
That new AR is *sick!* Advertising and research implications for the emerging field of augmented reality marketing

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Abstract: Augmented reality (AR) is a rapidly developing technological breakthrough and represents a new marketplace for consumers. Opportunities for success and risks of failure exist when designing augmented reality advertising and promotional campaigns. This study evaluates the risk of augmented reality sickness, its relationship with task technology fit, misfit, and the combined outcomes on user perceptions. Data was collected through an experimental research design and analysed via structural equation modelling. The results show that AR sickness affects perceptions regarding ease of use, usefulness, and attitude about augmented reality technology. Higher levels of AR sickness are associated with lower perceptions of task technology fit and higher perceptions of misfit. Task technology misfit is a critical concern potentially leading to a blocking effect where users increasingly disengage from the content and/or device. Scholarly implications for future research and practical implications to mitigate AR sickness in augmented reality advertising are discussed.

Keywords: augmented reality; AR; augmented reality advertising; augmented reality marketing; augmented reality sickness; task technology fit; task technology misfit; advertising.

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1 Introduction

Sick is a slang term used in many parts of the Western world to describe something that trendsetters consider *very cool* (Tagliamonte, 2016). Augmented reality (AR) experiences carry that reputation as an exciting new way to interact with our surroundings (Zhang et al., 2023). The use of AR and virtual reality (VR), collectively referred to as mixed reality (MR), is experiencing rapid growth and attention (Gleim et al., 2024; Samala et al., 2023). MR mediums are widely adopted for use in human physiology and are increasingly studied for use in business and consumer applications. MR solutions offer possibilities in physical rehabilitation (Karamians et al., 2020; Mekbib et al., 2020), psychological therapy (Chesham et al., 2018; Fodor et al., 2018), and training and education (Howard and Gutworth, 2021; Howard et al., 2021), as well as many other applications. In this article, we specifically focus our attention on AR. Confidence is growing about the potential for business and consumer applications of AR technology with products such as Orion® and Quest 3® by Meta, Vision Pro® by Apple, and the zSpace® training platform (Grande et al., 2024; Sag, 2024; Hidayat and Wardat, 2024).

The development pace of new AR products portends a wider marketplace adoption in our immediate future as evidenced through first and second-generation Orion prototypes by Meta (Vanian, 2024), and now a third-generation release which includes an electromyography (EMT) technology wristband alongside an updated pair of glasses (Scott, 2025). As new technological marketplaces expand, businesses are likely to become more interested in running promotional campaigns using these new technologies. Past examples of this phenomenon include the shift from print and radio to television advertising which began in 1941 (McDonald and Scott, 2017). Around the year 2000, advertisers began to shift dollars toward internet-based advertising (Drèze and Hussherr, 2003). More recently, spending on digital advertising is increasingly devoted to mobile applications and across various social media channels (Pintol and Hadziahmetovic, 2024; Truong et al., 2010).

One major advantage of this shift into various forms of online advertising is related to the corresponding increase in online and virtual shopping experiences (Duong and Thi, 2024). Online advertising (as opposed to the mass market approach) allows retailers to immediately convert online or virtual product interest into measurable online purchase behaviours via click-through shopping capabilities. For reasons such as this, advertisers are contemplating how to best run effective promotional campaigns in AR, and scholars are beginning to study the outcomes (Mercado-González et al., 2021; Tsai et al., 2020).

The depth of interactivity within AR systems is possibly one of the greatest potential benefits of this new type of promotional activity (Du et al., 2022). However, there are also risks of failure with AR promotional campaigns (Pfaff and Spann, 2023). A study about a recent consumer trial of Meta's Quest 3 indicates that a poor overall experience with the headset technology may be contributing to the slow adoption of the product (Hennig-Thurau et al., 2025). Another such risk of using any AR technology is related to the condition known as AR sickness (Kaufeld et al., 2022).

Researchers have repeatedly found that AR sickness (i.e., cybersickness, VR sickness, simulation sickness, AR-induced symptoms and effects) is among the largest concerns when applying these technologies across various purposes (e.g., rehabilitation and training) (Howard and Van Zandt, 2021; Martirosov et al., 2022; Conner et al., 2022). Those who experience AR sickness exhibit reduced performance outcomes and have poorer perceptions of the medium (Howard and Van Zandt, 2021; Saredakis et al., 2020). These outcomes have resulted in many calls for researchers to investigate the dynamics of AR sickness to understand exactly how it influences user experiences and perceptions, including the study of novel outcomes and mediators of these effects such as the impact on attitudes and perceptions of AR technology which may additionally impact any response to AR advertising and promotions.

Research shows that a positive relationship exists between AR advertising effectiveness and attitude toward an ad (Yang et al., 2020). However, those scholars also note in that article that "...not *all* AR ads would result in positive effects...and it would be worthwhile to explore contexts in which the effects change or become negative" (pp.8-9). AR sickness is one such context that may cause variation in attitudes about AR technology. This study seeks to explore that topic and answer the call for research about underwhelming AR technology experiences and begins to apply these findings to the domain of advertising and its potential to impact consumer perceptions of a brand (Du et al., 2022). We rely on and incorporate the concepts of task technology fit (TTF) and misfit (TTM) to understand these effects. TTF theory proposes that any technology can possess one of many different levels of fit with various tasks being completed by the user of that technology (Goodhue and Thompson, 1995). That is, the same technology can have a high fit with certain tasks but can be perceived to have a poor fit with other tasks. Further, extended TTF (e-TTF) theory (Howard and Rose, 2019) proposes that a low level of TTF is not simply the opposite of a 'good TTF' (Howard and Rose, 2019). Instead, TTM is a unique phenomenon producing different outcomes than TTF, and low levels of TTF are not the same as high levels of TTM (Howard and Hair, 2023). Task technology misfit occurs because technologies often have a set of features that are perceived as either too little or too much for the task at hand. We suggest that TTF and TTM mediate the relationships between AR sickness and user perceptions, such that users have worse perceptions of AR experiences due to AR sickness because they perceive that AR does not fit the task at hand. If supported, our results would suggest that advertisers should adjust their promotions and advertising to minimise feelings of AR sickness when utilising AR technology for marketing purposes and consider focusing advertising and research efforts toward AR devices that induce lower levels of AR sickness.

By applying TTF and e-TTF theory, we provide a novel perspective to understand AR sickness and its implications on perceptions regarding the ease of use, usefulness, and attitude about AR technology. Our results show that AR sickness does indeed affect TTF,

misfit and the resulting user perceptions. As users experienced higher levels of AR sickness, AR technology produced lower perceptions of TTF and higher perceptions of technology misfit. User perceptions of task technology misfit are a particular concern for advertisers. We believe this study points to a blocking effect where perceptions about TTM are associated with a disengagement from the content and/or device. We additionally found that the effects from AR sickness negatively impacted the perceived ease of use and usefulness of AR technology due to the mediating effect of TTF. For this reason, we call for AR research in the domain of marketing to investigate common factors and antecedents to AR sickness, TTF, and TTM when using AR in promotions and advertising. We also need more research to better understand how to minimise the symptoms of AR sickness through the evaluation of both AR *advertising content* and AR *hardware design*.

2 Theory and hypothesis development

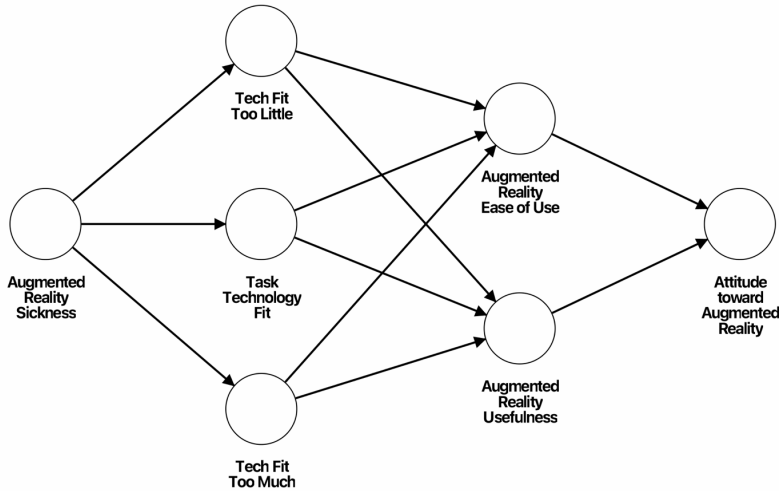
TTF theory gained notoriety based on the idea that a fit for any technology could change across various tasks (Goodhue and Thompson, 1995). Foundational to this theory is the notion that variation exists in the match between any technology and the task at hand. The level of TTF match or 'fit' is theorised to have a close association with user reactions. These ideas were recently extended by Howard and Rose (2019) to include the idea of misfit, or TTM, which we identify as e-TTF theory (Howard and Hair, 2023). e-TTF theory suggests that TTM is not simply the inverse of TTF; instead, it is a unique construct that can predict outcomes beyond TTF. Two types of TTM are differentiated in this theoretical extension – a technology can either be *too little* or *too much* for the task. Too little refers to instances in which the technology has too few features for the task, whereas too much refers to instances in which the technology has too many features for the task.

Prior research indicates increasing levels of cybersickness negatively impacted usability ratings for an MR system (Voinescu et al., 2023). When users experience AR sickness, we propose they will perceive AR systems as having worse TTF with the intended task. Users who experience AR sickness will have difficulties using AR and may disengage with the technology because the AR experience is perceived as not adequately fitting the task. This situation will result in a negative relationship between AR sickness and TTF and a positive relation between AR sickness and TTM. Advertising efforts may fail when an audience disengages with the message before receiving and internalising its meaning. Thus, from a marketing perspective, the level of AR sickness experienced by users is a central, key implication for businesses as they contemplate promotional campaigns and advertising strategies.

TTF theory has been proposed as a key lead-in explanatory variable and part of a larger, integrated theoretical model which also includes the unified theory of acceptance and use of technology (Dishaw and Strong, 1999). The technology acceptance model theory proposes that users will not accept and begin regularly using new technologies unless those users perceive that the *ease of use* and *usefulness* of the technology meet acceptable levels (Davis, 1989). Users' *attitude toward the technology* is considered a separate but equally important perception. Based on these theories and the following hypotheses, we developed the research model shown in Figure 1. This model proposes that the level of AR sickness experienced by users of an AR system will be related to

their perceptions of TTF and misfit. Moreover, the levels of TTF and TTM will impact users' perceptions of the ease of use, usefulness and attitude toward AR technology.

Figure 1 Conceptual research model



2.1 AR sickness and TTF /misfit

AR sickness is a condition where users experience symptoms such as eye fatigue, disorientation, and nausea during and/or directly after a session with alternative reality technology (Chang et al., 2020). Many factors are cited as potential causes of AR sickness including a mismatch between the visuals and vestibular sensations (balance from inner ear), the display or hardware issues, the content being viewed, the level of interaction with the simulated space, and many other individual or environmental factors (Tian et al., 2022). AR refers to devices that project or immerses simulated three-dimensional objects or environments into the real world (Bulearca and Tamarjan, 2010). AR differs from VR, because VR requires a fully simulated environment where a user's ability to see any aspect of the real world is fully occluded (Berryman, 2012; De Silva et al., 2019; Gleim et al., 2024). People can experience AR sickness when using a head-mounted display or even a computer monitor equipped with AR projection technology (Saredakis et al., 2020).

Technology users experience many consequences from AR sickness. Some people cognitively disengage with the simulation and may even look away or disconnect from the simulation program to remedy their feelings of sickness (Howard and Van Zandt, 2021). When doing so, these users will likely overlook aspects of the AR program that are relevant to the task or perceive the technology as having fewer features versus those not experiencing AR sickness. In the context of advertising, AR filters are commonly employed on social media channels (Tsou and Rodgers, 2024), yet AR sickness may result in a user disengaging from that platform. In that scenario, users will not fully view or consume an AR advertisement. Given these considerations, we propose that AR sickness positively relates to both too much and too little TTF. If users experiencing AR

sickness perceive the program as having less TTF and more TTM, they will likewise have overall negative perceptions of the AR program.

H1a Increased feelings of AR sickness will result in a lower perception of TTF.

H1b Increased feelings of AR sickness will result in higher perceptions of task technology misfit.

2.2 *TTF /misfit and AR ease of use*

The role of advertising within AR spaces such as the metaverse is not fully understood (Kim, 2021). This is in part, due to a multitude of AR devices with differing capabilities (Arena et al., 2022). Regardless of the device, however, the relationship between TTF and ease of use is likely to exist because any technology tailored to fit a specific task should reduce the cognitive load on users (Sweller, 2010). When a cognitive load is decreased in one area, the result is an increase in cognitive capacity for other priorities. With less capacity devoted toward figuring out how to use a technology for a task, users should find more capacity available to complete specific objectives. Recent evidence supports this reasoning because an increased perception of TTF is positively related to the belief that a technology is both beneficial and user-friendly (Aulia and Marsasi, 2024). Thus, when there is a high level of fit between the task and the technology, users can more quickly and easily understand how the technology could be used for any associated activities.

In the field of education and training, TTF was found to significantly influence users' perceptions regarding ease of use (Kim and Song, 2022). In the field of organisational behaviour, research has shown that when technologies fit well with user tasks the technology is perceived to be easier to use (Isaac et al., 2017). In educational and professional contexts, a good TTF and the ease of use were important considerations leading to future adoption of that technology (Chirchir et al., 2019). The fit between task requirements and technology characteristics in the hospitality industry increased both ease of use and user satisfaction (Schrier et al., 2010).

As previously noted, TTM is not necessarily a low level of TTF even though TTM has been identified as a critical factor influencing perceptions about the ease of use (Howard and Rose, 2019). Those authors proposed that when users perceive a misfit, they experience additional cognitive and operational burdens which will contribute to more difficulty in use. In the context of the workday, users who struggled to effectively use tools when they did not align with their job requirements experienced higher levels of stress due to the misfit between the task and the technology (Benlian, 2020). A misalignment between user tasks and technology increases the difficulty of completing any objective and may lead to frustration. This frustration can have spillover effects and negatively impact a user's perceptions about the technology's ease of use (Hsieh et al., 2011). As has been shown in various technological contexts, we believe the same relationship between TTF, TTM, and ease of use will exist for those who are attempting to use AR to complete tasks.

H2a TTF is positively related to perceptions of AR ease of use.

H2b Task technology misfit will have a negative relationship with AR ease of use.

2.3 TTF /misfit and AR usefulness

TTF theory emphasises that technology's usefulness is significantly determined by its alignment with task requirements (Goodhue and Thompson, 1995). In other words, when the capabilities of a technology are well-matched to the demands of the task, users perceive the technology as more useful. Many different elements of a technology can interact to influence this notion of perceived usefulness among the users (Gebauer and Ginsburg, 2009). Those researchers further suggested that the perception of a technology's usefulness is not just a function of its inherent features but also of how well those features align with the specific needs of the current task at hand. These ideas indicate that higher levels of technological alignment to a task will result in higher levels of perception about the usefulness of that technology. Empirical evidence also supports the relationship between TTF and perceived usefulness of technology in various contexts (Isaac et al., 2017; Junglas et al., 2008).

Meanwhile the opposite effect may simultaneously occur. Users who believe a technology is too little or too much for the task are likely to see low levels of perceived usefulness in the technology (Yang et al., 2013). Google Glass® is an example of an AR technology that was perceived as requiring too much technology. Examples of concerns included the need for Google Glass users to specifically point their lens directly at the object being recorded, the use of an obscure recording application called Winky, and the need to tether that recording session directly to an Android capable smartphone or use the (now defunct) Google Plus sharing platform (Chalfen, 2014). There were also other concerns related to privacy about when and where it was appropriate to use the technology for the task of recording video and whether Google Glass could be set to a mode of continuous recording (Klein et al., 2020). Ultimately, Google made the decision to fully discontinue support for Google Glass in 2023. The feeling by users of a task-technology misfit when using AR could be just as powerful, or even more powerful in predicting the lack of usefulness of that technology.

H3a TTF is positively related to perceptions of AR usefulness.

H3b Task technology misfit will have a negative relationship with AR usefulness.

2.4 Ease of use, usefulness, and attitudes about AR

Perceptions about ease of use and usefulness shape attitudes toward a technology according to the unified theory of technology acceptance and use (Davis, 1989; Venkatesh and Davis, 2000). Ease of use and usefulness drive the initial adoption of a technology, and reinforce positive attitudes over time (Legris et al., 2003). This dual perception, that a technology is both easy to use and useful, theoretically positively impacts users' attitudes about the technology (King and He, 2006; Venkatesh et al., 2003).

If users perceive a technology as being easy to use, they often believe that fewer barriers exist to achieve their objective (Gefen and Straub, 2000). As previously noted, higher ease of use perceptions are likely to reduce any cognitive efforts devoted to operating the technology, which will increase the desire for the technology among users (Agarwal and Karahanna, 2000). The combination of increased desire and a reduction in task barriers could easily generate more favourable attitudes toward a technology. In fact, recent studies about AR technology indicate that ease of use actively predicts important

relationships with other variables. A study involving AR mobile applications in an educational setting found a positive link between ease of use and attitude (Chen et al., 2023). Another study in an educational setting shows that ease of use was related to users' attitudes about MR applications within electronic textbooks (Jang et al., 2021). An education technology study similarly found that users can perceive electronic (e)book technology as positive or negative depending on its usefulness with the associated course (Merkle et al., 2022). In the retail cosmetics environment, ease of use was a significant predictor of trust when using AR technology to virtually try on make-up (Anifa and Sanaji, 2022), which is relevant because trust often correlates with attitude.

But what about the relationship between AR, advertising, and advertising research? One study gives evidence that a positive relationship is likely to exist between the satisfaction of an AR advertisement and consumers' purchase intentions (Sung, 2021). This finding supports TAM which proposes that increases in ease of use are often associated with increases in satisfaction and behavioural intentions. Another study established a relationship between AR advertising interactions and brand liking which is a positive emotion or feeling toward a particular brand (Tsai et al., 2020). This finding is important because increased positive feelings toward something are often associated with an increased positive attitude. Based on the evidence above and the basic mechanisms within the theory of technology acceptance and use, we believe that increases in AR ease of use will positively correlate with increases in attitude toward AR.

H4 AR ease of use will be positively related to attitudes about AR.

The perceived usefulness of a technology is a different idea than the ease of use. Both are theorised to impact attitude towards a technology in different ways. Ease of use reduces cognitive load, however when users perceive that a technology has a high level of usefulness, they are likely to believe the technology will enable a more efficient task completion. This belief is positively related to the attitude toward that technology (Venkatesh and Davis, 2000). An important literature review of the many different versions of the technology acceptance model shows that perceived usefulness was identified multiple times as a key predictor of positive attitudes across nearly every model (Lai, 2017). Empirical evidence abounds in support of these models.

Perceived usefulness of AR technology positively correlated with attitude in a cross-cultural study in an educational environment (Shen et al., 2022). Regarding consumers' use of AR in a retail setting, perceived usefulness is related to positive attitudes (Alam et al., 2021). In a study about AR mobile applications, perceived usefulness moderated the relationship between attitude and engagement such that when perceived usefulness increased, the relationship between attitude and engagement grew more positive (Arghashi and Yuksel, 2022). In line with the evidence above and the theory of technology acceptance and use, we believe that increases in AR usefulness will positively correlate with increases in attitude toward AR.

H5 AR usefulness will be positively related to attitudes about AR.

3 Methodology

3.1 Experimental research design

We collected data utilising an experimental research design by voluntarily inviting participants to use an AR computer terminal in a lab setting for approximately 30 minutes. Participants wore specialised glasses enabling three-dimensional viewing of projected imagery in AR to engage in the experiment. A handheld synaptic pointing/clicking device allowed each user to manipulate three dimensional objects in real-time while using two different applications. The first application was an introductory application commonly referred to as a ‘sandbox’, where users could circulate around a virtual room and pick up, move, turn over, zoom in/out, and set down various items such as a picture frame, chess pieces, and a hinged box. The second application gave users the ability to complete the same activities while studying and learning about anatomy and physiology with a scalable (up to life-size) three-dimensional human body.

Data collection occurred via questionnaires which were administered in two stages. After agreeing to participate, respondents completed the first questionnaire by answering many questions about their demographic profile, personality, and frequency of technology usage. After viewing a demonstration showing them how to wear the glasses and control the synaptic hardware on the computer terminal, they began using the AR software and hardware. The demonstrator remained available while rotating around the lab to answer questions and offer support. When participants were comfortable using the sandbox, after approximately 10 minutes, they began using the second application. When the session concluded after approximately 30 minutes, users completed a second questionnaire. These questions measured perceptions, physiological discomfort and included statements asking for users to identify their level of agreement about the adequacy and value of the technology. When data is collected during a multi-wave study, the threat of CMV is believed to be lower (Howard et al., 2024). The data were not subjected to post-hoc treatments such as item level correction (Merkle, 2025).

One-hundred and fifty qualified participants completed both questionnaires. A review of the answers resulted in 31 respondents being removed due to either large swaths of missing data or straight-line response tendencies. The final sample included 119 responses. The mean age of the respondents was 25 with an overall range between 18 and 48. Sixty respondents reported using AR prior to the experiment, 54 respondents reported having never used AR, and five respondents left the question blank.

3.2 Measures

Each measurement scale was selected from previously published research pertaining to these topics. The language used for each item remains largely unchanged from those prior studies.

3.2.1 AR sickness

AR sickness was measured via a multi-item scale of symptoms and effects people experience when using simulators or other alternate reality devices. These questions are asked to participants immediately after they complete a session using a simulation device (Kennedy et al., 1993). Participants rated how strongly they disagree or agree with

various statements on a seven-point Likert scale. An example question from this scale is, 'Please indicate the extent to which you are presently experiencing the following effects right now: Eyestrain'.

3.2.2 TTF, too little technology, too much technology

The scales for TTF, too little technology, and too much technology measure participants' perspective of how well the technology fits the purpose of the task (Howard and Rose, 2019). Six items measure TTF, six items measure too little technology for the task, and six additional items measure too much technology for the task. Answers are rated on a seven-point Likert scale from strongly disagree to strongly agree. An example of a question from these scales is, 'The technology has the exact functions needed for the task'.

3.2.3 AR usage outcomes

Measures pertaining to the outcomes of using AR assess participants' perceptions of ease of use, usefulness, and overall attitude about the technology (Rese et al., 2017). Four items were used to measure each outcome. On a seven-point Likert scale, respondents rated their disagreement or agreement with various statements when reflecting about their experience using AR. 'It was easy to learn how to use the AR technology application', is an example of a question from these scales.

3.3 Data analysis

SmartPLS 4 was used to execute the structural equation model and analysis (Ringle et al., 2022). PLS structural equation modelling facilitates the analysis of the relationships between independent and dependent variables within an exploratory research model (Sarstedt et al., 2020). Models with PLS-SEM follow a confirmatory composite analysis, which is a multi-step process including an evaluation of the measurement model followed by an assessment of the structural model (Sarstedt and Cheah, 2019; Hair et al., 2020). Table 1 reflects the means, standard deviations, correlations, and Cronbach alpha measures of reliability shown on the diagonal. The measures are reliable and acceptable because Cronbach alpha is above 0.7 (Hair et al., 2023).

3.4 Measurement model

Confirmatory composite analysis includes an assessment of item loadings a review of construct reliability, convergent, and discriminant validity, and evaluations for nomological and predictive validity (Hair et al., 2020). This measurement model included 46 items. Forty-three items loaded appropriately onto their constructs and were retained due to statistical significance ($p < 0.001$) and importance to the meaning of their latent constructs (Hair et al., 2019).

Table 1 Constructs, correlations, and Cronbach alpha (*on diagonal*)

	Mean	St. dev.	1	2	3	4	5	6	7
1 AR sickness	1.89	0.92	0.93						
2 Task technology fit	5.76	1.01	-0.36***	0.89					
3 Task tech fit too little	2.55	1.13	0.36***	-0.58***	0.83				
4 Task tech fit too much	3.07	1.30	0.45***	-0.50***	0.61***	0.84			
5 AR ease of use	5.53	1.02	-0.38***	0.70***	-0.46***	-0.29***	0.83		
6 AR usefulness	5.66	1.14	-0.46***	0.60***	-0.44***	-0.36***	0.76***	0.88	
7 Attitude toward AR	5.72	1.17	-0.39***	0.58***	-0.45***	-0.34***	0.72***	0.79***	0.89

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, ns = not significant.

The measures used to assess convergent and discriminant validity are shown in Table 2. Convergent validity is demonstrated for each construct because the average variance extracted (AVE) exceeds the recommended threshold of 0.50 (Hair et al., 2023). In this study, discriminant validity was assessed according to the heterotrait-monotrait (HTMT) method using 10,000 bootstrapped samples in SmartPLS (Hair et al., 2022). Discriminant validity between the constructs is supported by the HTMT ratios for each construct, which are all below 0.90 (Henseler et al., 2015).

Table 2 Convergent and discriminant validity (HTMT)

	1	2	3	4	5	6	7
1 AR sickness	<i>0.51</i>						
2 Task technology fit	0.38	<i>0.64</i>					
3 Task tech fit too little	0.40	0.64	<i>0.59</i>				
4 Task tech fit too much	0.47	0.68	0.49	<i>0.55</i>			
5 AR ease of use	0.43	0.81	0.54	0.39	<i>0.66</i>		
6 AR usefulness	0.49	0.68	0.49	0.37	0.89	<i>0.73</i>	
7 Attitude toward AR	0.42	0.64	0.50	0.35	0.83	0.89	<i>0.75</i>

Note: AVE expressed on diagonal.

Nomological validity is often evaluated through the correlation of constructs within the model or with other studies or variables outside of the model to confirm theoretical consistency with prior empirical results. The nomological relationships in this research model are supported by numerous studies as noted in the literature review and by the theories of TTF and technology acceptance and use.

3.5 Structural model

Confirmatory composite analysis also involves an evaluation of the structural model. Here we review multicollinearity, path coefficients and their statistical significance, and total variance explained in the dependent variables (Hair et al., 2020). A variance inflation factor (VIF) for each latent construct is used to assess the presence of multicollinearity. In this model all values of VIF are below 3.0, as such, multicollinearity is not a problem (Hair et al., 2023). Path coefficients and statistical significance in PLS-SEM are assessed using a bootstrapping procedure. This procedure generates a confidence interval with a p-value for a normalised mean path coefficient by randomly drawing smaller within-model samples 10,000 times (Hair et al., 2022). The results are shown in Table 3 and further discussed below.

In addition to the in-sample evaluation of the structural model, PLSpredict is a procedure useful to test for out-of-sample predictive ability via a hold-out sampling procedure (Shmueli et al., 2019; Hair et al., 2020). In this analysis, we specified three folds and ten iterations for each fold, which resulted in an n of more than 30 observations in each fold. The results show that the item error terms (RMSE and MAE) from the PLS model were lower than the error terms estimated in a linear regression model containing the same configuration. The lower error terms in the PLS model indicate higher out-of-sample predictive consistency when compared to a standard linear regression model (Shmueli et al., 2019; Hair et al., 2020).

Table 3 Structural model path analysis

<i>Paths</i>	<i>Model</i>	<i>R²</i>	<i>Hyp.</i>	<i>Result</i>
AR sickness → Task technology fit	-0.37***	0.14*	H1a	Yes
AR sickness → Tech fit too little	0.37***	0.14**	H1b	Yes
AR sickness → Tech fit too much	0.45***	0.20**		
Task technology fit → AR ease of use	0.66***	0.50***	H2a	Yes
Tech fit too little → AR ease of use	-0.10ns		H2b	No
Tech fit too much → AR ease of use	0.02ns			
Task technology fit → AR usefulness	0.52***	***	H3a	Yes
Tech fit too little → AR usefulness	-0.13ns		H3b	No
Tech fit too much → AR usefulness	-0.03ns			
AR ease of use → AR attitude	0.29*	0.66***	H4	Yes
AR usefulness → AR attitude	0.58***		H5	Yes
<i>Post-hoc mediation analysis</i>				
AR sickness → Task technology fit → AR ease of use	-0.24***			
AR sickness → Task technology fit → AR usefulness	-0.19*			
Task technology fit → AR ease of use → AR attitude	0.19*			
Task technology fit → AR usefulness → AR attitude	0.30**			

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, ns = not significant.

Also shown in Table 3 is an assessment of the model R^2 values, along with the strength, direction, and statistical significance of the path coefficients. AR sickness explains between 14% and 20% of the variance in perceptions about TTF and misfit. For those who felt the technology fit the task, that belief explained 38% to 50% of the variation in responses about AR eases of use and usefulness. Finally, and in line with the technology acceptance model, 66% of the variation in attitudes about AR are predicted by perceptions of AR ease of use and AR usefulness. Moreover, AR sickness was a better explanation for those who felt the AR technology was too much for the task, versus too little or just right. This is an indication that the technology currently required to use AR may be seen as a barrier to adoption for individuals who are susceptible to AR sickness. In post-hoc analysis, we additionally found that feelings about TTF mediate the relationship between AR sickness and users' perceptions about AR. However, no mediating relationship exists between AR perceptions and those who felt the technology was a misfit for the tasks. These findings are described and explained in greater detail below.

3.6 Control variables and multi-group analysis

To evaluate the potential effect of age on the latent constructs, we included age as a control variable. Age does not appear to explain the amount of AR sickness (-0.134 , $p = 0.082$), TTF (-0.048 , $p = 0.471$), or attitude toward AR (-0.004 , $p = 0.916$). We cannot reject the null for any of those relationships. We also conducted a MGA for those who had previously used AR technology versus those who had never used AR to determine whether any significant differences existed in the structural model. The result

of the MGA shows that no differences existed in the mean level of each latent construct, nor did any meaningful differences exist across the path coefficients for the two groups. This condition held under the bootstrap method and the parametric method for MGA.

3.7 *Tests of hypotheses*

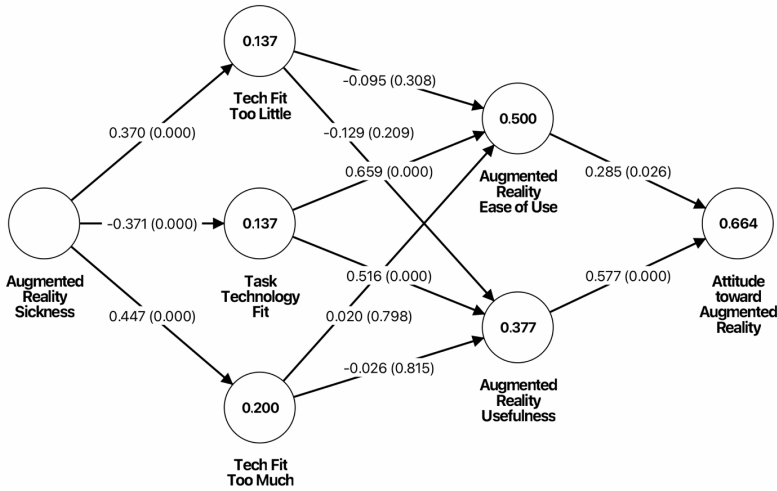
The first two hypotheses evaluated the relationships between AR sickness and TTF and misfit. AR sickness is negatively related to TTF and positively related to misfit in both cases, with too little and too much technology. The path coefficient between AR sickness and TTF is -0.37 ($p < 0.001$). Whereas the path coefficient between AR sickness and TTM too little is 0.37 ($p < 0.001$), and TTM too much is 0.45 ($p < 0.001$). Based on these results we can reject the null for hypothesis 1a and 1b. This outcome indicates the symptoms of AR sickness play a significant role in our ability to assess how well AR technology fits or misfits those tasks we are attempting to complete when using AR hardware and software.

Hypothesis 2b proposes that as participants increasingly believe that the AR technology fits the task, they will believe that AR technology is easier to use. We also proposed the inverse relationship here in 2b about technology misfit, meaning those who believe the technology is either too much or too little for the task will find the technology will be more difficult to use. The path coefficient between TTF and AR ease of use is 0.66 ($p < 0.001$). Whereas the path coefficient between TTM too little and AR ease of use is -0.10 , and not statistically significant, and TTM too much and AR ease of use is 0.02 , and not statistically significant. These results indicate we can reject the null for Hypothesis 2a but we must accept the null for Hypothesis 2b. As users perceive a higher level of TTF, we also see an increasing belief that the technology is easy to use. In contrast, perceptions about task technology misfit appear to be completely unrelated to a users' perception about ease of use.

Hypothesis 3a stipulates that as participants increasingly believe the AR technology fits the task, they will believe that technology is more useful. We also proposed the inverse relationship with Hypothesis 3b about technology misfit, meaning those who believe the technology is either too much or too little for the task will find the technology less useful. The path coefficient between TTF and AR usefulness is 0.52 ($p < 0.001$). Whereas the path coefficient between TTM too little and AR usefulness is -0.13 , and not statistically significant, and TTM too much and AR usefulness is -0.03 , and not statistically significant. Based on this outcome, again we can reject the null hypothesis for 3a. As the perception of TTF increases, we also observe an increase in the belief that the technology is useful. But when task technology misfit increases, we do not observe any relationship with perceptions of usefulness.

The fourth hypothesis suggests that as participants increasingly believe the AR technology is easy to use, they will have a more positive attitude about AR technology. We also proposed the same relationship between AR usefulness and attitude with hypothesis five. The path coefficient between AR ease of use and attitudes about AR was 0.29 ($p = 0.026$). The path coefficient between AR usefulness and attitude about AR is 0.58 ($p < 0.001$). Both hypotheses were supported. In line with the technology acceptance model, we found that as users' perceptions about AR's ease of use and usefulness increase, we can expect to observe a corresponding increase in those users' overall attitudes about AR technology. Figure 2 depicts the results of each individual hypothesis test.

Figure 2 Hypotheses test results



3.8 Post-hoc mediation analysis

Post-hoc mediation analysis highlights important findings about the relationship between AR sickness, TTF, and various outcomes when using AR technology. First, we find that AR sickness’ negative impact on the outcomes of using AR depend on the level of TTF perceived by that user. As shown toward the bottom of Table 3, higher levels of TTF attenuate the negative indirect effect of AR sickness on perceived ease of use (-0.24, $p < 0.01$), usefulness (-0.19, $p < 0.01$). From a practical perspective, this means the even at very high levels of TTF, AR sickness continues to negatively impact user perceptions about the performance (ease of use) and capability (usefulness) of AR hardware and software.

We also observe mediating effects with ease of use (0.19, $p < 0.034$) and usefulness (0.30, $p < 0.007$) in the relationship between TTF and attitude toward AR. This indicates that when an AR technology is perceived to be a good fit for the task, users will generally have a positive attitude toward that AR technology. However, the overall impact from TTF on users’ attitudes can still be significantly altered based on their corresponding perceptions about how easy it is to use AR and how useful the AR technology appears.

4 Discussion

The goal of this research was to explore the impact of AR sickness and its relationship with perceptions about AR device usage, and then discuss potential implications for the emerging AR advertising research stream and highlight some practical industry concerns when thinking about immersive AR advertising (Cowan et al., 2024). We identified three key results from the experiment. One result is that, within the context of using AR, AR sickness is occurring and has a relationship with TTF and both types of perceived TTM. The second finding is that perceptions of TTF are related to users’ perceptions about the

ease of use and usefulness. With that second finding, we additionally note two indirect relationships:

- 1 AR sickness is indirectly related to users' perceptions about the ease of use and usefulness.
- 2 TTF is indirectly related to overall attitudes toward AR systems.

Third, we find that high levels of perceived TTM are unrelated to users' perceptions about the ease of use, and usefulness of AR technology. We believe this third result is a critical finding indicating that higher perceptions of task technology misfit create a blocking effect on opinions about AR technology representing user disengagement with the content and/or device and will disrupt any advertising goals.

We discuss our findings and their implications in more detail below and then apply them specifically to the domain of advertising. In doing so, we rely on theories about the technology acceptance model and TTF and misfit, which together suggest that certain conditions, such as AR sickness, could impact the perception of TTF and TTM which are also related to perceptions about AR technology use and adoption outcomes (Yasmin and Akhter, 2023).

First, our findings show that in the context of using AR, AR sickness is occurring and is related to TTF and both types of perceived TTM. When AR users experience AR sickness, their perception of TTF decreases, versus those who are not experiencing the same symptoms. Conversely, perceptions of task technology misfit increase when users experience AR sickness. This condition is true for both those who feel the AR technology is too little and those who feel it is too much for the task.

This result suggests that advertisers must be careful to:

- 1 design immersive, engaging AR experiences that have a low likelihood to induce AR sickness
- 2 place these promotions with AR channels/devices that are a good technological fit for the engaging AR experience used in the promotion.

Advertisers may need to understand the propensity of an AR device to induce AR sickness. AR sickness related to the hardware is outside of advertiser control. But just as social media and television campaigns are pre-selected to run only on certain channels, it would be perhaps wise for marketers to restrict AR commercial advertising to run on devices with higher perceived TTF and a lower propensity to induce AR sickness.

Second, we find that perceptions of TTF are related to users' perceptions about the ease of use, usefulness, and indirectly related to overall attitude toward AR systems. When users perceive a high TTF, they are more likely to view the technology as beneficial and straightforward to use, which will foster a more favourable attitude toward the technology (Schrier et al., 2010). In the context of business, when a technology improves worker performance or adds a clear advantage to daily routines, those users are more likely to develop a positive attitude toward the technology. This study indicates the same type of positive attitudes could be produced with AR advertising, so long as the AR technology does not induce AR sickness and is a good task fit for the AR interaction.

Along with this second finding we also see counterbalancing indirect effects from AR sickness on user perceptions via a mediating effect from TTF. The indirect path results in Table 3, through TTF, show that as AR sickness increases, user perceptions of both AR usefulness and AR ease of use are decreasing. This is a significant concern for advertisers

seeking to use promotional AR advertising to persuade an audience or send a brand message to its customers.

Third, we did not detect a relationship between task technology misfit and perception outcomes, perhaps because of a cognitive blocking effect due to inconsistent levels of disengagement from the device. Measures for TTM too little and TTM too much were unrelated to ease of use and usefulness. We believe that these results indicate that people who were experiencing AR sickness due to a misfit may have cognitively disengaged with the AR technology which could prevent the formation of an opinion. In some situations, people who experience AR sickness look away from the technology to remedy their feelings of sickness (Howard and Van Zandt, 2021). These users may not return to the technology and are likely to overlook aspects of the technology that are relevant to the task and unable to form a complete perception of ease of use, usefulness, or general attitudes. Within the context of advertising, these symptoms will result in lost audience levels and a lack of consumption of the promotional material.

This result begins to indicate that advertisers should build in proxies for their advertisement testing to observe and learn when certain AR scenes and experiences potentially induce AR sickness and disengagement and cause users to rate the experience as a misfit of the technology. Testing advertising for AR sickness-inducing situations may be more difficult than it seems because AR experiences are not the same for each user. AR advertising often allows users to choose how and when to engage with various interactive elements in the virtual space. An approach that may work for advertising testing is for advertisers to sync up the advertisement being viewed in another space so that evaluators can see what is happening that causes users to disengage from the technology.

Alternate reality advertising research has thus far evaluated issues such as product placement (Chen and Wang, 2019), inspection and play (Tsai et al., 2020), augmented narratives (Tsou and Rodgers, 2024), and many other areas of interest. The advertising industry regularly updates its strategies for advertising across new mediums, such as augmented and VR (Kim, 2021; Truong et al., 2010). One area needing further investigation includes research about contexts where AR advertising may generate neutral or negative attitudes among viewers (Yang et al., 2020). This article is a beginning line of inquiry into the impact of AR sickness, its relationship with TTF, and any resulting user perceptions about attitude and usefulness of the AR device. Below, we conclude by noting and describing several mitigation strategies for AR sickness and practical remedies for AR advertising.

4.1 AR sickness mitigation and implications for AR advertising

The results in our experiment demonstrate that the level of AR sickness in conjunction with the perception of TTF and TTM together play a central role in determining user perceptions and ultimately shaping user attitudes about AR technology. Thus, according to theory and the empirical results from our study, AR sickness is likely to be a key antecedent to overall user adoption of AR across industries. Advertising industry research additionally indicates that immersive AR experiences shape brand perceptions and consumer behaviour (Sands et al., 2024). These thoughts should motivate action among advertisers to consider ways to reduce AR sickness during AR promotions. Below, we

discuss various ways that advertisers could begin to mitigate AR sickness and summarise this information into three major implications for advertisers.

4.1.1 AR sickness mitigation approaches

Researchers are currently focused on studying five broad areas aimed at mitigating or preventing AR sickness (Lawson and Stanney, 2021). One remedy involves the inclusion of an Earth-based horizon into the alternate reality background (Hemmerich et al., 2020; Shahnewaz Ferdous et al., 2021; Cao et al., 2021). A second fix could be related to minimising or eliminating the differences in normal eye or head motion tracking of a moving object versus the simulated alternate reality tracking of the movement of virtual objects (Stauffert et al., 2020; Palmisano et al., 2020). A third strategy for mitigating AR sickness involves reducing or restricting the amount of head motion required to use AR, which has been shown to reduce the strain due to abnormal head-eye coordination, or so-called oculomotor disturbances (Hughes et al., 2020). The fourth suggestion for reducing AR sickness involves regular maintenance of a user's equilibrium, which can be more plainly described as taking breaks when using AR (Jasper et al., 2020). Finally, the fifth approach currently under investigation is deepening our understanding about the factors related to individual susceptibility to AR sickness (Golding et al., 2021).

Hardware device companies have responded to these findings in numerous ways. Meta's line of Oculus, Quest 2, and Quest 3 devices included progressively improved external camera technology to allow users to partially view the real world outside of the fully occluded virtual environment. When Apple's VisionPro was introduced to the marketplace in 2023, they highlighted in some of their promotional strategies, the ability to blend the real world with AR. Therefore, these hardware devices offer AR app designers the ability to take advantage of horizon anchoring. Other hardware improvements such as increasing the refresh rate to above 120 frames per second (fps) result in lower levels of AR sickness (Wang et al., 2023). It is also plausible that a hardware-required start-up calibration/warm-up period during initial device usage may reduce AR sickness, but we have been unable to find any peer-reviewed research explicitly testing this procedure.

The advertising community, including both researchers and practitioners, should take additional action based on the above mitigating factors and the results from our study. From a practitioner perspective, we suggest three immediate potential remedies for the design and distribution of AR advertising. Many of these design remedies are currently under research and investigation within the AR/VR gaming industry. We suggest that similar experimentation could occur in advertising because within the context of consumer-based gaming, the content of augmented/VR experiences (not the device hardware), has been found to be the strongest factor related to AR sickness (Saredakis et al., 2020; Oh and Son, 2022).

4.1.2 Implications for AR advertising

The first implication for advertisers is related to the first mitigating factor noted above, the Earth-based horizon approach (Hemmerich et al., 2020). We suggest that any advertisers using immersive AR promotions include an earth-based horizon within their AR promotional experiences until more is known about how the removal of that horizon impacts AR sickness. This horizon could be enabled through simulation in advertising

design, or true anchoring by offering some augmented view of the real surroundings (if the AR device has that capability).

Technology characteristics are a key antecedent of TTF (Marikyan and Papagiannidis, 2023). The presence or absence of a stable horizon is one such characteristic. Therefore, TTF theory would suggest that horizon anchoring, as a technology characteristic which reduces AR sickness, could improve user perceptions of AR TTF. This theoretical rationale is consistent with the findings in our experiment. AR sickness has a negative relationship with TTF.

The second implication for advertisers is related to the second and third mitigation approaches previously noted. These techniques include offering an AR experience with realistic motion tracking and restricting the required amount of full head movement (Stauffert et al., 2020; Hughes et al., 2020). Research shows that AR users are more susceptible to AR sickness when they are exposed to unrealistic alternate reality object motion, and/or required to rapidly and unusually move their head in an AR environment (Palmisano et al., 2020). Therefore, we suggest that advertisers use a small beginnings approach when designing AR promotional experiences until we know more about how to control AR sickness in an immersive environment.

By small beginnings, we mean that advertisers could use simple AR promotions across non-immersive devices such as the AR technology available via mobile phone cameras. This approach would limit the speed of objects in motion and head movements to those that naturally occur by users who are holding a device and viewing a virtual object in a real world setting on their screen. Retailers, such as Home Depot and Oakley sunglasses, are currently using this approach to allow viewers to try-out products by projecting them into their own space and on their own face. Small beginnings will also allow the advertising industry to gather evidence to address concerns by some executives about the reach and cost-effectiveness of AR promotions (Marder et al., 2024).

From a theoretical perspective, research shows that users will adopt and choose technologies based, in part, on perceived TTF (Faqih and Jaradat, 2021; Ling et al., 2021). Based on these findings, we believe most users choose their mobile phone, in part, because of confidence in the phones' technological fit for various tasks. If users already believe in a high level of TTF with their mobile device, small beginnings with AR promotions on those familiar consumer devices is a logical first step for advertisers. This approach will greatly restrict AR sickness-inducing issues such as unrealistic alternate reality object motions and significantly reduce any rapid or unusual movement of user's heads resulting in a more positive experience for the user. This reasoning is in line with the results from our experiment. The mediating impact of TTF, noted in Table 3, shows that as the level of TTF increases, lower levels of AR sickness have a more positive indirect impact on perceptions about AR ease of use and usefulness, which is also associated with improving attitudes about AR technology.

The third implication for advertisers is focused on the fourth and fifth mitigation strategies noted above which both indicate a need for user-customised AR experiences. Research shows that some users benefit from frequent equilibrium-restoring breaks when using AR (Jasper et al., 2020), and that various factors may cause some users to be more susceptible to AR sickness than others (Golding et al., 2021). Here, we suggest that advertisers could begin with a disclaiming note of caution at the beginning of an immersive promotion and offer an interactive choice about how users would like to consume the promotion.

Other industries currently practice the use of a disclaiming note of caution. For example, before an audience views a new feature film, a movie rating is displayed to indicate the level of maturity necessary to enjoy the content of the film. In theme parks, riders are cautioned about certain pre-existing conditions, such that if a user has those conditions, they should strongly consider avoiding the attraction. If an AR promotion is likely to induce AR sickness among certain users, advertisers could simply notify those users ahead of time and give them the option to view a safe, alternative version of the promotion.

Research shows that an emphasis on a co-creative approach with users in an immersive environment can lead to improved attention and higher levels of tangible delight (Leung et al., 2024.). AR users may desire some ‘agency’ in their immersive experience to choose their preferred level of immersion. From a theoretical perspective, agency has been proposed as a potential factor impacting a user’s perception of TTF in the realm of human-computer interaction (Cornelio et al., 2022). We believe the findings in our experiment related to AR sickness’ positive relationship with task technology misfit may be partly related to a lack of user agency in our experimental design. That is, some users may want to dial down (or dial up) the level of AR interactivity or pause the use of AR technology due to feelings of AR sickness. Advertisers could therefore mitigate AR sickness at the user level by designing promotions that allow users to choose among varying levels of AR immersion.

The results and implications of this study should enable advertising researchers and practitioners to develop more comprehensive expectations and strategies related to the development of AR advertising and its effectiveness. Most AR programs are anticipated to produce some level of AR sickness. Our results show that current AR technology systematically produces less TTF and the same or more TTM. This is a concern for advertisers, because if users are disengaging from the AR advertising content prior to completing the viewing experience, they will miss the brand message and perhaps never return to hear it.

4.2 Limitations and future research

Lab based experiments have several limitations. First, experimental settings often involve a controlled environment that does not reflect real-world conditions. For this reason, we cannot claim that this study has high levels of external validity (Mook, 1983). Because we conducted this experiment in a lab-based environment, we are unsure how or if these results will be replicable in the field. However, a recent set of two controlled experiments compared cybersickness for lab-based vs. field-based alternate reality users (Quirós-Ramírez et al., 2025). The researchers detected no significant differences between the two groups which lends some support for external validity.

Second, uncontrolled, extraneous variables in a lab experiment can cause spurious conclusions (Campbell and Stanley, 2015). Prior to conducting the experiment, we did not screen users for pre-existing feelings of nausea or discomfort. Because we do not know how many or which participants were not feeling well on the day of the study, we cannot conclude with full certainty that the symptoms of AR sickness were only related to device usage during the experiment. Lastly, experimental designs only allow for short-term manipulations. This makes it difficult to study long-term effects and other processes that may occur over extended periods of time (Kazdin, 2021). For example, a longitudinal experimental study can address the question of how many users who

experience AR sickness are willing to return to using the technology and whether AR sickness is a condition that people can adjust to and eventually overcome with repeated usage or other interventions.

Future research can help to alleviate some of these limitations. A real-world test-marketing experiment could be beneficial to increase external validity. In this experiment, users should be presented with multiple immersive AR product experiences for competitors in a product family. Prior to the experiment, medical testing and evaluation can pre-screen out any 'day-of' sicknesses that may complicate the interpretation of the results. During the experiment researchers can monitor AR sickness and disengagement. Then at the end of the experiment, researchers can collect data on perceptions about the technology and product preferences. Finally, they could allow participants to choose only one product to take home with them to determine purchase intent.

Another future research direction should include a longitudinal design so that researchers can understand the ramifications of AR sickness induced disengagement with AR technology. In this study, researchers could use a range of AR devices and control the advertisements across those devices. This approach can help to begin disentangling when AR sickness is induced by the device versus when AR sickness is a result of the specific interactive advertisement by evaluating the so-called relationship between 'flow state' and AR sickness (Duong and Thi, 2024). Sample size may be a challenge for this research design, because we will need to access participants who have already chosen once to disengage from the technology. However, bringing these participants back to the experiment and allowing them a second and perhaps third opportunity to use AR could help us understand whether this condition is stable, increasing, or diminishing over time.

Some research suggests that AR sickness progressively increases with the duration of AR technology usage, but these results vary (Stanney et al., 2020). To investigate the impact of time-to-AR sickness and its effect on advertising and brand perceptions, an experiment could evaluate the placement of AR advertising. The control group would view an advertisement at the beginning of new AR application. The treatment group would view the same ad at either five, 10, or 15-minute intervals and a differences analysis could help us understand any changes in advertising or brand perceptions. A third control group within this experimental design could be exposed to some type of calibration/warm-up activity with random AR advertising again occurring at five, 10 and 15-minute intervals to help us determine whether a warm-up can mitigate AR sickness. Results from this experiment could help advertisers understand the impact of ad placement on various advertising outcomes and offer a way to begin mapping some potential stages of inbound marketing behaviours related to AR usage in the same way that they are understood to occur in digital marketing (Fayed, 2025).

A different experiment could be targeted toward hardware device manufacturers and involve pausing or temporary shutdowns of device usage when AR sickness symptoms are detected. Various experimental designs could be used for this research after a review of the most often occurring/recognisable symptoms is identified. Experimental observation techniques could first try to detect and pause AR device usage during live sessions and then take measurements or collect self-report perceptions of AR sickness. A study along these lines could also help us understand whether various personal factors act as mediators or moderators in an immersive AR experience (Sands et al., 2024). Ultimately, results from these studies could empower hardware manufacturers to make

the investment in automated sensing equipment to improve the AR user experience. Advertisers could then perhaps design into their campaigns a disabling feature for AR promotions after initial detection of potential AR sickness symptoms to avoid any negative impact on ad effectiveness.

In summary, we conclude that when using AR, AR sickness is related to TTF and both types of TTM. Lower levels of AR sickness generate higher perceptions of TTF and higher perceptions about augmented realities' ease of use, usefulness, and attitude about the technology. For these individuals, immersive experience AR advertising appears to be a good opportunity waiting to happen. On the other hand, we observe that high incidences of AR sickness are related to low TTF and high TTM. For users who rated AR with low TTF, their perceptions about the ease of use, usefulness, and attitude about the technology were also low. We additionally found that perceptions of TTM are seemingly unrelated to the formation of consistent perceptions about AR, which is likely reflecting a cognitive or physical disengagement from the AR technology. This is a concern for the advertising industry as they consider AR campaigns, because in these situations users may associate the discomfort of the experience with the brand, while never hearing the full brand message.

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Declarations

The authors report they have no conflicts of interest to declare regarding this article.

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