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Decoding Brand Experience in AR Vs. Web Interfaces via Gaussian Graphical Models

ABSTRACT

In the saturated digital marketplace, Augmented Reality (AR) has shifted from a novelty to a critical interface tool, directly overcoming the physical limitations of product evaluation. This paper investigates the structure of conditional dependencies within brand experience indicators across two distinct digital environments: traditional static web interfaces and interactive AR virtual try-on tools. Utilizing a field experiment design with a global cosmetics brand (Garnier) as the stimulus, data were gathered through a single-phase protocol focusing solely on AR (Study A) and a sequential within-subjects protocol comparing Web and AR platforms (Study B). To capture the dynamic, interconnected nature of consumer perceptions, a network approach using Gaussian Graphical Models (GGM) was deployed to map and compare the conditional networks of brand experience items across both mediums. The structural analysis reveals moderately dense networks in both contexts, empirically demonstrating that brand experience operates as a highly integrated, holistic system rather than a set of independent dimensions. Ultimately, the findings highlight how immersive technologies reconfigure consumer touchpoints, offering fresh methodological insights for digital interface design and visual marketing analytics.

Jelena Spajić [1]
Ksenija Mićić [2]
Bojana Milić [1]

[1] Faculty of Technical Sciences, Department of Industrial Engineering and Management, Novi Sad, Serbia
[2] L'Oréal Balkan, Belgrade, Serbia

KEY WORDS
Augmented reality (AR), virtual try-on, brand experience, Gaussian Graphical Model (GGM), network analysis

1. Introduction

The rapid evolution of digital commerce has compelled brands to transition from static online touchpoints to highly immersive visual interfaces. In this context, brand experience emerges primarily as a psychological and symbolic construct concerned with meaning and emotion rather than simple transaction ease (e.g. Mićić, 2026). It is specifically evoked by brand-identified stimuli, such as visual identity, interactive elements, and ambient design. Grounding this concept, Brakus et al. (2009) define brand experience as subjective, internal consumer responses (sensations, feelings, and cognitions) and behavioral responses elicited by brand-related stimuli across the entire customer journey. Empirically validated as a direct operationalization of Schmitt's (1999) strategic experiential modules, the four-dimensional framework by Brakus et al. (2009) captures four distinct facets:

- Sensory Experience: Aesthetic impressions and direct stimulation of the human perceptual apparatus (sight, sound, touch, taste, smell) that leave a memorable perceptual trace.
- Affective Experience: Emotional responses ranging from subtle moods to deep affective resonance, transforming transactional interactions into emotionally charged relationships.
- Intellectual Experience: The stimulation of complex mental activity, convergent/divergent thinking, imagination, and problem-solving curiosity.
- Behavioral Experience: Bodily actions, physical engagement, and lifestyle changes resulting from interactive motor activities.

While Schmitt (1999) originally formulated experiential modules from a managerial perspective, Brakus et al. (2009) refined the framework into a consumer-centric scale optimized for quantitative measurement, omitting the relational dimension due to its empirical overlap with affective and behavioral dimensions.

In existing literature, brand experience dimensions are almost exclusively treated as independent latent variables acting in parallel. However, the immersive nature of AR forces the simultaneous activation of multiple sensory and cognitive channels. Interactive real-time features imply that immediate visual cues spill over into emotional states or trigger intellectual curiosity. Recent empirical work confirms that AR-induced psychological states create cross-dimensional cognitive offloading and unique predictive pathways unobserved in static digital formats (Hilken et al., 2017; Yim et al., 2017; Heller et al., 2019; Rauschnabel et al., 2022; Kim et al., 2023; Mitrović et al., 2024; Mićić, 2026). To address this structural shift, it is essential to move beyond traditional latent factor models and examine how these dimensions interact network-wise. Consequently, this study poses the following research question: What are the structural characteristics and conditional interdependencies of brand experience dimensions within an augmented reality environment compared to traditional web interfaces?

2. Methods

2.1. Experimental design and context

A multi-stage quantitative experimental field experiment was conducted to maintain ecological validity. Hair color products from Garnier were selected as the experimental stimulus, as Garnier represents a highly familiar global brand with a mature, globally deployed virtual try-on platform. Hair coloring represents a high-involvement purchasing decision characterized by strong visual evaluation requirements and an inherent inability to conduct physical pre-purchase trials. The methodology encompasses two independent experimental protocols:

- Study A (Single-phase AR Protocol): Participants interacted exclusively with the AR virtual try-on tool prior to completing the evaluation instrument (N=142).
- Study B (Sequential Within-Subjects Protocol): A separate cohort evaluated the product line first on the official static web interface (Phase 1) and subsequently engaged with the AR virtual try-on tool (Phase 2), completing evaluations after each stage (N=126).

2.2. Sample and procedure

Data collection was conducted in Serbia in October and November 2025 using a structured online questionnaire distributed via purposive and virtual snowball sampling (Baltar & Brunet, 2012). From an initial pool of 324 responses, 56 were excluded following quality control procedures, yielding a final validated sample of 268 real consumers (NstudyA=142; NstudyB=126). In line with the target population for hair color products, both cohorts were overwhelmingly female (Study A: 99.3%; Study B: 94.4%) with broad age representation across 18 to over 55 years, centered around the 25–34 age bracket (~33%). Approximately two-thirds of respondents in both samples actively use hair dye products (~68%), ensuring high category involvement, while roughly 27% had prior experience with AR try-on tools. Participation was voluntary, anonymous, and conducted in accordance with digital ethics guidelines.

2.3. Measures and questionnaire development

Data was collected via structured electronic questionnaires. The four core dimensions defined by Brakus et al. (2009): Sensory (SBE), Affective (ABE), Behavioral (BBE), and Intellectual (IBE) brand experience, were operationalized on 7-point Likert scales. Reverse-coded items (SBE3R, ABE2R, BBE3R, IBE2R) were retained specifically as diagnostic indicators of experiential disengagement and friction. The complete operationalization of the four brand experience dimensions, adapted for the digital virtual try-on context based on Brakus et al. (2009), along with the corresponding item codes and adapted items, is provided in Table 1.

Table 1 (part 1)

Brand Experience Measurement Scale and Item Operationalization (adapted from Brakus et al., 2009)

Code	Dimension	Adapted Items
SBE1	Sensory	Virtual try-on of Garnier hair colors is visually appealing.
SBE2	Sensory	Virtual try-on of Garnier hair colors is visually and sensorially interesting.
SBE3R	Sensory (Reverse)	Virtual try-on of Garnier hair colors is not appealing to my senses.
ABE1	Affective	Virtual try-on of Garnier hair colors induces certain feelings in me (mood, excitement, trust...).

Table 1 (part 2)
Brand Experience Measurement Scale and Item Operationalization (adapted from Brakus et al., 2009)

Code	Dimension	Adapted Items
ABE2R	Affective (Reverse)	I do not feel strong emotions toward the Garnier brand while using the virtual hair color try-on tool.
ABE3	Affective	While using the Garnier virtual hair color try-on tool, I feel pleasure and emotional satisfaction.
BBE1	Behavioral	Virtual try-on of Garnier hair colors encourages me to take concrete actions regarding the product (exploring options, comparing shades...).
BBE2	Behavioral	Virtual try-on of Garnier hair colors influences my behavior (browsing products, planning a purchase...).
BBE3R	Behavioral (Reverse)	Virtual try-on of Garnier hair colors is not action oriented.
IBE1	Intellectual	Virtual try-on of Garnier hair colors makes me think about the products.
IBE2R	Intellectual (Reverse)	Virtual try-on of Garnier hair colors does not make me think.
IBE3	Intellectual	Virtual try-on of Garnier hair colors stimulates my curiosity and motivates me to explore further.

2.4. Gaussian graphical models (GGM)

Unlike traditional latent factor models, Gaussian Graphical Models (GGMs) treat brand experience as a dynamic system of directly interconnected indicators, a property particularly suited for immersive AR environments where sensory, cognitive, and emotional responses co-activate (Epskamp et al., 2018). Nodes represent survey items, while edges reflect conditional partial correlations after controlling for all other variables.

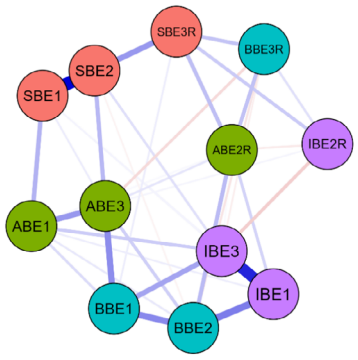
To prevent overfitting and eliminate spurious connections in sample-level estimates, regularization was applied via the EBICglasso (Least Absolute Shrinkage and Selection Operator) algorithm in JASP, yielding a sparse, parsimonious network retaining only strong empirical signals (Epskamp et al., 2018). Network topology was evaluated using edge weights, sparsity indices, Node Strength, and Expected Influence (EI), a key centrality metric that accounts for both positive and negative associations (Robinaugh et al., 2016). Traditional closeness and betweenness metrics were excluded due to known instability under LASSO penalization.

Network stability and parameter replicability were verified via 1,000 non-parametric bootstrap iterations and case-dropping bootstrap procedures (Epskamp et al., 2018). Consequently, structural inferences focus exclusively on robust, high-stability patterns.

3. Results

3.1. Study A: standalone AR network structure

The estimated GGM for Study A revealed a dense network with 39 non-zero edges out of 66 possible pairs (sparsity index = 0.409). Under pure AR exposure, brand experience functions as an integrated, co-activating network.



» **Figure 1:** *Network analysis using GGM for the four-dimensional brand experience framework: Study A*

Key partial correlations reflect immediate cross-dimensional spillover:

8. Sensory Coherence: The strongest positive edge occurred between SBE1 ↔ SBE2 (rpartial=0.636), demonstrating that AR provides a highly unified perceptual anchor.

9. Cognitive-Behavioral Coupling: High internal cognitive alignment (IBE1 ↔ IBE3, 0.548) actively coupled with behavioral exploration (BBE2 ↔ IBE1, 0.325).
10. Affective Activation and Action Linkage: Emotional stimulation connected directly to motor/behavioral action (ABE3 ↔ BBE1, 0.283). Furthermore, the strong edge between BBE1 ↔ BBE2 (0.294) confirms the internal coherence of the behavioral dimension, suggesting that in an augmented reality context, affective activation is not isolated but directly feeds into behavioral action and user engagement.

Centrality indices revealed that sensory aspects are the core drivers of the network. Specifically, visual appeal (SBE1: Expected Influence = 0.778) and sensory interest (SBE2: Strength = 1.252, EI = 1.135) emerged as central network hubs, indicating that the initial sensory impression activates and propagates through the rest of the brand experience dimensions. Conversely, reverse-coded non-engagement items (e.g., IBE2R: EI =-2.138) remained at the network periphery, showing minimal integration with the core positive experience nodes.

3.2. Study B: comparative network analysis (AR vs. Web)

The comparative structural analysis of the estimated networks (Figure 2) reveals fundamental insights into how brand experience operates across traditional and immersive digital channels. The AR network displays 39 non-zero edges out of 66 potential connections (sparsity index = 0.409), whereas the Web network exhibits 41 non-zero edges (sparsity index = 0.379).

Both empirical structures reflect moderately dense, highly interconnected networks. From a theoretical standpoint, this pattern reinforces a core premise: brand experience does not function as a set of isolated, independent dimensions. Instead, regardless of the digital medium deployed, brand experience operates as a highly integrated system of mutually reinforcing perceptual, affective, cognitive, and behavioral nodes. However, as illustrated in Figure 2, comparing Study A (AR experience) and Study B (Web vs. AR) reveals clear structural shifts in how information is processed across channels.

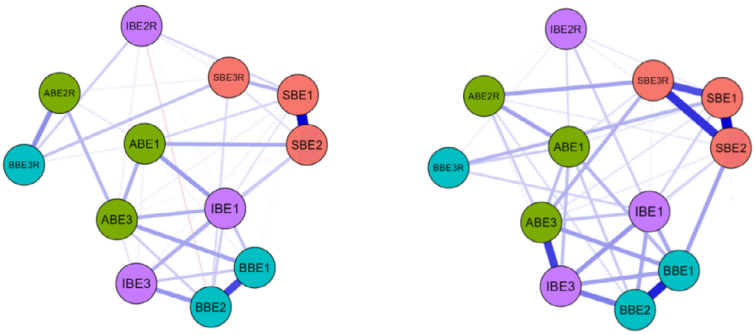
Centrality shifts across media are detailed in Table 2. While sensory visual interest (SBE2) maintains high centrality across both interfaces (AR: Strength = 1.083, EI = 1.101; Web: Strength = 1.011, EI = 1.011), comparing the baseline Web environment to the subsequent AR exposure reveals clear structural shifts. In the Web condition, user experience is predominantly driven by pragmatic, goal-oriented behavior (BBE1: EI = 0.922) and information-seeking curiosity (IBE3: EI = 0.685).

Upon transition to the AR interface, centrality sharply shifts toward sensory immersion and direct cognitive engagement. Specifically, sensory appeal (SBE1) increases in expected influence from 0.685 in Web to 1.040 in AR, while cognitive thinking (IBE1) jumps from 0.197 to 0.865. Conversely, pragmatic behavioral searching (BBE1: EI = 0.517) and informational curiosity (IBE3: EI =-0.039) recede in importance under AR conditions. Across both interfaces, reverse-coded items (except for SBE3R in the Web condition) consistently remain at the network periphery, confirming the structural stability of the underlying brand experience network.

Table 2

Standardized Centrality Metrics for AR and Web Interfaces (Study B)

Item	AR Strength	AR Expected Influence	Web Strength	Web Expected Influence
SBE1	1.018	1.040	0.685	0.685
SBE2	1.083	1.101	1.011	1.011
SBE3R	-1.036	-0.900	0.532	0.532
ABE1	0.141	0.212	-0.063	-0.063
ABE2R	-1.157	-1.014	-1.029	-1.029
ABE3	0.708	0.747	0.514	0.514
BBE1	0.465	0.517	0.922	0.922
BBE2	0.859	0.419	0.145	0.145
BBE3R	-1.007	-0.872	-1.667	-1.667
IBE1	0.833	0.865	0.197	0.197
IB2R	-1.783	-2.076	-1.934	-1.934
IBE3	-0.124	-0.039	0.685	0.685



» **Figure 2:** *Gaussian Graphical Models for Augmented Reality (left) and Website (right): Study B*

4. Discussion

Addressing the research question, the empirical network structures demonstrate that brand experience in AR is not merely an amplified version of web browsing, but an architectural reconfiguration of consumer perceptions:

1. Simultaneous multi-sensory activation in AR: In line with Heller et al. (2019) and Rauschnabel et al. (2022), AR interfaces anchor consumer experience in sensory co-activation (SBE1, SBE2). Real-time visual feedback reduces cognitive strain, enabling direct transfers between sensory perception, curiosity (IBE1), and emotional engagement (ABE3).
2. Task-oriented processing in static web: Static web interfaces require active cognitive processing and manual search behaviors (BBE1, IBE3). Consumers must mentally bridge the gap between static product images and real-life application, shifting centrality toward behavioral search actions.
3. Rejection of unidimensional latency: Network connectivity metrics affirm that brand dimensions (Brakus et al., 2009) act as mutually reinforcing components within an interactive system, validating GGM network analysis as a superior diagnostic tool for immersive UX environments.

5. Conclusions

This study advances digital marketing literature by demonstrating that AR virtual try-on technology fundamentally reconfigures the internal structure of brand experience. By treating sensory, affective, behavioral, and intellectual dimensions as connected network nodes rather than isolated latent variables, we show that AR serves as a powerful sensory-cognitive engine. For UX strategists, AR deployment should be treated not as a secondary promotional feature, but as a primary perceptual anchor designed to streamline decision-making and deepen brand engagement.

This paper represents part of a broader PhD thesis research exploring the mechanisms of augmented reality and brand equity in digital environments (Mićić, 2026). To build upon these empirical findings, future research should embrace larger, cross-cultural samples to enhance the generalizability of the network structures across diverse consumer segments. Furthermore, expanding this methodology to other product categories and industries (such as fashion apparel, eyewear, home furnishings, and interactive automobile configurators) will test the structural boundary conditions of immersive brand networks. Future studies could also deploy longitudinal experimental designs to track how network dependencies evolve over repeated AR exposure, as well as combine psychometric network modeling with objective physiological measures (e.g., eye-tracking and facial coding) to map the exact cognitive and sensory pathways of immersive consumer interfaces.

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