

**COMPARING THE EFFECT OF TWO-DIMENSIONAL DISPLAY AND
THREE-DIMENSIONAL TRY ON TECHNOLOGIES ON THE
CONSIDERATION SET FORMATION AND FINAL CHOICE ON THE
WEBSITES**

*Ayşegül SAĞKAYA GÜNGÖR**
*Tuğçe OZANSOY ÇADIRCI***

Alınış Tarihi: 03 Kasım 2017

Kabul Tarihi: 21 Haziran 2018

Abstract: The conceptualization of virtual three-dimensional experiences has emerged lately because advancements in the technology have led to immersive experiences in virtual environments. This new technology enables users to get the information about a product that is very similar to the real product examination. On the other hand, there is already an online display opportunity that is familiar to the online customer, i.e., two dimensional (2-D) product view. A laboratory experiment was conducted to explore what difference Virtual try-on (3-D try-on) technology creates in the consideration set formation and final choice decision (which are based on consideration set theory) compared to the 2-D product display in the website of a well-known international company. The experiment was conducted with the participation of the university students. The results revealed an increase in the number of products taken into the consideration set, and a significant increase in the probabilities of the products to be taken into the consideration set, favoring the 3-D try-on technology in both cases. However, a statistically significant difference was not observed in the final choice outcome. The possible reasons are discussed, along with theoretical and practical implications of the study.

Keywords: 3-D Try-On Technology, 2-D Display Technology, Augmented Reality, Consideration Set Theory, Logistic Regression

**WEB SİTELERİNDE KULLANILAN İKİ BOYUTLU ÜRÜN
GÖRÜNTÜLEME TEKNOLOJİSİ İLE ÜÇ BOYUTLU ÜRÜN DENEME
TEKNOLOJİSİNİN DEĞERLENDİRME KÜMESİ OLUŞUMUNDAKİ VE
SATIN ALMA KARARINDAKİ ETKİSİNİN KARŞILAŞTIRILMASI**

Öz: Teknolojideki ilerlemelerin sanal ortamlarda tüketiciyi içine alan deneyimlere imkân sağlaması, son zamanlarda sanal üç boyutlu deneyimin kavramsallaştırılmasına yol açtı. Sanal üç boyutlu ürün deneme (3-D deneme) teknolojisinin, iki boyutlu ürün görüntülemeye kıyasla, ürünün dikkate alınanlar kümesine girmesinde ve son seçim kararında bir fark yaratıp yaratmadığını keşfetmek amacıyla tanınmış uluslararası bir şirketin web sitesi kullanılarak bir laboratuvar deneyi tasarlanmıştır. tanınmış bir uluslararası şirketin web sitesi. Deney, üniversite öğrencilerinin katılımıyla gerçekleştirilmiştir. Sonuçlara göre; dikkate alınanlar kümesine dahil edilen ürün sayısında ve bir ürünün dikkate alınanlar kümesine girme olasılığında üç boyutlu ürün deneme teknolojisi anlamlı bir fark yaratmaktadır. Ancak, son seçim kararında istatistiksel olarak anlamlı bir fark gözlemlenmemiştir. Olası sebepler, araştırmanın teorik ve pratik sonuçları ile birlikte çalışmada tartışılmıştır.

* Işık University, Faculty of Economic and Administrative Sciences, Department of Management

** Yıldız Technical University, Faculty of Economic and Administrative Sciences, Department of Management

Anahtar Kelimeler: 3-D Ürün Deneme Teknolojisi, 2-D Ürün Görüntüleme Teknolojisi, Arttırılmış Gerçeklik, Küme Teorisi, Lojistik Regresyon

I.Introduction

The concept of immersive virtual experiences has been introduced with the development of multisensory online experiences. Although two dimensional (2-D) product displays are still the dominant type, online retailers begin to incorporate sensory technologies into their e-stores. The most attention-grabbing of all is augmented reality (AR); which is an interactive tool which complements physical environment with virtual attributes (Javornik, 2016). There are different types of implementations of AR, in the form of virtual mirrors, virtual catalogs, and 3-D virtual try-on.

As a new and promising technology, 3-D virtual try-on technology (referred as 3-D try-on in the study) enables consumers to experience a product that is very similar to the direct product try-on. With the help of visual sensors, real-world experience is replaced, and it may create a positive experience to stimulate purchase (Khakimdjanova and Park, 2005). Moreover, interactivity and engagement (Dierks, 2017), in addition to the entertainment value of the technology, enhance the virtual shopping experience. However, not much is known about how efficient the technology is, in inducing the purchase decision. The paper approaches 3-D try-on by studying consumer decision-making process and explores to which extent it contributes to the consideration set formation and final choice. While achieving the stated objectives, it compares 2-D classical display with 3-D try-on technology.

The study is grounded on the consideration set theory which defines the way consumers cope with complex purchase decisions. The theory operates with four consecutive sets; namely universal set, awareness set (knowledge set), consideration set, and the final choice; each of which is formed with the refinement of the previous one (Roberts, 1989). The approach of the study is based on the necessity of the consideration set formation before the purchase decision. The product has first to be included in the consideration set to be considered as a purchase alternative (Roberts and Lattin, 1991).

By introducing 3-D try-on as a tool to be used by the practitioners, and using the consideration set theory, we try to answer four different research questions related to the consideration set formation and final choice, detailed in the below sections. To answer these research questions, a laboratory experiment was conducted with the participation of the university students. The study narrows the research gap in the digital marketing and e-commerce area by answering one of the frequently asked questions by the scholars and practitioners about the items that should be offered to influence consideration set formation, thus final choice. To our knowledge, it is the first time that the consideration set theory is applied in the context of 3-D virtual technologies.

II.Theoretical Background and Research Questions

A. Consideration Set Theory

In an attempt to define how consumers cope with complex buying decisions, marketing scholars have introduced consideration set theory. The theory operates with the concept of consecutive sets formed during the decision-making process by the decision maker. The formation of successive sets is a sequential process to ease the complexity of decision-making (Betmann, 1979). In this multistage decision-making mechanism (Gensch, 1987), there is a successive perfection of alternatives considered (Roberts, 1989) to reach the best decision. The theory defines four nested, hierarchical sets: universal set, awareness set (knowledge set), consideration set, and the final choice (Figure 1).

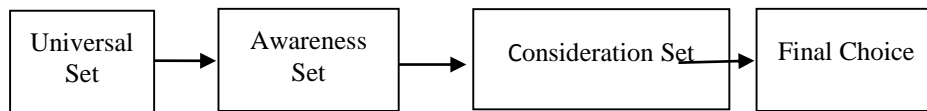


Figure 1. *Successive sets in consideration set theory*

Universal set. The first set that is formed by the introduction of a need of the consumer is the universal set. “The universal set refers to the totality of all alternatives (usually branded products or services) that could be obtained or purchased by any consumer under any circumstance” (Shocker et al. 1991: 182). These alternatives could be any product displayed in text, video, audio or image on the Web page, TV ad, magazine or radio ad (Ho and Tam, 2005). It is the largest set formed during the decision making process. The decision maker is not necessarily aware of all the available alternatives, and most of the time it is almost impossible. Therefore, it is only the part of the universal set that the consumer considers (Thill, 1992).

Awareness set (Knowledge set). The second set in the decision-making process is a subset of the universal set, thus contains less number of alternatives (Alba and Chattopadhyay, 1985). With the limited cognitive capacity, it is not possible for the consumers to be aware of all the possible alternatives in the market. This set includes alternatives that a consumer is “aware” at a given time (Shocker et al. 1991). It was also called as the retrieval set in the old studies (e.g., Kardes et al. 1993) since it includes the items that a given consumer can retrieve from the memory. The number and variety of the items in this set depend on the individuals' attention, processing capacity, expertise, and comprehension (Shocker et al. 1991). Depending on the attention and the processing capacity of the individual, it may contain the items that the individual is exposed at the time of decision making (e.g., a brand name in a supermarket) (Shocker et al. 1991).

Consideration set. After gathering enough information, consumers select a set of alternatives among the available ones to form the consideration set (Howard and Sheth, 1969). It consists of the items that more closely meet the immediate goal of the consumer than the others (Shocker et al. 1991). The items in this set are the limit to the purchase decision (Roberts and Lattin, 1991); and one item from this set would be the final choice. Stigler (1961) suggested that formation of consideration set is the result of the marginal cost of the search process. He stated that it is time to stop seeking more information when the marginal cost of search exceeds marginal benefits obtained from the search process. The size of consideration set varies, even in the exact time of decision making, depending on the number of alternatives available, level of task difficulty (Shugan, 1980) and cognitive processing capacity of the individual (Shocker et al. 1991). So, the content of the consideration set is dynamic. In the presence of 3-D technologies, characteristics that will affect the size of the consideration set should be combined with the characteristics of the people experiencing virtual features. That is because personal traits like self-congruence (Gabish, 2011) and cognitive involvement (Huang and Liao, 2014) have impacts on consumer responses.

To reach the final stage, a relatively simple criterion is used to refine alternatives at first, and then a detailed analysis of alternatives is undertaken by the consumer (Roberts, 1989). The refinement of the alternatives enables consumers to compare less number of items and requires less effort for the cognitive capacity to compare (Gensch, 1987; Shocker et al. 1991).

Choice set. The last set of the decision-making process is the choice set. It has a static form since the information collection process has come to an end at this stage. Among this set, one (or more than one) item will be purchased. And the process ends with a choice outcome.

B. Three Dimensional (3-D) Try-on Technology in Online Retailing

In need of new technologies that will enhance the online shopping experience, retailers explored the potential of three dimensional (3-D) displays of the products. The attempt is to create a real life-like shopping experience (Yaoyuneyong et al. 2014). It is possible to examine a product (clothes, accessories, etc.) on the consumer's body/face from multiple angles, since, with the help of a webcam, scanned part of the body is immersed on the screen (Pachoulakis and Kapetanakis, 2012).

According to the Huang and Liao (2014), AR technologies are persuasive that can create and deliver not only the functional benefits but also the experiential value. It is not only a technological tool but provides users with interactive and vicarious simulation experience. Since it holds hedonic and utilitarian values (Kim and Forsythe, 2007), it will lead to form a sustainable relationship with customers. Moreover, the immersive virtual experience can bring search attributes to the fore, rather than experience attributes. The more

search attributes and information value provided by the 3-D environment, compared to the 2-D environment, the less the risk perceived by the consumer (Shin and Baytar, 2014). Additionally, the format of presentation of a product can alter the perception of the product positively (Li et al. 2002; 2015).

Consideration set theory states the information collection necessity of the individual consumer to form the consideration set. The 3-D virtual try-on can provide extensive information, while it provides new options for content delivery, and the virtual product trials (Javornik, 2016). At the same time, a feeling of direct product experience can make the consumer feel like an actual presence in the virtual surrounding (Javornik, 2016).

Starting from the early dates, the concept took the attention of the researchers. It is not only 3-D try-on, but also virtual mirrors, augmented reality, and virtual catalogs are in concern of the theoreticians. Dating back to 2004, there are studies in the literature on 3-D body scan applications (Loker et al. 2004). 3-D try-on technology is considered as a variation of augmented reality (AR). Moreover, smart in-store technologies (i.e., smart/virtual mirror) are regarded as 3-D try-on. The studies mostly focused on how the AR technology is perceived as they work on different variables. To give some examples; researchers work on perceived enjoyment (Yaoyuneyong et al. 2016; Spreer and Kaltweit, 2014; Papagiannidis et al. 2014; Kim and Forsythe, 2007; Buelarca and Tamarjan, 2010; Rese et al. 2014), perceived usefulness and value (Poncin and Mimoun; 2014; Huang and Liao; 2015; Oh et al. 2008), and perceived risk (Kim and Forsythe, 2008; Yaoyuneyong e al. 2014; Shin and Baytar, 2014; In Shim and Lee, 2011). There are studies comparing 2-D and 3-D displays. Some focused on advertising (Li et al. 2002; 2015; Yaoyuneyong et al. 2016), or the effect of various constructs on purchase decision and effectiveness (Lee, 2012; Papagiannidis et al. 2014; Verhagen et al. 2013; Kim et al. 2017).

According to the previous literature, 3-D try-on technology provides the online user with an immersive shopping experience, has both functional (utilitarian) and hedonic benefits, and reduces perceived risk. Combining those perceived benefits with what the consideration set theory suggests, the current study poses the following research questions that will form the base of the study:

RQ1. Does 3-D try-on technology make any difference in the products' inclusion in the consideration set compared to 2-D display?

RQ2. If yes, how much does it increase the probability of the product to be included in the consideration set compared to 2-D display's probability?

RQ3. Does 3-D try-on technology make any difference in the product to be chosen as the final purchase compared to 2-D display?

RQ4. If yes, how much does it increase the probability of the product to be chosen as the final purchase compared to 2-D display's probability?

III. Methodology

A. Participants

The sample consists of undergraduate students of a university. University students were found compatible for the purpose because they are one of the heavy user groups of the sunglasses, the product used in the experiment. Participants were randomly assigned one of the two groups. A total of 98 responds were obtained. Among this 98 responses; 50 has experienced 3-D try-on technology, while 48 has experienced 2-D product display. The average age of the participants was 21 (The age was asked as an open-ended question and stated as an exact number by the participants). The average hour spent online per week was more than 6 hours, while the average frequency of online shopping was 2-3 times/month. The average amount of money spent online per year was between 301-500 TL. And the average number of products bought last year was 5-6 products by the participants. Details of the sample characteristics are summarized in Table 1.

Table 1. *Sample Characteristics*

		2-D display (N ₁ =48) (%)	3-D try-on (N ₂ =50) (%)
Gender	Male	28 (58.3)	29 (58.0)
	Female	20 (41.7)	21 (42.0)
Income	0-2000	18 (37.5)	18 (36.0)
	2001-4000	28 (58.3)	14 (28.0)
	4001-6000	0 (0)	12 (24.0)
	6000+	2 (4)	6 (12.0)
Weekly time spent online (hr)	Less than 1	0 (0)	0 (0.0)
	1-3	8 (16.7)	4 (8.0)
	4-6	6 (12.5)	6 (12.0)
	6+	34 (70.8)	40 (80.0)
The frequency of online shopping	Everyday	2 (4.2)	1 (2.0)
	2-3 times/week	6 (12.5)	0 (0.0)
	Once/week	8 (16.7)	10 (20.0)
	2-3 times/month	12 (25.0)	14 (28.0)
	Once/month	6 (12.5)	8 (16.0)
	Less than once/month	14 (29.2)	19 (38.0)
Amount spent online/year	Less than 100	18 (37.5)	20 (40.0)
	101-300	16 (33.3)	10 (20.0)
	301-500	4 (8.3)	8 (16.0)
	500+	10 (20.8)	12 (24.0)
Number of products bought last year	None	2 (4.2)	6 (12.0)
	1-5	32 (66.7)	24 (48.0)
	6-10	8 (16.7)	10 (20.0)
	10+	6 (12.5)	10 (20.0)

B. Procedure

The effectiveness of 2-D display and 3-D try-on technologies in the formation of users' consideration set is the main theme of this research. Building on the definition of Li et al. (2002: 46; 2015: 154), in the current study, 3-D try-on technology was operationally defined as "a user-controlled product image in which consumer is immersed in the experience with the help a webcam, and may rotate and move the product for detailed inspection". 2-D product display is defined as "a non-interactive static product image presented for inspection, an ordinary indirect non-interactive experience."

The study explores which technology is most likely to influence consumers' product inclusion in the consideration set, and final purchase decision. To measure the effectiveness of two different technologies, a laboratory experiment was conducted. The experiment was designed by using an actual website of a well-known international company that has both 2-D display and 3-D try-on technology online. In a real setting, it is not possible to control all external factors, but the advantageous point is in the realism of the experimental setting (Waiguny et al. 2013). A natural setting ensures external validity.

The product on the website used for the experiment was sunglasses. Sunglasses were considered as a suitable product for the purpose, because 1) Prior to buying sunglasses, people want to try them on, 2) Since it is a self-expressive and status signaling product (Kassim et al. 2016), it is one of the high involvement products for which people generally ask for more information, 3) Sunglasses are in common use during summer time 4) Sunglasses are considered as a neutral product type which implies no gender differences in use (Gupta et al. 2000).

The study was completed in two parts. At the first part, participants were asked to enter the Website in which the experiment would be conducted. In the website, at the different sessions, a group of participants experienced 2-D display; and another group experienced 3-D try-on technology, exactly under the same conditions. At the second part, participants required to fill an online questionnaire about their demographic information and their internet use and online purchase habits. And they required answering three questions about their wish to take more information about sunglasses and intention to buy (the exact questions are stated at the measurement of the dependent variables section), as well as the number of sunglasses that they put in the shopping basket.

At the 3-D try-on session, the participants viewed the 3-D try-on technology on the website. For 3-D try-on to operate, a camera was required. All the computers had internal cameras. Following the directions from the website, the participant needed to scan his/her face first. With the face mapping technology, the scanned face of the participant appeared on the screen. There were sunglasses at the bottom of the face image. After selecting sunglasses with a click on it, it was put on the face on the screen. Then, one could see the face from the front and could turn it left and right. Therefore it is possible to see the

face with sunglasses from almost all angles. A screenshot of the Web page, showing directions to create users' virtual model, is presented in Figure 1.

The second session which was the 2-D display experience was an ordinary one. It was not possible to put any sunglasses on. One could only view the sunglasses on the screen, and rotate it to see from different angles only.

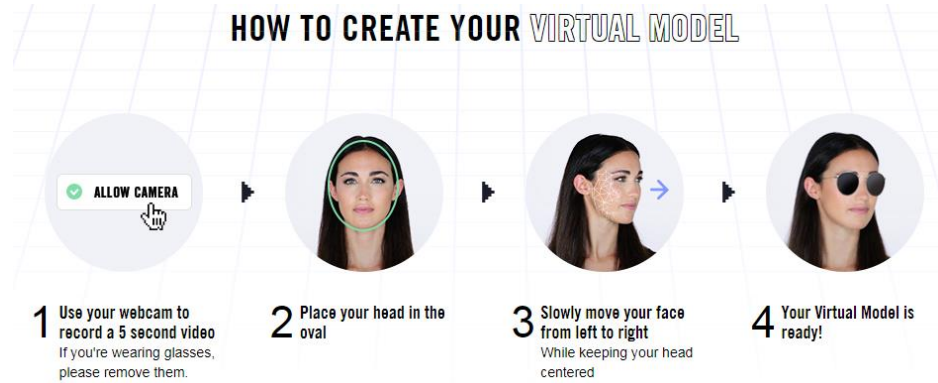


Figure 2. Directions to create your virtual model on 3-D try-on Website

C. Measurement of Dependent Variables

Each experimental session took 20 minutes. Before the experiment participants were informed about their task which was to view the sunglasses (either on the screen or the face depending on the experimental scenario), and put some to the shopping basket if they wanted to and do nothing more. Then they were asked three questions to measure the dependent variables:

- 1) How many sunglasses did you put in your shopping basket?
- 2) Would you like to take more information about the sunglasses that you put into your shopping basket?
- 3) Would you like to buy any of the sunglasses which are in your shopping basket?

The first question gives information about the size of the consideration set while the set is formed. The second question was an indication of consideration set formation. They may require more information about the available glass colors of the sunglasses, UV-filter capability, whether the glasses are polarized, etc. According to the theory, when people require more information, they are moving from awareness set to the consideration set. The third question is a direct question to final purchase choice. Answers to the latter questions were binary variables ($Yes=1$; $No=0$). We are expecting these two questions would be answered differently by two groups that lived through two different experiences on the website.

D. Controls

Since participants' online experience and online commercial activity can affect their behavior and acceptance of two different technologies, the similarity analysis of two groups of these variables are required. For the purpose, Pearson chi-square test was conducted to explore similarities and differences between two groups. According to the results, two groups were similar on all measured dimensions (See Table 2).

Table 2. Results of the analysis of similarities and differences between two experiment groups

	Gender	Age	Weekly time spent online (hr)	Freq. of online shopping	Amount spent online/year	Number of products bought last year
Chi-square	3.657	16.61	1.709	5.403	1.483	2.163
Df	1	12	2	4	3	3
P	0.08	0.165	0.425	0.248	0.686	0.539

E. Findings

Consideration set formation. A two-way analysis of variance (ANOVA) was conducted with the presence of 2-D display or 3-D try-on technologies as the independent variables, and the number of sunglasses put in the basket as the dependent variable. When the results are compared, participants who experienced 2-D display had a mean value of 1.75 sunglasses on the shopping basket, whereas the mean value was 2.52 for the ones who experienced 3-D try-on technology. According to the results, participants wanted to consider more number of sunglasses when they use 3-D try-on compared to the 2-D display ($F(1,95) = 13.434$; $p < 0.01$). The result of ANOVA analysis is displayed in Table 3.

Table 3. Results of ANOVA Analysis

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	4.581	1	4.581	13.434	0.006
Within Groups	32.398	95	0.341		
Total	36.980	96			

To predict the probabilities to take the sunglasses into the consideration set, a logistic regression analysis was conducted with the dependent variable being the answer to the question of "Would you like to take more information about the sunglasses that you put into your shopping basket?"

According to the logistic model, the presence of 2-D display or 3-D try-on technology had significantly different effects on the dependent variable (-2LL=61,403; $\chi^2=6.015$; df=1; p=0.014). The model had 67.3% correct classification. The statistical significance of Wald statistics has proved the relationship between the type of technology used and the intent to take the sunglasses into the consideration set (Table 4). The B being a positive number (1.455) implied an increase in the probability to put the sunglasses in the shopping basket (consideration set) when the 3-D try-on technology was implemented.

Although the used technology made a difference, the explained variance was 15.5% (Nagelkerke $R^2=0.155$). The small value of variance implied the effect of other variables on the dependent variable (Crow 2006, s. 32). This result is not unexpected since the study focuses on the effect of only one variable, which is the use of 2-D display vs. 3-D try-on technology. Anyhow, it has been proven that the different technologies used have different effects on consideration set formation.

Table 4. *The summary of the logistic regression model for consideration set formation*

	B	S.E.	Wald	df	Sig.	Exp (B)
Technology used (2D vs 3D try on)	1.455	0.613	5.630	1	0.018	4.286
Constant	-0.511	0.422	1.468	1	0.000	0.600

To calculate the probabilities logit and odds were calculated from the logistic model. According to the results, 3-D try-on display of the products has a higher probability (72%) to be taken into consideration set compared to 2-D display (62%). The probability calculations are depicted in Table 5. There is a difference of 10% which is a significant difference proven by the chi-square test beforehand ($\chi^2=6.015$; df=1; p=0.014).

Table 5. *Probability calculations for consideration set formation*

	2-D display (x=0)	3-D try-on (x=1)
Logit ^a	-0.511	0.944
Odds ^b	1.66	2.57
Probability ^c	0.62	0.72

^aLogit=-0.511+1.455x

^bOdds = e^{logit}

^cProbability= odds/(1+odds)

Final choice. A logistic regression analysis was conducted with the 2-D display, 3-D try-on technologies as the independent variables. The purchase intention of any sunglasses was used as the dependent variable. Results showed that, when the intention to buy sunglasses from the Website is considered, the percentage of participants that wanted to buy was more in 3-D try-on technology (60.5%) compared to 2-D display (52%). Although there was 8.5% increase in the percentage of participants that wanted to buy sunglasses in the presence of 3-D try-on technology, the difference was not statistically significant ($\chi^2=0.551$; $df=1$; $p=0.458$). At the same time, as can be observed in Table 6 the coefficients in the model did not show any statistical significance. It can be concluded that 2-D display and 3-D try-on technologies do not make any difference in the purchase intention of consumers, for the time being. The results and the possible explanations are discussed further in the discussion section.

Table 6. *The summary of the logistic regression model for final choice*

	B	S.E.	Wald	df	Sig	Exp(B)
Technology used (2-D display vs. 3-D try-on)	0.431	0.581	0.549	1	0.459	0.650
Constant	0.511	0.422	1.468	1	0.226	1.667

IV. Discussion

The aim of the current study is to compare the effect of 2-D display vs. 3-D try-on technologies at an e-commerce Web site on consideration set formation and final purchase decision. We speculate that the possibility of inclusion of a product in the consideration set may have been altered by the introduction of 3-D try-on technology, which may result in an increase of the probability rather than a classical 2-D display that normally consumers use to view the product. Grounding on the consideration set theory, the empirical findings support part of our expectations. They indicate that 3-D try-on is effectively contributing to the products' inclusion into the consideration set. However, consumers are still looking for more evidence to select the product as the final purchase choice. Specifically, while the products are displayed in the classical 2-D setting, the probability to take the product into consideration set is 62%. However, when 3-D try-on technology is present, the probability significantly increases to 72% ($\chi^2=6.015$; $df=1$; $p=0.014$). Unfortunately, the same is not observed in the final choice decision. No significant difference was detected between two different displays in the purchase decision.

In an online shopping experience, an ordinary Web site with 2-D display guides consumers with only visual sensors. However, with a 3-D display, a sense of real-life emerges, and the customer is taken into an immersive experience with a feeling of a presence of a real-product (Li et al. 2002; 2015). As a result, the feeling of immersion and the presence of the product, along with excitement

(Yaoyuneyong et al. 2016), leads the products' to be taken into the consideration set for further investigation.

Consideration set formation is expressed by the need for information collection. Sunglasses are high involvement products. Since they are expensive; status signaling and self-expressive (Kassim et al. 2016), consumers require detailed information, and try them on before purchase. 3-D try-on opportunity, combined with good visuals and easy use of technology, may guide the consumer's initial assessment of the product. Since at first a simple criterion is used to assess the alternatives available (it is to view the sunglasses on the virtual face, in this case) (Roberts, 1989), the item is taken into consideration set for detailed analysis. Moreover, it could be stated that the results of the findings could be generalized for high involvement products.

Related literature indicates that there is great risk perception of consumers while shopping online (Chiu et al. 2014; Nguyen et al. 2017; Kim and Peterson, 2017). It is most of the time the lack of trust, poor quality of visuals, insufficient information supply and the lack of sensory inputs that inhibit the online shopping experience. They all contribute to the risk perception of the shopper. The informative benefits supplied by the 3-D try-on technology that conveys product information in detail reduces the risk perception of the consumer (Kim and Forsythe, 2008; Shin and Baytar, 2014). The consumer acting on the reduced risk will include the product in the consideration set easier.

Contrary to the positive effect of 3-D try-on on consideration set formation, the technology is yet not that effective on the final choice. There are contradictory findings in the literature about the effectiveness of interactive technologies on the final choice. However, there is still evidence in the literature supporting our findings. In the study by Li et al. (2002; 2015); they discovered that 3-D or 2-D advertising display did not make any difference on purchase intention. According to Nah et al. (2011) product rotation, as a visual simulation, creates a sense of immersion and telepresence, and impacts affective and cognitive responses. The researchers did not state an effect on conative responses that include purchase intention of a product. Moreover, in their study on interactive technologies, specifically on augmented reality (AR), Kim and Lennon (2008) posit that both verbal and visual information affect brand knowledge and attitude, but online verbal representation has a greater effect on purchase intention. It suggests that visual 3-D try-on is not enough by itself for the final purchase decision. In addition to the above arguments, consumers perceive virtual try-on technology as more entertaining than functional, since the way items displayed on the screen (on the consumer body or face) is not helping much to show how the item would look on the consumers (Kim and Forsythe, 2008). Although informative, and causes the product to be considered, the 3-D try-on technology must still evolve, and it surely will. Huang and Liu (2013) suggest that visual cues have to be supported with aesthetics, entertainment and

service excellence has to be formed to persuade customers to change their behavior.

Given that the product used in the study is a high involvement product; the insignificant result for the final choice could also be attributed to the product type. Xu et al. (2015) suggested that information requirements of consumers are not same for different types of product. In their study, they differentiated between experience and search goods and suggested that it is more difficult for consumers to evaluate experience goods online, because of the need to feel the attributes. Related literature suggested that the sunglasses belong to the experience product type (Moon et al. 2008; Weathers et al. 2007). It can be inferred that the real-touch of the product is required to be purchased.

The study is conducted to narrow the research gap in the context of AR technologies regarding their effectiveness. According to the on-going theoretical discourse, perceived usefulness and perceived risk are two antecedents regarding the acceptance of any kind of technology, leading the purchase intention (Davis, 1989). In the online environment, as the information provided to the user increases, the risk perception decreases (Shin and Baytar, 2014), leading a confident purchase decision. The aim of the 3-D try-on is to provide a consumer a real-life like shopping experience with the extensive information delivery, product trial (Javornik, 2016), the feeling of telepresence and enjoyment (Yaoyuneyong et al. 2016). Therefore, it is concluded that 3-D try-on technology has the potential to reduce the perceived risk felt with the 2-D display, and increase the usefulness of online shopping with its hedonic and utilitarian benefits (Poncin and Mimoun; 2014).

The last but not the least, the 3-D try-on technology is quite a new technology which is making a considerable difference in the consideration set formation. Having seen the product on the face, although on the screen, makes the decision process easier for the consumer as the consideration set theory suggests.

Theoretical contributions. 3-D try-on technology is rather a new display method for electronic retailers. Although it has a great potential to be used as a differentiating strategy, there has been little research to assess the potential of 3-D try-on technology up to now. This study attempts to bridge the gap on the promising potential of 3-D try-on use, as well as to provide an extensible framework to investigate further the effectiveness of the 3-D try-on technology. The central aim of the current study was to investigate the effect of 2-D display and 3-D try-on technology in the consideration set formation and final buying decision. First of all, to our knowledge, it is the first time that the subject is under investigation, and that's why the findings are contributing to the literature.

Second, the study takes the consideration set theory as the base and refers to it in exploring the reactions of consumers in the presence of 2-D display or 3-D try-on technology. No study has been encountered during literature review applying consideration set theory to the 3-D try-on technology, or any other three

dimensional virtual technologies. The findings of the study explored the significant effect of 3-D try-on on consideration set formation. Since no ever colleague has ever worked on the subject before, the findings will certainly shed a light for the scholars in the future studies. On the other hand, the literature indicates that 3-D try-on does not create a significant difference in final purchase decision (Nah et al. 2011; Li et al. 2002; 2015). Our empirical results confirmed these findings.

Third, the study employed the logistic model to predict the probabilities in the formation of the consideration set. So, the theoretical contribution is not limited to point out the differentiating effects of different displays on a Web site, but also to predict the probabilities by calculating the exact percentage points.

Practical contributions. Today's e-marketplace has changed considerably with the introduction of the new tools at the disposal of the e-retailers. It is more information transparent, interactive and consumer engaged (Dierks, 2017). A new tool that contributes to these features is the 3-D try-on. Despite the lack of direct contact, 3-D try-on is a candidate to engender a real-life product experience (Overmars and Poels, 2015), as it has many advantages.

The first practical contribution of the study lies in the findings. Although, for the time being, the 3-D try-on does not make any difference for the final purchase decision, it is an effective tool in the consideration set formation, as the first step to the final purchase. By creating interactivity and engagement (Dierks, 2017), and unique customer experience (Huang and Liu, 2013), 3-D try-on could be one of the convincing technologies, inducing the final purchase. By helping the consideration set formation, it may also aid in multiple sales (Kim and Forsythe, 2008). Furthermore, an improved understanding of how 3-D try-on affects the consumers' consideration set formation may lead to the development of the technology to take further steps in the consumer buying decision process, such as final choice.

The most important drawback of the online shopping is the lack of direct product experience; i.e., the inability to try the product on in 2-D product displays. With the 3-D try-on, there is a feeling of direct experience of a product (Javornik, 2016), along with a sense of presence. It enables the consumers to view/try the product on, facilitating the evaluation of the product (Kim and Forsythe, 2008). This is the information gathered about the product, along with the direct experience-like feeling, that leads to the inclusion of the product in the consideration set. The study revealed that it should be improved to induce purchase decision.

The literature takes attention to the consumers' perception of risk while shopping online (Chiu et al. 2014; Nguyen et al. 2017; Kim and Peterson, 2017). It prohibits the consumers' engagement with shopping. The informative value of the 3-D try-on has the capacity to minimize the risk perception (Shin and Baytar, 2014). Thus the technology helps the consideration set formation also by reducing the risk.

Limitations and Future Research Directions. Just as any study, there are potential limitations that may cause the colleagues to be careful in approaching the findings of the study. First, the sample consisted of the university students. Although they are compatible with the product used in the experiment, with a different genre of the sample, different results may be obtained. Second, there may be a potential limitation caused by the product type used (sunglasses). Sunglasses are classified as an experience good (Moon et al. 2008). The results may be different with a search good. Repeating the experiment with other product types will lead to the further elaboration of the results. Third, we acknowledge the potential limitation caused by the experimental setting. Since there are almost no distractions in a laboratory setting, students tend to be more focused on the experiment. It is suggested as future research to apply the same scenario in a field setting. The current study explores the probabilities only. It may be another study to explore the content and the size of the consideration set in the presence of 3-D try-on. The findings of the study are limited to the consideration set theory which set the basis of the paper. 3-D try-on technologies are new both to the marketing literature and to the practitioners. Thus, it can be further explored with the help of the technology acceptance model (TAM), elaboration likelihood model (ELM), or the other models and theories that may be helpful.

Despite all the mentioned limitations, this paper represents a step to conceptualize the use and adoption of a relatively new area in online shopping.

V. Conclusion

3-D try-on technologies used in e-commerce sites will be adopted if an only if their effect on consumer attitude and behavior are assured. The current work represents an effort to explore the effect of the technology on consumer behavior. While proving the superiority of 3-D try-on technology on consideration set formation, the work points out the difference between 2-D display and 3-D try-on technology. As suggested by the previous work (Dierks, 2017) and the current research, it is a technology that e-retailers can allocate resource to increase market share. Forthcoming research will enhance and elaborate the findings in virtual 3-D technologies while taking this study as a step.

References

- Alba, J. W., and Chattopadhyay, A. (1985) "Effects of context and part-category cues on recall of competing brands", *Journal of Marketing Research*, p. 340-349.
- Bettman, J. R. (1979). *An Information Processing Theory of Consumer Choice*, Addison-Wesley, Reading, MA.
- Bulearca, M., and Tamarjan, D. (2010) "Augmented reality: A sustainable marketing tool", *Global Business and Management Research: An International Journal*, 2(2), p. 237-252.

- Chiu, C. M., Wang, E. T., Fang, Y. H., and Huang, H. Y. (2014) "Understanding customers' repeat purchase intentions in B2C e-commerce: the roles of utilitarian value, hedonic value, and perceived risk", *Information Systems Journal*, 24(1), p. 85-114.
- Crow, J. J. (2006) "Examining Cognitive Processes of Unstructured Decision Making", Ph.D. Thesis, Kansas State University, Manhattan.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), p. 319–340.
- Dierks, A. (2017), "Chapter A: Changing consumer behavior as a challenge for brand management", In *Re-Modeling the Brand Purchase Funnel*, Springer Fachmedien Wiesbaden, p.1-36
- Gabish J. (2011) "Virtual world brand experience and its impact on real-world purchasing behavior", *Journal of Brand Management*, 19 (1), p. 18-32.
- Gensch, D. H. (1987) "A two-stage disaggregate attribute choice model", *Marketing Science*, 6(3), p. 223-239.
- Gupta P.B., Gould S.J., and Grabner-Kräuter S. (2000) "Product placements in movies: A crosscultural analysis of Austrian, French and American consumers' attitudes towards this emerging, international promotional medium", *Journal of Advertising*, 29 (4), p. 41-57.
- Ho, S. Y., and Tam, K. Y. (2005) "An empirical examination of the effects of web personalization at different stages of decision making", *International Journal of Human Computer Interaction*, 19(1), p. 95-112.
- Howard, J. A., and Sheth, J. N. (1969). *The Theory of Buyer Behavior*, John Wiley and Sons, Inc., New York.
- Huang, T. L., and Liao, S. (2015) "A model of acceptance of augmented-reality interactive technology: the moderating role of cognitive innovativeness", *Electronic Commerce Research*, 15(2), p. 269-295.
- In Shim, S., and Lee, Y. (2011) "Consumer's perceived risk reduction by 3D virtual model", *International Journal of Retail and Distribution Management*, 39(12), p. 945-959.
- Javornik, A. (2016) "Augmented reality: Research agenda for studying the impact of its media characteristics on consumer behaviour", *Journal of Retailing and Consumer Services*, 30, 252-261.
- Kassim, N. M., Bogari, N., Salamah, N., and Zain, M. (2016) "Product status signaling as mediator between materialism and product satisfaction of Saudis and Malaysians", *Social Behavior and Personality: An International Journal*, 44(6), p. 973-985.
- Kardes, F. R., Kalyanaram, G., Chandrashekar, M., and Dornoff, R. J. (1993) "Brand retrieval, consideration set composition, consumer choice, and the pioneering advantage", *Journal of Consumer Research*, 20(1), p. 62-75.

- Khakimdjanova, L., and Park, J. (2005) "Online visual merchandising practice of apparel e-merchants", *Journal of Retail and Consumer Services*, 12, 307–318.
- Kim, M., and Lennon, S. (2008) "The effects of visual and verbal information on attitudes and purchase intentions in internet shopping", *Psychology and Marketing*, 25(2), p. 146-178.
- Kim, Y., and Peterson, R. A. (2017) "A meta-analysis of online trust relationships in e-commerce", *Journal of Interactive Marketing*, 38, 44-54.
- Kim, H. Y., Lee, J. Y., Mun, J. M., and Johnson, K. K. (2017) "Consumer adoption of smart in-store technology: assessing the predictive value of attitude versus beliefs in the technology acceptance model", *International Journal of Fashion Design, Technology and Education*, 10(1), p. 26-36.
- Kim, J., and Forsythe, S. (2007) "Hedonic usage of product virtualization technologies in online apparel shopping", *International Journal of Retail and Distribution Management*, 35(6), p. 502-514.
- Kim, J., and Forsythe, S. (2008) "Adoption of virtual try-on technology for online apparel shopping", *Journal of Interactive Marketing*, 22(2), p. 45-59.
- Li, H., Daugherty, T., and Biocca, F. (2002) "Impact of 3-D advertising on product knowledge, brand attitude, and purchase intention: The mediating role of presence", *Journal of Advertising*, 31(3), p. 43-57.
- Li, H., Daugherty, T., and Biocca, F. (2015), "Impact of 3-D advertising on product knowledge, brand attitude and purchase intention: The mediating role of presence", Stafford, M.R., and Faber, R.J. (Ed.) *Advertising, Promotion, and New Media*, Routledge, New York, USA, p.148-174.
- Lee, K. Y. (2012) "Consumer processing of virtual experience in e-commerce: A test of an integrated framework", *Computers in Human Behavior*, 28(6), p. 2134-2142.
- Loker, S., Ashdown, S. P., Cowie, L., and Schoenfeder, K. A. (2004) "Consumer interest in commercial applications of body scan data", *Journal of Textile and Apparel Technology and Management*, 4(1), p. 1–13.
- Moon, J., Chadee, D., and Tikoo, S. (2008) "Culture, product type, and price influences on consumer purchase intention to buy personalized products online", *Journal of Business Research*, 61(1), p. 31-39.
- Nah, F. F. H., Eschenbrenner, B., and DeWester, D. (2011) "Enhancing brand equity through flow and telepresence: A comparison of 2D and 3D virtual worlds", *MIS Quarterly*, 35(3), p. 731-747.
- Nguyen, T. T. H., Do, D. T. D., and Do, H. T. (2017) "The impact of Perceived Risk on Perceived Value and Purchase Intention in E-Commerce: Case study on Hochiminh City". Unpublished doctoral dissertation, FPT University (FUG HCM), p. Ho Chi Minh City, Vietnam.

- Oh, H., Yoon, S. Y., and Shyu, C. R. (2008) "How can virtual reality reshape furniture retailing?", *Clothing and Textiles Research Journal*, 26(2), p. 143-163.
- Overmars, S., and Poels, K. (2015) "How product representation shapes virtual experiences and re-patronage intentions: the role of mental imagery processing and experiential value", *The International Review of Retail, Distribution and Consumer Research*, 25(3), p. 236-259.
- Pachoulakis, I., and Kapetanakis, K. (2012) "Augmented reality platforms for virtual fitting rooms", *International Journal of Multimedia and Its Applications*, 4(4), p. 35-46.
- Papagiannidis, S., See-To, E., and Bourlakis, M. (2014) "Virtual test-driving: The impact of simulated products on purchase intention", *Journal of Retailing and Consumer Services*, 21(5), p. 877-887.
- Poncin, I., and Mimoun, M. S. B. (2014) "The impact of "e-atmospherics" on physical stores", *Journal of Retailing and Consumer Services*, 21(5), p. 851-859.
- Rese, A., Schreiber, S., and Baier, D. (2014) "Technology acceptance modeling of augmented reality at the point of sale: Can surveys be replaced by an analysis of online reviews?", *Journal of Retailing and Consumer Services*, 21(5), p. 869-876.
- Roberts, J. H., and Lattin, J. M. (1991) "Development and testing of a model of consideration set composition", *Journal of Marketing Research*, 429-440.
- Roberts, J. (1989) "A grounded model of consideration set size and composition", *Advances in Consumer Research*, 16, 749-757.
- Shocker, A. D., Ben-Akiva, M., Boccara, B., and Nedungadi, P. (1991) "Consideration set influences on consumer decision-making and choice: Issues, models, and suggestions", *Marketing Letters*, 2(3), p. 181-197.
- Shin, E., and Baytar, F. (2014) "Apparel Fit and Size Concerns and Intentions to Use Virtual Try-On: Impacts of Body Satisfaction and Images of Models' Bodies", *Clothing and Textiles Research Journal*, 32(1), p. 20-33.
- Shugan, S. M. (1980) "The cost of thinking", *Journal of Consumer Research*, 7(2), p. 99-111.
- Spreer, P., and Kallweit, K. (2014) "Augmented reality in retail: Assessing the acceptance and potential for multimedia product presentation at the PoS", *Transactions on Marketing Research*, 1(1), p. 20-35.
- Stigler, G. (1961) "The economics of information", *Journal of Political Economy*, 69, 213-225.
- Thill, J. C. (1992) "Choice set formation for destination choice modelling", *Progress in Human Geography*, 16(3), p. 361-382.

- Verhagen, T., Vonkeman, C. C., Feldberg, J. F. M., and Verhagen, P. (2013), "Making online products more tangible and likeable: The role of local presence as product presentation mechanism", Research momerandum, Available at <http://dare.uvu.vu.nl/bitstream/handle/1871/40414/2013-3.pdf?sequence=1> (Last retrieved 24.08.2017)
- Waiguny, M. K., Nelson, M. R., and Marko, B. (2013) "How advergence content influences explicit and implicit brand attitudes: When violence spills over", *Journal of Advertising*, 42(2-3), p. 155-169.
- Weathers, D., Sharma, S., and Wood, S. L. (2007) "Effects of online communication practices on consumer perceptions of performance uncertainty for search and experience goods", *Journal of retailing*, 83(4), p. 393-401.
- Xu, P., Chen, L., and Santhanam, R. (2015) "Will video be the next generation of e-commerce product reviews? Presentation format and the role of product type", *Decision Support Systems*, 73, 85-96.
- Yaoyuneyong, G., Foster, J., Johnson, E., and Johnson, D. (2016) "Augmented reality marketing: Consumer preferences and attitudes toward hypermedia print ads", *Journal of Interactive Advertising*, 16(1), p. 16-30.
- Yaoyuneyong, G., Foster, J. K., and Flynn, L. R. (2014) "Factors impacting the efficacy of augmented reality virtual dressing room technology as a tool for online visual merchandising", *Journal of Global Fashion Marketing*, 5(4), p. 283-296.