brands available on the market. However, some consumers are ready to pay high prices for the latest smartphone models such as Samsung Galaxy S8 as compared to older models like Samsung Galaxy S2, S3 and S4.

The quality of the smartphone camera in terms of megapixels influences consumer preference in the South Korean market. The higher the number of megapixels, the more favourable the smartphone brand is. Consumers are more concerned about the best picture quality possible.

The smartphone memory (RAM) determines its processing speed. Consumers in the South Korean market judge smartphones with higher RAM to be more favourable than those with lower processing speeds. They have a higher preference for smartphones with the highest possible RAM.

The battery life is the total number of hours a battery can support the smartphone's functioning before shutting down. Consumers in the South Korean market judge smartphones with the longest battery life to be more favourable than those with lower battery life. They have a higher preference for smartphones with the longest possible battery life. From the open-ended question responses, we can deduce that consumers in South Korea are wary about battery explosions for their safety. Smartphone manufacturers must, therefore, ensure the safety of smartphone attributes to strengthen customer loyalty.

Smartphone storage determines the amount of space available for archiving pictures, videos, documents, and music [Sayassatov and Cho, 2016]. Consumers in the South Korean market judge smartphones with the highest storage to be more favourable than those with lower storage. They have a higher preference for smartphones with the highest possible storage.

6.1 Implications

The research approach used in this study helps to explain the basics of Conjoint Analysis (CA) and can benefit management that is trying to create the right products at the right price for consumers. Management faced with decisions among different options made up of conjoined features could develop key insights into consumer choice using CA. The potential applications of CA are numerous in fields such as insurance/banking services, job selection and workplace loyalty, consumer packaged goods, travel and tourism and consumer electronics.

Companies that want to make more than one version of products to target distinct market segments may utilise CA. Targeting enhances customer retention as a number of different products can be offered to the customers. Therefore CA can be used in assessing the attractiveness of a market segment. Attractive market segments can be approached with well-designed marketing mix strategies.

This research makes a major theoretical contribution which differentiates it from other con-

sumer behaviour literature. It maps out smartphone brands across smartphone attributes from the customers' perspectives, which helps to discover the aspects of consumer choice used in the smartphone purchase situation. The focus on smartphone brand choices enabled us to detect how consumers determine their preferences. Therefore this study extends research on how consumers make smartphone choice.

This research makes another academic contribution in CA research on attributes as it identifies an unexplored important research subject. When CA is used to study a complex design that has multiple attributes, this sometimes causes a problem of information overload which burdens respondents and weakens the validity of an experiment. To minimise the impact of such problems, Kano model and an integrated hierarchical survey design may be used for large CA [Kim, 2016]. Therefore, this study recommends future studies to do CA with multiple smartphone attributes so as to fill the existing research gap. This would help to understand how consumer preferences vary in case of a complex attribute design.

Regarding practical implications, our findings provide details of attributes of smartphones related to smartphone purchase decisions and assesses each attribute's relative importance using utility analysis. The relevance of brand needs to be emphasised as consumers indicated their preference for the various brands available in the South Korean smartphone market, with the Samsung brand being the most preferred, followed by the iPhone brand; the LG and Huawei brands were the least preferred. Consumers are encouraged to analyse smartphone brands carefully when making choices. They should choose smartphones with the best attribute combinations.

Consumers attach different levels of importance to smartphone attributes of different brands when making a smartphone purchase. Thus, smartphone companies need to have a good understanding of the ways in which their smartphones' attributes compare with those of their competitors. This will enable them to come up with competitive strategies based on product attributes.

This study will help marketers to find the possible combination of features that influence consumer smartphone choice. Marketers may focus on developing a strong smartphone brand in the market to reach their target consumers so that they make a favourable purchase decision. Brand development must be considered as a priority and should be seen as an investment instead of a cost. Sales Managers may lower smartphone prices to increase their sales margins. Furthermore, marketers may consider the camera, memory, battery life, and storage capacity of smartphones while designing advertising campaigns.

The results can guide smartphone manufacturers in the mature market to understand the important smartphone attributes that influence consumers' choice. Therefore, smartphone manufacturers may consider producing smartphones with advanced technology features that present more quality and durability to customers. The brand is very important as most consumers go for the most favourable one. So, they must strive

to be the best possible brand. They may offer low priced smartphones models, with the highest megapixel Camera, fastest processing speed i.e. Memory (RAM), safe batteries with highest possible life, and highest possible storage.

Manufacturers may emphasize the smartphone design because it has strong effects on customer satisfaction [Kim et al., 2016]. Mobile companies may devote their innovative and creative minds to ensure production of attractive smartphone designs with the best attribute combinations relative to competitors. Attractive smartphone designs appeal to customers' tastes and preferences. Smartphone design provides psychological comfort and meets functional convenience [Kim et al., 2016].

6.2 Limitations and Future Studies

Responses were collected from students by a convenience sampling using an online survey, which may not fully represent the entire population. This may cause some biases. Future research replication involving a non-student population is encouraged to capture preferences of those who did not have access to the online survey.

Participants were recruited only from South Korea. Thus results may differ by country as a different business and economic environments exist in other countries. For example, Samsung's Galaxy is most preferred in South Korea; Huawei is preferred in China and iPhone is most preferred brand in the U.S. Future research is therefore encouraged in underdeveloped parts of the world like Africa. This would help to see the variability of consumers' smartphone preferences.

Smartphone choices may be as a result of other attributes other than the ones identified in this research. The smartphone attributes used here may not be fully reflective of the exact purchase situation. Therefore, other attributes which drive the smartphone choice could be introduced in future research; for example, colours, size and purpose of smartphones.

This research used an experimental design, calling into question the causality [Creswell, 2008]. The study, however, used survey-like questions. Surveys have been the dominant choice in consumer behaviour research, although experiments are more accurate [Darley et al., 2010]. In this regard, the use of Conjoint Analysis (CA) was favourable.

Although CA is superior in many aspects, one of the challenges associated with it- and with standard importance analysis-is that it takes into consideration the extremes within an attribute, whether or not the part-worth utilities follow rational preference order [Orme, 2013]. This can be problematic because the importance calculations can capitalise on a random error and attributes with little importance can be upwardly biased in importance. This implies that there will always be differences in the part-worth utilities of various levels, which are sometimes a result of random noise alone [Orme 2013]. Measurement error can be reduced by including more conjoint questions in future studies and having more data from respondents.

There is also a chance of common method variance due to the fact that measures were col-

lected from the same survey instrument at the same point in time [Ida, 2012]. Future studies are encouraged to adopt longitudinal studies of around one year in duration. This will enable the capture of consumer preferences that evolve over time.

7. Conclusion

The rapid technological developments in the mobile phone industry can make significant contributions to current and future smartphones. Smartphones have become part of consumers' lives as they facilitate mobile banking, e-commerce and mobile payments. They play an important role in the financial inclusion of the unbanked and underbanked consumers. It is important to understand how smartphone users make their choices and which attributes are most important to them. Our research introduces Choice-Based Conjoint (CBC) analysis, which is an exciting innovation in Conjoint Analysis (CA) research, with a focus on consumer smartphone preference based on attributes. Compared with other CA approaches, CBC analysis is more realistic and accurate. Respondents evaluated smartphone purchase scenarios with combinations of smartphone attributes and utilities were obtained by Hierarchical Bayes estimation. This analysis reveals the trade-offs consumers make while choosing a smartphone based on attributes. The brand was the most important factor influencing consumers' smartphone choice, followed by price, camera, memory, battery life, and storage. This study introduces an avenue for smartphone attributes research which is relevant to practitioners in the smartphone industry as it helps them to understand the trade-offs consumers are willing to make in smartphone choices. We hope our research approach stimulates more CA research in other areas like banking and insurance services, job selection and workplace loyalty, consumer packaged goods, and travel and tourism.

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