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Is Augmented Reality Advertising a Cure-all? An Empirical Investigation of the Impact of Innovation Resistance on Augmented Reality Advertising Effectiveness

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ABSTRACT

This study employs an experimental design to investigate the conditions under which the use of AR may be particularly effective or rather ineffective in advertising contexts. We first discuss the inconsistent results regarding the effectiveness of AR on advertising message comprehension and argue that these inconsistencies can be at least partly explained by the moderating effect of an individual's resistance to innovation (i.e., AR technologies). We then provide statistically significant interaction effects between ad types (AR-based, traditional 2D) and innovation resistance. Finally, we suggest that the effect of AR on certain variables is constrained or unconstrained by an individual's level of receptivity or resistance to a new technology-based advertising platform, and that flow experience is equivalent regardless of these levels.

Key words*: Augmented Reality, Augmented Reality Advertising, Message Comprehension, Flow, Advertising Effectiveness*.

1. INTRODUCTION

1.1 General discussion

The brand communications environment has dramatically changed in recent years. Digital technologies are fundamentally changing the way advertisers interact and communicate. In particular, there have been continuous efforts toward the integration of new technologies and brand communication, which makes brand communication attractive to consumers. The use of digital content also facilitates the potential for consumer experience with various products and brands. These activities often use augmented reality (AR) technology, which enables consumers to perceive digital environments as physically real and to experience products and brands realistically in AR interfaces. While AR technology has already been adopted for other business sectors, such as training, education, healthcare, tourism, and video gaming, and has made a large impact there, the use of AR in marketing communication has been widely popularized only since late 2012 [1], [2].

Marketers hold an intuitive belief that AR, by providing highly entertaining content with high media richness and inherent interactivity, will undoubtedly lead to positive advertising effects. Indeed, previous studies have consistently reported that AR yields better advertising outcomes, including increased purchase intentions, preferences, product interest, and attitude, toward an ad and a brand when compared to other alternatives that do not use AR in advertising (e.g., [2]-[4]). From a consumer-learning perspective, however, studies have produced inconsistent results. Most previous research indicates that AR leads to improved memory and learning [5]-[7]. For example, the degree of message comprehension afforded by AR is shown to be higher than that by traditional ways of delivering messages to users [8], [9]. In contrast, other studies show no differential comprehension of messages as a function of 3D AR or even higher comprehension and message retention for traditional print ads than AR-based ads [3], [10], [11].

Thus, the first goal of this study is to empirically examine whether the use of AR in advertising contexts positively influences consumers' comprehension of messages in terms of consumer learning and other advertising variables such as consumer interest in ads and flow experience in evaluating advertising performance. We choose these variables since they have been identified in many studies of technology-based advertising as critical variables that should be utilized when

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measuring advertising effectiveness [9], [12], but have been relatively less focused in previous theorization and research on AR advertising [11]. In particular, while positing that there are overall benefits of AR, this study has found that the impact of AR on advertising message comprehension varies under certain conditions. We will first examine the relationships between consumer resistance to innovation (i.e., AR technologies) and other variables (message comprehension, perceived interest in ads, and flow experience). Then, we will offer some insights to explain the conditions that likely underlie consumer perceptions of AR for both enhancing and attenuating advertising effectiveness.

2. CONCEPTUAL BACKGROUND

2.1 AR and its use in print advertising

AR is a type of virtual reality that is augmented by computer-generated sensory input, such as sound or graphics [9], [13], [14]. Many scholars have provided various definitions of AR, but it appears that AR applications must share the following three properties: (a) a blending of virtual- and real-world elements that are (b) interactive in real time and (c) accurately aligned in 3D interfaces [2], [6], [14].

In the current study, reflecting the major properties of AR, AR refers to a technology that places augmented 3D images into print ads, which are viewed using an app on consumers' mobile phones or on tablet computers in real time. Through the cameras and sensors in the devices, this technology adds layers of digital content, including text, sound, video, 2D virtual images, or 3D objects, directly over the print ad displayed on the screen [2], [15], [16]. The appeal of AR is particularly evident in mobile advertising combined with print ads. With the advent of smart mobile devices, it is now possible for advertisers to create more engagement than is possible in print advertising. In fact, in cross-media advertising, device-based AR experiences that interact with other advertising platforms (i.e., print ads) is a particular AR application likely to have a substantial importance for future trends in advertising [2].

2.2 Advertising message comprehension

From a consumer perspective, comprehension and learning are basically inseparable [17]. Thus, a typical measure of consumer learning can be to measure the degree to which consumers accurately comprehend the advertising message as intended by advertisers [18]. As mentioned earlier, in terms of the role of AR interfaces in learning, there has been ongoing controversy over whether the use of AR enhances the comprehension of messages. For example, it is suggested that media are mere vehicles delivering groceries (i.e., communication methods), having no influence on nutrition (i.e., learning) [19], [20]. According to his dictum, communication technologies serve only as vehicles for treatments or instructional techniques; they do not directly influence learning. Relatedly, it is also concluded that there is no substantial difference in learning outcomes in comparison studies across different media [21]. The underlying premise here is that AR technologies do not necessarily play a key role in the process of comprehending advertising messages presented to consumers. Although AR interfaces may attract users' initial attention and allow them to acquire the opportunity to transfer information to memory, they might gradually lose viewers' attention. In the same context, Kalawsky et al. (2000) conducted an experimental investigation of short-term memory and comprehension of information provided by AR displays and did not find a clear distinction between AR and conventional display formats in performance. In another empirical study on message comprehension and learning in traditional 2D print advertising and AR-based advertising, Connolly et al. (2010) reported that 2D print advertisements were more effective in delivering factual information and led to higher retention of messages. Consistent with these findings, Lee et al.'s (2016) study also expressed concern over using AR technologies in the context of learning in adult education, stating that no significant difference was found between the control and the AR exposure group.

In contrast, several accounts have argued that AR advertising is effective in comprehension and learning. For example, it was found that the interactive aspects in a computer-mediated communication context (i.e., Web ads) have a positive impact on consumer memory [22]. These assertions might cause the assumption that the interactive features of AR would be beneficial for advertisers aspiring to deliver more precise messages and minimize misinterpretations about products, services, and brands. That is, a central characteristic of AR is that it enables consumers to learn more about products by providing high levels of virtually experiential values and creating opportunities to interact with brands [2], [11]. In fact, several empirical studies have examined the impact of using AR and reported strong evidence that AR has a positive and direct influence on message learning (e.g., [5]-[9]).

Therefore, in this study, we empirically examine whether the use of AR for print ads positively affects message comprehension. Given that there are contradictory results and assumptions regarding consumer comprehensions of intended advertising messages, we ask the following research question:

RQ1: Will the use of AR in print advertising positively influence comprehension of messages more than traditional print ads?

2.3 Consumer interest in AR advertising

Consumer interest in advertising can be an indicator of effective advertising [23]. According to the Elaboration Likelihood Model, consumer interest in particular ads is associated with increased cognitive devotion, which may increase the likelihood of processing the message content [24]. Therefore, the more interest consumers show in advertising, the more likely it is that they will process the ad messages cognitively [24] and the more their memories and comprehension of messages in the ads will be improved [25], [26].

The innovative use of new emerging technologies such as AR stimulates consumers to become interested and immersed in new devices and platforms [9], [11]. In turn, consumers' affective and cognitive responses to new forms of content delivery may spontaneously increase their interest in the

content and guide the more elaborative processing of the message content. Thus, with the help of AR technologies that connect with consumer interest, the use of AR may increase consumer interest in ads; therefore, the following hypothesis is formulated:

H1: AR ads will generate higher levels of interest than traditional 2D print ads

2.4 Flow experience in AR advertising

Among features commonly noted for AR, such as immersion, interaction, and navigation [27], practitioners often use the physical immersion capabilities of AR, which provide users with images of virtual scene elements [9]. More specifically, experiencing complete sensory immersion via AR can be characterized by the theory of flow because it seems to occur when people are actively engaged in tasks such as playing video games or following specific interactions within an environment [29]. The concept of flow refers to a state of complete absorption or engagement in an activity [28]. The concept has been widely applied to a broad range of research areas, for example, online marketing [30], [31], education [9], [12], [27], media usage [36], and daily life [28], [29].

AR researchers and new media marketing researchers have used flow assessments to investigate the levels and nature of consumers' experienced immersion in virtual environments. Previous studies have suggested consistent findings that flow experiences with total immersion lead to positive behavioral and perceptual outcomes, such as compelling online shopping experiences [31], learning achievement [9], [11], [32], and adoption intent for new media or technologies [9].

Among the many positive marketing consequences of flow, Hoffman and Novak (1996) originally proposed the positive impact of flow experience on consumer learning. In accordance with this, several studies have demonstrated a positive relationship between flow experiences and learning outcomes (e.g., [33], [34]). What appears to be lacking in previous observations is the identification of whether the use of AR technologies in advertising helps create flow experiences that maximize advertising responses. We examine whether AR-based advertising content contributes to flow experiences and how effective it is compared to traditional advertising platforms. Applying the prior study results (i.e., the positive impact of AR technologies on flow experience), we state the following hypothesis:

H2: AR ads will result in more increased flow experiences than traditional 2D print ads

2.5 Relationships among message comprehension, interest in ads, flow experiences, and innovation resistance

There have apparently been inconsistent results in studies of whether AR can enable consumers to comprehend the messages in advertising better. Such inconsistent results deserve further exploration and explanation. When studies continue to report inconsistent findings about the relationship between independent and dependent variables, it is necessary to consider the hypothetical possibility that there is a moderating mechanism and a potential variable affecting the outcomes [35]. Although there can be many factors playing roles in processing, we particularly focus here on the personal variable that reflects a consumer's affective state in new media technologies, which is an important moderator of the effectiveness of advertising on a new medium platform. We speculate that the relationship between the use of AR and advertising effectiveness will be constrained by consumers' psychological characteristics.

The relevant affective factor to examine in this study is an individual consumer's perceived resistance to innovation [37], [38]. In fact, despite the wide range of perspectives and approaches to new media technologies, past studies have shown potential limitations in that they focus only on technology adoption and diffusion [37]-[40]. Users' potential negative perceptions pertaining to the adoption of new technologies and/or systems have been less well studied [41]. Given this limitation, the concept of innovation resistance (IR) has been proposed by Ram (1987) to fill this research gap. According to Ram's (1987) conceptualization, IR refers to an attitude defined as the extent to which individuals themselves feel threatened by change [37].

In the research on new technology-aided advertising, to the best of our knowledge, very little consideration has been given to the role of the IR factor in consumer-learning sectors. When we consider AR as a typical technology-based innovation, we can see that consumers may exhibit different degrees of resistance to it as a new technology. Considering Ram's (1987) assertion that resistance to innovation is dependent on the psychological characteristics of individuals, the impact of AR is assumed to vary depending on the extent to which individuals resist innovation. Therefore, it can be argued that message processing is more pronounced when AR-based ads are exposed to consumers whose IR levels (i.e., AR technology) are relatively low. Through such cognitive processing, advertising messages are likely to be better understood and remembered. Moreover, it is likely that consumers with lower resistance to AR technologies access AR apps and control 3D ad contents more actively than those with higher levels of resistance. Consequently, lower resistance to AR technologies can lead to better comprehension and learning through enhancing users' self-efficacies. Self-efficacy is a critical motivational factor in comprehension and has been identified as enhancing learning performance [42], [43]. With increased self-efficacy beliefs, consumers are more likely to be confident in themselves and more motivated to learn, which in turn will lead to better learning.

Along the same lines, lower resistance to AR technologies may result in a higher interest in AR-based ads, and therefore, lead to high levels of flow experiences. Conversely, inverse cases will accordingly lead to opposite results. That is, consumers with high levels of IR may be less comfortable with AR-based experiences that involve interacting with ad contents that incorporate digitally generated imagery on top of views of the real world, as compared to consumers with low levels of IR. They are more likely to prefer less technology-intensive advertisements that they have experienced on traditional advertising platforms. Therefore, AR-based ads may have a negative impact on advertising effectiveness (i.e., message comprehension, perceived interest in ads, and flow experiences) for those who have higher resistance to AR technologies. This

reasoning leads to the following hypotheses, which predict that the degree of IR will moderate the effect of AR on advertising outcomes. Specifically, we hypothesize the following:

H3a: People with high (low) IR will show lower (higher) levels of message comprehension of AR ads than people with low (high) IR

H3b: People with high (low) IR will show higher (lower) levels of message comprehension of traditional 2D print ads than people with low (high) IR

H4a: People with high (low) IR will show lower (higher) levels of interest in AR ads than people with low (high) IR

H4b: People with high (low) IR will show higher (lower) levels of interest in traditional 2D ads than people with low (high) IR

H5: People with high (low) IR will experience lower (higher) levels of flow of viewing AR ads than people with low (high) IR

3. METHODOLOGY

3.1 Experiment design

This study used a post-test-only control group experimental design. In this experiment, we additionally adopted a 2 (ad type: AR-based vs. traditional 2D) × 2 (IR: low vs. high) factorial design, where ad type was a manipulated variable and IR was a measured variable.

Participants in this study were 120 young adults covering the age range from 25 and 32 (83% male; M age = 29) at a community center in Seoul, South Korea. Participation was voluntary; the sample audience was generally considered to be an ideal target audience for AR marketing in terms of gender and age [44]. Thus, they represent an appropriate population for this study. Participants were selected on an opportunity basis. Half were randomly assigned to an experimental group equipped with a smartphone with a pre-installed app to view AR-based advertisements with a smartphone, and the other half were randomly assigned to a control group to view traditional 2D print advertisements with the same product information.

3.2 Stimulus materials

The stimuli were real color print advertisements that used mobile AR technologies to embed videos and virtual 3D images inside the print. We selected a stimulus product with the consideration of two principles: (1) the product should represent a typical example that takes full advantage of AR (e.g., high media richness and interactivity) when used in advertising and (2) the expression of creative ideas in the advertisement should be natural without necessarily exposing the AR contents. Accordingly, health care/medical products, precision instruments, passenger cars, and fashion clothing goods were initially selected as appropriate product categories for this study. We consulted with a professional in creating mobile AR apps, and finally, selected an air filter as the product for the stimulus ad, as the product seemed to meet our criteria.

To minimize brand familiarity effects, a fictitious brand name was used. The ad stimulus was created by a professional AR company and the embedded AR contents were intended to visualize what consumers may want to know and emphasized specific functions and features of the product. For example, a simulation of air pollution from traffic as it was being vacuumed through the filter inside the product was seen in 3D when using AR-related apps. Consequently, a four-page print ad with different advertising elements (e.g., images, layouts, and advertising copies) of each page was created and all elements on each page were designed to look like a series of print ads. We created a series of ads to adequately show the important features of AR. Each page of the ads contained a short news video, a product demonstration video, and 3D images to help participants understand product attributes and the effects of indoor air pollution.

The same stimulus ad was presented to both the experimental and control groups. The only difference between the traditional 2D and AR-based ads was that the interactive work was manipulated such that the selected subjects were exposed to AR contents through a smartphone AR app. That is, the stimulus ad is non-interactive per se, but displays interactive contents when participants use the AR app.

3.3 Procedures

Subjects in the experimental and control groups first viewed the few pages of informational material in a laboratory setting. This initial test served two purposes: (a) the informational messages provided the subjects with background knowledge, such as the health risks of air pollution and indoor air pollution in any home, and (b) the test was intended to measure and/or check the subjects' initial level of message comprehension, interest in, and perceived flow experience with ads. To reduce demand characteristics and hypothesis guessing, the subjects were told that the purpose of the study was to learn how people act when thinking about air pollution. After exposure to the informational materials, the subjects completed questionnaires measuring their comprehension of messages, initial interest in the materials, and perceived levels of flow experience.

Following this test, four pages of test stimuli (ads) were presented to the subjects. The same questionnaires were completed for the initial test and the post-test. In particular, for subjects in the experimental conditions, the ads were followed by giving a demonstration of how to use the AR app on their smartphone to view embedded AR contents such as news videos with sound or 3D images (see Figure 1, 2, and 3).

With the installed AR app, the experimental group could simply point their phone cameras at certain images on each print ad to see extra information on top of what could be seen in the print. On the other hand, subjects in the control group viewed the same ads without exposure to AR contents.

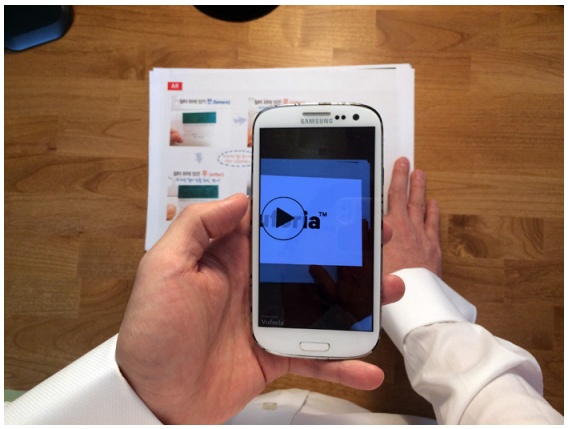

Fig. 1. One of the authors of this paper activates the AR app

Fig. 2. A demonstration of AR to play a news video

Fig. 3. A demonstration of AR to display 3D images

3.4 Measures

All items used in this study are listed in Table 1. To assess message comprehension, four existing five-point semantic differential scale items were adopted [45], [46]. Participants' interest in ads was measured with four five-point Likert-scale items based on the previous study [47]. Participants' perceived levels of flow experience, which consist of four sub-constructs (i.e., distortion in time perception, concentration, control, and autotelic behavior), were assessed with 10 five-point Likert scales based on previous studies [11], [31]. Additionally, the five perceived IR items (five-point Likert scale) were adapted from items used in previous research [48].

Table 1. Summary of dependent measures

Variables	Scale Items	α	Source
Message comprehension	The messages are difficult/easy to understand. The messages are complicated/simple. The messages are confusing/clear. The messages are vague/obvious.	.87	[46]
Interest	The advertising contents are interesting. I enjoyed viewing the advertisements. I have interest in the product. I like this type of advertisement.	.79	[11]
Distortion in time perception (Flow)	Time goes by very quickly when viewing the ads. I tend to lose track of time when viewing the ad. I tend to experience an insentient sense to time when viewing the ads.	.86	[31]
Concentration (Flow)	I am always totally absorbed in the ads while viewing. I am always absolutely focused on the ads while viewing. My attention is always highly concentrated while viewing the ads.	.85	[28]
Control (Flow)	I am confident about controlling the ad contents as I wish.	N/A	[28]
Autotelic experience (Flow)	I want to have the experience of viewing the ads again. I enjoyed viewing the ads themselves. It was very meaningful to view the ads.	.86	[11]
Innovation Resistance	The use of AR in advertising is not necessary. AR ads do not offer any advantage compared to traditional 2D ads. If possible, I would like to refuse AR ads. I find traditional 2D ads more friendly after exposure. I have a strong notion that AR is difficult to use.	.93	[48]

The personal level of product involvement can affect the dependent variables. Therefore, in this study, participants' involvement with the product category was controlled using as a covariate.

4. RESULTS

4.1 Manipulation checks

We manipulated the type of advertisements (AR-based vs. traditional 2D), and manipulation checks with two items were used for each group. Before testing to determine whether, or to what extent, AR-based ads can generate better advertising effectiveness, respondents were asked to indicate their agreement with statements relating to the manipulated variable (i.e., "I think this type of advertisement allows people to participate in the ad," "I think that the ads use 3D elements") on a 5-point scale, with 1 indicating strongly disagree and 5 indicating strongly agree. The results suggest that respondents in experimental conditions considered their ads significantly more interactive and dynamic than those in the control group (M_{AR} = 4.70 vs. M_{2D} = 1.98, F[1, 78] = 630.4, p < .001). Therefore, the manipulation of ad type had the intended effect.

4.2 Effects of AR on message comprehension

Although a randomized group experiment was conducted in this study, it was necessary to equate the experimental and control groups on the basis of ability to understand unfamiliar messages, because hypothesized impacts of variables were considered to be dependent on the subjects' initial levels for each dependent variable [49]. Therefore, to ensure that the test was conducted on the basis of same initial levels of message comprehension, both groups were exposed to informational material, and a t-test comparison of the mean scores of message comprehension between the two groups revealed p = 0.22, indicating no significant difference in the degree to which they comprehended the meaning of the messages (M_{AR} = 3.46 vs. M_{2D} = 3.33). We assumed that subjects in this study had the same level of understanding of messages.

We then conducted a one-way analysis of covariance (ANCOVA), with age and gender as covariates, on the post-test. Within a technology context, as many have noted, age and gender differences are likely to have an influence on an individual's performance, perception, and attitude [50], [51]. Thus, in the current study, we controlled for age and gender effects. The results indicate that there were no significant differences between the two groups (M_{AR} = 3.45 vs. M_{2D} = 3.35, F[1, 76] = .63, p = .42, partial η^2 = .01). The results suggest that the use of AR in advertising has no significant effects on enhancing respondents' message comprehension.

4.3 Effects of AR on consumer interest in advertisements

Following the same procedures, a t-test with experimental and control groups was performed to compare subjects' initial levels of interest in the information messages related to the stimulus materials. On the test, mean scores for subjects in the two groups were not statistically different (M_{AR} = 3.38 vs. M_{2D} = 3.21; t[78] = 1.79, p = .08). These results indicate that both groups initially had the same level of interest in the context of our study.

Mean scores of interest in the ads between the two groups were compared by conducting ANCOVA with age and gender as covariates. In the analyses of post-test measures, the subjects' levels of interest were greater under the condition in which they were asked to use the AR app and view the contents (M_{AR} = 3.94) than those in the other conditions (M2D = 3.16; F[1,76] = 112.04, p < .001, partial η^2 = .60). The present results strongly suggest that AR contents in advertising have causal effects on respondents' interest in ads, and therefore, **H1** was supported.

4.4 Effects of AR on flow experiences

On the basis of same initial levels of subjects' perceived flow experience (M_{AR} = 2.38 vs. M_{2D} = 2.31; t[78] = 1.32, p = .38), we tested our prediction using ANCOVA with ad type as the independent variable and age and gender as covariates. As expected, the test demonstrated statistically significant effects of AR on flow experience (M_{AR} = 3.40 vs. M_{2D} = 2.53; F[1, 76] = 268.30, p < .001, partial η^2 = .62). In support of Hypothesis 2, when AR-based advertisements are presented, these results confirm that AR increases the level of an individual's flow experience.

4.5 Testing for interaction effects

This test was conducted to determine whether the reported relationships between ad type and the three study variables (message comprehension, interest in ads, perceived flow experience) were moderated by IR. As for the level of perceived IR, the data were divided into high and low groups using a mean split. Hypotheses 3a, 3b, 4a, 4b, and 5 predict a statistical interaction of ad type with an individual's perceived IR on advertising outcomes, and to test these hypotheses, a series of two-way analysis of covariance (ANCOVA), with age and gender as covariates, was performed for statistical analysis. The analysis revealed a significant interaction effect between ad type and individuals' levels of IR (F[1, 76] = 17.16, p < .001, partial η^2 = .40; see Fig. 4).

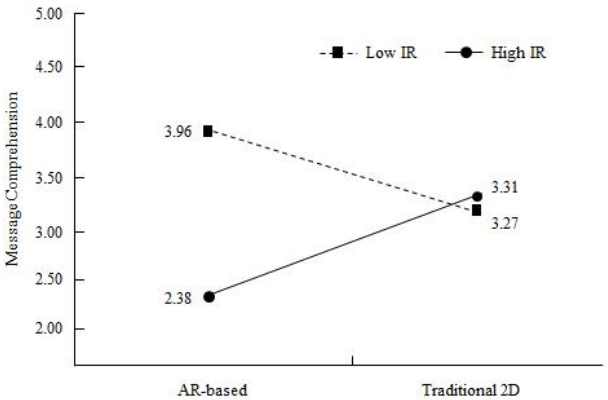

Fig. 4. Interaction Effect of Ad Type and IR on Message Comprehension

The analysis indicated that, while there was a significant main effect for perceived IR (F[1, 76)]= 15.52, p = .001), the main effect of ad type was not significant (p = .53). This is

consistent with the result reported earlier for **RQ1**. Specifically, supporting **H3a**, the ANCOVA on message comprehension scores identified that, when respondents had higher levels of IR, their levels of message comprehension were much lower for AR-based ads (M_{AR} = 2.38, SD = .18) than for those who had low IR (M_{AR} = 3.96, SD = .29). As Figure 4 clearly indicates, only respondents with low IR could understand the meaning of advertising messages better in AR-based ads than in traditional 2D ads (t[38] = 7.49, $p < .001$).

Our test results indicate that respondents with higher levels of IR showed higher levels of comprehension of advertising messages for traditional 2D ads than those with low IR. However, the difference was not statistically significant, indicating that Hypothesis 3b was not supported (M_{2D} = 3.31 vs. M_{2D} = 3.27; t[38] = -.13, p = .90).

Next, we examined the results pertaining to **H4a** and **H4b**, which predict that the degree of IR will moderate the effect of AR on individuals' interest in ads. A separate ANCOVA with individuals' interest in ads as the dependent variable and ad type and individuals' perceived IR as the independent factors was conducted. Paralleling the findings above, the test results for this measure revealed a significant interaction of ad type and individuals' level of IR (F[1, 76] = 5.03, p = .05, partial η^2 = .16; see Fig. 5), with one main effect of ad type (F[1, 76] = 8.5, p = .01).

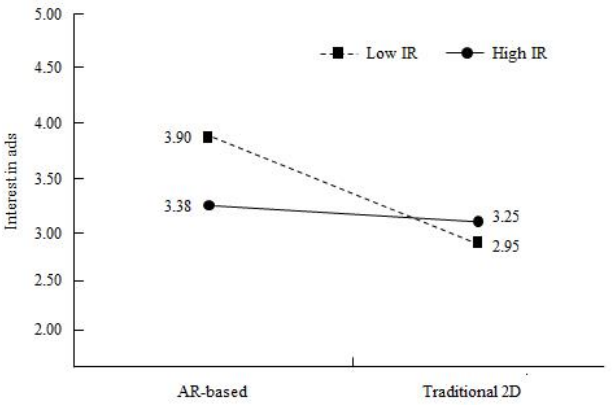

Fig. 5. Interaction Effect of Ad Type and IR on Interest in Ads

Consistent with our prediction, **H4a** was strongly supported by the finding that respondents with higher levels of IR showed lower degrees of interest in AR-based ads than those with low IR (M_{AR} = 3.38 vs. M_{2D} = 3.90; t[38] = 2.40, p = .03). On the other hand, **H4b** was not supported by the result, although respondents with higher levels of IR felt more interested in traditional 2D ads than those with low IR (M_{2D} = 3.25 vs. M_{2D} = 2.95); the mean difference was not statistically significant (t[38] = -1.11, p = .29; see Fig. 5).

However, no significant interaction was observed for perceived flow experience regardless of independent variables, specifically ad type and IR (F[1, 76] = .02, p = .90, partial η^2 = .00; see Fig. 6). Therefore, **H5** was not supported.

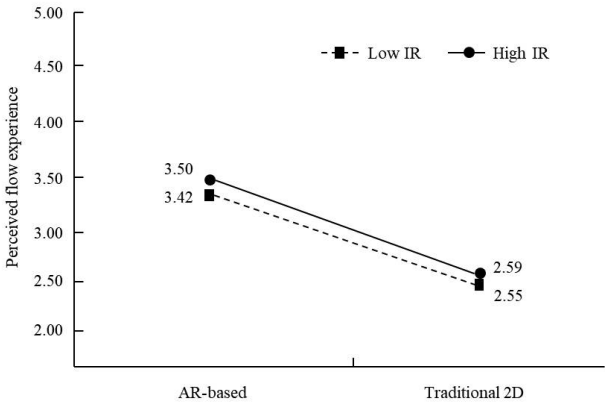

Fig. 6. Interaction Effect of Ad Type and IR on Flow Experience

5. DISCUSSION AND IMPLICATIONS

Previous researchers have recognized that AR has positive effects on advertising outcomes such as ad and/or brand attitudes, behavioral intentions, and perceptions of advertising contents. For example, the ability to virtually deliver high-quality 3D images of products, enhanced telepresence, and interactivity with products have been acknowledged as major benefits of AR [2], [3], [11], [52], [53]. However, although there have been many academic attempts to theoretically describe AR technology's significant potential as a new platform for marketing communication, research on the effectiveness of AR from the consumer-learning perspective is still limited in amount and scope. In particular, researchers have produced asymmetric findings with regard to whether AR enhances message comprehension, and there has not been any conclusive agreement on the effect of AR positively influencing consumers' understanding of advertising messages [3], [5], [6], [8], [10], [11].

In attempting to explain these inconsistent results, the first goal of this study was to investigate whether the use of AR in advertising positively affects respondents' levels of message comprehension, including critical variables such as interest in and flow experiences with ads. In doing so, the current study followed an experimental/control group design using the type of advertisement (AR-based, traditional 2D) as an independent variable. The results show that AR-based ads are more effective in increasing respondents' interest in ads and generating greater flow experience levels than traditional 2D ads. However, a significant effect of AR on enhancing message comprehension levels was not observed in our subjects.

Given these results, the second objective in this study was to investigate whether and in what way the impact of AR on advertising message comprehension and other variables may be contingent on certain conditions. A deeper analysis of the data suggests that the levels of IR (either high or low) moderate the impacts of AR on comprehension. As our proposed mechanism, the findings suggest that an individual's perceived IR moderates the impact of AR on comprehension and perceived interest in ads. Specifically, we assert that the effect of AR advertising varies depending on the degree of an individual's

perceived IR and its effectiveness is greatest when his/her perceived IR is low.

However, the results of the current study contradict our expectation that the flow experience attained in viewing AR ads is not moderated by the strength of an individual's perception of resistance to innovation. These results may be explained by the nature of flow, which unconsciously engages and motivates users in computer-mediated environments, thereby enhancing virtual learning through telepresence when a technology is vivid and interactive [9], [30]. If the flow experience is caused unconsciously among technology users, while IR is a response based on a conscious thinking process ([54]), individuals' AR activities that cause a flow experience are not likely to be influenced by their conscious resistance to AR technology. This assumption is in line with the theory on flow, which states that flow is a particular type of user cognitive response that is, in general, produced almost automatically, often without conscious thinking processes [28], [29], [55].

This study contributes to both theory and practice. First, by conducting an experiment using real AR-based ads, we investigated when and why individuals show higher comprehension of advertising messages and interest in AR ads compared to traditional print ads. In particular, we investigated the moderating effect of IR on AR effectiveness in terms of both enhancement and attenuation of advertising message comprehension. This offers insight into understanding previous findings that report either significant or insignificant effects of AR in consumer-learning contexts. Conceptually, we argue that at least one possible explanation for the inconsistent results that previous studies have yielded can be created by focusing on the function of both ad type and personal factors. As an example, this study proposes an individual difference variable (IR).

The current study also provides useful guidelines for implementing AR technologies in advertising practices. As we argued earlier, the use of AR in advertising will be effective, but not always. If advertisers want to enhance consumer understanding of the messages related to a product (or service) with less concern for the propensity for an individual to innovate, their goal can be achieved by adopting AR for their advertising. However, since implementing AR requires a high cost of time and money, it might not be worthwhile for consumers with high resistance to the technology, since the costs are likely to exceed the benefits. Perhaps these consumers may actually prefer more traditional advertisements over technology-based ads such as mobile AR ads. Therefore, marketers should consider how consumers are likely to perceive a novel technology. Our findings suggest that it is necessary for marketers to promote the advantages and user-friendliness of a technology-based advertising platform, especially if their market is likely to be high in IR or needs detailed information about products from the advertising media. In addition, firms should ensure that their technology-based advertisements are adequately designed to be easy to use for certain consumers in these target groups to reduce resistance.

6. LIMITATIONS AND FUTURE DIRECTIONS

This study has several limitations. First, although our data indicate that the use of AR in advertising is more effective in generating higher interest in ads and flow experiences, it is still possible that a novelty effect, which tends to disappear over time [19], has played a critical role in more favorable responses [2]. As such, it may be possible for respondents to perceive a level of novelty while viewing augmented 3D contents; therefore, the novelty effect of AR-based advertisements is expected to increase respondents' opportunity to become immersed in the stimuli [56], which results in increased interest in ads and flow experience. Therefore, in order to obtain a more comprehensive picture of the nature of AR for enhancing advertising effectiveness, future researchers must investigate whether AR will lead to positive long-term effects on consumers' affective and cognitive responses.

Another limitation is that this study is based only on a selected product category and has limited dependent variables. Although we paid careful attention to minimizing potential problems in the selection of a product for the experiment, the impact of AR on consumer responses may vary with the product category. Recognizing previous claims that the relationships among consumers' cognitive and behavioral responses, such as the amount of attention, product evaluation, brand attitude, purchase intention, and comprehension effort, may vary with different product types [57], [58], future studies in this area may attempt to establish whether the effects of AR differ according to product type (e.g., high vs. low involvement products). Therefore, to validate our arguments, future study on AR effectiveness should extend to other consumer product and service categories and investigate the relationships among variables not included in this study. We also propose that an individual's IR can be a moderator. However, there may be some other potential variables that might moderate AR effects. Thus, the other potential moderators should be examined in future AR research.

Despite these limitations, this study provides insights into what AR can do well and what it cannot do. While most previous studies have supported the intuitive belief of advertisers that AR technologies can enhance advertising effectiveness, in this paper, we focus on a specific interaction mechanism that is responsible for such effectiveness. This study enriches the previous findings by identifying an individual's IR as a moderator that affects the impact of AR on consumer responses to ads.

Returning now to our propositional problem that AR advertising is not a cure-all, we see that marketers rush ahead to use AR without careful thinking, which sometimes is not effective. There are, in fact, advantages and disadvantages to using AR in advertising. We conclude by hoping that our findings presented here will help marketers understand their AR-based campaigns. In their efforts to step up their marketing, AR may have a positive or negative impact on its effectiveness, which may help determine whether to utilize new technology-based advertising platforms or traditional forms of advertising.

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