Purchase Intention in Augmented Reality vs. Web Shopping: A Multimodal Exploration

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Abstract

Augmented reality (AR) is gaining traction as a tool for immersive digital marketing, yet its influence on consumer decision-making remains underexplored, particularly when delivered through head-mounted displays (HMDs). This pilot study investigates how AR affects physiological engagement and purchase intention by comparing AR and web shopping experiences across galvanic skin response, heart rate variability, heart rate, and eye movement metrics, alongside perceived usefulness and enjoyment. Eighteen participants completed a shopping task in one of two conditions while physiological and self-report data were collected. Although some significant differences were observed in eye-tracking metrics, most physiological and self-reported outcomes did not reach statistical significance. Regression analyses revealed promising — but inconclusive — trends linking both physiological and attitudinal predictors to purchase intention, as seen through willingness-to-pay (WTP). These findings underscore the need for larger, better-powered studies but offer methodological insights into integrating multimodal data for intelligent AR systems and the Stimulus-Organism-Response (SOR) framework.

CCS Concepts

• **Human-centered computing** → **User studies**; **Mixed / augmented reality**.

Keywords

Augmented reality, eye-tracking, consumer behavior, intelligent VR/AR/MR, galvanic skin response, heart rate

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1 Introduction

Augmented reality (AR) is reshaping digital marketing by enabling in-situ product inspection and interaction, yet its impact on consumer decision-making—especially with head-mounted displays (HMDs)—remains unclear. Web shopping is the mainstream benchmark, making AR–web comparisons practically and theoretically useful. Prior work, grounded in the Stimulus–Organism–Response (SOR) model [Mehrabian 1974], suggests AR can heighten engagement [Arghashi and Yuksel 2022; Yang et al. 2020] and reduce uncertainty [Barta et al. 2023; Tan et al. 2022] and perceived risk [Bonnin 2020], but most evidence relies on self-reports and mobile/web implementations [Barta et al. 2023; Bonnin 2020; Park and Kim 2023; Poushneh and Vasquez-Parraga 2017; Zhang et al. 2019], leaving HMD AR and objective physiological indicators underexplored.

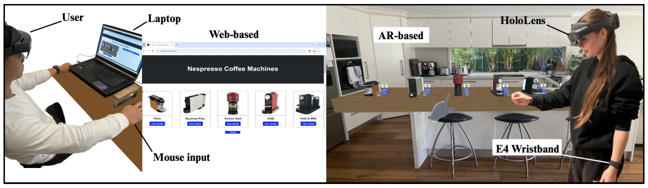

Figure 1: Web vs. AR shopping experiences. The user on the left is experiencing web shopping. The user on the right is experiencing AR shopping. Both users are monitored for physiological and eye-tracking data.

Physiological signals—galvanic skin response (GSR) [Abbott 2022; Pozharliev et al. 2022; Sheng and Joginapelly 2012], heart rate (HR) [Potter and Bolls 2012], heart-rate variability (HRV) [Sheng and Joginapelly 2012], and eye-tracking [Abbott 2022; Sheng and Joginapelly 2012; Szymkowiak et al. 2021; Yang et al. 2020]—offer complementary evidence of affective and cognitive states beyond self-reports. We compare a HMD-based AR shopping experience with a matched web interface (Figure 1), collecting multimodal data alongside perceived enjoyment/usefulness, and use willingness-to-pay (WTP) as a behavioral proxy for purchase intention [Barta et al. 2023]. Our goals are to (i) assess whether physiological/eye-tracking signals relate to WTP, and (ii) examine whether hedonic and utilitarian appraisals contribute to WTP. In doing so, we provide a compact protocol for multimodal SOR analysis in immersive commerce and identify signals to prioritize in future, adequately powered studies.

2 Related work

2.1 Theoretical foundations: the SOR model

The SOR model [Mehrabian 1974] explains how environmental *stimuli* influence the *organism* (affect, cognition, physiology) and drive *responses* such as purchase intention. It is widely applied in digital marketing to link interface/advertising cues to decision-making

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[Sheng and Joginapelly 2012]. Recent work extends SOR to immersive media, showing AR can intensify organism states via interactivity and presence, with downstream effects on engagement and WTP [Barta et al. 2023; Poushneh and Vasquez-Parraga 2017; Pozharliev et al. 2022; Szymkowiak et al. 2021; Trivedi et al. 2022; Uhm et al. 2022; Yang et al. 2020]. However, physiological pathways within SOR—particularly for HMD AR—remain underexplored. Guided by SOR, we examine self-reported and physiological/eye-tracking responses during AR vs. web shopping and identify which signals most closely relate to purchase intentions in immersive settings [Yang et al. 2020].

2.2 Augmented reality in retail settings

AR overlays virtual content onto real environments, bridging online and physical shopping and enhancing product visualization, engagement, and trust [Brengman et al. 2019; Javornik 2016; Poushneh and Vasquez-Parraga 2017]. Prior studies show AR can reduce uncertainty and cognitive dissonance and increase purchase intentions, perceived ownership, and trust [Barta et al. 2023; Pozharliev et al. 2022; Tan et al. 2022]. Most studies, however, focus on mobile/web AR in fashion [Beck and Crié 2018; Bonnin 2020; Park and Kim 2023; Poushneh and Vasquez-Parraga 2017; Watson et al. 2018; Zhang et al. 2019], cosmetics [Smink et al. 2019; Tan et al. 2022; Whang et al. 2021], and furniture/decoration [Brengman et al. 2019; Heller et al. 2019; Javornik 2016; Pozharliev et al. 2022; Qin et al. 2021]. The potential of AR HMD's larger field-of-view (FOV) and hands-free interaction for interactive, high-involvement products is still under-examined. We address this gap by comparing HMD AR with a matched web experience using interactive coffee machines to assess engagement and WTP.

2.3 Physiological measures and purchase intention in immersive AR contexts

Self-reports (e.g., purchase intention, WTP, satisfaction) are common in consumer research but are susceptible to bias and recall error [Abbott 2022]. Consumer neuroscience complements self-report with physiological indices of unconscious affective and cognitive reactions [Arghashi and Yuksel 2022; Dutta et al. 2022]. Common measures include GSR [Abbott 2022; Pozharliev et al. 2022; Sheng and Joginapelly 2012], HR [Potter and Bolls 2012], HRV [Forte et al. 2019; Sheng and Joginapelly 2012], and eye-tracking [Abbott 2022; Holmqvist and Andersson 2017; Sheng and Joginapelly 2012; Szymkowiak et al. 2021; Yang et al. 2020], indexing arousal, regulation, and attentional allocation; notably, GSR has been linked to WTP [Pozharliev et al. 2022]. While these predictors show promise in 2D marketing settings [Sheng and Joginapelly 2012; Szymkowiak et al. 2021], their behavior in embodied HMD AR remains unclear. HMD interactions with spatially embedded hands-on manipulation can heighten presence and agency [Barta et al. 2023; Brengman et al. 2019], potentially altering physiological dynamics relative to flat screens [Forte et al. 2019]. Consequently, it is uncertain whether established physiological–intention relationships generalize to HMD AR, calling for more nuanced inquiry [Park and Kim 2023].

2.4 Perceived enjoyment and usefulness in AR experiences

AR shopping engages both hedonic and utilitarian value; these constructs are central to Technology Acceptance Model (TAM) and related models of intention formation [Davis 1989]. Perceived enjoyment reflects intrinsic pleasure and engagement. AR can raise enjoyment through sensory immersion, embodied interactivity, and realism, which relate to stronger affective responses and trust [Hilken et al. 2017; Pozharliev et al. 2022]. Perceived usefulness captures functional benefit. By enabling in-situ product inspection, AR reduces uncertainty and boosts evaluation confidence, mitigating cognitive dissonance [Barta et al. 2023]. These pathways often reinforce each other when experiences are both enjoyable and effective [Hilken et al. 2017].

3 Objectives

Our objective is to test two pathways through which HMD AR shopping may influence consumer valuation. First, we examine whether embodied, immersive interaction elicits distinctive physiological and attentional signals that relate to WTP. Second, we assess whether perceived enjoyment (hedonic) and perceived usefulness (utilitarian) contribute to WTP. Framed within SOR, our research model is: Stimulus (AR vs. web) → Organism (physiology/eye-tracking; enjoyment/usefulness) → Response (WTP). We state two hypotheses:

H1: AR-induced GSR, HRV/HR, and eye-movement velocities are associated with consumer purchase intentions, as measured by WTP.

H2: Exposure to AR shopping stimuli is associated with increased perceived enjoyment and usefulness, which in turn are associated with greater WTP and purchase intention.

4 Materials and method

4.1 Participants

Eighteen adults (8 female, 10 male; 18–66 years, $M = 28.9$) were recruited in this pilot study; analyses included 17 after one outlier removal (AR: $N = 8$; web: $N = 9$). AR familiarity varied (1–7 Likert; overall $M = 3.71$, $SD = 1.49$). Inclusion criteria required participants to be over the age of 18 and not taking medications affecting physiology. Participation was voluntary and unpaid. Procedures were approved by the institutional ethics committee, and written informed consent was obtained.

4.2 Experiment design and task

We conducted a between-participants comparison of AR and a web interface (see Figure 1). After consent and random assignment, participants were instrumented (HMD and physiology wristband), completed baseline recordings (eye-tracking, GSR, HR, HRV), a brief familiarization, the main task, and a post-task survey. The task comprised five trials using interactive coffee machines with parity across conditions: select item, view animation with sound, and access product information. Surveys captured demographics, AR familiarity, perceived enjoyment, perceived usefulness, purchase interest, WTP, and workload (NASA-TLX) [Hart and Staveland 1988].

4.3 Experiment setup and signals

AR was delivered on Microsoft HoloLens 2; web ran on a 17-inch laptop. Eye-tracking provided linear and angular eye-movement velocities. Physiology was recorded with an Empatica E4 wristband. Surveys were administered via Qualtrics.

4.4 Data processing and analysis

Eye-tracking and physiological signals were cleaned for missing or erroneous values, baseline-adjusted, and averaged across the five trials per participant. We ran independent-samples t-tests for group comparisons and exploratory multiple regressions predicting WTP from (i) physiology/eye-tracking and (ii) perceived enjoyment/usefulness. Bonferroni correction was applied to t-tests.

4.5 Power and sample size

A priori power analyses indicated substantially larger samples are needed to detect medium effects total for physiology-based regression ($N = 46$ per group), and perceived enjoyment/usefulness regression ($N = 68$ per group). For the independent samples t-tests the sample requirement was $N = 64$ per group to detect a medium effect. With $N = 17$, this pilot is underpowered, therefore results are interpreted as exploratory and hypothesis-generating.

5 Results

5.1 Physiological results

Baseline-adjusted GSR and HRV trended higher in AR than web, but differences were not significant. HR, a common arousal index [Potter and Bolls 2012], was higher in AR but did not survive Bonferroni correction. Eye-movement metrics showed clear AR > web effects: both linear velocity (LV) and angular velocity (AV) were significantly higher, indicating greater visual scanning in AR [Holmqvist and Andersson 2017]. The results from these data are presented below in Table 1.

Table 1: Physiological measures: baseline-adjusted means (M) and SD by condition, with between-group tests.

Measure	Unit	AR ($N = 8$)		Web ($N = 9$)		p
		M	SD	M	SD	(Bonferroni $\alpha = .004$)
GSR	μS	0.6154	1.3285	0.1995	0.4306	.385
HRV	ms	0.0148	0.0148	0.0010	0.0141	.060
HR	bpm	4.3584	6.7246	-1.6925	4.2147	$.036^{\dagger}$
LV	m/s	0.0675	0.0243	0.0101	0.0389	$.002^{*}$
AV	rad/s	10.0371	3.8580	0.5047	0.7612	$<.001^{*}$

Notes: * significant at Bonferroni-adjusted $\alpha = .004$; † not significant after correction.

5.2 Self-reported results

Self-reported purchase interest increased more from pre to post in AR than on the web, but between-group differences were not significant. WTP, both high (WTPH) and low (WTPL) bounds, trended higher in AR without reaching significance. Perceived enjoyment and perceived usefulness were directionally higher in AR but non-significant. NASA–TLX scores were higher in AR, suggesting greater cognitive/physical demand, though not significantly so. The results from the surveys are presented in Table 2.

Table 2: Self-reported measures by condition with between-group tests.

Measure	AR ($N = 8$)		Web ($N = 9$)		p	Scale
	M	SD	M	SD		
Purchase interest (pre)	3.33	2.179	3.22	1.922	.195	7-pt Likert
Purchase interest (post)	4.89	1.616	3.67	2.179	.195	7-pt Likert
WTPH ($)	317.04	376.59	270.87	124.75	.731	Contingent valuation
WTPL ($)	183.44	226.35	127.22	65.42	.484	Contingent valuation
Perceived enjoyment	6.11	0.601	5.11	1.269	.055	7-pt Likert
Perceived usefulness	5.78	0.667	5.44	0.726	.326	7-pt Likert
NASA–TLX (overall)	19.44	19.30	10.78	19.33	.355	0–100

5.3 Regression analysis

Within-condition regressions did not yield significant predictors of WTP. In AR, comparatively larger (non-significant) standardized β weights were observed for LV and HRV. In the web condition, perceived enjoyment showed comparatively larger weights—especially for WTPL—than perceived usefulness, which was relatively stronger in AR. Given the small sample, these patterns are exploratory, therefore H1 and H2 remain unproven and inconclusive (see Table 3).

Table 3: Exploratory regressions predicting WTP.

Model	Condition	R^2	Adj. R^2	F(df1,df2)	Model p	Key weights (standardized β)
Physio	AR–WTPH	.580	-.470	.553 (5,2)	.744	LV (−1.573), HRV (−1.348)
Physio	AR–WTPL	.674	-.142	.825 (5,2)	.628	LV (−1.666), HRV (−1.304)
Physio	Web–WTPH	.721	.256	1.550 (5,3)	.381	GSR (−0.870), AV (−0.839)
Physio	Web–WTPL	.651	.070	1.120 (5,3)	.494	HRV (0.730), LV (−0.728)
Self-report	AR–WTPH	.276	-.013	.955 (2,5)	.445	Enjoy (−0.148), Usef (0.538)
Self-report	AR–WTPL	.431	.204	1.896 (2,5)	.244	Enjoy (0.008), Usef (0.655)
Self-report	Web–WTPH	.378	.171	1.824 (2,6)	.241	Enjoy (0.481), Usef (0.215)
Self-report	Web–WTPL	.555	.406	3.735 (2,6)	.088	Enjoy (0.595), Usef (0.245)

Notes: Enjoy = enjoyment; Usef = usefulness. "Physio" models use LV, AV, GSR, HRV, HR; "Self-report" models use enjoyment/usefulness.

6 Discussion and Conclusion

This pilot study examined how AR HMD shopping relates to engagement and purchase intention (WTP) using multimodal signals alongside self-reports. Given the limited sample size, all trends should be interpreted as preliminary indicators rather than confirmatory results.

Physiology. AR elicited higher eye-movement velocities, consistent with greater visuospatial scanning [Duchowski 2017; Holmqvist and Andersson 2017]. However, these differences may partially reflect confounding interface and interaction modality constraints, with AR providing a larger FOV and standing/gesture-based input vs. seated/mouse input on the web. This may have elevated scanning and effort independent of behavioral intent or engagement level, consistent with higher NASA–TLX in AR. HR was higher in AR before correction, whereas GSR and HRV differences were not reliable. Together, these signals may reflect attentional demands or motor/novelty effects rather than affect alone, underscoring the need to control FOV, posture, and input effort in future work.

Predicting WTP.. No regression model produced significant predictors. In AR, LV and HRV showed comparatively larger (non-significant) standardized weights. In the web condition perceived enjoyment weighed more than usefulness. These trends align with hedonic–utilitarian value formation [Barta et al. 2023; Hilken et al.

2017] but, given the small N, remain preliminary and hypothesis-generating rather than confirmatory.

Self-reports. AR was rated directionally higher in enjoyment and usefulness and showed larger pre→post gains in purchase interest, though none were significant. This mirrors prior work showing self-reports may under-capture subconscious responses and can be influenced by recall or demand [Sheng and Joginapelly 2012]. The alignment of higher eye-velocity with higher (non-significant) enjoyment/usefulness suggests, but does not confirm, a link between attentional allocation and perceived value in AR.

Contributions. Methodologically, this work demonstrates a compact multimodal protocol for SOR-based analysis of AR HMD shopping, integrating synchronized physiology, eye-tracking, and valuation data. Conceptually, we outline two plausible pathways, subconscious physiological responses and conscious appraisals (enjoyment/usefulness), that may relate to purchase outcomes. Practically, AR may heighten visuospatial engagement without immediately shifting WTP at pilot scale; marketers might treat AR as an engagement lever with potential downstream effects.

Limitations and future directions. The study is underpowered (pilot $N = 17$), with short exposure windows that may not fully capture physiological sensitivity. Future work should: (i) increase power; (ii) control for confounding variables by matching perceptual scale, posture, and input effort across conditions; (iii) segment time-series signals by task phase (inspection, comparison, decision) to disentangle engagement from motor/novelty effects; and (iv) expand sensing (e.g. pupil dilation, facial affect, electroencephalogram) to refine organism measures.

Conclusion. AR HMDs reliably increased visual scanning, with LV and HRV emerging as promising candidates for future predictive models. While perceived enjoyment and usefulness showed context-dependent trends, limited power precluded statistical confirmation. Although the results were inconclusive, these findings nonetheless highlight the promise of multimodal, SOR-based approaches that integrate physiological and attitudinal signals. With larger samples and tighter control, such signals could inform intelligent AR systems that personalize experiences and assess their impact on consumer valuation.

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