Impact of Metaverse-Based Marketing Strategy on Generation Z Consumers' Participation Intention in Automotive Brand Marketing

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ABSTRACT

Metaverse-based marketing extends digital brand engagement by combining immersive product presentation, social interaction, personalised content, and platform-mediated consumer participation. In China, where digital platforms, short-form video commerce, electric-vehicle competition, and interactive brand communication are highly developed, automotive brands increasingly use virtual launches, VR/AR experiences, avatar-led interactions, gamified activities, and virtual showrooms to engage digitally fluent Generation Z consumers. However, it remains unclear whether conventional technology-acceptance and experiential-marketing constructs are sufficient to explain participation intention in this high-involvement context. This study tests, rather than assumes, the explanatory power of an integrated Technology Acceptance Model (TAM) and Experiential Marketing Theory (EMT) baseline framework. Using survey data from 451 Chinese Generation Z consumers, the study examines perceived ease of use, perceived usefulness, immersion, social interaction, personalised content, attitude, and participation intention. The measurement model was validated in a first stage, and a Harman single-factor test indicated that one factor accounted for only 12.26% of the variance, below the 50% threshold: all Cronbach's alpha values exceeded .80, composite reliability ranged from .877 to .921 and average variance extracted ranged from .634 to .699, while the Fornell–Larcker criterion and HTMT ratios confirmed discriminant validity, so the null structural results are unlikely to reflect measurement artefacts. On that basis, the descriptive findings indicate generally positive evaluations of metaverse-based automotive brand marketing. However, the structural results show that none of the proposed direct or attitude-mediated relationships are statistically significant, and the R^2 values indicate negligible explanatory power. The findings suggest that favourable descriptive perceptions do not necessarily become meaningful structural predictors of participation intention. The study, therefore, identifies a boundary condition for applying TAM–EMT logic to metaverse-based automotive marketing and argues that future models should incorporate additional mechanisms such as perceived enjoyment, brand trust, social influence, perceived risk, brand involvement, information quality, privacy concern, and offline conversion value, and that immersion may function as an intermediate mechanism rather than a direct antecedent of attitude. The findings caution automotive marketers against assuming that usability, usefulness, immersion, interaction, and personalisation alone are sufficient to explain Generation Z participation intention.

Keywords: metaverse marketing, automotive brand marketing, Generation Z, Technology Acceptance Model, Experiential Marketing Theory

INTRODUCTION

Metaverse-based marketing extends digital brand engagement by combining immersive product presentation, social interaction, platform-mediated participation, and personalised communication. Rather than relying only on one-way advertising, brands can use virtual spaces, augmented and virtual reality functions, interactive avatars, real-time 3D environments, gamified activities, virtual product demonstrations, and social communities

to create more participatory forms of consumer engagement. In marketing research, the metaverse has been associated with new opportunities for brand interaction, value co-creation, immersive experience design, and data-driven personalisation.

China provides an important context for examining this phenomenon. Chinese consumers are deeply embedded in platform-based digital environments, including short-video platforms, livestreaming ecosystems, WeChat channels, online communities, mobile commerce, and personalised recommendation systems. These digital practices make Chinese consumers highly familiar with platform-mediated interaction. At the same time, China's automotive sector is undergoing rapid digitalisation, strong electric-vehicle competition, and experimentation with virtual launches, online showrooms, and immersive customer engagement.

The automotive industry is particularly suitable for examining the limits of metaverse-based marketing because vehicles are high-involvement products. Consumers normally evaluate design, performance, safety, price, technology, after-sales service, brand credibility, and emotional value before developing stronger purchase-related attitudes. Metaverse-based automotive marketing may support this evaluation process through virtual showrooms, 3D product demonstrations, immersive launches, virtual test drives, avatar-based consultation, and interactive brand communities. However, such experiences may remain exploratory or entertainment-oriented unless they provide credible information, trust, and clear links to offline decision-making.

Generation Z consumers are central to this transformation. In this study, Generation Z refers to Chinese consumers born between 1995 and 2009, subject to the age and consent criteria applied during data collection. This group has grown up with mobile internet, short-video platforms, online communities, gamified interaction, livestreaming, and personalised recommendation systems. Digital fluency, however, does not necessarily mean that Generation Z consumers will participate meaningfully in metaverse-based automotive brand marketing. In high-involvement automotive contexts, consumers may evaluate immersive brand activities positively while still requiring trust, risk reduction, credible information, and offline conversion pathways before forming stronger participation intention.

This creates an important theoretical tension. Technology acceptance research, particularly the Technology Acceptance Model (TAM), suggests that perceived ease of use and perceived usefulness shape user evaluations of technology. Experiential Marketing Theory (EMT), in contrast, emphasises sensory, affective, cognitive, behavioural, and relational dimensions of consumer experience. Metaverse-based automotive marketing appears to involve both technology acceptance and experiential engagement. Consumers are not only using a digital system; they are also experiencing a branded virtual environment. Nevertheless, the explanatory power of combining TAM and EMT in this context should not be assumed.

Existing technology-acceptance and experiential-marketing models may overestimate the predictive role of usability, usefulness, and immersive experience in high-involvement automotive contexts. In China's platform-based digital ecosystem, Generation Z consumers may evaluate metaverse automotive activities positively while still treating them as entertainment, social content, or exploratory brand exposure rather than as meaningful participation drivers. Therefore, this study tests the explanatory limits of an integrated TAM–EMT baseline model in the context of metaverse-based automotive brand marketing among Chinese Generation Z consumers.

The study is guided by six research questions. First, to what extent does perceived ease of use influence perceived usefulness in metaverse-based automotive brand marketing? Second, to what extent do technological factors influence attitude? Third, to what extent do experiential factors influence attitude? Fourth, to what extent does attitude influence participation intention? Fifth, does attitude mediate the relationships between technological and experiential factors and participation intention? Sixth, how much explanatory power does the TAM–EMT baseline model provide for understanding Generation Z consumers' participation intention in China's metaverse-based automotive marketing context?

The study makes a cautious contribution by testing, rather than validating, the TAM–EMT baseline framework. The contribution is not that the framework is confirmed. Rather, the study shows that favourable descriptive evaluations of metaverse-based automotive brand marketing do not necessarily translate into statistically significant structural effects. This helps identify a boundary condition for applying generic technology-

acceptance and experiential-marketing constructs to high-involvement, brand-mediated, immersive digital environments.

LITERATURE REVIEW

Metaverse marketing and immersive consumer engagement

Brand marketing has increasingly shifted from message exposure to consumer interaction. In digital environments, brands compete not only through advertising content but also through platform experiences, social participation, interactive storytelling, personalisation, and community engagement. The metaverse extends this movement by enabling firms to create virtual spaces in which consumers can explore products, communicate through avatars, participate in gamified tasks, attend virtual launches, and interact with other consumers.

For this study, metaverse-based automotive brand marketing is defined as a cross-platform, experience-based marketing environment that may include virtual showrooms, VR/AR experiences, avatar-led interaction, gamified brand activities, immersive product demonstrations, online brand communities, virtual product launches, and related platform-based interactive experiences. This definition is intentionally broader than headset-based virtual reality because many Chinese consumers encounter immersive brand content through mobile platforms, short-video channels, WeChat ecosystems, brand applications, and virtual events.

Recent empirical work has begun to specify how metaverse environments generate consumer responses. Barrera and Shah (2023), integrating a review of 164 articles with practitioner perspectives, propose that metaverse experiences are designed and characterised along three dimensions—immersiveness, sociability, and environmental fidelity—which correspond closely to the immersion, social interaction and personalised content dimensions adopted here. Empirically, immersion, social interaction and personalisation have been shown to raise shopping intention in metaverse retail among Generation Z consumers (Pillai et al., 2025), while perceived social presence raises purchase intention in metaverse retailing through metaverse identification (Zhang et al., 2025). Gleim et al. (2025) further suggest that self-expression, engagement, social influence and uncertainty avoidance dominate the pre-purchase stage, whereas hyper-personalised experience and service-script disruption differentiate the purchase stage. Taken together, this body of work indicates that immersion, sociability and personalisation can drive participation—but typically through identification-, presence- or enjoyment-based mechanisms rather than through a generic sense of ease or utility. That possibility motivates the present test.

Automotive brand marketing and high-involvement decision-making

Automotive marketing differs from many low-involvement consumer contexts. Vehicles are expensive, technically complex, identity-relevant, and closely linked to safety, mobility, lifestyle, and long-term ownership. Consumers, therefore, require more than visual stimulation or platform convenience. They often require trustworthy information, transparent pricing, safety explanations, comparison tools, expert consultation, and opportunities to connect online experience with offline test drives or dealership visits.

Metaverse-based automotive marketing may help consumers visualise vehicle design, compare features, simulate use scenarios, customise options, interact with digital spokespersons, and participate in virtual launch events. However, these activities may increase awareness or curiosity without necessarily producing stronger participation intention through attitude. This makes the automotive context a useful setting for testing whether technology acceptance and experiential evaluation are sufficient explanatory mechanisms.

Recent evidence from China strengthens this argument. Zhang et al. (2025) used 348 respondents intending to buy a new car through a metaverse automotive retailing platform and found that perceived social presence of others raised purchase intention via metaverse identification; consumer stickiness and friend accompaniment strengthened this path, and environmentally friendly vehicles strengthened the identification–intention link more than conventional vehicles did. Their study therefore points to social presence, identification and product type—not usability or product-evaluation utility—as the operative mechanisms in automotive metaverse settings. Barta et al. (2023), comparing live-stream shopping on Instagram with a metaverse environment experimentally,

likewise show that telepresence and co-presence in the metaverse generate stronger purchase-relevant responses than linear streaming. The contrast with the present study is informative and is taken up in the discussion.

Generation Z and China's platform-based digital consumption

Chinese Generation Z consumers are highly exposed to mobile-first, platform-mediated digital communication. They are familiar with short-video platforms, livestreaming, online communities, gamified interaction, influencer communication, recommendation systems, and branded digital experiences. This makes them a relevant population for studying participation in metaverse-based automotive brand marketing.

However, digital familiarity can also create a ceiling effect. If most respondents already perceive digital marketing platforms as easy to use and generally useful, perceived ease of use and perceived usefulness may show limited variance and may not strongly predict attitude or participation intention. In addition, Generation Z consumers may participate in metaverse-related brand activities for enjoyment, social visibility, novelty, peer relevance, or entertainment rather than because they form a conventional positive attitude toward the marketing platform.

Recent Chinese evidence illustrates both the promise and the limits of this argument for cars. Industry analysis suggests that China's Generation Z cohort numbers roughly 250 million people with a consumption scale of about 5.97 trillion yuan, that this cohort accepts electric vehicles markedly more readily than older cohorts and is willing to pay premiums for intelligent driving, and that it evaluates vehicles rationally on range, price, safety and performance as well as on appearance and self-expression (China EV Hundred People's Society & Li Si Strategy Consulting, 2025). Market research on post-1995 car buyers similarly reports that this group relies far more on short-video and social recommendation platforms and far less on official brand channels than any earlier cohort, and treats visual appeal, handling and advanced configuration as its strongest purchase drivers (J.D. Power, 2025). Huang and Wu (2025), studying 989 Chinese Generation Z respondents, find that attitudes and cultural pride jointly mediate the effect of product attributes and social influences on purchase intention. The emerging picture is one of a generation that is digitally fluent yet rationally demanding, which makes Generation Z an appropriate but exacting context for testing participation mechanisms.

TAM, EMT, and their limits in immersive automotive marketing

The Technology Acceptance Model proposes that perceived usefulness and perceived ease of use are central determinants of technology acceptance. Perceived usefulness refers to the degree to which users believe that using a system provides valuable benefits, while perceived ease of use refers to the degree to which users believe that a system requires minimal effort. In metaverse-based automotive marketing, these constructs are relevant because consumers must be able to access, navigate, and understand virtual environments and must perceive the experience as useful for product learning or brand engagement.

Experiential Marketing Theory argues that consumer responses are shaped by sensory, affective, cognitive, behavioural, and relational experiences. In this study, EMT is operationalised through immersion, social interaction, and personalised content. Immersion reflects the extent to which consumers feel absorbed in a virtual automotive marketing environment. Social interaction reflects communication with other users, brand avatars, or virtual representatives. Personalised content reflects the degree to which the experience matches individual needs, preferences, or interests.

Although TAM and EMT are theoretically relevant, they may be insufficient in high-involvement automotive metaverse contexts. Participation intention may also depend on perceived enjoyment, brand trust, perceived risk, information credibility, social influence, brand involvement, privacy concern, and offline conversion value. Therefore, the TAM–EMT framework is treated in this study as a baseline explanatory model whose limits are empirically tested.

Empirical extensions of TAM into metaverse settings show that results depend heavily on where immersion is positioned. Zhang, Quoquab and Mohammad (2025), studying Generation Y adoption of metaverse applications with 205 respondents, found that perceived ease of use and perceived usefulness shaped intention through

immersion and a sense of presence, with perceived enjoyment and personal innovativeness also contributing. Abdeljaber et al. (2025), extending TAM to metaverse shopping with 523 respondents, found that usefulness, ease of use, enjoyment and herd behaviour drove adoption intention while cyber risk acted as a barrier, and that immersion and perceived curiosity enhanced the TAM constructs. Taken together, these studies suggest that when immersion is modelled as an intermediate mechanism, TAM constructs regain explanatory power. In the present study immersion is entered as a direct antecedent of attitude alongside ease of use and usefulness, and no attitudinal pathway emerges. The contrast therefore points to the position of immersion in the causal chain, rather than to its mere inclusion, as a plausible determinant of TAM-based success in metaverse contexts.

The theoretical links in this study rest on two distinct logics that make the baseline hypotheses non-trivial. TAM predicts that ease of use and usefulness shape evaluations because users are assumed to be motivated by instrumental efficiency (Davis, 1989; Venkatesh et al., 2012). EMT, by contrast, assumes that sensory, affective, cognitive, behavioural and relational stimuli create holistic brand experiences that influence evaluation through affective and symbolic routes (Brakus et al., 2009; Schmitt, 1999). Combining them implies that participation intention should be jointly driven by instrumental and experiential appraisals, with attitude as the conduit. This expectation is reasonable in general digital-consumer settings, but it is less certain in high-involvement automotive contexts where consumers routinely separate entertainment value from purchase-relevant judgement. The baseline model therefore provides a strong theoretical benchmark precisely because its failure would be informative about the boundary of these theories, rather than a mere null result.

Conceptual framework and hypotheses

The conceptual framework positions perceived ease of use, perceived usefulness, immersion, social interaction, and personalised content as antecedents of attitude (see Figure 1). Attitude is positioned as the immediate predictor of participation intention and as the mediating mechanism linking technological and experiential factors to participation intention. The framework is not presented as exhaustive; instead, it provides a theoretically grounded baseline for testing whether conventional TAM and EMT constructs can explain participation intention in this context.

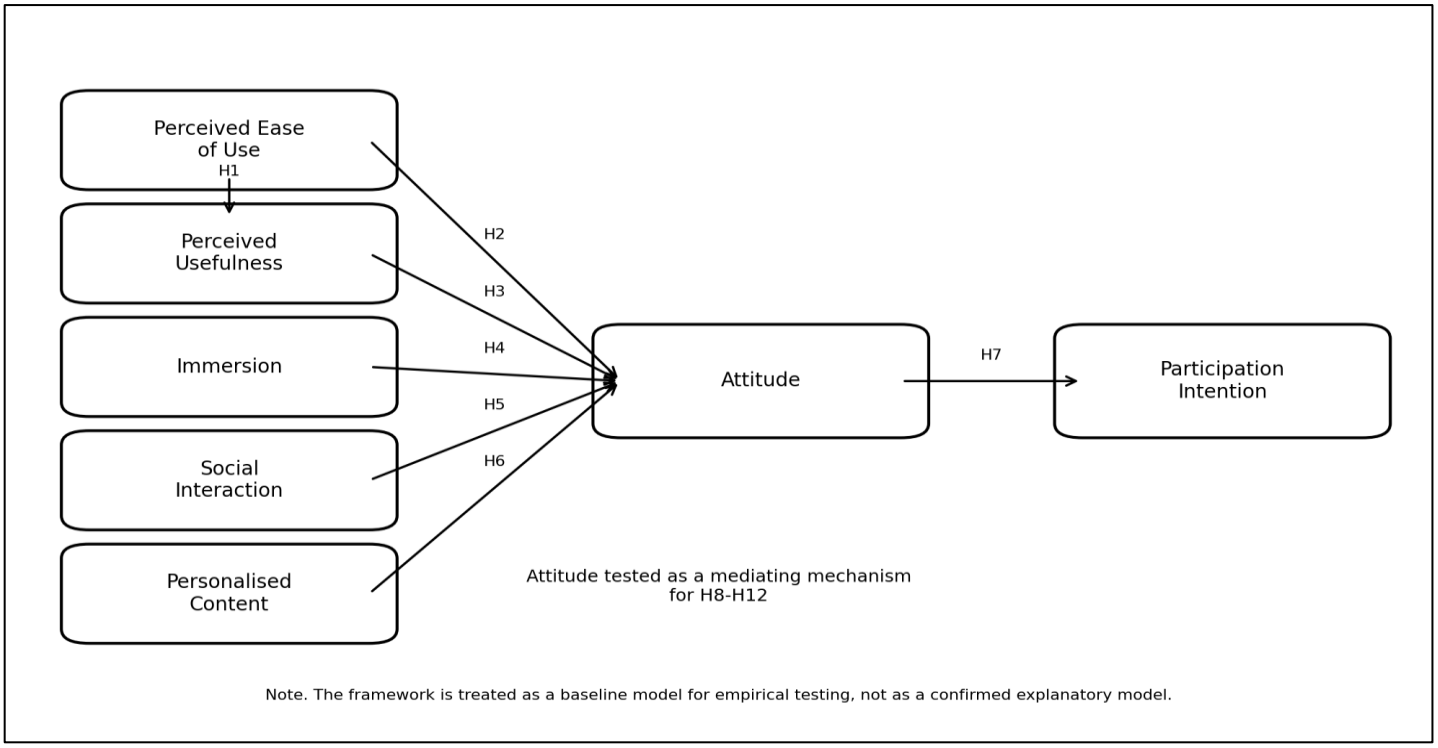

Figure 1: Revised TAM–EMT baseline conceptual framework

H1: Perceived ease of use positively influences perceived usefulness in metaverse-based automotive brand marketing.

H2: Perceived ease of use positively influences attitude toward metaverse-based automotive brand marketing.

H3: Perceived usefulness positively influences attitude toward metaverse-based automotive brand marketing.

H4: Immersion positively influences attitude toward metaverse-based automotive brand marketing.

H5: Social interaction positively influences attitude toward metaverse-based automotive brand marketing.

H6: Personalised content positively influences attitude toward metaverse-based automotive brand marketing.

H7: Attitude positively influences Generation Z consumers' intention to participate in metaverse-based automotive brand marketing.

H8: Attitude mediates the relationship between perceived ease of use and participation intention.

H9: Attitude mediates the relationship between perceived usefulness and participation intention.

H10: Attitude mediates the relationship between immersion and participation intention.

H11: Attitude mediates the relationship between social interaction and participation intention.

H12: Attitude mediates the relationship between personalised content and participation intention.

METHODOLOGY

Research design and context

This study used a quantitative, cross-sectional survey design to test the explanatory power of a TAM–EMT baseline model in the context of metaverse-based automotive brand marketing among Chinese Generation Z consumers. The design was appropriate for examining associations among latent constructs at one point in time; however, the findings are interpreted as associational rather than causal because the data were self-reported and cross-sectional.

Population, sampling, and data collection

The target population comprised Chinese Generation Z consumers who had awareness of, exposure to, or experience with metaverse-based automotive brand marketing activities. Generation Z was defined as consumers born between 1995 and 2009, consistent with the screening question used in the questionnaire and with the age and consent procedures applied during data collection. A purposive sampling approach was used because respondents had to meet three screening criteria: awareness of the metaverse concept, prior personal experience with metaverse activities, and birth year within the specified range. Of the 460 questionnaires returned, nine were removed because respondents indicated that they were not familiar with the metaverse concept and were directed to the end of the survey; the remaining 451 cases passed all screening checks and were retained. Data were collected over a six-week period in 2025 through online platforms and communities relevant to the target group, including WeChat, Douyin, Bilibili, and automotive-related online communities. As with all purposive online samples, this procedure limits population representativeness and the generalisability of the results, a limitation addressed in the final section. The questionnaire was distributed through online platforms and communities relevant to the target group, including WeChat, Douyin, Bilibili, and automotive-related online communities.

Instrument and measures

The questionnaire measured demographic profile, exposure channels, participation activities, and seven constructs: perceived ease of use, perceived usefulness, immersion, social interaction, personalised content, attitude, and participation intention (see Table 1). Perceived ease of use and perceived usefulness were adapted from established TAM instruments (Davis, 1989; Venkatesh & Davis, 2000), while immersion, social

interaction, and personalised content were adapted from experiential marketing and metaverse experience scales (Brakus et al., 2009; Schmitt, 1999). Attitude and participation intention followed the formulations used in prior technology-acceptance and participation research. The items were translated into Chinese for data collection and checked for clarity by two academic reviewers with expertise in marketing and scale development; minor wording adjustments were made to improve comprehension for a Chinese Generation Z audience. A small pre-test was conducted before the main survey to confirm that the items were understandable and that the scale functioned as intended. Attitude and participation intention were included to test the evaluative and behavioural mechanism of the baseline model. All construct items were measured using a five-point Likert scale.

Table 1: Constructs and Retained Items

Construct	Operational meaning	Items
Perceived Ease of Use (PEOU)	Ease of learning, accessing, and operating metaverse-based automotive marketing	5
Perceived Usefulness (PU)	Usefulness for information, experience, or product understanding	5
Immersion (IMM)	Absorption, focus, and presence in the virtual automotive environment	4
Social Interaction (SI)	Communication with brands, avatars, representatives, or other users	5
Personalised Content (PC)	Content matching needs, preferences, and interests	5
Attitude (ATT)	Overall positive or negative evaluation of the activity	4
Participation Intention (PI)	Willingness to participate in future metaverse-based automotive brand activities	4

Data analysis and reporting scope

The analysis followed the two-stage PLS-SEM procedure recommended by Hair et al. (2022). Stage one evaluated the measurement model through reliability analysis, exploratory factor analysis suitability tests, convergent validity (standardised indicator loadings, composite reliability and average variance extracted) and discriminant validity (Fornell–Larcker criterion and HTMT ratios); stage two evaluated the structural model using bootstrapped path analysis, coefficient of determination assessment and mediation analysis. Cronbach's alpha was used to assess internal consistency at the construct level, and the Kaiser–Meyer–Olkin statistic and Bartlett's test were used to assess factor analysis suitability. Bootstrapping was used to estimate path coefficients, t-values, p-values, confidence intervals and indirect effects. The resulting measurement evidence is reported below in Tables 2 and 3.

Measurement model and scale validation

The measurement model was examined before any structural inference was drawn, so that the null structural findings could not be attributed to weak, ambiguous or inconsistent measurement.

The suitability of the data for factor analysis was established first. The Kaiser–Meyer–Olkin measure of sampling adequacy was .828 and Bartlett's test of sphericity was significant (approximate chi-square = 6831.129, df = 496, p = .000), showing that the correlation matrix departed sufficiently from an identity matrix. An exploratory principal-component factor analysis with varimax rotation was then conducted on the 32 retained items (5 + 5 + 4 + 5 + 5 + 4 + 4). Seven factors were extracted with eigenvalues of 3.922, 3.610, 3.361, 3.015, 2.812, 2.571 and 2.482, together explaining 68.0% of the total variance; each construct was then represented by a single factor with an eigenvalue above 1, every item loaded on its theoretically assigned construct at a coefficient above .60, and no item cross-loaded above .40 on any other construct. All 32 items were therefore retained and each construct was represented by its full item set in the PLS-SEM estimation. Because all data came from a single survey instrument, a Harman single-factor test was also conducted as a procedural check on common method bias. The first factor accounted for 12.26% of the total variance, well below the conventional 50% criterion, and seven distinct factors with eigenvalues above 1 emerged, indicating that common method variance was not dominant in these data.

Table 2 reports reliability and convergent validity. All construct-level Cronbach's alpha values exceeded the .70 threshold, and all composite reliability (CR) estimates exceeded .80, indicating acceptable internal consistency. Convergent validity was supported by standardised indicator loadings between .750 and .879, CR values between .877 and .921, and average variance extracted (AVE) values between .634 and .699; every AVE exceeded the .50 benchmark, so more than half of each construct's variance was explained by its indicators.

Discriminant validity was assessed with the Fornell–Larcker criterion and the Heterotrait–Monotrait (HTMT) ratio following Henseler et al. (2015). Table 3 reports the square root of the AVE for each construct on the diagonal together with the construct correlations. Every diagonal value exceeded its corresponding off-diagonal correlation, satisfying the Fornell–Larcker criterion. HTMT values ranged from .026 to .092, below the conservative .85 cut-off and below the stricter .65 cut-off for every construct pair, so discriminant validity was retained. Variance inflation factors were also checked for the predictors of each endogenous construct and all fell below 1.02 (the largest value was 1.016), indicating no problematic collinearity. Overall, the measurement model provided sound reliability and validity, which allows the subsequent null structural findings to be interpreted with confidence.

Table 2: Reliability and Convergent Validity Results

Construct	Items	Cronbach's alpha	CR	AVE	Indicator loadings
Perceived Ease of Use	5	.851	.897	.634	.757–.825
Perceived Usefulness	5	.888	.920	.697	.800–.863
Immersion	4	.810	.877	.641	.750–.831
Social Interaction	5	.892	.921	.699	.823–.864
Personalised Content	5	.879	.913	.677	.774–.863
Attitude	4	.852	.901	.695	.793–.879
Participation Intention	4	**.845**	**.897**	**.686**	**.808–.865**

Table 3: Discriminant Validity — Fornell–Larcker Criterion (square roots of AVE shown in bold on the diagonal)

Construct	PEOU	PU	IMM	SI	PC	ATT	PI
PEOU	.796	-.051	.041	-.029	-.103	-.004	.019
PU	-.051	.835	-.048	-.003	.052	.049	-.016
IMM	.041	-.048	.801	.062	.004	-.039	.005
SI	-.029	-.003	.062	.836	.052	.008	-.070
PC	-.103	.052	.004	.052	.823	.025	.063
ATT	-.004	.049	-.039	.008	.025	.834	-.024
PI	.019	-.016	.005	-.070	.063	-.024	.828

FINDINGS AND RESULTS

Respondent profile and exposure

A total of 451 valid responses were analysed. The sample comprised 214 male respondents (47.5%) and 237 female respondents (52.5%). Respondents came from different educational backgrounds, occupations, monthly disposable consumption groups, and city tiers, indicating that the sample was not restricted to a single gender group or only first-tier cities.

Respondents reported exposure to metaverse-based automotive brand marketing through multiple digital channels. Short-video platforms such as Douyin and Kuaishou were reported by all respondents (451; 100.0%), followed by WeChat official accounts/video channels (411; 91.1%), Xiaohongshu/Weibo and other graphic platforms (144; 31.9%), automotive brand official apps/websites (119; 26.4%), VR/AR device applications (101; 22.4%), automotive virtual communities/games (46; 10.2%), friend or community recommendation (42; 9.3%), and other channels (51; 11.3%). This result should be interpreted cautiously because the 100.0% short-video

exposure may reflect the sampling frame, screening approach, or the centrality of short-video platforms in China's digital ecosystem; it should not be interpreted to mean that metaverse-based automotive marketing is equivalent to short-video marketing.

The main forms of participation were virtual product launches or new car exhibitions (405; 89.8%), VR/AR experiences (255; 56.5%), game tasks in metaverse interactive spaces (240; 53.2%), interaction with users or brand avatars (205; 45.5%), digital spokesperson-led brand interaction (149; 33.0%), virtual showroom livestreaming or scene roaming (101; 22.4%), and virtual test-drive or experience activities (88; 19.5%). Because the marketing stimulus was deliberately broad, the participation formats were examined separately as an exploratory check on whether specific formats were associated with different levels of participation intention. Respondents who reported VR/AR experiences (n = 255) recorded a higher mean participation intention than those who did not (4.37 vs. 4.19, Welch t = 2.05, p = .041), and the same pattern appeared for virtual test-drive or experience activities (n = 88; 4.46 vs. 4.25, Welch t = 2.06, p = .040). No other format showed a statistically reliable difference. These comparisons were not corrected for multiple testing and are exploratory; they should be read as descriptive evidence that participation formats are not interchangeable, not as confirmatory tests of format effects. The null structural results therefore should not be taken to mean that every metaverse format is equally inert — different formats may operate through different mechanisms that the pooled baseline model cannot detect.

Descriptive results

Table 5 summarises the construct means. Respondents generally evaluated metaverse-based automotive brand marketing positively. However, descriptive positivity should not be treated as hypothesis support, because means indicate levels of agreement, not predictive relationships among constructs.

Table 5: Construct Descriptive Statistics and Reliability

Construct	N	Mean	Interpretation	Cronbach alpha
Perceived Ease of Use (PEOU)	451	4.5002	Very positive	.851
Perceived Usefulness (PU)	451	4.2927	Positive	.888
Immersion (IMM)	451	4.0970	Positive	.810
Social Interaction (SI)	451	3.8909	Moderately positive	.892
Personalised Content (PC)	451	3.8102	Moderately positive	.879
Attitude (ATT)	451	3.9917	Positive	.852
Participation Intention (PI)	451	4.2921	Positive	.845

All construct-level Cronbach's alpha values exceeded .80 (.810–.892), indicating acceptable internal consistency and consistent with the composite reliability and validity evidence reported in Tables 2 and 3. The overall scale alpha was .706, which is acceptable but lower than construct-level values because the questionnaire measured several theoretically distinct constructs.

Structural model and mediation results

The structural model results (see Table 6) show that none of the direct hypotheses were statistically supported at the .05 level. Small negative coefficients, where present, should not be interpreted as evidence of negative effects because they were statistically non-significant. Instead, the results indicate that this dataset did not empirically support the proposed TAM–EMT baseline relationships.

Table 6: Direct Hypothesis Testing Results

Hypothesis	Path	beta	p-value	Decision
H1	PEOU -> PU	-.051	.318	Not supported
H2	PEOU -> ATT	.002	.964	Not supported
H3	PU -> ATT	.046	.358	Not supported
H4	IMM -> ATT	-.037	.399	Not supported

H5	SI -> ATT	.010	.839	Not supported
H6	PC -> ATT	.022	.642	Not supported
H7	ATT -> PI	-.024	.571	Not supported

The R^2 values further indicate very weak explanatory power. Perceived ease of use explained only 0.3% of the variance in perceived usefulness ($R^2 = .003$). The five antecedent variables explained only 0.4% of the variance in attitude ($R^2 = .004$). Attitude explained only 0.1% of the variance in participation intention ($R^2 = .001$). Therefore, the TAM–EMT baseline model did not meaningfully explain the endogenous constructs in the current dataset.

The mediation analysis shows (see Table 7) that attitude did not significantly mediate the relationships between perceived ease of use, perceived usefulness, immersion, social interaction, personalised content, and participation intention. All indirect effects had p-values above .05, and the available bootstrap confidence intervals included zero. Hence, H8 to H12 were not supported.

Table 7: Mediation Hypothesis Testing Results

Hypothesis	Indirect path	Indirect beta	p-value	Decision
H8	PEOU -> ATT -> PI	-.00005	.983	Not supported
H9	PU -> ATT -> PI	-.00111	.731	Not supported
H10	IMM -> ATT -> PI	.00090	.741	Not supported
H11	SI -> ATT -> PI	-.00024	.922	Not supported
H12	PC -> ATT -> PI	-.00054	.834	Not supported

Diagnostic interpretation of non-significant findings

The non-significant findings require cautious interpretation. First, the high mean scores for perceived ease of use, perceived usefulness, and participation intention suggest possible restricted variance or ceiling effects, which would attenuate path estimates. Second, the operationalisation of metaverse-based automotive brand marketing was broad, covering short-video platforms, WeChat, VR/AR applications, virtual launches, gamified tasks, avatars, and virtual showrooms. These experiences are related but not identical, and combining them may have introduced conceptual heterogeneity that a single-path model cannot capture. Third, the baseline model may be theoretically incomplete because participation intention may depend on omitted mechanisms such as perceived enjoyment, social visibility, brand trust, perceived risk, information credibility, privacy concern, brand involvement, technology readiness, and offline conversion value. The reliability and validity evidence reported in Tables 2 and 3 rules out measurement unreliability as a simple explanation for this pattern, so the explanation must be sought in the model specification and the response process rather than in the quality of the scales. A fourth observation sharpens this conclusion. The seven constructs were almost mutually orthogonal in this sample, with the largest absolute inter-construct correlation equal to .103 and the mean absolute correlation equal to .031 (Table 3). The null paths are therefore not the residue of attenuated but patterned covariation; the constructs simply did not covary, which is a property of the responses rather than of the quality of the scales.

Overall, the findings do not validate the TAM–EMT baseline model. They show that favourable descriptive perceptions of metaverse-based automotive brand marketing did not translate into statistically significant direct or mediated structural effects. The model should therefore be treated as empirically unsupported in its current specification and as evidence of a boundary condition requiring future model refinement.

DISCUSSION

Interpretation of the non-significant findings

This study examined Generation Z consumers' participation intention toward metaverse-based automotive brand marketing in China using an integrated TAM–EMT framework. The descriptive results were favourable: perceived ease of use received the highest mean score, followed by perceived usefulness and participation intention, whereas social interaction and personalised content scored comparatively lower, suggesting that

current metaverse-based automotive marketing is stronger in accessibility and product presentation than in relational depth and individual relevance. Structurally, however, no hypothesised direct or mediated path reached significance and the R^2 values were negligible. The non-significant findings should not be read as evidence that usability, usefulness, immersion, interaction and personalisation are irrelevant to metaverse-based automotive marketing.

Three explanations are consistent with the pattern. First, the omitted-mechanism account: recent metaverse research typically finds effects when immersion, social interaction and personalisation operate through intermediate states such as metaverse identification, perceived presence, flow or enjoyment (Pillai et al., 2025; Zhang et al., 2025), whereas this study routes them directly into attitude. Second, the boundary account: in high-involvement automotive settings, participation is plausibly gated by trust, perceived risk, information credibility and offline conversion pathways that the baseline model leaves unmeasured, so even positive evaluative responses may not convert into participation intention. Third, the measurement-scope account: because metaverse-based automotive marketing was operationalised broadly across short-video, WeChat, VR/AR and virtual-launch formats, a single attitude construct may have been responding to heterogeneous experiences, which attenuates common path estimates. A fourth, format-based account receives direct support from the exploratory comparison reported above: VR/AR and virtual test-drive participants expressed significantly higher participation intention than non-participants, whereas the most common format — virtual launches — did not. This suggests that the pooled null result may conceal heterogeneity across marketing formats, with experiential and trial-oriented formats carrying more participatory relevance than launch-viewing formats. These explanations are not mutually exclusive, and the cross-sectional design cannot discriminate between them.

What the results do establish is where TAM–EMT logic stops. Replicable prior work in metaverse retailing reports significant effects for constructs that are null here—immersion and social interaction among Generation Z shoppers (Pillai et al., 2025), social presence in automotive metaverse retailing (Zhang et al., 2025)—but consistently via identification- and presence-based mediators rather than through a direct evaluative route. The present null pattern therefore redirects the theoretical question from whether immersion and ease of use matter to how they are wired into the model. That redirection is the specific boundary condition this study identifies.

Theoretical Implications

The study offers three cautious theoretical contributions. First, it identifies a boundary condition for applying TAM and EMT jointly to immersive, brand-mediated and high-involvement marketing: the integrated framework is theoretically plausible yet empirically unsupported in its current specification, which indicates that generic usability and experience constructs do not automatically travel into automotive metaverse contexts. Second, it reframes the role of immersion. Because immersion recovers significance when placed downstream of TAM constructs in prior metaverse studies (Zhang et al., 2025; Abdeljaber et al., 2025) but is null as a direct antecedent of attitude here, the findings suggest that immersion functions better as a mediator than as a parallel antecedent. Third, it demonstrates that favourable descriptive evaluations and statistically significant structural effects are empirically separable in participation research, a distinction that is easily obscured when survey means are reported without corresponding path estimates. Fourth, the exploratory format-level comparison indicates that pooling heterogeneous metaverse formats into a single stimulus can mask meaningful differences: trial-oriented and immersive formats were associated with higher participation intention than launch-viewing formats, pointing to format as a boundary condition that future TAM–EMT applications should model explicitly.

The weak explanatory power also suggests that attitude may not be the central psychological mechanism linking technological and experiential evaluations to participation intention in this setting. Future models should consider alternative mechanisms such as perceived enjoyment, flow experience, metaverse identification, brand trust, consumer engagement, social visibility, perceived authenticity and emotional attachment, and should treat attitude as one possible mediator among several rather than as the default channel.

Practical Implications

The findings do not identify factors that drive participation intention. Rather, they show which commonly assumed factors did not explain participation intention in the tested model, and they point to where managerially

controllable actions are and are not likely to pay off. Because the path evidence is null, the recommendations below are framed as cautious design hypotheses derived from the descriptive and exposure evidence, and they are consolidated in Table 8.

Two descriptive conclusions carry practical weight. First, automotive brands should avoid assuming that positive evaluations of usability, usefulness, immersion, interaction and personalisation automatically produce stronger participation intention; these elements may be necessary design conditions, but they are not sufficient on their own. Second, the comparatively lower scores for social interaction and personalised content, together with the concentration of participation in virtual launches and VR/AR experiences rather than virtual test drives, indicate that current metaverse automotive campaigns are strong at reach and weak at relational depth and at linking online exposure to offline action.

Table 8 converts these readings into concrete initiatives for automotive marketers. The initiatives are ordered from diagnostic reframing to concrete platform design, and each is tied to the evidence that generated it.

Table 8: Summary of Findings and Actionable Managerial Initiatives (actionable initiatives shown in bold)

Evidence from this study	**Managerial reading**	**Actionable initiatives**
All direct and mediation paths are non-significant; $R^2 \leq .004$	Descriptive appeal is not evidence of a causal lever	Reframe metaverse KPIs from satisfaction and attitude scores to conversion metrics such as test-drive bookings, dealership visits, and completed vehicle configurations.
Perceived ease of use mean 4.50 (highest); PEOU→PU and PEOU→Attitude null	Usability is an entry ticket, not a differentiator	Treat platform usability, onboarding and navigation as baseline hygiene, and stop funding separate usability campaigns as a participation strategy.
Social interaction 3.89 and personalised content 3.81 are the lowest means	Relational depth and individual relevance are under-built	Add brand-expert and real-owner avatar salons, live engineer Q&A sessions, and preference-based vehicle configuration paths inside the virtual showroom.
Short-video exposure 100.0%; only 19.5% experienced virtual test-drive activities	Reach is high at the top of the funnel and thin at the bottom	Embed one-tap test-drive booking and dealership hand-off at the end of every virtual launch, livestream and VR/AR session.
Participation concentrates in virtual launches (89.8%) and VR/AR (56.5%)	Engagement in one format does not generalise to others	Segment metaverse campaigns by format (virtual launch, VR/AR, gamified task, avatar consultation) and evaluate participation separately for each format.
Trust, risk, information credibility and privacy were not modelled	High-involvement scepticism is left unaddressed	Publish pricing transparency, safety and range credentials in-world, add expert verification badges to avatar consultants, and surface clear data-use and privacy notices.
Attitude mediated none of the five antecedent–intention links	Engagement metrics obscure genuine behavioural response	Stop reporting participation-intention survey scores as a proxy for participation; track behavioural logs such as sessions returned, items configured and bookings completed.

Taken together, the initiatives in Table 8 shift the strategic emphasis of metaverse-based automotive marketing from reach generation to conversion engineering. The study does not confirm that these initiatives will raise participation intention; it identifies them as the most defensible places to intervene given what the evidence does and does not support.

LIMITATIONS AND FUTURE RESEARCH

This study has several limitations. First, the proposed TAM–EMT baseline model had very weak explanatory power and should not be interpreted as an empirically validated model. Second, metaverse-based automotive marketing was operationalised broadly to include cross-platform digital experiences, which may have introduced conceptual heterogeneity. Third, the study relied on self-reported data, which may be affected by social

desirability bias or response consistency issues. A Harman single-factor test suggested that common method variance was not dominant (12.26% of variance explained by the first factor), and the measurement model met conventional reliability and validity thresholds (Tables 2 and 3); nevertheless, a statistical check cannot fully rule out common method bias in single-source survey data (Podsakoff et al., 2003). Fourth, the study used a cross-sectional survey design, which limits causal inference. Fifth, purposive online sampling limits population representativeness, and the sample was restricted to Chinese Generation Z consumers, so the findings may not generalise to other countries, age groups, or automotive market contexts. Finally, the study examined participation intention rather than actual participation, dealership visits, test-drive bookings, or purchase behaviour.

Future research directions

Future research should refine the baseline model by incorporating additional psychological, social, technological, and brand-related variables. Perceived enjoyment and flow experience should be examined because metaverse platforms may be used for entertainment and absorption as much as for information search. Brand trust, perceived risk, information credibility, privacy concern, and perceived authenticity should also be included because automotive decisions involve high cost, safety, long-term ownership, and substantial uncertainty.

Future studies should distinguish among different forms of metaverse-based automotive marketing, including virtual showrooms, VR/AR experiences, avatar-led consultation, gamified tasks, livestreamed virtual showrooms, short-video metaverse-related content, and virtual test drives. These forms may influence participation intention through different mechanisms. Longitudinal, experimental, or mixed-method designs would also help explain why consumers may report positive perceptions while showing weak structural relationships in survey models. Future work should further replace self-reported participation intention with behavioural engagement data — such as platform sessions, virtual showroom dwell time, vehicle-configuration actions, test-drive bookings, and dealership visits — so that stated intentions can be validated against actual participation. Experiments that manipulate format (for example, virtual launch versus virtual test drive) would also permit causal inferences about the format differences suggested by the exploratory results.

CONCLUSION

This study tested the explanatory power of a TAM–EMT baseline model of Generation Z consumers' participation intention in metaverse-based automotive brand marketing in China. Measurement validity was established before the structural test, and a Harman single-factor test indicated that common method variance was not dominant, so the null results can be interpreted with confidence. What the findings show is that the framework, in its current specification, has negligible explanatory power: favourable descriptive evaluations of metaverse-based automotive brand marketing did not translate into statistically significant direct or mediated structural effects. The central lesson for researchers and practitioners alike is that positive descriptive evaluations of immersive automotive marketing do not necessarily become meaningful structural predictors of participation intention, and that future models should locate mechanisms such as immersion, identification, enjoyment and trust within the causal chain rather than assuming their effects.

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