Multimedia Tools and Applications (2021) 80:27299–27322
https://doi.org/10.1007/s11042-021-11057-x

The influence of cybersickness and the media devices' mobility on the persuasive effects of 360° commercials

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Received: 19 August 2020 / Revised: 4 January 2021 / Accepted: 5 May 2021 /
Published online: 17 May 2021

Abstract
With the rise of immersive media, advertisers have started to use 360° commercials to engage and persuade consumers. Two experiments were conducted to address research gaps and to validate the positive impact of 360° commercials in realistic settings. The first study ($N = 62$) compared the effects of 360° commercials using either a mobile cardboard head-mounted display (HMD) or a laptop. This experiment was conducted in the participants' living rooms and incorporated individual feelings of cybersickness as a moderator. The participants who experienced the 360° commercial with the HMD reported higher spatial presence and product evaluation, but their purchase intentions were only increased when their reported cybersickness was low. The second experiment ($N = 197$) was conducted online and analyzed the impact of 360° commercials that were experienced with mobile (smartphone/tablet) or static (laptop/desktop) devices instead of HMDs. The positive effects of omnidirectional videos were stronger when participants used mobile devices.

Keywords Immersive advertising · Spatial presence · Cybersickness · Advertising effectiveness · Virtual reality

1 Introduction

Immersive media are on the rise [5, 74]. New technological devices, such as head-mounted virtual reality (VR) headsets, mixed reality glasses, and data gloves, have become available to the mass market (e.g., [60]). Even media users who are not willing to pay several hundred

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dollars can acquire phone-based head-mounted displays (HMDs) made of cardboard or plastic [78]. By inserting their smartphones into such HMD frames, users can easily experience diverse content, such as 360° documentaries or rollercoaster rides. With about 15 million units shipped by 2019, Google cardboard headsets may be more prominent than high-quality devices in the homes of media users [64]. For instance, Sony's PS4 VR headset, which can be considered the most successful high-quality headset, has sold only about 5 million units worldwide [48]. In addition to the mass production of a range of VR devices, media companies are working on new applications to make immersive content available to the mass market. Numerous augmented reality and VR applications can be downloaded, and social media channels have already enabled the incorporation of immersive content [3]. YouTube, for example, has introduced a special VR channel, whereas Facebook, Instagram, Twitter, WeChat, and Snapchat have enabled the integration of 360° videos and pictures in social media feeds. Consequently, marketing professionals are already using immersive media forms for advertising purposes [20]. These advertising efforts are diverse, ranging from experimental marketing forms (e.g., in-store promotional campaigns) to social media advertising, but scientific research on the effectiveness of these media forms seems to be scarce. Because of the relatively high cost of producing immersive media content such as 360° commercials, the effectiveness must be analyzed before immersive media forms can be recommended as advertising vehicles [52]. Before summarizing previous research on immersive advertising and identifying research gaps, we clarify the relevant terminology concerning immersive media and their psychological consequences.

2 Immersive media and spatial presence

Immersive media technologies, such as video games, stereoscopic movies (i.e., 3D movies), and VR simulations, can closely simulate unmediated sensory experiences. The level of immersiveness can be assessed objectively on the basis of the levels of vividness and interactivity a medium can offer [55, 70, 73]. The concept of vividness describes the richness of the medium; that is, how many sensory impressions the medium can deliver ("sensory breadth") and how good or realistic these sensory impressions are ("sensory depth") [73]. Whereas vividness can be understood as the level of realness of the virtual world, the degree of interactivity describes the extent and realism of the actions that can be performed in the virtual environment. Interactivity can be understood as a stimulus-driven variable that is determined by the technological features of the medium [73]. More specifically, three factors contribute to interactivity. The first factor is the "speed" of the possible interactions. If the system immediately reacts in accordance with the user's action and the interactions are therefore perceived as occurring in real time, the level of interactivity is naturally high. The second factor incorporates the "range" of interactivity, indicating how many attributes of the virtual environment can be manipulated by the user. It further includes the amount of variation possible within each attribute. If users can manipulate many different factors in the virtual world in multiple ways, the level of interactivity should be perceived as high. The third contributing factor is called "mapping." Steuer [73] described mapping as the "way in which human actions are connected to actions within a mediated environment" (p. 86). Therefore, immersion represents what the technology can deliver [70]. The various types of immersive media forms have been systemized by Flavián et al. [27], who introduced the "EPI Cube" (technological Embodiment/perceptual Presence/behavioral Interactivity). Different forms of immersive

media can be classified on these three dimensions. Whereas VR applications combined with haptic devices score high on all three dimensions, passive 360° videos enable medium levels of embodiment and interactivity along with relatively high levels of spatial presence (for more information on the systemization of immersive media, see [27, 78]).

Generally, the concepts of immersiveness and spatial presence are closely linked but are separated by definition and perspective. Immersive media forms should be able to foster the subjective perception of spatial presence, that is, the *perceptual illusion of non-mediation* and the *sense of being there* [43, 51, 82]. Spatial presence thus describes a subjective perception, whereas the immersiveness of a medium can be judged rather objectively [70]. Several different terms have been introduced to describe this perception in addition to spatial presence, such as "telepresence," "physical presence," or simply "presence" [23, 37, 43]. However, using the term "presence" might be ambiguous because several subtypes of presence exist other than spatial presence, such as social presence (i.e., being with another; [7]) and self-presence (i.e., having the perception of embodying an avatar in a virtual world; e.g., [6]). Consequently, in this article, we use the more specific term "spatial presence."

Wirth et al. [82] described spatial presence as a two-dimensional construct that includes a shift in self-location and a shifted perception of action possibility. Media users experiencing immersive media forms might have the feeling that they are part of the mediated environment (i.e., self-location) and that they can interact with the virtual elements (i.e., possible actions). A meta-analysis conducted by Cummings and Bailenson [17] found a medium-sized effect of immersive technology on spatial presence, supporting the notion that immersive media characteristics, such as vividness and interactivity, can be considered supporting elements in the emergence of spatial presence. Wirth et al.'s [82] process model of the formation of spatial presence experiences includes additional factors that can enhance spatial presence, such as user characteristics (e.g., immersive tendencies).

3 Immersive advertising

In light of the recent hype around immersive media, the advertising industry is reacting accordingly. Marketing managers are using immersive technologies such as 360° commercials to create a unique brand image and to engage their (potential) customers [20, 52, 76]. A total of 75% of the top world brands have already employed some kind of VR technology for marketing purposes [52]. However, the use of sophisticated VR technology for advertising purposes is costly and only partially scalable because specific technological hardware is required to experience these media forms (e.g., body-tracking for branded VR games; [67, 76]). Therefore, advertising specialists have begun to use omnidirectional commercials, which offer a 360° experience and can be produced relatively easily with 360° cameras [52]. In contrast to standard unidirectional videos, the user can look around freely and experience a 360° point of view during the reception of omnidirectional videos [63]. Although the user is placed in a fixed position and cannot interact with objects in the virtual environment, they should still feel as though they are in a different location [27]. Thus, although 360° videos do not enable the same immersive experience as that of sophisticated VR simulations or games, they should enable feelings of spatial presence and might be perceived as a precursor to VR.

Numerous brands have already produced promotional 360° videos [3, 20, 52]. Tommy Hilfiger, for instance, offered their customers a real runway experience where, sitting directly next to the catwalk, they could view the new collection at Manhattan's Park Avenue Armory.

The car brand Smart enabled individuals to drive a SmartForTwo Cabrio through the streets of Miami. Using an HMD, the user could look around and see dancers performing along the way. Boursin, a cheese brand, created a virtual experience that allowed consumers to travel through a well-stocked refrigerator, surrounded by flying peppercorns and bottles of champagne.

There are divergent ways to experience omnidirectional videos. Using an HMD, users can experience commercials in the most immersive way wherever and whenever they want. If they do not own an HMD, they can still watch omnidirectional commercials on their mobile devices or computer screens. Smartphones or tablets can simply be tilted to experience the 360° point of view, or consumers can change the view by swiping their touchscreens [27]. By using a computer mouse and keyboard to change the individual point of view, users can also watch 360° videos on static screens [26]. The option to use omnidirectional commercials in different ways in their marketing campaigns might appeal to advertisers, as the production costs of 360° commercials are considerably higher than those of standard videos [53]. Consequently, it would be beneficial if a 360° commercial that was originally produced for an in-store promotional campaign could be "recycled" and uploaded to YouTube or integrated in the company's social media channel afterwards. Customers could simply watch the 360° video at home using their HMDs or regular electronic devices. Additional options for use might justify the relatively high production costs of 360° commercials. Nonetheless, it is questionable whether 360° commercials still have superior effects when experienced at home, using less immersive devices. Research on the impact of omnidirectional commercials is still scarce, especially in terms of differentiating the effects of various settings and devices. Thus, in the next section, we begin by presenting previous research on different forms of immersive advertising, followed by a summary of studies that have focused explicitly on the impact of 360° commercials.

3.1 Research on different forms of immersive advertising

Immersive 360° commercials are a relatively new phenomenon, but other immersive media forms have been used as advertising vehicles for several years and have been the subject of academic research. Examples of these media forms include 3D product presentations on websites (e.g., [14, 54]), product placements in 3D movies or games (e.g., [11, 67, 75]), and 3D commercials (e.g., [85]). These types of advertising have been compared with their less immersive counterparts in experimental studies (e.g., 2D vs. 3D commercials; [85]) and have largely been found to be more effective. Elevated feelings of spatial presence have been identified and demonstrated to mediate persuasive effects.

3.1.1 Spatial presence and persuasive effects

Several studies have used the concept of spatial presence to explain the heightened persuasive effects of rich or interactive media. In the context of advertising, both traditional and new advertising forms have been studied. For instance, Kim and Biocca [43] utilized a television infomercial to illustrate the positive impact of spatial presence on brand evaluation. These researchers did not directly manipulate the immersiveness of the commercial; rather, they varied the room illumination and the visual angle of the screen. Cauberghe et al. [13] focused on the impact of perceived interactivity during commercial breaks, and Yim et al. [85] manipulated the vividness of a television advertisement by adding another dimension of depth. Studies about digital or online advertisements [15, 21, 22, 39, 44, 46, 54] and integrated forms of advertising [33, 59, 67] have also reported positive effects that were attributed to elevated levels of spatial presence.

Although the positive impact of spatial presence on advertising effectiveness has been confirmed in various settings, the underlying mechanism has only recently been studied. Yim et al. [85] used the Affect Infusion Model [28] as the theoretical foundation to explain the more positive effects of 3D commercials compared with traditional 2D advertisements. The Affect Infusion Model asserts that both positive and negative moods can be transferred to cognitions about or evaluations of objects. Here, the affect experienced is used as actual information. According to Yim et al. [85], participants who viewed a 3D commercial experienced higher levels of enjoyment than did those who viewed a 2D commercial, and they used this affect to evaluate the associated branded product [80]. Spatial presence has been connected with heightened levels of enjoyment [36]. Intensified experiences of flow [16] or the need for psychological escapism (i.e., the psychological tendency to escape from reality into mediated environments; [41]) have been mentioned as a possible explanations for this connection [35, 36, 45, 57]. However, some scholars believe that positive affect is not the only reason for the persuasive power of spatial presence. Media users are believed to be less critical during media reception if they are confronted with immersive media forms (e.g., [11]). Generally, if people are confronted with persuasive appeals and notice the persuasive intent, they may feel that their freedom is threatened, generating various forms of resistance (e.g., evaluative persuasion knowledge or counterarguing), which could significantly reduce persuasive effectiveness [29, 47]. Some scholars have suggested that spatial presence may inhibit this resistance because of the heightened positive affect elicited by spatial presence [32] or because media users do not have sufficient cognitive resources to enable forms of cognitive resistance [2, 61, 81].

3.1.2 Previous research on 360° commercials

Because immersive 360° videos have only recently gained popularity, few studies have analyzed their impact on persuasive effectiveness [9, 20, 26, 52, 53, 78, 83, 86]. For instance, using a 360° video featuring the outdoor fashion brand The North Face, Van Kerrebroeck et al. [78] analyzed the effects on perceived vividness, spatial presence, attitudes toward the ad, brand evaluation, and purchase intentions. To view the 360° video, participants used either a cardboard headset or a mobile phone. As predicted, the 360° video elicited higher values for all dependent variables when experienced with the HMD. De Gauquier et al. [20] used the same branded video and study design but also analyzed the impact on brand personality impressions. In line with Van Kerrebroeck et al. [78], they found that participants in the HMD condition reported more positive brand attitudes and higher levels of purchase intention, and also perceived the brand as more exciting and sophisticated. Wu and Lin [83] confirmed that the increase in advertising effectiveness observed with more immersive media forms was elicited by higher levels of spatial presence and consequent enjoyment. Although Leung et al. [53] also reported that a 360° commercial had positive short-term effects on the evaluation of and behavioral intentions toward a hotel brand, the effects were no longer evident after one month. Feng et al. [26] reported superior persuasive effects for only one of three analyzed 360° commercials. Several other studies have examined the persuasive impact of 360° videos on social causes, such as corporate social responsibility initiatives [52] and fundraising or environmental appeals [9, 12, 86], and explored the impact of 360° documentaries [10, 77]. However, not all previous studies have found positive effects of 360° videos compared with unidirectional videos [9, 26, 77]. Feng et al. [26] found 360° commercials to have superior persuasive effects only if the commercial included a moderate degree of narrative structure.

When 360° commercials included a low or high level of narrative structure, they did not outperform their unidirectional counterparts. Van Damme et al. [77] reported similar non-significant results concerning the prosocial impact of a documentary. Breves [9] reported a positive impact of 360° videos when they were experienced with high-quality HMDs, but experiencing 360° videos with low-quality devices (i.e., cardboard headsets) did not increase the persuasive effectivity of a fundraising appeal. The quality of the media experience seems to be an important element, since low quality experiences can lead to high cognitive load and feelings of cybersickness [30, 31].

Previous studies have not always been able to demonstrate a superior impact of immersive 360° videos on persuasion, despite these videos being associated with elevated levels of spatial presence. One reason for this might be the misperception of motion during the reception of 360° videos, which could trigger side effects of VR technology, such as increased cognitive load, headaches, dizziness, or nausea, and interfere with the media experience. All of these negative sensations are symptoms of cybersickness, which may decrease the positive affect elicited by spatial presence because of its unpleasant nature, thus reducing persuasive effectiveness [40].

3.2 Cybersickness

The feeling of cybersickness refers to visually stimulated motion sickness that may be experienced in virtual environments [50]. The consequences of cybersickness may include eyestrain, vomiting, disorientation, headaches, and nausea. Cybersickness is most likely to be caused by a mismatch between the vestibular and visual systems: Virtual environments often simulate movement, although the actual position of the media user does not change, resulting in a false perception of motion, which can cause cybersickness [19, 50, 85]. Cybersickness has been labeled as a common and unwanted effect of HMD use that is most likely to be caused by the change of perspective that comes from moving the head [18, 84]. Researchers believe that the unwanted side effects caused by cybersickness may significantly reduce the acceptance and use of commercial HMDs [19, 84]. Depending on the individual user, the technology used, the quality of the experience, and the virtual environment, the level of cybersickness can vary greatly [19, 56, 65, 68].

These unpleasant side effects may also influence the perception of 360° content that is experienced with HMDs and thus they should not be neglected in research on advertising experienced with HMDs. Cybersickness can be considered an irritation that may diminish or neutralize the positive effects of 360° commercials [1, 24, 25, 85]. Only a few previous studies on immersive advertising have considered the level of cybersickness and analyzed its negative impact [40, 85]. For instance, Yim et al. [85] reported that 3D commercials that were experienced using 3D glasses could give rise to cybersickness for some individuals, who consequently reported lower levels of spatial presence. However, cybersickness might not only affect spatial presence, but also decrease persuasive effectiveness because of reduced media enjoyment [40, 69]. In the context of e-commerce, Israel et al. [40] even suggested that minimizing the negative effects of cybersickness should be the primary focus of retailers when using HMDs for product presentations. However, these authors did not measure persuasive effectiveness and thus did not connect it to the level of cybersickness [40]. To the best of our knowledge, no research to date has analyzed the impact of cybersickness on the persuasive effectiveness of 360° commercials experienced with HMDs.

3.3 Research gaps

The aforementioned studies offer valuable insights and provide important implications for advertising practitioners, but some research gaps can be identified for studies on the impact of 360° commercials experienced with HMDs and with regular screens.

Previous studies using HMDs were conducted in laboratory or classroom settings [20, 53, 78, 83], although media users would not normally stream immersive commercials in such locations. HMD owners are most likely to watch omnidirectional commercials in their own living rooms, and those who do not own any type of HMD may watch immersive advertisements during in-store promotions or on their laptops or smartphones (e.g., [4, 78]). Furthermore, previous studies also used student samples, further reducing the generalizability of the results, as age has been found to play a role in the acceptance of new technologies [79]. Finally, and most importantly, the negative consequences (e.g., cybersickness) that may arise from viewing 360° commercials with HMDs that potentially reduce advertising effectivity have been neglected in existing research [40]. Flavián et al. [27] explicitly invited researchers to consider negative technology-based experiences and their effect on the customer experience. It seems important for marketing professionals to know not only whether 360° commercials are more effective in highly controlled studies, but also whether they are likely to be effective in less controlled settings and more real-life situations [72].

Lee et al. [52] conducted an online experiment using 360° videos that were experienced on regular screens, but they did not include a control group that viewed a standard unidirectional commercial. Feng et al. [26] did not consider the mobility of the devices used in their online experiment. Participants may have used static devices (e.g., desktop computers) instead of mobile devices (e.g., smartphones, tablets), and thus they may not have fully experienced the added value of omnidirectional commercials [27]. This may explain why only one of the three analyzed 360° commercials outperformed its unidirectional counterpart.

To address these limitations in the existing research, we conducted two studies that considered these factors. Intending to replicate the findings of De Gauquier et al. [20] and Van Kerrebroeck et al. [78] concerning the added value of 360° commercials experienced with HMDs, we conducted the first study using a sample, setting, and commercial that differed from those used in previous studies. Additionally, cybersickness was incorporated as a moderator of the positive impact of immersive media. Because the level of cybersickness can vary greatly depending on the individual user, the technology used, and the virtual environment, advertisers should be interested in knowing the possible negative consequences of 360° videos before they integrate these videos into their campaigns [19, 56, 65]. The second experiment also compared the impact of 360° and unidirectional commercials but did not use HMDs. Although HMD sales are increasing, only 4% of the online population currently owns a headset [5]. As immersive commercials can be streamed online and are incorporated in social media advertising campaigns, individuals might instead experience 360° commercials on their mobile phones or on desktop computers. A few studies have analyzed the impact of 360° commercials experienced on regular screens, but these studies either did not include a control condition [52] or did not consider the type of device used [26]. Hence, it seems relevant to analyze whether 360° commercials experienced on mobile (e.g., smartphones) or static (e.g., laptops) devices instead of with HMDs are still more effective than unidirectional commercials.

4 Study 1: HMDs and cybersickness

4.1 Hypotheses

Because of higher levels of vividness and interactivity, 360° commercials experienced with an HMD should foster feelings of spatial presence [73, 78]. Researchers have shown that individuals who report spatial presence experience media enjoyment, and that this affect can be transferred to the advertised brand [78, 83, 85]. Some scholars have even suggested that cognitive resistance might be limited by an enjoyable media experience [32]. Brand evaluations should therefore be higher when participants experience 360° commercials than when they view unidirectional commercials. Multiple studies have validated the impact of product evaluation on behavioral intentions (e.g., [54, 78, 85]). If consumers evaluate a branded product positively, they should be more inclined to purchase it. As already mentioned, the first hypothesis is mainly meant to replicate previous findings on 360° commercials experienced with HMDs [20, 78].

> **H1**: Participants who experience immersive commercials using an HMD report higher feelings of spatial presence (**H1A**), more positive brand evaluations (**H1B**), and stronger purchase intentions (**H1C**) than do participants who experience unidirectional commercials.

However, some studies have reported that 360° videos experienced with HMDs did not enhance persuasive effectiveness [9, 77]. For instance, Breves [9] found that people who saw a 360° fundraising video using a cardboard HMD were not more likely to donate afterwards, compared with participants who used a regular screen. Even though the technology was able to elicit higher levels of spatial presence, the persuasive effects were not enhanced. This might be because of the negative side effects of HMDs, such as cybersickness. As already mentioned, cybersickness and other negative effects of immersive media should not be neglected in marketing research [27, 40]. Negative side effects can be considered an "irritation," lessening the persuasive impact of spatial presence [1, 85]. Because people differ in their susceptibility to cybersickness, the level of cybersickness was considered as a moderator of the positive impact of spatial presence on brand evaluation and purchase intentions. If participants feel sick during the media experience, the negative affect should reduce or even annul the positive affect caused by feelings of spatial presence (see Fig. 1).

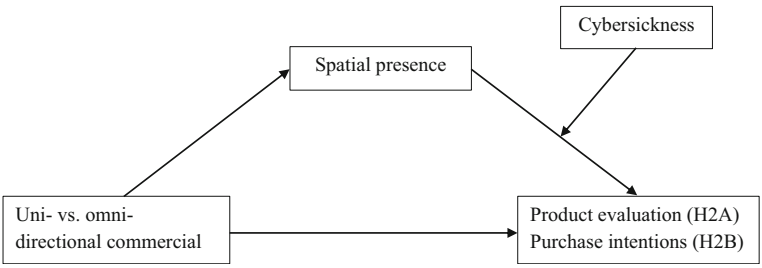


Fig. 1 Research model (Study 1; Hypothesis 2)

H2: Cybersickness moderates the positive impact of spatial presence on brand evaluations **(H2A)** and purchase intentions **(H2B).**

4.2 Method

4.2.1 Design and stimulus

This experimental study used a 2 X 1 between-subjects design. The participants were randomly assigned to one of two conditions (unidirectional or omnidirectional video). The participants assigned to the omnidirectional video condition experienced the 360° commercial with an HMD. A foldable cardboard-style HMD was selected, and a smartphone (iPhone 5) was inserted into the device to play the immersive 360° commercial. In the omnidirectional condition, the participants were able to look around freely using the HMD. The participants assigned to the unidirectional video condition used a laptop (MacBook Pro; 13″) to view a pre-recorded version of the 360° video that fully captured the storyline of the commercial. Because the video was pre-recorded, the participants could not interact with it or change their point of view. The 360° commercial, produced for the promotion of Bahlsen's new "Cookie Chips" branded product, featured a bakery where the Cookie Chips are made directly in front of the media users (see [88] for the full commercial). The commercial included some humorous elements. All participants used the same AKG headphones.

4.2.2 Measurements

To measure the spatial presence of the participants, we used the Spatial Presence Experience Scale [37]. The scale consists of eight items, including questions assessing the two dimensions of self-location (e.g., "I felt like I was actually there in the environment of the presentation") and possible actions (e.g., "I had the impression that I could be active in the environment of the presentation"). The participants were asked to indicate their level of agreement on a seven-point Likert scale (with a score of 1 corresponding to *totally disagree* and a score of 7 to *totally agree*). The reliability of the scale was satisfactory ($\alpha = .93$; $M = 3.96$, $SD = 1.74$). Bracken's [8] scale was used to evaluate the recipient's level of cybersickness. For instance, using a seven-point Likert scale, the recipients were asked to indicate the degree of nausea that they experienced while watching the advertisement. After excluding one of the five original items, the reliability of this scale was satisfactory $\alpha = .86$ ($M = 1.45$, $SD = 0.94$). Spears and Singh's [71] scales were used to measure the level of persuasion. Here, semantic differentials were presented. For instance, participants indicated the appeal (with a score of 1 corresponding to *unappealing* and a score of 7 to *appealing*) of Bahlsen's Cookie Chips and how likely they were to buy the product (e.g., very low/high purchase interest). These scales had satisfactory reliability, with $\alpha = .94$ (five items; $M = 5.39$, $SD = 1.06$) for product evaluation and $\alpha = .92$ (five items; $M = 4.09$, $SD = 1.31$) for purchase intention. All items are listed in Appendix Table 4.

4.2.3 Sample and procedure

Although some studies have reported that immersive advertising has superior effects compared with less immersive forms, the external validity of most of these results is questionable. Previous

studies have used convenience samples of students, with exclusively young and well-educated participants experiencing media stimuli and reporting perceived presence and the consequent effects (e.g., [20, 54, 78, 85]). All of these studies used laboratory experiments, thus further diminishing the external validity of the results [54, 66]. Because external validity can be understood as the ability to generalize the differences and relationships found in a scientific study to other settings, people, and times, homogenous student samples might be perceived as problematic [66, 72]. Some of the authors of previous work have noted insufficient external validity as a study limitation, stressing the need for more diverse samples to generalize the results [54, 78]. Consequently, this study focused on researching the effects of immersive commercials using a setting that was high in external validity and a more diverse sample.

To reach a more diverse sample and enable the use of a natural setting, a rather unusual approach was taken. The researcher visited the homes of the participants so that they could view the commercial in their own domestic environment without having to go to a university laboratory. For each participant, the researcher played the commercial on either a laptop or a cardboard HMD after adjusting the environment as thoroughly as possible. For instance, possible sources of noise or other potential distractions were removed. Although the presence of the researcher might still have affected the reception process of the participants, they were likely to have felt more at ease in their own homes than they would have in a laboratory setting, thus enabling a more natural reception situation. Additionally, people who do not regularly visit university campuses were able to participate in the experiment. After watching the commercial and completing the questionnaire, the participants received a bag of Bahlsen's Cookie Chips as a thank-you gift. In order to enable comparability, all experimental sessions were conducted by the same researcher.

Before participants were recruited, the sample sizes of earlier studies as well as recommendations made by researchers that employed HMDs in their study design were considered. Most studies employed or recommended the employment of about 30 participants per experimental group [49, 62]. A total of 64 people participated in the experiment. Two participants were excluded because they indicated that they had already seen the commercial, resulting in a final sample size of 62. The participants were recruited by the researchers via advertisements and personal connections (e.g., acquaintances, relatives, and friends). Half of the volunteers viewed the unidirectional commercial on a laptop, and the other half used the cardboard HMD with the iPhone 5 to watch the 360° commercial. The mean age of the final sample was $M = 25.89$ ($SD = 10.54$) years, with a range of 18 to 59. Thirty-seven (60%) participants were female, and approximately 34% of the participants were students. Three quarters of the participants stated that a high school diploma was their highest educational attainment, approximately 10% reported having finished compulsory or secondary school, and approximately 13% reported having a university degree. The appropriate tests indicated no differences between the two groups in the distribution of gender (χ^2 [1, $N = 62$] = 0.60, $p = .437$), educational background (χ^2 [3, $N = 62$] = 2.19, $p = .534$), or age (t[60] = −1.27, $p = .208$). Approximately 30% of the participants had heard of the new Cookie Chips branded product before participating in the study, and there was no difference between the two groups on this variable (χ^2 [1, $N = 62$] = 0.08, $p = .783$).

4.3 Results

To test the first hypothesis, three independent t-tests were calculated using SPSS, Version 24. There were significant differences between the groups in the results concerning spatial

Table 1 Means and standard deviations (Study 1)

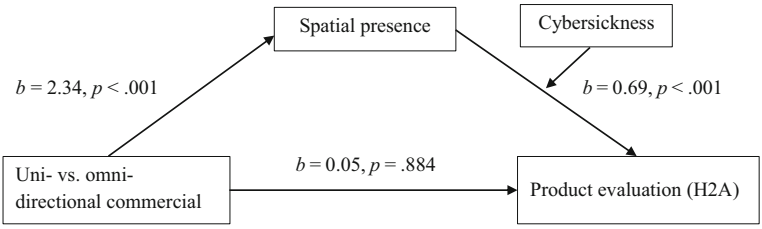
	Condition			
	360° commercial (n=31)		Unidirectional commercial (n=31)	
Dependent variable	*M*	*SD*	*M*	*SD*
Spatial presence	5.13	1.22	2.79	1.35
Product evaluation	5.66	0.88	5.12	1.16
Purchase intentions	4.17	1.20	4.02	1.43

M, Mean; *SD*, Standard Deviation; $N = 62$; 7-point Likert scales were employed

presence, $t(60) = -7.15$, $p < .001$; $d_{Cohen} = 1.82$ (**H1A✓**) and product evaluation, $t(60) = -2.07$, $p = .022$; $d_{Cohen} = 0.52$ (**H1B✓**). Purchase intention was not significantly affected by the manipulation, $t(60) = -0.44$, $p = .330$ (**H1C✗**). Means and standard deviations are reported in Table 1.

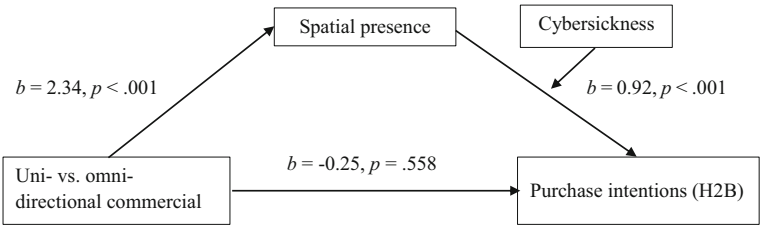
Two separate moderated mediation analyses were calculated using the PROCESS Macro 3.0 ([38]; Model 14) to test the second hypothesis. The reported regression coefficients are unstandardized, and the bootstrapping method ($m = 5.000$) was used. The level of immersiveness of the commercial (unidirectional or omnidirectional, coded as 0 and 1, respectively) was hypothesized to influence the overall spatial presence, which, in turn, should elicit more positive product evaluations (H2A; see Fig. 2) and stronger purchase intentions (H2B; see Fig. 3). Individual-level cybersickness was used as a moderator of the effects of spatial presence on brand evaluations and purchase intentions. Typically, one standard deviation above and one standard deviation below the mean of the moderator are used to represent high- and low-level conditioning. Therefore, the conditional effects of spatial presence on product evaluation and purchase intentions were calculated at the values of the moderator corresponding to low (reported value = 1.00), average (reported value = 1.45), and high (reported value = 2.38) levels of cybersickness. As expected after validating the first hypothesis, the level of immersiveness of the commercial had a significant impact on perceived spatial presence.

Spatial presence, in turn, positively influenced product evaluation. Nonetheless, the indirect effect was only significant for participants with low levels of cybersickness—not for those with average or high levels of cybersickness (see Fig. 2). Both the interaction between spatial



Conditional indirect effects of X on Y at values of the moderator:
Low level of cybersickness: $b = 0.32$, 95% confidence interval (CI): 0.13 to 0.52
Average level of cybersickness: $b = 0.16$, 95% CI: -0.05 to 0.37
High level of cybersickness: $b = -0.18$, 95% CI: -0.58 to 0.21

Fig. 2 Moderated mediation analysis concerning product evaluations (Hypothesis 2A) with unstandardized regression coefficients



Conditional indirect effects of X on Y at values of the moderator:
Low level of cybersickness: $b = 0.34$, 95% confidence intervals (CI): 0.09 to 0.59
Average level of cybersickness: $b = 0.08$, 95% CI: -0.19 to 0.35
High level of cybersickness: $b = -0.47$, 95% CI: -0.97 to 0.04

Fig. 3 Moderated mediation analysis concerning purchase intentions (Hypothesis 2B) with unstandardized regression coefficients

presence and cybersickness ($b = -0.37$, 95% confidence interval [CI]: −0.64 to −0.09) and the index of moderated mediation ($b = -0.86$, 95% CI: −1.62 to −0.26) reached significance, supporting H2A. The model explained 26% of the variance in individuals' product evaluation.

A second moderated mediation analysis demonstrated that spatial presence also influenced the participants' purchase intentions. Both the interaction effect of spatial presence and cybersickness ($b = -0.58$, 95% CI: −0.93 to −0.23) and the index of moderated mediation ($b = -1.36$, 95% CI: −2.13 to −0.55) reached significance. The indirect effect was only significant for participants who reported low levels of cybersickness (see Fig. 3). The model explained 22% of the variance in purchase intentions.

4.4 Discussion

This experimental study analyzed the impact of 360° commercials on different components of advertising efficacy. A commercial for an existing branded product was used as stimulus material, and the study had a relatively diverse sample and a natural setting. The first hypothesis was meant to replicate previous results on the superior persuasive impact of 360° commercials. Omnidirectional commercials positively influenced spatial presence and product evaluations, but purchase intentions did not differ between the experimental groups. This finding stands in contrast to the reports of De Gauquier et al. [20] and Van Kerrebroeck et al. [78]. Considering that the participants in the present study saw a commercial for cookies, it seems plausible that cybersickness might have had a stronger impact in our study than in previous research employing an outdoor fashion ad [20, 78]. This consideration is supported by the results of the moderated mediation analyses. A positive indirect effect of the 360° commercial on product evaluations and purchase intentions via spatial presence was found only for individuals who reported low levels of cybersickness. Individuals who feel nauseated might be less inclined to engage with commercials for edible products than with commercials for fashion brands, which would explain the differences between our findings and those reported in previous work, but this possibility should be validated in future empirical research.

5 Study 2: experiencing 360° commercials on non-wearable devices

Although 360° commercials are optimized for the use of HMDs, only 4% of the online population owns a headset, and people might therefore use other devices to experience these commercials [5].

Mobile devices such as smartphones and tablets should be more suitable than static devices because they can be freely rotated and tilted to watch 360° videos, enabling a more natural interaction [73]. Whether 360° commercials experienced without HMDs can actually elicit greater feelings of spatial presence and persuasive effectiveness is uncertain, especially if the omnidirectional commercials are watched on static monitors that do not allow for natural interaction.

Compared with unidirectional commercials, 360° commercials experienced without using HMDs should still offer higher levels of vividness (e.g., 360° point of view) and interactivity (e.g., the opportunity to choose where to look); therefore, even without using HMDs, there is reason to believe that users experiencing omnidirectional commercials will report higher levels of spatial presence [26]. Based on the results of previous studies that have identified spatial presence as a catalyst for advertising effectiveness (e.g., [78, 85]), 360° videos experienced without using HMDs should elicit more favorable brand attitudes and higher purchase intentions than those experienced with unidirectional videos.

> **H3**: Participants who experience 360° commercials without using HMDs report higher feelings of spatial presence (**H3A**), more positive product evaluations (**H3B**), and stronger purchase intentions (**H3C**) than do participants who experience unidirectional commercials.

Because mobile devices such as mobile phones and tablets can be moved naturally to experience 360° videos, these handheld devices should be better suited to elicit feelings of spatial presence than static devices [27]. Hence, mobile devices should be more effective in influencing relevant advertising dimensions, such as product evaluation and purchase intentions.

> **H4**: Participants who experience 360° commercials using mobile devices report higher feelings of spatial presence (**H4A**), more positive product evaluations (**H4B**), and stronger purchase intentions (**H4C**) than do participants using static devices.

5.1 Method

5.1.1 Design and material

This online study used a 2 X 2 between-subjects design. In line with the first experiment, participants were randomly assigned to watch a pre-recorded unidirectional version of the commercial or the 360° commercial. For their participation in this experiment, the participants were free to use either a mobile device (smartphone or tablet) or a static device (desktop or laptop computer). Consequently, the type of device was used as a quasi-experimental factor (see Table 2).

Table 2 Composition of groups

	Mobile device	Non-mobile device	Total
Unidirectional commercial	78	39	117
360° commercial	52	28	80
Total	130	67	197

In this experiment, an immersive commercial for cream cheese (Boursin®; for the full commercial, see [87]) that enabled a journey through a virtual refrigerator was used as the stimulus material. The full VR experience was originally provided at pop-up locations, but the commercial can also be streamed online [20].

5.1.2 Measurements

After the participants were welcomed on the first page of the online questionnaire, they were presented with a hyperlink to one of the Boursin® commercials and were asked to watch the video in full-screen mode. In line with the first study, the Spatial Presence Experience Scale, based on Hartmann et al. [37], was used to measure spatial presence (eight items; $\alpha = .93$; $M = 2.54$; SD = 0.94). Spears and Singh's [71] scales were used to measure both brand evaluation (five items; $\alpha = .90$; $M = 3.32$; $SD = 0.92$) and purchase intentions (five items; $\alpha = .89$; $M = 3.08$; $SD = 0.94$). The participants were consistently asked to indicate their agreement on Likert scales ranging from 1 (*I do not agree at all*) to 5 (*I agree completely*).

5.1.3 Participants

In total, 210 participants were recruited online using social media. An outlier analysis showed that several participants answered unusually quickly and were thus excluded because they may not have completely watched the commercial ($n = 9$). After additional cases showing response bias ($n = 4$) were excluded, the final sample size was $N = 197$. On average, participants were 25.35 ($SD = 7.04$) years old, with a range of 18 to 58. Approximately 65% of the participants were female ($n = 128$), and 69% of the participants were students. Thirty-one percent of the participants were either employed or self-employed. There was no difference between the groups in terms of age ($F_{(3,\ 193)} = 0.52$, $p = .669$), gender (χ^2 [3, $N = 197$] = 2.64, $p = .450$), or employment status (χ^2 [12, $N = 197$] = 10.16, $p = .602$). The participants had not seen the commercial before the experiment but indicated that they were rather familiar with the Boursin® brand ($M = 3.91$, $SD = 1.19$; on a five-point Likert scale). There was no difference between the groups concerning prior brand familiarity ($F_{(3,\ 193)} = 0.22$, $p = .879$).

5.2 Results

Using spatial presence, product evaluation, and purchase intentions as the dependent variables, we conducted three two-way ANCOVAs. We decided to use gender as a covariate because there are gender differences in visual perception and in attitudes toward technology (e.g., [34]), and we found correlations between gender and the dependent variables (see Appendix Table 6). Significant main effects of the 360° video on spatial presence ($F_{(3,\ 193)} = 11.61$, $p < .001$; partial $\eta^2 = .057$, **H3A✓**), product evaluation ($F_{(3,\ 193)} = 3.08$, $p = .041$; partial $\eta^2 = .016$, **H3B✓**), and purchase intentions ($F_{(3,\ 193)} = 10.71$, $p < .001$; partial $\eta^2 = .053$, **H3C✓**) were observed. Compared with participants who viewed the unidirectional commercial, those who saw the 360° commercial reported significantly higher values (see Table 3).

Additionally, there were significant interaction effects between the type of device and the immersiveness of the commercial on both spatial presence ($F_{(3,\ 193)} = 3.43$, $p = .033$; partial $\eta^2 = .018$, **H4A✓**; see Fig. 4) and brand evaluation ($F_{(3,\ 193)} = 2.90$, $p = .045$; partial $\eta^2 = .015$, **H4B✓**; Fig. 5), with the participants who experienced the 360° commercial using mobile devices reporting significantly higher values on both variables. The effect of this interaction on

Table 3 Means and standard deviations (Study 2)

	Condition			
	360° commercial (n=80)		Unidirectional commercial (n=117)	
Dependent variable	*M*	*SD*	*M*	*SD*
Spatial presence	2.88	0.95	2.31	0.87
Product evaluation	3.53	0.95	3.18	0.87
Purchase intentions	3.38	0.87	2.87	0.93

M, Mean; *SD*, Standard Deviation; $N = 197$; 5-point Likert scales were employed

purchase intentions was not significant ($F_{(3, 193)} = 0.58$, $p = .225$, **H4C✘**; see Fig. 6); independent of the type of device used, individuals who experienced the 360° commercial indicated higher purchase intentions.

5.3 Discussion

Compared with the standard unidirectional commercial, the 360° commercial was found to elicit higher levels of spatial presence, even when it was experienced online without the use of an HMD. Additionally, individuals reported more positive product evaluations and higher purchase intentions when viewing the 360° commercial than when viewing the standard unidirectional commercial. The interaction effect between the type of device (mobile or static) and the immersiveness of the commercial (unidirectional or 360° video) only reached significance for two of the dependent variables. Participants who experienced the 360° commercial using a smartphone or tablet indicated significantly higher levels of spatial presence and brand evaluation. In sum, 360° commercials can increase advertising effectiveness even without using HMDs. However, compared with laptop or desktop computers, mobile devices are better suited to maximize the advantages of omnidirectional commercials.

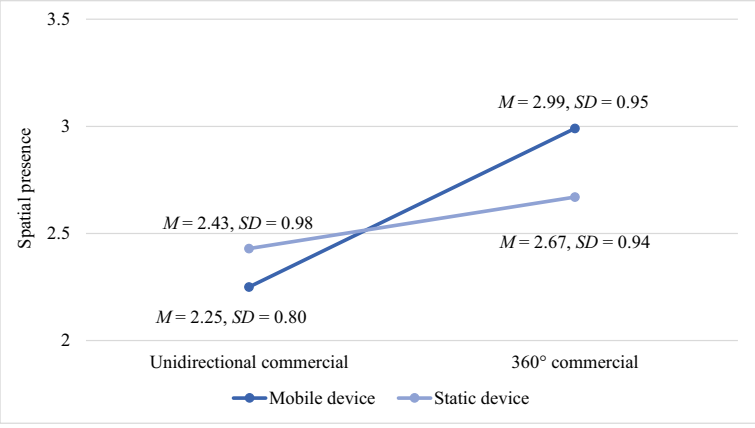


Fig. 4 Descriptive values and interaction concerning spatial presence (Hypothesis 4A). A 5-point Likert scale was employed

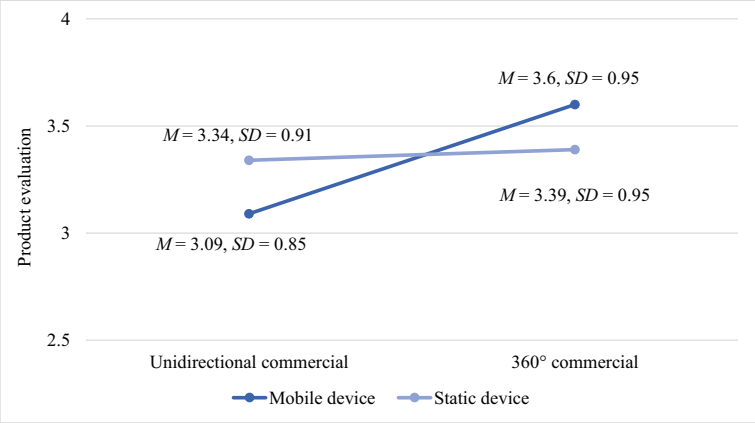


Fig. 5 Descriptive values and interaction concerning product evaluations (Hypothesis 4B). A 5-point Likert scale was employed

6 General discussion and implications

Both experiments demonstrated that 360° commercials are able to elicit higher levels of spatial presence than are standard unidirectional commercials. The possibility to choose where to look increased the perception of being inside the pictured environment, and individuals felt as if they could actually participate in the storyline of this type of commercial. This was the case whether the 360° commercial was experienced with a cardboard HMD, a mobile device (smartphone or tablet), or a static devices (laptop or desktop computer).

In line with the findings of previous research, higher perceptions of spatial presence increased advertising effectivity [78, 85]. More positive product attitudes were reported after exposure to 360° commercials than after exposure to unidirectional commercials. The mediation analysis in the first experiment also showed that spatial presence was positively associated with both product attitudes and purchase intentions and therefore could be validated as a mediator of persuasive effects.

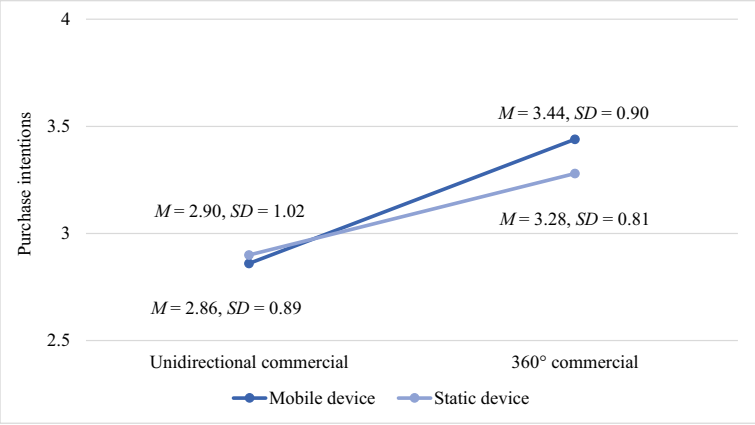


Fig. 6 Descriptive values and interaction concerning purchase intentions (Hypothesis 4C). A 5-point Likert scale was employed

The results concerning purchase intentions were less consistent across the two studies. Whereas the first study did not find higher levels of purchase intentions, the second experiment identified a medium-sized effect of the 360° commercial on behavioral intentions, independend of the mobility of the employed device. The results of the moderated mediation analysis suggest that individuals' feelings of cybersickness elicited by HMD use were responsible for the non-significant effect found in the first experiment. Participants who reported that they felt unwell or sick during the media reception were unlikely to report positive purchase intentions afterwards. Cybersickness has been identified as an "irritation" that can neutralize or diminish the positive effects of advertising [1, 24, 25]. The negative interaction between cybersickness and spatial presence concerning persuasive effects suggests that the positive affect elicited by feelings of spatial presence might be reduced or even overshadowed by the negative affect caused by cybersickness. Because the participants in the second study did not use an HMD, they were unlikely to have experienced feelings of cybersickness. They therefore experienced no form of irritation that could diminish the positive impact of spatial presence on advertising effectiveness and consequently reported higher purchase intentions.

Participants in the second experiment used either mobile or static devices to watch the 360° commercial. As expected, mobile devices were better suited to experience the immersive content and elicited higher levels of spatial presence. Thus, individuals using mobile devices also reported more positive product evaluations. Surprisingly, there was no interaction effect on purchase intentions; independent of the medium, participants who saw the 360° commercial were more likely than those who viewed the unidirectional commercial to indicate positive behavioral intentions concerning the product. Future studies should analyze other factors that might have an impact on behavioral intentions in order to understand why the mobility of the device affected the evaluations, but not the purchase intentions.

The reported results provide valuable insights for advertisers. Considered in light of previous work, our findings suggest that 360° commercials that are experienced using HMDs might not be equally suitable for all product categories. De Gauquier et al. [20] and Van Kerrebroeck et al. [78] reported higher purchase intentions for a fashion brand after exposure to branded 360° videos, but our study failed to replicate these results for a cookie brand. As already mentioned, cybersickness was identified as a moderating variable, and this might be more relevant and impactful for edible products. If media users feel unwell after exposure to 360° commercials, they might still be inclined to purchase a new jacket because they evaluate the branded product positively, but they might not be in the mood to purchase edible products. Therefore, the use of 360° commercials for food items should be considered carefully, especially for in-store promotions where the goal might be to introduce and sell new food items. If food brands want to incorporate 360° commercials in their in-store campaigns or use them at pop-up locations, the commercials should be of high-quality and try to avoid elements that contribute to feelings of cybersickness (e.g., fast cuts or movements), or they should target consumer groups that can be considered early adopters of technology. These individuals are likely to be familiar with HMDs and should therefore be less likely to experience or at least less likely to be disturbed by symptoms of cybersickness. Additionally, 360° commercials should also be made freely accessible online and incorporated in social media campaigns. Because 90% of social media users access their chosen platforms via mobile devices [42], 360° commercials might be especially effective if they are incorporated into users' social media feeds.

7 Limitations and future research

Although the two experimental studies were able to deliver interesting results, a few aspects should be reflected on critically. The first study aimed to employ a diverse sample and a natural setting, but the total number of participants was rather small and cannot be considered representative, as most participants were relatively young and highly educated. However, these individuals may be the target group of 360° commercials and thus should be considered suitable for this study. The domestic setting of the first study was more natural than a classical laboratory experiment, but another setting might enable even higher levels of external validity. For instance, it would be interesting to conduct a field experiment in a retail store and observe the behavior of the participants after experiencing the 360° commercial, especially in terms of their purchase behavior. Furthermore, it has to be acknowledged that due to the domestic setting, levels of internal validity were rather low.

The second study employed a quasi-experimental approach but only differentiated between mobile and static devices, without considering screen size or the quality of the device. Furthermore, we cannot be sure that the participants actually watched the videos. Participants who answered the questionnaire too quickly were excluded from the analysis, but some of the included participants may still have skipped the commercial. Furthermore, we let the participants choose the type of device they wanted to use. This resulted in uneven group sizes. We did not want to ask them to use a specific device because we believed it to be unlikely that participants would switch devices after they had started answering the questionnaire. For example, if someone started the survey on their smartphone and was then instructed to use a laptop to watch a video, they might not have continued with the study. A laboratory experiment using mobile and static devices might be better suited to compare groups and to replicate the findings of this experiment under controlled conditions.

Enhanced spatial presence has been used to explain the superior effects of 360° commercials compared with less immersive videos, but the results of the two experiments presented here did not provide further theoretical knowledge on the underlying mechanism. Some previous studies have used enhanced media enjoyment and affect transfer processes as an explanation (e.g., [85]). However, other researchers have suggested that spatial presence might reduce cognitive resistance (e.g., [32]). Future studies should analyze the persuasive mechanism of spatial presence more closely and provide empirical support for the aforementioned assumptions.

Additional factors that are potentially fruitful areas of focus for future research are the quality of the HMD and the option to make the experience even more immersive. Breves [9] reported that a high-quality device could elicit higher levels of spatial presence compared with a cardboard HMD, thus enhancing persuasive effectiveness. Furthermore, the negative side effects of HMDs may be reduced by the more comfortable fit of high-quality devices (e.g., because of face cushions). Currently, VR-devices that include olfactory stimuli and thus can enhance feelings of spatial presence are being designed [58]. This innovative option could be an interesting tool to generate positive and unique brand experiences. Because the VR market is shifting rapidly and new devices are introduced to the market regularly, it is relevant to carefully observe and compare the persuasive impact of different types of HMDs. Future research may be able to provide practical advice to advertisers who want to conduct promotional in-store campaigns and are uncertain about which VR device to use. Complementary qualitative methods should also be employed to learn about the user experience and to optimize the content of 360° commercials.

8 Conclusion

Overall, we believe that with the new wave of VR applications, the advertising market will adapt and change. Therefore, it is also relevant to analyze whether the impact of immersive content diminishes over time as media users become accustomed to the new opportunities (i.e., the novelty effect). Because research has already shown the positive impact of traditional media on spatial presence and persuasion, positive effects may be reduced but should not disappear completely after users grow accustomed to 360° commercials [13, 43]. Immersive media therefore seem to be suitable advertising vehicles, but attention should be paid to creating content that does not elicit cybersickness.

Appendix 1

Table 4 Measurements

Spatial Presence [37]
I felt like I was actually there in the environment of the presentation.
It seemed as though I actually took part in the action of the presentation.
It was as though my true location had shifted to the environment in the presentation.
I felt as though I was physically present in the environment of the presentation.
The objects in the presentation gave me the feeling that I could do things with them.
I had the impression that I could act in the environment of the presentation.
I felt like I could move around among the objects in the presentation.
It seemed to me that I could do whatever I wanted in the environment of the presentation.
Cybersickness [8]
To what degree did you experience stomach awareness while watching the advertisement?
To what degree did you experience nausea while watching the advertisement?
To what degree did you experience dizziness with your eyes open while watching the advertisement?
To what degree did you experience dizziness with your eyes closed while watching the advertisement?
Product Evaluation [71]
Unappealing–appealing
Bad–good
Unpleasant–pleasant
Negative–positive
Unlikeable–likeable
Purchase Intention [71]
Definitely not buy it–definitely buy it
Definitely do not intend to buy it–definitely intend to buy it
Very low purchase intent–high purchase intent
Never buy it–definitely buy it
Probably not buy it–probably buy it
Brand familiarity
How familiar are you with the brand Boursin?

Appendix 2

Table 5 Intercorrelations (Study 1)

		1	2	3	4	5	6
1	Spatial Presence	–					
2	Cybersickness	.37**	–				
3	Product Evaluation	.40**	.07	–			
4	Purchase Intention	.21	−.01	.70**	–		
5	Age	.11	.02	−.13	−.27*	–	
6	Gender[i]	−.03	−.10	.02	.01	.09	–

*$p < .05$; ** $p < .01$; [i] 0 = female, 1 = male

Appendix 3

Table 6 Intercorrelations (Study 2)

		1	2	3	4	5
1	Spatial Presence	–				
2	Product Evaluation	.62**	–			
3	Purchase Intention	.61**	.73**	–		
4	Age	.01	−.03	−.03	–	
5	Gender[i]	−.16*	−.28**	−.22**	.20**	–

*$p < .05$; **$p < .01$; [i] 0 = female, 1 = male

Appendix 4

Table 7 Main and interaction effects ($N = 197$)

Source	df	MS	F	p	partial $\eta 2$
Spatial Presence					
Commercial	1	9.28	11.61	< .001	.057
Device	1	0.36	0.45	.251	.002
Commercial X Device	1	2.74	3.43	.033	.018
Gender (Covariate)	1	3.00	3.76	.027	.019
Error	192	.80			
Product evaluation					
Commercial	1	2.35	3.08	< .05	.016
Device	1	0.01	0.01	.457	.000
Commercial X Device	1	2.21	2.90	.045	.015
Gender (Covariate)	1	11.05	14.50	< .001	.070
Error	192	0.76			
Purchase intention					
Commercial	1	8.46	10.71	< .001	.053
Device	1	0.33	0.41	.276	.002
Commercial X Device	1	0.46	0.58	.225	.003
Gender (Covariate)	1	6.96	8.81	.002	.044
Error	192	0.79			

df = degrees of freedom; MS = Mean squares

Acknowledgements The authors confirm that the manuscript has been submitted solely to this journal and is not published, in press, or submitted elsewhere. This work was not supported by grants or funding. There are no financial interests or benefits dependent on this manuscript.

Funding Open Access funding enabled and organized by Projekt DEAL

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