Futuristic VR image presentation technique for better mobile commerce effectiveness*

Park Ji-seop
Busan Catholic University, Department of Business Information
Professor

Contents

* 본 논문은 Virtual Reality (2020.07)에 출판된 저자의 논문을 수정 및 보완한 것임

Abstract

Previous studies show that VR images can influence consumers' attitudes and behaviors by evoking imagination. In this study, we introduce a reality-based closed-loop 3D image (hereafter Virtualgraph). Then we try to see whether such image would increase evocativeness in a mobile commerce environment and whether higher telepresence of the visual image of a product can increase the purchase intention of that product. In order to find the above, we developed a model comprised of constructs containing telepresence, perceived value price, perceived food quality, and vividness of visual imagery questionnaire (VVIQ). We used Virtualgraph application to conduct an experiment, and then conducted an interview as well as a survey. As results of the experiment, survey and interview, we found the followings. First, users evoke imagination better with Virtualgraph than with still images. Second, increased evocativeness affects purchase intention if the perceived quality of fresh food product is satifactory. Third, increased evocativeness makes users value products higher and do even much higher when the perceived quality of fresh food product is good. From the interview, we could find that the experimental group had higher purchase intentions and perceived products as more expensive ones. Also, they perceived images of products clearer and more vivid than did the control group. We also discuss the strategic implications of using Virtualgraph in mobile shopping malls.

Keywords | Virtualgraph, Reality–based Closed–loop 3D image, Evocativeness, Guided Imagery, Telepresence, VR images, VR Contents

1. INTRODUCTION

Virtual reality technology is recently spotlighted again for its potentials in online business sector. Kuo-Wei Su et al. (2019) argue that the virtual reality technology provides users with better shopping experiences. There are various studies about virtual reality and its effects on shopping experience and those studies are mainly divided into two categories: research on visual technology (Kung Wong Lau and Pui Yuen Lee 2019; Edmanuel Cruz et al. 2019) and interaction technology (Brengman et al. 2019; Chien-Min We et al. 2017; Francisco Felip et al. 2019). However, if we need to understand users' shop-ping experience from virtual reality environment, it should be useful to have holistic approach encom-passing both technology and human factors rather than focusing on either technology-oriented or be-havior-oriented approach. In academia, in fact, there are few studies dealing both with virtual reality technology and human factors together.

According to imagery theory, certain situation may evoke imagery which were formed in the past. (MacKay and Fesenmaier 1997, Pylyshyn 2003, Coman and Rauh 2003). "Evocative" refers to "tending to bring a memory, mood, or image, for example, subtly or indirectly to mind" by definition. We devel-oped our evocativeness concept with reference to guided imagery (Tusek, Church et al. 1997) and im-agery instruction (Rodríguez-Ardura and Martínez-López 2014), and we examined how evocativeness affects purchase intention. Guided imagery or imagery instruction is to make people evoke imagination in an intended way. It is interpreted in the same sense as evocativeness. Here in this study, evocativeness is operationally defined as the degree to which a consumer can bring a memory or images from experi-ence.

When a consumer sees a product or an image of the product, a consumer recalls past experiences. We posit that evoking memories depends substantially on visualizing the products in commercial sites. This is why marketers and researchers emphasize the role of evocativeness.

Understanding its importance, we reach subsequent research questions:

How can we increase evoca-tiveness? If we are able to deliver richer, more interactive messages in e-commerce, can we expect great-er evocativeness and purchase intention as well?

Virtualgraph is defined as "reality-based closed-loop 3D image to make more realistic" (Park, et al. 2018). In their study, they developed Virtualgraph application and made the virtualgraph images haptic-enabled. Then they tried to see if the Virtualgraph images ever increase telepresence to prove the effica-cy of the brand-new imaging technique. According to their study, vividness and interactivity are higher with Virtualgraph than with still images.

We also focus on the role of evocativeness in consumers' behavior as stated in the research questions. Perceived Food Quality and Perceived Value Price were used as mediating variables to examine various effects of evocativeness on purchase intention, and the Vividness of Visual Imagery Questionnaire vari-able was used to control the differing imagination ability over individuals. The reason we used food for our experiment is that it is easier to let participants recall images or imagine. Details about variables, study designs and procedure will be explained in detail in the later section. Academic and practical implications will also be discussed in the later section.

2. THEORETICAL BACKGROUND

2.1. Virtual Reality Based Shopping and Consumer Behavior

Pegler (2001) defined visual merchandising as a product presentation that communicates product concepts to customers and encourages them to buy in stores in a sustainable way. Increased interaction design in virtual reality plays an important role in increasing user performance and immersion, so re-searchers design interactions with users in virtual reality to deliver better product concepts to customers. Recent studies about

interaction design in the context of shopping experiences actively deal with aug-mented reality and further, mixed reality technologies. According to Edmanuel Cruz et al. (2019), for instance, augmented reality technology is applied to large retail stores to show the destination's mer-chandise with arrows pointing to the destination when the user moves around the store with a smartphone. According to Francisco Felip et al. (2019), mixed reality technology offers a unique shop-ping experience and exemplify mixed reality case. In their example, mixed reality systems allow users to touch the actual product while wearing the HMD (Francisco Felip et al. 2019). In addition, there are studies that allow users to see the product through stereoscopic VR and wear the haptic glove to experi-ence the product realistically (Kung Wong Lau and Pui Yuen Lee, 2019). Haptics play a very important role in the shopping experience in virtual reality because users experience the tangibility of products to build a mental of representation and perceive physical presence of product features (Verhagen et al. 2016). In virtual reality shopping, users can increase their imagination through a haptic experience, and based on this fact, we have inserted haptic feedback into the experimental stimulus.

2.2. Relationship between evocativeness and purchase intention

Researchers have explored the relationship between imagery and its effects on consumer behavior and found that imagery improves memory (Swann and Miller 1982), affects brand attitudes (Bone and Ellen 1992), and positively influences perceptions of events (Gregory, Cialdini et al. 1982, Sherman, Cialdini et al. 1985). Researchers also found that imagery affected consumers' actual purchasing behav-iors (Petrova and Cialdini 2008).

Purchase intention, which is more specific concept of purchase behavior, refers to an individual's planned behavior or predictable future behavior. It is defined as a subjective possibility that leads to consumer beliefs and actual purchasing behavior (Engel & Blackwell. 1982). In more practical meaning, purchase intention means individuals' intention

to perform a specific behavior or make the decision to buy a product or service.

In the domain of cognitive psychology, evocation is used as tool of psychotherapy. Psychotherapists use evocative techniques that deliberately tap into and then draw out the relevant but still unconscious parts of patients' pasts such that patients can make sense of their current emotional distress (O'Donohue, Fisher et al. 2004).

In marketing, when consumers perceive products more vivid, they engage more with the product and further recall more product information (Petrova and Cialdini 2005). Also, when consumers imagine their experience with a product, they tend to recall similar products from their past experience (Robertson 1971). These tendencies are activated only when consumers have sufficient knowledge and clues about the product (Paivio and Csapo 1973, Wright and Rip 1980, Richardson 1983).

"Evocation" refers to vivid reminiscences of specific phenomena and suggests images that evoke ex-periences and meaning (Van Manen 1997, Nicol 2008). In a lexical sense, evocation refers to "some-thing that brings something up or brings something to mind or memory" (Webster 2006). It can be in-ferred that any media type that facilitates vivid evocation will produce higher product purchasing inten-tion:

H1: Evocativeness will affect purchase intention.

The remaining variables associated with Evocativeness (e.g., Perceived value price (PVP), Perceived food quality (PFQ), Telepresence (TELE), Vividness of Visual Imagery Questionnaire (VVIQ)) are intro-duced hereafter.

2.3. Visual Stimulation and Perceived Food Quality

Among diverse products, food is believed to be one of the best items for recalling previous experi-ences. Taste and smell are closely related to purchasing behavior, reminding consumers of places and events they have experienced before (Johnson 2001).

Research related to the taste of food can be found in the marketing field, including in studies of how beer brands (Makens 1965) and movie theatre popcorn containers (Wansink and Park 2001) affect con-sumers' taste perceptions and in studies that suggest that advertising text that stimulates all five senses is more effective than text that evokes only a single sensation (Elder and Krishna 2010).

Studies have revealed that certain parts of the brain are stimulated when consumers imagine visual stimuli for food; specifically, experiments were conducted using functional MRI (fMRI) to study how the human brain responds to visual and olfactory food stimuli (Stice, Spoor et al. 2008), what part of the brain responds when a person views a food video (Cheng, Meltzoff et al. 2006), and how the brain re-sponds to being shown a variety of food images and then the actual food (Führer, Zysset et al. 2008).

In addition, food images, rather than the actual, material food product, activate the orbitofrontal cor-tex area, which is responsible for cognitive function related to desire and motivation in the brain (Simmons, Martin et al. 2005). Studies showed that on brain fMRI, the orbital frontal cortex was more significantly activated among the participants who viewed food images than it was among those who viewed industrial images (Stice, Spoor et al. 2008). Thus, it is indirectly known that food evokes stronger feelings than do other products.

When consumers look at food photos, they imagine that they are eating the food showin in the photo. Then consequantly, their purchase intention tends to increase while imagining that they are directly involved with the food consumption (Petrova and Cialdini 2008). Studies have shown that hedonic stimulants affect purchase intentions (Mikalef et al 2013, Zhang and Benyoucef 2016). The food stimu-lants used in this study are expected to influence the purchase intention. Therefore, we established the following hypotheses:

H2: Evocativeness will affect perceived food quality.

H3: Perceived food quality will affect purchase intention.

2.4. Perceived Value Price

According to Day (Day and Day 1990), if prices are not important when there are two products to choose from, consumers will classify the two products as similar and their purchase behaviors will be similar to their past behaviors; moreover, if consumers consider the two products relatively equal, they will choose based on other criteria instead. When consumers think that the price difference between two products is significant, they tend to perceive the two products as different and choose based on the price of the products, sometimes choosing the higher-priced product if their choice is between a high price and a low price (Day and Day 1990). In short, when consumers perceive two products as similar, they choose by price or by other factors such as product information. In this cognitive process, consumers tend to think of proper price by arbitrarily combining meaningful information to themselves (Zeithaml 1982).

Jacoby and Olson (Jocoby 1977) defined the perceived "value" price of a product as a consumer's subjective perception of a product's price. In other words, consumers tend to purchase products based on information found from malls, Web and from the experience. In sum, both product reference prices and information shown on websites affect the perceived value prices of products.

According to Wells et. al. (2011) - a paper entitled "website quality as a signal", when consumers face a website with high quality and elaboration, they tend to perceive products sold in the website more qualitied ones. Thus, they may tend to think the price of those products would be reasonable and be-come more generous about pricing. From the above, we hypothesize H4 and H5.

H4: Evocativeness will affect perceived value price.

H5: Perceived value price will affect purchase intention

2.5. Telepresence

"Telepresence" is a physical experience of a spatially separated virtual place and is an important ele-ment in understanding how individuals experience technology-mediated environments such as games, TV, movies, and virtual reality.

Steuer's (Steuer 1992) concept of telepresence, which consists of two dimensions: vividness and in-teractivity; vividness refers to the richness of what is presented and is divided into breadth and depth. Studies on telepresence have looked at response speed (Held and Durlach 1992), sharp image resolution and color quality (Held and Durlach 1992, Barfield and Weghorst 1993, Böcker and Mühlbach 1993), users' ability to modify virtual environments (Sheridan 1996), and scene update rates (Barfield and Hendrix 1995), and authors have found all of these to be important. Users who experience increased telepresence show increased involvement, amusement, memory and improved performance, and they are more easily persuaded. In addition, high telepresence provides individuals with realistic virtual experi-ences that have the same persuasive effects and communicative abilities as events have in the real world (Lombard and Ditton 1997).

High telepresence has a palpable effect on enhancing individuals' imaginations, memories, and pur-chasing behaviors (Rodríguez-Ardura and Martínez-López 2014) and is known to be effective for con-sumers, and 3D product advertisements have more positive effects on purchase intention than does 2D advertising (Li, Daugherty et al. 2002, Klein 2003); the higher the telepresence of a product advertise-ment, the more positive the attitude toward the advertisement.

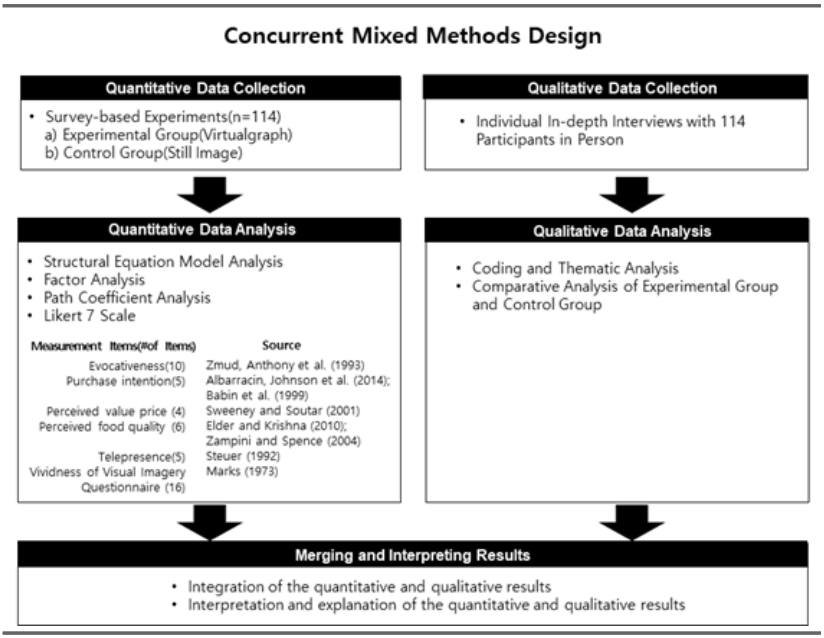
We thus established the following hypotheses based on previous studies:

H6: Telepresence will affect purchase intention.

H7: Telepresence will affect perceived food quality.

H8: Telepresence will affect perceived value price.

3. RESEARCH METHODS



| Fig 1 | Concurrent mixed methods design procedures

To make our study more rigorous, we divided our methodologies into quantitative and qualitative. For the quantitative research, we administered a questionnaire using Likert scale, and for the qualitative research, we conducted interviews.

Using both quantitative and qualitative research methods simultaneously to approach one problem is called mixed-methods research (Creswell and Clark 2017), and it is effective for better understanding the experimental results (Cyr, Head et al. 2009), of the phenomena found in exploratory research such as this study. We used the mixed methods, the best-known design among the mixed-method research designs proposed by Creswell & Plano Clark (2012). Concurrent mixed methods design is mainly used when researchers use two different research methods to confirm or

cross-validate the findings. Fig. 1 shows the mixed-method research procedure used in this study.

Participants were randomly divided into two groups: 57 for experimental group and 57 for control group. In the quantitative data collection as depicted in Fig 1, 114 participants were recruited for participating in questionnaire as well as experiments. The collected data were analyzed by structural equation modeling analysis, factor analysis, and path coefficient analysis. In a qualitative study, 114 participants were interviewed face-to-face, followed by coding and thematic analysis. After completing the two studies, we integrated the quantitative and qualitative findings into implications.

In this study, we attempted to maximize evocativeness by selecting foods as our sample products from mobile shopping malls. We selected taste and freshness (Um, Kim et al. 2005) as the criteria for the foods and defined the overall effect as perceived food quality. We also used the VVIQ (Marks 1973) score as a control variable to measure the participants' imaginations.

3.1. Vividness of Visual Imagery Questionnaire

According to imagery studies, individuals differ widely in their ability to imagine vividly (Marks 1973, McKelvie and Demers 1979, McKelvie 1994, Hatakeyama 1997, Amedi, Malach et al. 2005) and the most representative tool for measuring the ability to visualize imagery is Marks's (Marks 1973) Vividness of Visual Imagery Questionnaire (VVIQ). This tool is designed to allow individuals to imagine multiple images in their minds and to record on a five-point scale how vivid the images are; image examples include "Imagine the sun rising on the horizon of the sea." If a participant scores this image with a 1, the image in the mind was not vivid, whereas if the score was 5, the participant considered the image as vivid as the real thing. The VVIQ has been validated in more than 900 studies in the field of psychology, and the findings suggest that the scale predicts individual cognitive, motor, and creative imagery performance

(Cui, Jeter et al. 2007). In addition, in neurological studies using fMRI, the VVIQ score was found to correlate highly with the level of visual cortex activity (Cui, Jeter et al. 2007).

In this study, we used the VVIQ score as a control variable to measure participants' perceptions of vividness and minimize the effects of evocativeness caused by individual abilities to imagine.

3.2. Participants

A total of 114 participants were recruited publicly on the school board. Out of 114 participants, 59.6% are males and 40.4% are females.

| Table 1 | Participants

Category		Frequency
Gender	Male	68
	Female	46
Total		114
Age	16~20	4
	21~25	53
	26~30	43
	31~35	10
	36~40	3
	Above 41	1
Total		114
Highest level of education	High School	1
	Some College	85
	College	11
	Higher than Graduate school	17
Total		114

Fifty-two participants (46.5%) were 21–25 years old, 43 (37.7%) were age 26–30, 8.8% were 31–35, 4 (3.5%) were 16–20 years old, 3 (2.6%) were 36–40, and 1 (0.9%) was age 41. Most of the participants, 74.6% (85), were college students, and 14.9% (17) were graduate students. Before starting the questionnaire, participants were asked to fill out informed consent in the way that they could not proceed to the next step unless they agreed with them.

3.3. Experiment Setting Using Virtualgraph

"Virtualgraph refers to a reality-based closed-loop 3D image, meaning 'draw an image closest to the reality.' Virtualgraph is based on the telepresence theory" (Park, Choi et al. 2018). This can be interpreted as a 3D imaging technique enabling users to experience the objects in more realistic way or as one type of VR imaging techniques which can be differentiated by its interactive characteristics.

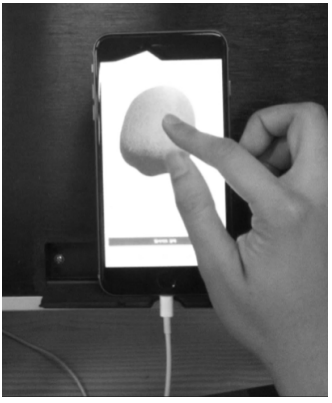
In this study, we constructed an experimental setting by preparing for two different mobile screens: One with Virtualgraph, the other with still images. In the operation of experiment, we divided participants into two groups: experimental group and control group. Virtualgraph-enabled mobile pages are provided only to experimental group and still image pages are shown only to control group. The conditions of the experimental and control groups were equal.

Table 2 displays both image types. With the still images, the user could swipe the product image to the left or right or zoom in or out, whereas for the Virtualgraph, the user could view all sides of the product, in the same way as 3D photos, and the fruits squeezing sounds was transmitted with the vibration. These haptic effect and sound effect were embedded in the Virtualgraph: When the user pressed the product image on the 3D force-touch display, sound, haptic and visual effects were generated, and the image shape changed according to the amount of pressure the user applied.

| Table 2 | The still and virtualgraph samples used in the experiment

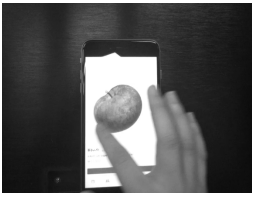
A) Still Image Samples

Swiping

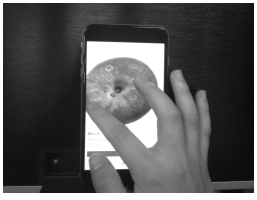


Zoom in/out

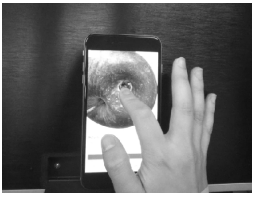
B) Virtualgraph Samples



Rotating



Zoom in/out



Squeezing

In the literature, images such as virtualgraphs are classified as 3D images (Li, Daugherty et al. 2002), and for this study, we considered them 3D images as well. We applied the concept of telepresence to the virtualgraphs based on our literature review findings. Previous studies have shown that high telepresence stimulates individuals' imaginations (Rodríguez-Ardura and Martínez-López 2014), so that virtuaglraphs with high telepresence could be expected to be more evocative. In the following section, we describe how we attempted to increase the telepresence of the virtualgraphs we introduced.

In Steuer's (Steuer 1992) conceptualization, telepresence consists of vividness and interactivity, so to increase telepresence, both vividness and interactivity should be increased. For this study, it was first necessary to improve the vividness of the virtualgraphs, that is, the image quality, color quality, and image sharpness (Held and Durlach 1992, Barfield and Weghorst 1993, Böcker and Mühlbach 1993). To accomplish this goal, we took more than 200 pictures at 4608 × 3072 resolution of all sides of the prod-uct using a Panasonic DMC-GH4 DSLR camera so that the user could see all sides vividly. We then converted those images into 3D objects using 3D modeling in Reality Capture (Photogrammetry soft-ware).

Next, in order to improve interactivity, the scene update rate must be high, and the ability to modify the virtual environment must be superior (Barfield and Hendrix 1995, Sheridan 1996), so we decided to add the interactivity to the content itself; specifically, we edited the 3D objects modeled with real pho-tographs in Unity3D software. Unity3D can give the user different interaction effects, so we were able to animate the 3D objects with sound, haptic and visual effects based on the attributes of the real, actual products. When the user pressed the Virtualgraph through the 3D force-touch display panel applied to the Apple iPhone 7+, the surface shape of the product was transformed. For this study, we used fruit for the experimental samples, and we designed the samples with the Facebook payment page interface; for the study, we selected apple, tangerine, mango, banana, and kiwi after referring to a list of the 10 fruits consumers buy most frequently online in South Korea.

For the Virtualgraph, the actual fruit was placed on an electronic scale and photographed, and the sur-face of the fruit was deformed when it was pressed in 100 g increments to represent the real transfor-mation of the fruit in the image; additionally, we applied the same pressure to the Virtualgraph as the pressure applied to the actual fruits. As a result, when the user pressed the fruit in the Virtualgraph with a force of 100 g, the image was deformed as though the actual fruit had been pressed with 100 g of pres-sure. In the Virtualgraph, the surface of the fruit was indented when the user pressed the picture just as the surface of the real

fruit would be when the user pressed the actual fruit with the same force.

This process can be explained as increasing the interactivity of telepresence. With high levels of viv-idness and interactivity, a high-telepresence virtualgraphs can provide a more realistic buying experi-ence. It is now possible to provide individuals with imagery that is as if they were actually buying goods at the local "brick and mortar" store.

3.4. Experimental Procedure

Experimental stimulus was developed in a smartphone application. When a participant arrived at the lab, he or she was guided to a table where a smart phone was placed on. Once they fill out informed con-sents, they get started. Instruction shown to participants was like the following.

"While you are browsing through mobile applications to buy food products to eat with your family at home, you stopped looking at the next product on the screen. Let's assume that the average market price for this product is $XX and your budget is ample. And make sure you decide whether to buy the product or not by looking at the product details.

Now, when you're ready to see the next screen, press Space button."

If a participant watches an experimental stimulus for 30 seconds, stimuli screen automatically switch-es to the questionnaire screen. Participants fill out the questionnaire and press the "Done" button to advance to the next experimental stimulus. This program ends when a participant completes 5 sets of stimuli and questionnaires. After completing the above, the participants were asked to answer the face-to-face interviews.

At the end of the experiment, we asked the following as a manipulation check: "Do you think the im-age of the shopping mall you've seen has helped you imagine fruit?" It shows the manipulation check results; based on the seven-point Likert scale, the average score was 5.07 (SD = 1.45) in

the experimental group and 5.21 (SD = 1.35) in the control group; the t-test results showed no significant difference be-tween the two groups (p 〈 0.59). Once the participant had responded to all five stimuli and answered the questionnaire, the experiment ended, after which we conducted face-to-face interviews with each partic-ipant for two to five minutes. In the interviews, we showed the experimental group the still images the control group had seen and showed the control group the Virtualgraph so that the two groups could compare the differences between the still and Virtualgraph. The participants were allowed to speak freely about the two images, and we recorded and transcribed the interviews. We then conducted sum-mative content analysis (Hsieh and Shannon 2005) of the transcripts, which entailed calculating the numbers of times participants had used specific words and phrases.

3.5. Verifying the Content Validity of the Evocativeness Measure

Each question of the questionnaire was rated on a seven-point Likert scale, and participants completed the questionnaires after they viewed mobile commerce pages with either Virtualgraph or still images. We analyzed these data using SPSS 20.0 (IBM Corp., Chicago, IL, USA) for statistical analysis and Smart PLS 2.0 (https://www.smartpls.com/) for equation modeling. We measured perceived food quality, perceived value price, and purchase intention using validated measurement items from other studies and measured evocativeness based on the visual stimuli.

To maximize the content validity of the evocativeness measure, we invited 12 experts with more than 10 years of research experience in marketing, cognitive science, computer science, and management information system to discuss the criteria and item development; the experts agreed that the items should gauge individuals' past, present, and future evocations from the experiment stimuli. Images have been utilized in a variety of applications such as mental therapy (Miller 1973) and improving athletes' skills (Ekstrom, Dermen et al. 1976), and

separately, reproductive imagination evokes past memory, and creative imagination evokes future images to change individuals' viewpoints (Betts 1923) and induce specific images (Liang, Hsu et al. 2013). Table 3 shows the questionnaire items we derived from our experts' input. We divided evocativeness into past or present/future and developed the questionnaire to measure the participants' five senses' responses to past, present, and future evocations of the visual stimuli.

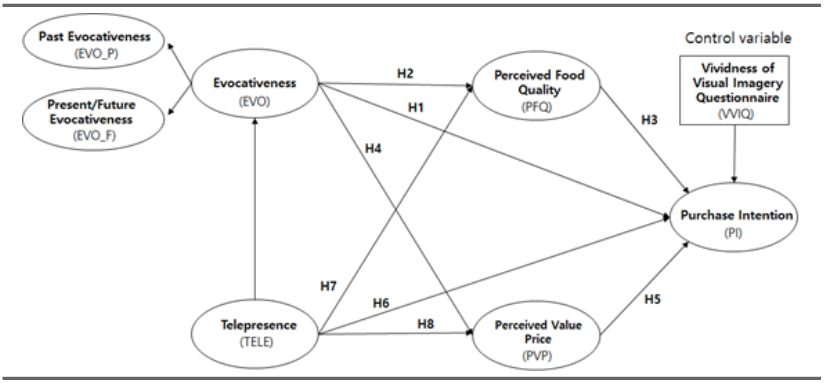
| Table 3 | Evocativeness Questionnaire Questions

Classification	Questions Texts
[EVO_P] Past evocativeness questions (Reproductive imagery)	[P1] The image reminded me of fruit I had seen in the past.
	[P2] The image reminded me of the smell of fruit I had experienced in the past.
	[P3] The image reminded me of the taste of fruit I had experienced in the past.
	[P4] The image reminded me of the texture of fruit I had experienced in the past.
	[P5] The image reminded me of fruit I had experienced in the past.
[EVO_F] Present/future evocativeness questions(Creative imagery)	[F1] The image will remind me of the fruit I saw.
	[F2] The image will remind me of the smell of the fruit.
	[F3] The image will remind me of the taste of the fruit.
	[F4] The image will remind me of the texture of the fruit.
	[F5] The image will remind me of the sound of the fruit.

3.6. Construct Analysis of Evocativeness

Because we were measuring product evocativeness based on participants' past and present/future experiences, we used reflective second-order construct analysis to assess the measure (Bradley and Henseler 2007). Second-order construct analysis takes three possible forms: a two-step approach, the well-known hierarchical component approach,

and the hybrid approach. We attempted to combine the three, but we ultimately used the second approach, which produced the best result. Fig. 2 shows the research model's measurement variables, and shows our first- and second-order evocativeness constructs for the analysis.



| Fig 2 | Research model

3.7. Reliability and Validity of the Measurement Model

Table 4 gives the operational definitions of the five variables we used in this study, including the lit-erature we used to derive them; these factors are considered important in e-commerce. Most of mesure-ment items used in the questionnaire are drawn from scales of literature except evocativeness (Zmud, Anthony et al. 1993, Albarracin, Johnson et al. 2014, Babin, Babin et al. 1999, Sweeney and Soutar 2001, Elder and Krishna 2010, Zampini and Spence 2004, Steuer 1992, Marks 1973). Scales for evoca-tiveness were created based on text of a study by Zmud, Anthony et al. (1993).

| Table 4 | Research measurement categories

Factor	Category	Related Research
Evocativeness (EVO)	Previous experience with the product	Zmud, Anthony et al. (1993)
	Imagination about the past, present, and future of the product	
Purchase intention (PI)	Intention to purchase the product	Albarracin, Johnson et al. (2014); Babin et al. (1999)
Perceived value price (PVP)	Monetary value of the product	Sweeney and Soutar (2001)
Perceived food quality (PFQ)	Perceived taste of the product	Elder and Krishna (2010)
	Perceived freshness of the product	Zampini and Spence (2004)
Telepresence (TELE)	Telepresence of the product	Steuer (1992)
Vividness of Visual Imagery Questionnaire (VVIQ)	Differences in individual imagery	Marks (1973)

Evocativeness (EVO) refers to how much an image has evoked a user, purchase intention (PI) represents how much a user want to buy after the stimuli, perceived value price (PVP) is how much the expected monetary value is, perceived food quality (PFQ) measures subjective thoughts of the quality of food products, telepresence (TELE) is related to how realistic a user perceive from a screen, and vividness of visual imagery questionnaire (VVIQ) refers to individual's ability to imagine something. VVIQ is used for controlling for the differences among users.

We conducted both exploratory and confirmatory factor analyses (EFA and CFA, respectively) to check validity and reliability, using SPSS for the EFA and Smart PLS for the CFA.

A newly developed construct, evocativeness needed to be verified for validity and reliability. We first tested the second-order variables, product evocativeness of past memories and of present and future imagination, and then we tested the first-order variable.

The Cronbach's alpha coefficients for both sub-variables were higher than 0.8, which is regarded as reliable. Table 6 displays the EFA results and the Cronbach's alphas.

| Table 5 | EFA Results for Evocativeness

Testing Variables			Components		Cronbach's Alpha
Variables	Sub-variables		1	2	
EVO	EVO_P	P1	0.87	0.20	0.88
		P3	0.87	0.30	
		P4	0.69	0.64	
	EVO_F	F7	0.17	0.85	0.84
		F8	0.30	0.81	
		F10	0.60	0.70	

As shown in Table 5, six evocativeness factors, EVO_P1, EVO_P3, EVO_P4, EVO_F7, EVO_F8, and EVO_F10, had Cronbach's alphas that far exceeded 0.8, and their components' factor loadings were higher than 0.6. The four factors—EVO_P2, EVO_P5, EVO_F6, and EVO_F9—that asked if the images of the mall triggered in the participants' memories of previous experience with other images or present or future thoughts about the stimuli did not fit our research model theory, and thus we removed them. Table 6 presents the EFA results for all variables.

| Table 6 | EFA Results for All Variables

Variables	Components				
	1	2	3	4	5
PFQ_3	**.892**	.156	.186	.214	.139
PFQ_2	**.886**	.186	.188	.196	.150
PFQ_3	**.864**	.233	.186	.210	.207
PFQ_1	**.851**	.301	.136	.227	.164
PFQ_1	**.844**	.185	.204	.264	.173
PFQ_2	**.700**	.457	.236	.061	.217
EVO_P3	.252	**.906**	.115	.045	.131
EVO_F8	.180	**.904**	.198	.019	.072
EVO_P4	.144	**.733**	.096	.247	.343
EVO_F7	.259	**.692**	.332	.140	−.059
EVO_P1	.108	**.648**	.065	.267	.456
EVO_F10	.282	**.596**	.347	.090	−.021
TELE_3	.183	.235	**.898**	.118	.115
TELE_4	.093	.217	**.888**	.129	.220
TELE_1	.218	.163	**.866**	.144	.169
TELE_5	.274	.164	**.782**	.138	.091
PVP_1	.311	.176	.208	**.832**	.076
PVP _2	.555	.202	.209	**.687**	.177
PVP _3	.590	.188	.248	**.666**	.141
PI_1	.492	.214	.426	.105	**.670**
PI_2	.516	.208	.324	.136	**.658**
PI_3	.530	.224	.387	.131	**.656**

As Table 6 shows, the EFA results indicated no issues with our selected variables or their suitability for our model (Kaiser-Meyer-Olkin test = 0.88, Bartlett's test = 1843.49). All factor loadings were higher than 0.5 which is low when considering CFA. But if the model is exploarive, 0.5 is acceptable for EFA. In addition, the Cronbach's alphas for all variables exceeded 0.9, supporting high internal consistency between measurement categories.

Next, we conducted CFA to verify internal consistency and discriminant validity using Smart PLS 2.0. Table 7 shows the overall compatibility of the PLS (partial least squares) path model, including that composite reliability exceeded 0.9, and the mean dispersion above 0.6 also showed high internal consistency; according to Fornell and Larcker (Fornell and Larcker 1981), composite reliability higher than 0.7 and mean dispersion higher than 0.7 indicate internal consistency.

| Table 7 | Overall Compatibility of the PLS Path Model

Category	Mean dispersion value (AVE)	Composite reliability	R Square	Cronbach's alpha	Communality
EVO	0.69	0.93	0.25	0.91	0.69
EVO_F	0.75	0.90	0.88	0.84	0.75
EVO_P	0.80	0.92	0.89	0.88	0.80
PFQ	0.88	0.98	0.39	0.97	0.88
PI	0.95	0.98	0.66	0.97	0.95
PVP	0.88	0.96	0.34	0.93	0.88
TELE	0.86	0.96		0.95	0.86
VVIQ	0.14	0.65		0.85	0.14

Meanwhile, Table 8 shows the discriminant validity results; the square roots of the mean dispersions all exceeded 0.7, as did the cross-factor loadings, which also indicated discriminant validity.

| Table 8 | Discriminant validity results

Category	EVO	EVO_F	EVO_P	PFQ	PI	PVP	TELE	VVIQ
EVO	1.00							
EVO_F	0.94	1.00						
EVO_P	0.94	0.77	1.00					
PFQ	0.58	0.54	0.55	1.00				
PI	0.57	0.53	0.54	0.74	1.00			
PVP	0.51	0.48	0.48	0.75	0.63	1.00		
TELE	0.50	0.52	0.43	0.50	0.62	0.49	1.00	
VVIQ	0.11	0.09	0.12	0.19	0.28	0.24	0.12	1.00

In brief, we analyzed all measurement items and found all to be suitable for use in the study.

4. ANALYSIS

4.1. Consumers' attitudes and responses regarding the virtua lgraph and still image stimuli

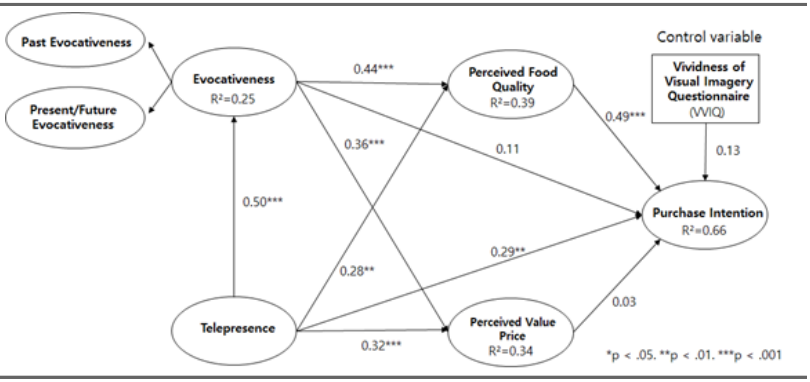
Table 9 present the findings from comparing the experimental and control groups' questionnaire responses.

| Table 9 | Comparative Analysis Results for the Experimental and Control Groups

Classification	Exp.			Cont.			t	Sig.
	N	M	SD	N	M	SD		
EVO	57	4.63	1.25	57	4.18	1.31	4.20	〈0.001***
PI		4.58	1.57		3.25	1.60	10.08	〈0.001***
PFQ		3.67	1.63		2.97	1.47	5.41	〈0.001***
PVP		3.79	1.42		3.30	1.33	4.28	〈0.001***
TELE		3.89	1.33		2.66	1.34	4.93	〈0.001***

As shown in the table, the participants in the experimental group who saw the Virtualgraph reported higher product evocativeness than did the participants in the control group who saw still images; the average evocativeness in the experimental group was 4.63 (SD = 1.25), whereas it was 4.18 (SD = 1.31) in the control group.

Similarly, the experimental group reported higher purchase intention, perceived food quality, and perceived value price than did the control group.



| Fig 3 | Full group analysis

The t-test results for the group comparisons were all statistically significant, with Fig. 3 displaying the results graphically.

4.2. Validating the path model

We used structural equation modeling to analyze the relationships between variables. Analysis types include covariance-based analysis such as LISREL and component-based analysis such as PLS. Generally, PLS is known to be stable with deviations in multivariable distribution and suitable for both exploratory and confirmatory research purposes (Chin 1998, Gefen, Straub et al. 2000). Moreover, PLS does not require hypotheses regarding multivariable normality, and it is thus less limited by sample size and, consequently, free from theoretical hypotheses and premises. Therefore, PLS is useful for early research models that have been just developed and not yet tested (Teo, Wei et al. 2003).

In this study, we measured the extent to which the visual stimuli evoked perceived food quality and perceived value price among participants and how much these influenced participants' purchase intentions. Using data from the 114 participants, we conducted PLS structural model analysis of 10,000 bootstrap samples to test our hypotheses. Table 10 reflects the analysis results.

| Table 10 | Study Hypothesis Testing Results

Hypothesis	Path	Path coefficient	t	R^2	Result
H1	EVO → PI	0.11	1.22	0.66	Not supported
H2	EVO → PFQ	0.44	6.31	0.39	Supported
H3	PFQ → PI	0.49	4.09		Supported
H4	EVO → PVP	0.36	4.42	0.34	Supported
H5	PVP → PI	0.03	0.27		Not supported
H6	TELE → PI	0.29	3.17	0.66	Supported
H7	TELE → PFQ	0.28	3.42	0.39	Supported
H8	TELE → PVP	0.32	3.53	0.34	Supported

The analysis results suggest that evocativeness does not directly affect purchase intention, and therefore H1 was rejected. However, H2 and H3 were supported in that EVO influenced PFQ and PFQ influenced purchase intention at $p < 0.00$. H4 was supported in that EVO influenced PVP. But H5 was not supported in that PVP doesn't influence purchase intention. We analyzed telepresence for its effects on participants' perceptions of food quality and of value price as well as their purchase intention, and H6, H7, and H8 were all supported.

In summary, evocativeness in this study influenced the participants' perceptions of food quality and value price, and telepresence influenced PFQ, PVP, and purchase intention. Additionally, PFQ had a direct effect on purchase intention, but PVP did not. In addition, we found that the VVIQ score used as a control variable had no significant effect on purchase intention.

4.3. Mediation analysis

We tested for four mediating effects of the study model; specifically, we examined the effects of the images on PFQ and PVP mediated through evocativeness and purchase intention.

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}}$$

$R^2_{included}$: Full model, $R^2_{excluded}$: Reduced model

| Equ 1 | A Method for Testing the Mediating Effect of the PLS Structural Equation Model

We investigated the images' effects on the relationship between PFQ and PVP mediated by telepresence and purchase intentions. We tested these mediating effects in the PLS structural equation model as well.

| Table 11 | Mediating effect verification

Path	Mediated Variable	Model Type	R^2	f^2	Size of Effect
EVO → PI	PFQ	Full Model	0.55	0.51	Big
		Reduced Model	0.32		
EVO → PI	PVP	Full Model	0.40	0.13	Small
		Reduced Model	0.32		
TELE → PI	PFQ	Full Model	0.55	0.38	Big
		Reduced Model	0.38		
TELE → PI	PVP	Full Model	0.40	0.03	Small
		Reduced Model	0.38		

Table 11 presents a formula proposed by Chin (Chin 1998) that we used to evaluate the suitability of our proposed model. With PLS, a high R^2 indicates a good model; if the R^2 for the model with the mediating variable is higher than that for the model that excludes the mediating variable, the variable is considered to have a mediating effect. At this time, the model including the mediating variable is called the full model, and the model without the mediating variable is called the reduced model. It is assumed that there is a small effect when the calculated f^2 is between 0.0 and 0.15, a medium effect when it is between 0.15 and 0.35, and a large effect if it is greater than 0.35 (Cohen 2013). The results in Table 12 were derived from calculating the equation.

As a result of analyzing the effects of the mediating variables, we found that evocativeness did not directly affect purchase intention but did affect purchase intention mediated by perceived food quality; we found that PFQ had a large mediating effect.

Evocativeness had a direct effect on perceived value price, but it did not affect purchase intention mediated by PVP. Thus we determined that the mediating effect was small.

We also analyzed the mediating effects of telepresence and purchase intentions and found that the mediating effect of PFQ was large but that of PVP was small.

4.4. Interviews Study

For this study, we used mixed methods, that is, both qualitative and quantitative research methods simultaneously. Using mixed methods allows for approaching a single research question using quantitative methods such as statistical analysis and qualitative methods such as questionnaires and interviews; then, based on the results of the two data analyses, the research results are deduced. The two types of data are characterized by independent or simultaneous or delayed time collection (Creswell and Clark 2017).

We added the interviews for this study because they complemented the problem whose answer was not revealed by the statistical analysis.

We showed two smartphones to participants: one with Virtualgraph, the other with still images. We then asked three questions; (1) "You saw products from two different devices. Please feel to say anything," (2) "Which one inspire your imagination more?" (3) "Why do you think so?" Table 13 summarizes the answers from the first question. During the interview, the term "Virtualgraph" was not used. We recorded everything they said. After that, while listening to the recording file, we labeled the words positive and negative

In the interviews, participants who gave out positive opinions for the Virtualgraph outnumber those who gave negative opinions. Respondents used a total of 5,011 words to evaluate the Virtualgraph, with a per-person average of 44, and of the total words that were used, 244 were positive, 58 were negative, and the remaining 4,709 were neutral; some of the negative comments used to evaluate the Virtualgraph was that they did not differ from the still images, they were "awkward," and participants did not want to buy the product.

| Table 12 | Positive Words Extracted from the Interview Data

No	Words	Description	%	Count
1	Angle	I like to see what I want	20.1%	49
2	Real	It looks real	17.2%	42
3	Haptic effect	I like this haptic effect	12.7%	31
4	Sound effect	I like this sound effect	9.8%	24
5	Clear	Good for seeing the product in detail	8.2%	20
6	Vivid	Looks vivid	6.1%	15
7	Purchase intention	Purchase intention increased	5.7%	14
8	Delicious	Looks delicious	2.5%	6
9	Interesting	It is interesting	2.5%	6
10	Confidence	Confidence increased	2.0%	5
11	Effort	It seems to me that it took effort	1.6%	4
12	Resistance	There was no resistance to it	1.6%	4
13	Fresh	Fresh feeling	1.2%	3
14	Information	Provide much more information	1.2%	3
15	Interactive	Interactive experience is good	1.2%	3
16	Novelty	It is a novelty	1.2%	3
17	Attractive	More attractive	0.8%	2
18	Easy	It is easy to manipulate.	0.8%	2
19	Quality	Looks good quality	0.8%	2
20	Effective	More effective	0.4%	1
21	Familiar	It is familiar	0.4%	1
22	Immersive	It is immersive	0.4%	1
23	Memory	Remains in the memory	0.4%	1
24	Stimulating	It stimulates various senses	0.4%	1
25	Unique	Looks unique	0.4%	1

Regarding the first question, the participants answered that it was good to be able to view the products from various angles in the Virtualgraph; they considered the images to be of real fruit, the haptic and sound effects were good, the product images were clear and vivid, the fruit was perceived to be delicious, and participants' purchase intentions increased.

The following is an example of what participants said. In this case, the second one is Virtualgraph images.

"I think the second one was much better. It's much more natural to rotate as I wish. When I press the image, the image is distorted. But the sounds coming from pressing are different, which seems to be desired stimuli. I want to buy."

For the second question, regarding which of the two images inspired the participants' imaginations, 102 (89.5%) answered that the Virtualgraph helped them to imagine the products, seven (6.1%) answered that there was no difference, and five (4.4%) selected the still images.

Here is another example.

"Whereas the first one can only be judged visually, the second one is not only visual, but it also helps to imagine a little more, including touch and hearing."

The third question was "Why do you think so?" The responses to the third question were similar to those for the first: 1) I could see the product from various angles; 2) the product seems real; 3) the haptic and sound effects; 4) it seems to stimulate my senses; and 5) the interactive effect.

The following is an example of the interview related to haptic function.

"I feel the texture by pressing it directly. Fruits I ate in the past popped up in my mind. This helped me to feel more purchasing."

As the interview results demonstrate, the participants who viewed the Virtualgraph was better able to engage with the products; they perceived the products as real, paid more attention to them, and demonstrated higher purchase intentions.

5. DISCUSSION AND CONCLUSION

As results of path analysis, H2, H3, H4, H6, H7, H8 were supported while H1 and H5 were not sup-ported. From this, it can be said that evocativeness has no direct influence on purchase intention and perceived value price does not affect purchase intention. Meanwhile, it is very interesting that evoca-tiveness affects perceived food quality and perceived value price. From this, it can be interpreted that a user who is able to evoke images from the past experience is more likely to perceive food better quali-tied and higher priced. In other words, only if a mobile shopping mall increases users' evocativeness, the shopping mall can get more benefits. From the rejection of H5, we can figure out that perceived price of a product and purchase intention have nothing to do with each other. Moderating effect of evocative-ness on the relationship between perceived value price and purchase intention was also not significant. It was quite confirmatory that telepresence affects perceived food quality, perceived value price, and purchase intention, which is consistent with prior studies.

Shopping mall administrators attempt to provide customers with information on product features and specifications and to understand the importance of product images (Chebat, Sirgy et al. 2010), often operating their own studios to study consumer criteria for selecting products, working diligently to im-prove image quality, and developing image production techniques. However, images still largely focus only on explaining products. We approached this research topic, which had not yet been explored in the literature, in an effort to define the quality of evocativeness.

In this study, we were able to confirm that a product's evocativeness contributed significantly to un-derstanding customers' perceptions and behaviors regarding purchasing products online. With our de-veloping and verifying new ways to measure product evocativeness in an online environment, our study results add a theoretical basis to studies on evocativeness. The results suggest that rich interactive im-ages can

increase product purchase intentions mediated by perceived food quality in online shopping sites. We rigorously validated our results using a questionnaire and interviews, which in turn contribut-ed significantly to validating our methodology.

In order to investigate whether the conclusions we reached were in fact obvious, we divided the con-tributions of this study into theoretical and practical. First, in terms of the theoretical contributions, our research focus was product evocativeness, and we established a theoretical basis for future evocativeness studies. Second, we verified that evocative imagery of food products in an online shopping mall affect-ed purchase intention, perceived food quality, and perceived value price; we also determined that the virtualgraphs were more evocative than was the general still imagery. Third, a new variable, evocative-ness, was proposed and its importance in mobile commerce was discussed. Findings from this study will give practioners insights. Finally, our use of mixed methods—a questionnaire and interviews—contributed significantly to validating our research approach.

In terms of practical contributions, the study findings suggest the application of interactive imagery as a way to improve evocativeness by verifying that virtualgraphs in an online shopping mall environ-ment aided in visualizing products; we found that consumers perceived higher value for products that were presented as Virtualgraph than for those that were presented as still images. Although the virtual-graphs did not directly affect purchase intentions, we found that evocativeness strongly influenced per-ceived food quality, which influenced purchase intentions.

Using Virtualgraph to display products, especially food, is an effective way to increase consumers' online product purchase intentions because relevant imagery information such as taste and smell is easi-ly evoked from seeing images of food. The results of this study provide online food marketers with strategies for increasing online food sales using rich interactive images. Specifically, the current study examined the influences of increased image evocativeness in an online shopping mall environment from various aspects.

The limitation of this study is that the participants are only limited to students. Although students are good candidates for high-tech users, yet it would be also good to study with non-student population for better understanging of consumers. Also in the analysis, we did not consider the possibilities of bias coming from participants' status such as being hungry and familiarity with e-commerce.

Interview studies, qualitative data collected from participants, were compared between the experi-mental and control groups, but quantitative data were not compared between the two groups. And, the only part of experimenting with fruit products can also hinder the validity of this paper. In addition, Virtualgraph had difficulty adding to the visual and haptic effects rather than still images, and it was difficult to find out exactly what part and image caused the correct comparison between the two groups. For example, each experiment participant has different ideas about fruits, so we will consider this further.

In addition, there are few mobile phone models that support Force Touch, making it difficult for the public to easily experience Virtualgraph content. In the future, it would be good to consider variety of devices and computing environments such as PCs, tablets, and HMD and to compare them. In order to increase generalizability, it would be good to extend to non-food goods.

References

Albarracin, D., B. T. Johnson and M. P. Zanna (2014). The handbook of attitudes, Psychology Press.

Amedi, A., R. Malach and A. Pascual-Leone (2005). Negative BOLD differentiates visual imagery and perception. Neu-ron 48(5): 859-872.

Babin, L. A., B. J. Babin and J. S. Boles (1999). The effects of consumer perceptions of the salesperson, product and dealer on purchase intentions. Journal of Retailing and Consumer Services 6(2): 91-97.

Baldauf, A., K. S. Cravens, A. Diamantopoulos and K. P. Zeugner-Roth (2009). The impact of product-country image and marketing efforts on retailer-perceived brand equity: an empirical analysis. Journal of Retailing 85(4): 437-452.

Barfield, W. and C. Hendrix (1995). The effect of update rate on the sense of presence within virtual environments. Virtual Reality 1(1): 3-15.

Barfield, W. and S. Weghorst (1993). The sense of presence within virtual environments: A conceptual framework. Ad-vances in Human Factors Ergonomics 19: 699-699.

Betts, G. H. (1923). The mind and its education, D. Appleton.

Böcker, M. and L. Mühlbach (1993). Communicative presence in videocommunications. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, SAGE Publications.

Bone, P. F. and P. S. Ellen (1992). The generation and consequences of communication -evoked imagery. Journal of Con-sumer Research 19(1): 93-104.

Bradley, W. and J. Henseler (2007). Modeling reflective higher-order constructs using three approaches with PLS path modeling: a Monte Carlo comparison.

Chebat, J.-C., M. J. Sirgy and S. Grzeskowiak (2010). How can shopping mall management best capture mall image? Journal of Business Research 63(7): 735-740.

Cheng, Y., A. N. Meltzoff and J. Decety (2006). Motivation modulates the activity of the human mirror-neuron system. Cerebral Cortex 17(8): 1979-1986.

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. Modern methods for business research 295(2): 295-336.

Cohen, J. (2013). Statistical power analysis for the behavioral sciences, Routledge.

Coman, E., & Rauh, C. (2003). The impact of imagination on computer mediated telepresence. Presence panel: Infor-mation Systems Division, International Communication Association.

Creswell, J. W. and V. L. P. Clark (2017). Designing and conducting mixed methods research, Sage publications.

Cui, X., C. B. Jeter, D. Yang, P. R. Montague and D. M. Eagleman (2007). Vividness of mental imagery: individual variabil-ity can be measured objectively. Vision research 47(4): 474-478.

Cyr, D., M. Head, H. Larios and B. Pan (2009). Exploring human images in website design: a multi-method approach. MIS quarterly: 539-566.

Cyr, D., M. Head, H. Larios and B. Pan (2009). EXPLORING HUMAN IMAGES IN WEBSITE DESIGN: A MULTI-METHOD APPROACH. MIS quarterly 33(3).

Day, G. S. and G. S. Day (1990). Market driven strategy: Processes for creating value, Free Press New York.

Engel, J. F., Blackwell, R. D., & Miniard, P. W. (1982). Consumer behavior. New York: Holt.

Ekstrom, R. B., D. Dermen and H. H. Harman (1976). Manual for kit of factor-referenced cognitive tests, Educational testing service Princeton, NJ.

Elder, R. S. and A. Krishna (2010). The effects of advertising copy on sensory thoughts and perceived taste. Journal of Consumer Research 36(5): 748-756.

Fornell, C. and D. F. Larcker (1981). Evaluating structural equation models with unobservable variables and measure-ment error. Journal of marketing research 18(1): 39-50.

Führer, D., S. Zysset and M. Stumvoll (2008). Brain activity in hunger and satiety: an exploratory visually stimulated FMRI study. Obesity 16(5): 945-950.

Gefen, D., D. W. Straub and M.-C. Boudreau (2000). And regression: guidelines for research practice. Communication for the Association of Information System 4(7).

Gregory, W. L., R. B. Cialdini and K. M. Carpenter (1982). Self-relevant scenarios as mediators of likelihood estimates and compliance: Does imagining make it so? Journal of Personality and Social Psychology 43(1): 89.

Gunawan, D. D., & Huarng, K. H. (2015). Viral effects of social network and media on consumers' purchase intention. Journal of Business Research, 68(11), 2237-2241.

Hatakeyama, T. (1997). Adults and children with high imagery show more pronounced perceptual priming effect. Per-ceptual and motor skills 84(3_suppl): 1315-1329.

Heeter, C. (1995). Communication research on consumer VR. Communication in the age of virtual reality: 191-218.

Held, R. M. and N. I. Durlach (1992). Telepresence. Presence: Teleoperators & Virtual Environments 1(1): 109-112.

Hsieh, H.-F. and S. E. Shannon (2005). Three approaches to qualitative content analysis. Qualitative health research 15(9): 1277-1288.

Jocoby, J. (1977). Consumer response to price: an attitudinal, information processing perspective. Moving ahead with attitude research.

Johnson, H. C. (2001). Marketing Memories: Favorite Recipes as Retrieval Cues in Autobiographical Memory.

Klein, L. R. (2003). Creating virtual product experiences: The role of telepresence. Journal of interactive Marketing 17(1): 41-55.

Li, H., T. Daugherty and F. Biocca (2002). Impact of 3-D advertising on product knowledge, brand attitude, and purchase intention: The mediating role of presence. Journal of advertising 31(3): 43-57.

Liang, C., Y. Hsu, C.-C. Chang and L.-J. Lin (2013). In search of an index of imagination for virtual experience designers. International Journal of Technology and Design Education 23(4): 1037-1046.

Lombard, M. (1995). Direct responses to people on the screen: Television and personal space. Communication Research 22(3): 288-324.

Lombard, M. and T. Ditton (1997). At the heart of it all: The concept of presence. Journal of computer-mediated commu-nication 3(2): JCMC321.

MacKay, K. J., & Fesenmaier, D. R. (1997). Pictorial element of destination in image formation. Annals of tourism re-search, 24(3), 537-565.

Makens, J. C. (1965). Effect of brand preference upon consumers perceived taste of turkey meat. Journal of Applied Psychology 49(4): 261.

Marks, D. F. (1973). Visual imagery differences and eye movements in the recall of pictures. Perception & Psychophysics 14(3): 407-412.

Marks, D. F. (1973). Visual imagery differences in the recall of pictures. British journal of Psychology 64(1): 17-24.

McKelvie, S. J. (1994). The Vividness of Visual Imagery Questionnaire as a predictor of facial recognition memory per-formance. British Journal of Psychology 85(1): 93-104.

McKelvie, S. J. and E. G. Demers (1979). Individual differences in reported visual imagery and memory performance. British Journal of Psychology 70(1): 51-57.

Miller, G. A. (1973). Communication, Language, and Meaning: Psychological Perspectives.

Mikalef, P., Giannakos, M. N., & Pateli, A. G. (2012, June). Exploring the Business Potential of Social Media: An Utilitari-an and Hedonic Motivation Approach. In Bled eConference, p. 21.

Mikalef, P., Giannakos, M., & Pateli, A. (2013). Shopping and word-of-mouth intentions on social media. Journal of theoretical and applied electronic commerce research, 8(1), 17-34.

Nicol, J. J. (2008). Creating vocative texts. The Qualitative Report 13(3): 316-333.

O'Donohue, W. T., J. E. Fisher and S. C. Hayes (2004). Cognitive behavior therapy: Applying empirically supported techniques in your practice, John Wiley & Sons.

Paivio, A. and K. Csapo (1973). Picture superiority in free recall: Imagery or dual coding? Cognitive psychology 5(2): 176-206.

Park, J., J. Choi, H. Kim and H. Kwon (2018). The influence of media type and length of time delay on user attitude: Ef-fects of product-focused virtual reality. Computers in Human Behavior.

Pegler, M. M., & Bliss, L. L. (2006). Visual merchandising and display. New York: Fairchild Publications.

Petrova, P. K. and R. B. Cialdini (2005). Fluency of consumption imagery and the backfire effects of imagery appeals. Journal of Consumer Research 32(3): 442-452.

Petrova, P. K. and R. B. Cialdini (2008). Evoking the imagination as a strategy of influence. Handbook of consumer psychology: 505-524.

Pylyshyn, Z. (2003). Return of the mental image: are there really pictures in the brain?. Trends in cognitive sciences, 7(3), 113-118.

Richardson, A. (1983). Imagery: Definition and types.

Robertson, T. S. (1971). Innovative behavior and communication. Holt, Rinehart and Winston. Inc., New York.

Rodríguez-Ardura, I. and F. J. Martínez-López (2014). Another look at 'being there'experiences in digital media: Explor-ing connections of telepresence with mental imagery. Computers in Human Behavior 30: 508-518.

Rolls, E. T. (2005). Emotion explained, Oxford University Press, USA.

Sheridan, T. B. (1996). Further musings on the psychophysics of presence. Presence: Teleoperators & Virtual Environ-ments 5(2): 241-246.

Sherman, S. J., R. B. Cialdini, D. F. Schwartzman and K. D. Reynolds (1985). Imagining can heighten or lower the per-ceived likelihood of contracting a disease: The mediating effect of ease of imagery. Personality and social psychology bulletin 11(1): 118-127.

Simmons, W. K., A. Martin and L. W. Barsalou (2005). Pictures of appetizing foods activate gustatory cortices for taste and reward. Cerebral Cortex 15(10): 1602-1608.

Steuer, J. (1992). Defining virtual reality: Dimensions determining telepresence. Journal of communication 42(4): 73-93.

Stice, E., S. Spoor, C. Bohon and D. Small (2008). Relation between obesity and blunted striatal response to food is mod-erated by TaqIA A1 allele. Science 322(5900): 449-452.

Swann, W. B. and L. C. Miller (1982). Why never forgetting a face matters: Visual imagery and social memory. Journal of Personality and Social Psychology 43(3): 475.

Sweeney, J. C. and G. N. Soutar (2001). Consumer perceived value: the development of a multiple item scale. Journal of retailing 77(2): 203-220.

Teo, H.-H., K. K. Wei and I. Benbasat (2003). Predicting intention to adopt interorganizational linkages: An institutional perspective. MIS quarterly: 19-49.

Tusek, D. L., J. M. Church, S. A. Strong, J. A. Grass and V. W. Fazio (1997). Guided imagery. Diseases of the colon & rectum 40(2): 172-178.

Um, H., D. Kim, K. Choi and G. Kim (2005). A survey on consumer's perception of fresh-cut agri-food products for quality enhancement. Journal of The Korean Society of Food Science and Nutrition 34.

Van Manen, M. (1997). From meaning to method. Qualitative health research 7(3): 345-369.

Wang, Y. J., M. S. Minor and J. Wei (2011). Aesthetics and the online shopping environment: Understanding consumer responses. Journal of Retailing 87(1): 46-58.

Wansink, B. and S. Park (2001). At the movies: how external cues and perceived taste impact consumption volume. Food Quality and Preference 12(1): 69-74.

Wells, J. D., Valacich, J. S., & Hess, T. J (2011). What signal are you sending? How website quality influences perceptions of product quality and purchase intentions. MIS quarterly 35(2): 373-396.

Wright, P. and P. D. Rip (1980). Product class advertising effects on first-time buyers' decision strategies. Journal of Con-sumer Research 7(2): 176-188.

Zampini, M. and C. Spence (2004). The role of auditory cues in modulating the perceived crispness and staleness of potato chips. Journal of sensory studies 19(5): 347-363.

Zeithaml, V. A. (1982). Consumer response to in-store price information environments. Journal of Consumer Research 8(4): 357-369.

Zhang, Kem ZK, and Morad Benyoucef. "Consumer behavior in social commerce: A literature review." Decision Support Systems 86 (2016): 95-108.

Zmud, R. W., W. P. Anthony and R. M. Stair Jr (1993). The use of mental imagery to facilitate information identification in requirements analysis. Journal of Management Information Systems 9(4): 175-191.

요약문

모바일 상거래 효과를 높이기 위한 미래형 VR 이미지 프레젠테이션 기술

박지섭
부산가톨릭대학교 경영정보학과 교수

VR 이미지는 상상력을 불러일으켜 소비자의 태도와 행동에 영향을 미칠 수 있다. 본 연구에서는 현실 기반의 닫힌 루프 3D 영상 (이하 Virtualgraph)을 소개한다. 그리고 이러한 이미지가 모바일 커머스 환경에서 소비자의 연상을 증가시킬 수 있는지, 제품의 시각적 이미지의 높은 원격 현전성이 해당 제품의 구매 의도를 높일 수 있는지를 살펴본다. 이를 위해서 우리는 원격 현전성, 지각된 가치 가격, 지각된 음식의 질, 시각적 이미지의 생생함에 대한 질문지 (VVIQ)로 구성된 모델을 개발하였다. 우리는 Virtualgraph 응용 프로그램을 사용하여 실험을 수행한 후 인터뷰와 설문 조사를 수행하였다. 실험, 설문 조사, 인터뷰 결과 우리는 다음과 같은 사항들을 알 수 있었다. 첫째, 사용자는 정지 이미지보다 Virtualgraph로 연상을 더 잘한다. 둘째, 신선 식품의 지각된 품질이 만족스럽다면 증가된 연상은 구매 의도에 영향을 미친다. 셋째, 증가된 연상은 상품을 높게 평가하게 하며, 신선 식품의 지각된 품질이 좋다면 그 평가는 더 높아진다. 인터뷰에서 우리는 Virtualgraph를 사용한 실험 그룹이 구매 의도가 더 높고 제품을 더 비싼 것으로 인식했음을 알 수 있었다. 또한 실험 그룹이 제품 이미지를 더 선명하고 생생하게 인식하였다. 마지막으로 우리는 모바일 쇼핑몰에서 Virtualgraph를 사용할 때의 전략적 시사점에 대해서 논의한다.

Keywords 가상 그래프, 현실 기반 닫힌 루프 3D 이미지, 연상, 지시적 심상, 원격 현전, VR 이미지, VR 콘텐츠

논문투고일: 2021. 01. 05 게재확정일: 2021. 01. 16