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Role of technology acceptance model in shaping consumer behaviors towards metaverse services

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Abstract
This study explores how buyers in the metaverse feel and act corresponding to virtual merchandise utilizing the models of the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). The review used an exploratory examination approach that coordinated subjective and quantitative philosophies to assess the effect of the metaverse on buyer inclinations and promoting procedures. A deliberate poll with an accentuation on TAM and UTAUT factors was given to an example of 385 individuals who were keen on virtual items. Seen utility and effortlessness of use significantly affect customer decisions and ways of behaving towards virtual items and administrations, as indicated by factual review led with SPSS. Furthermore, it was discovered that performance expectancy had an effect on how well metaverse-based product and service innovation worked, whereas effort expectancy had no discernible impact on meeting customer needs. The results emphasize how crucial it is to comprehend customer perceptions in order to improve the acceptance of virtual goods in the metaverse and direct upcoming marketing campaigns.

Keywords: UTAUT, metaverse, virtual goods, technology acceptance model, consumer behavior.

Introduction
The way that consumers engage and experience products has changed dramatically as a result of the quick development of technology, especially with the emergence of the metaverse a shared virtual environment that combines the virtual and physical worlds. Customers can interact in new and creative ways with digital products, services, and experiences in the immersive surroundings provided by the metaverse. As companies use this cutting-edge platform to improve customer engagement and satisfaction, it is critical to comprehend consumer attitudes and behaviors about virtual goods.
There is still a lack of information in the literature about the elements that affect consumers' acceptance and usage of virtual items, even though the metaverse has the ability to drastically alter their experiences. Two useful structures for appreciating these elements are the Unified Theory of Acceptance and Use of Technology (UTAUT) and the Technology Acceptance Model (TAM). As per TAM, individuals' goals to embrace new advances are profoundly impacted by their impression of new innovations' usefulness and straightforwardness of use. Along these lines, UTAUT adds further builds to the examination of technology reception, like exertion anticipation and execution hope.
With an emphasis on how the concepts of TAM and UTAUT might clarify the variables impacting consumer preferences and behaviors, this study attempts to investigate consumer attitudes about virtual commodities in the metaverse. The research aims to provide a thorough understanding of how the metaverse influences consumer decision-making processes and advertising strategies by utilizing a mixed-methods approach. In the end, this research should help create a more cohesive and customer-focused metaverse ecosystem by educating marketers and companies on how to increase the adoption of virtual goods.

Concept of Metaverse
The term "Metaverse" refers to a future form of the internet characterised by a persistent, networked, and immersive virtual environment. Various academic associations and IT companies have proposed varying conceptions of the Metaverse:
As stated in the whitepaper of the Metaverse Standards Forum, the Metaverse is "A convergence of virtually-enhanced physical and digital reality, where physical, augmented, and virtual reality objects and experiences are seamlessly combined and co-exist within a unified virtual space".

Metaverse Standards Forum (2023) The Metaverse is "A set of virtual 3Dspaces where you can share immersive experiences with other people even when you can't be together physically," According to Meta (2022).

Impact of Metaverse on Product Innovation

Product innovation has always needed labour-intensive, tangible processes, but the rise of the Metaverse is completely changing this strategy. Enterprises are offered a whole new and fascinating platform for product development and testing via the Metaverse, a vast networked virtual environment. It's a digital playground where imagination reigns supreme and real-world constraints disappear (Bale *et al*., 2022) [1].

Take the example of product prototyping, which is frequently hampered by budgetary, scheduling, and logistical issues. The Metaverse allows for the creation and modification of prototypes, eliminating the need for physical materials and facilitating almost rapid user input. A well-known corporation, Nike, is already utilizing this chance by seeking to patent their virtual sneakers (Lim *et al*., 2023) [7]. Them can try on and interact with shoes in the Metaverse before they are made in the real world, which eliminates waste and ensures that the completed product actually appeals to them.

The modification goes beyond traditional objects. We could not have predicted ten years ago that the Metaverse would give rise to entirely new product categories. Take virtual real estate as an illustration. Unlike physical property, the laws of physics do not apply to this digital terrain (Maulana *et al*., 2023) [8]. What makes it valuable are its placement in well-known virtual worlds, together with its capacity to host virtual events and display digital advertisements. Land is selling for a lot of money on websites like Decentral; some deals have reached $2.3 million (Mogaji, 2023) [11].

Consumer Preference

Consumer preferences are the results of analysing various customer decisions that affect market purchases. These factors have an impact on the choices that consumers make while making purchases of goods and services. Increasing the customer's level of satisfaction is the aim of every transaction.

The Theory of Revealed Preference was initially put forth by Paul Anthony Samuelson in 1938 [13]. It posits that customers' preferences can be uncovered by observing their decisions in different settings. For example, if a consumer chooses to buy the first product instead of the second, it might be assumed that they enjoy it. In a market, consumers base their final purchases on a range of considerations, such as cost, demand, brand, quality, features, physical characteristics, inflation, disposable income, longevity, happiness factor, extra services, etc. Numerous factors fall into the broad categories of personal, psychological, social, cultural, and environmental influences on consumer choices (Shen *et al*., 2021) [14].

The study of rational consumer behavior is known as consumer preference in microeconomics. It's important to keep in mind that this theory operates under certain assumptions and explains why people make the purchases they do. In order to ensure that they offer higher-quality products and services that will maximize sales and earn a profit, businesses evaluate and forecast how people's wants and perceptions will develop. A firm must adjust to the changing consumer preferences of its target audience and potential customers in order to stay relevant and competitive in the market. Companies periodically tweak and enhance their marketing strategies and sales tactics in an attempt to attract customers and influence their purchasing decisions. Because preferences change not only over time but also in response to geography, technology, demographics, market dynamics, and popular trends, analyzing consumer choices is an ongoing exercise. Furthermore, these behavioral projections are not without some degree of uncertainty.

Objectives of the study

1. To investigate the customer preferences and behaviors regarding virtual goods and services in the metaverse are influenced by perceived usefulness and simplicity of use, using the Technology Acceptance Model (TAM).
2. To evaluate the effectiveness and customer acceptability of metaverse-based product and service innovations are affected by performance expectancy and effort expectancy as defined by the Unified Theory of Acceptance and Use of Technology (UTAUT).
3. To examine the consumer habits and demographics relate to one another in the metaverse, identifying important adoption drivers and offering suggestions for focused marketing campaigns for virtual goods and services.

Literature Review

Mousa Al-Kfairy *et al*. (2024) [12] Examined variables that affect uptake and acceptance of metaverse technologies in the learning environment. Though immersive learning environments are popular rapidly, yet the significant gap lies in understanding user acceptance and involvement in such settings. The authors conducted a systematic review of 35 empirical studies using various theories from the information systems field, that include the Theory of Planned Behavior (TPB), the Unified Theory of Acceptance and Use of Technology (UTAUT), and the Technology Acceptance Model (TAM), among others in their study. The study utilized a wide range of methodologies, including surveys, interviews, and structural equation modeling, to examine the salient factors that influence learning outcomes in the metaverse. It identifies several critical variables that have a significant effect on the learning experience in metaverse-based environments: immersion, enjoyment, self-efficacy, behavioral intention, and effort expectation. The review also showed that the dynamics of adopting the metaverse are context-dependent, specifically in the sense that these factors act as moderators. The findings of the study provide rich insights for educators, policymakers, and technology developers to incorporate metaverse technologies into curricula. The authors urge further research on the long-term impacts of metaverse applications in education and the necessity of cultural adaptability in such technologies.

Aimed to discover how the metaverse can transform the travel and tourism industry into something new: offering opportunities for travellers to discover and engage with destinations in virtual environments. Partial Least Squares Structural Equation Modeling was used in this research for the analysis of the acceptance of metaverse technologies in a sample of 218 users from a high school population, which focused on targeting Millennial and Gen Z students. The review, based on the Unified Theory of Acceptance and Use of Technology 2 model, indicated that several factors

significantly influence the acceptance of metaverse technology: facilitating conditions, perceived worth, social influence, and desire to visit actual locations. Results showed a strong predictive ability regarding traveller's behavioral intentions to use metaverse applications and highlighted the role of these factors in shaping user behavior. The reviewed therefore, is important in underlining the utility of the UTAUT model for the analysis of changes in user behavior related to the adoption of metaverse technology in tourism, providing insightful knowledge in the understanding of adoption patterns and future effects on the tourism and travel industry.

Kaur *et al*. (2023) [6] developed a theoretical framework for the investigation of the engagement between Generation Z and the metaverse based on the Engel-Kollat-Blackwell model. A qualitative data gathering through 63 semi-structured interviews utilized deductive thematic analysis to analyze the findings. This review indicated that even if there were challenges in the process, the participants were motivated to be engaged with the metaverse. The study determined several key phases of consumer interaction with digital technologies including awareness, information search, engagement, and post-engagement evaluation which all fit well with the phases in the EKB model. The participants not only sought active participation opportunities but also called others to participate in the metaverse. This research delivers valuable empirical insights into consumer behavior dynamics in digital environments, providing an in-depth view of the opportunities and challenges businesses and consumers face within the metaverse. Practical implications for managers, IT developers, and policymakers who will try to spur consumer interest and involvement with metaverse-related technologies are also presented.

Esteky (2022) [5] explored the metaphorical connection between risk perception and geographical positioning to see how a consumer's physical location influences preferences and choice-making. The five significant research projects included in this study included a pilot study to explore how proximity to space margins impacts risk-seeking behavior. Esteky asserts that the more out-of-center people are located on a space, the greater the likelihood they will take riskier decisions. It showed through various decision-making scenarios, both virtual and real-world spatial manipulations that products located at the boundary are perceived as riskier, and hence more desirable since they evoke ideas of risk rather than safety. The review underlined the implications of the findings for consumers and businesses with the features and boundary conditions of these effects.

Underlined the importance of cultural heritage protection in the face of modernization and globalization. Their review explored the potential of metaverse's immersive and interactive features to support cultural preservation efforts, focusing on four key areas: sustainability, educational outreach, virtual reconstructions, and global accessibility. The authors conducted a systematic literature review based on PRISMA, analyzing existing research on digitization techniques in heritage preservation. They also conducted case studies to evaluate the problems concerning sustainability, authenticity, and representation as well as the potentials and challenges of virtually maintaining both tangible and intangible cultural assets. The research sought to identify best practices and principles for the proper application of metaverse technologies in the preservation of cultural heritage, providing valuable insights for innovative approaches in the digital age.

Buhalis *et al*. (2023) [4] explored the transformative potential of the metaverse, a cutting-edge technology increasingly influencing various sectors, such as tourism. Their review underlined how the metaverse makes it easy to shift from the real world to the virtual one, with the possibility of experiencing deep and rich experiences, including those related to historical events and historical figures. The authors emphasized that the integration of digital twins and the metaverse could greatly enhance tourism and travel management by fostering location awareness, brand development, and customer engagement. They argued that the metaverse would not replace physical travel but instead inspire real-world journeys by offering electronic connections to different destinations. This review identified disruptive features and components that could drive more efficient tourism management and marketing. The study offers a comprehensive review of the metaverse ecosystem in tourism and puts forward future research directions that unlock its potential in this domain.

Vikas Arya *et al*. (2023) [15] examined the growth of NFTs and intangible goods in the metaverse, with a focus on the "gamification of marketing activities" and its influence on consumer-based brand equity for those products. Based on social exchange theory, the authors have used cross-cultural data from two developing countries in Africa and Asia, using a two-stage hybrid approach that combined PLS-SEM and neural network modeling. Their study showed that authenticity forms the basis of promoting any brand in the metaverse, and authentic experiences evoke more trust and engagement for consumers. The review discussed if customer enthusiasm and involvement could play a role in enhancing brand experience in the metaverse, which remains an immersive and virtual phenomenon. By discussing these factors, the authors contributed to understanding promotion strategies of brands in a rapidly changing digital space, opening discussion points on leveraging consumer engagement for effective brand positioning in the virtual world.

Chris Bushell *et al*. (2022) [2] Examined the potential of the metaverse as a unique venue for brand interaction with consumer engagement in a virtual environment. The author therefore tries to explore the implications of the emerging technology for the future of branding in terms of extension through brands and celebrities' embracing the metaverse for marketing and branding activities. Using a mixed-method approach, the study gathered both literature review and interview data to establish the benefits and challenges associated with the metaverse as a branding tool. The authors looked to shed light on how people and businesses might use the metaverse as a means of communicating with greater reach and online community building. This literature review addresses important concepts, trends, and earlier studies related to virtual environments, branding in digital space, and the metaverse and its role in establishing novel types of interactions between consumers and brands

Research gap

The research gaps, the body of literature already available on the metaverse and its effects on branding, consumer behavior, and technology adoption provides insightful information on a number of topics related to this new discipline. There is still a dearth of thorough research that focuses exclusively on customer preferences and behaviors toward virtual goods and services in the metaverse, despite

studies that have examined the impact of theories like the Unified Theory of Acceptance and Use of Technology (UTAUT) and the Technology Acceptance Model (TAM) on user behavior in virtual environments. With little focus on how particular elements like perceived utility, effort expectancy, and performance expectation influence consumer involvement with metaverse-based goods and services, the majority of study focuses on more general technology adoption trends. Furthermore, while research has looked at adoption drivers in industries like tourism, education, and cultural heritage, little is known about how demographic and cultural characteristics affect consumer behavior in the metaverse. Furthermore, despite the fact that branding and marketing initiatives in the metaverse have been explored, more research is required to fully comprehend how brands can use the metaverse to engage consumers and how this involvement impacts long-term brand equity and loyalty. To close these gaps, further study is therefore required, especially in the areas of consumer decision-making, demographics' influence on metaverse adoption, and the particular ramifications for branding and marketing tactics in virtual environments.

Research Methodology

Research Design

Utilizing the Unified Theory of Acceptance and Use of Technology (UTAUT) and the Technology Acceptance Model (TAM), this study used an exploratory examination way to deal with research customer perspectives and ways of behaving about virtual products in the metaverse. The effect of the metaverse on buyer tastes and promoting techniques was researched utilizing a blended strategies procedure that included both subjective and quantitative information.

Data Collection

Measures of adoption readiness, TAM and UTAUT characteristics, and demographic data were all included in a standardized questionnaire. Online distribution of the surveys was preceded by reliability testing.

Locale of the study

In an effort to create a representative sample, those who were interested in virtual goods and metaverse experiences were included.

Sample Size and Sampling

This study uses a systematic sampling, to ensure that the sample is representative of the population of interest. A sample size was calculated by using an equation for population proportions, with an estimated 385 participants required for the study, considering a 5% margin of error and a 95% confidence level. Systematic sampling was used to select participants from a pool of interested people in the metaverse and virtual products.

Respondents for the study

The respondents for this study are individuals who are 18 years and older, with active participation or interest in virtual environments, digital products, and metaverse experiences. Participants are taken from different demographic backgrounds with the difference in technological literacy as well as experience in virtual goods. These may be gamers, tech enthusiasts, those who have experience with VR/AR, and individuals who actively participate in metaverse-based platforms or virtual commerce.

Tools used for Data Analysis

For statistical analysis, including reliability analysis using Cronbach's alpha, inferential statistics (regression, ANOVA), and descriptive statistics, SPSS was used.

Hypothesis

1. **H1a:** Perceived ease of use (TAM) significantly affects consumer preferences for virtual products and services in the metaverse.
2. **H1b:** Perceived usefulness (TAM) significantly influences consumer behaviors towards virtual products and services within the metaverse.
3. **H2a:** Performance expectancy (UTAUT) significantly impacts the effectiveness of metaverse-based product and service innovation.
4. **H2b:** Effort expectancy (UTAUT) significantly affects the ability of metaverse solutions to address consumer needs.

Variables

- **Dependent variable:** Consumer Preferences for Virtual Products and Services.
- **Independent variables:** Perceived Ease of Use (PEU), Perceived Usefulness (PU), Performance Expectancy (PE), Effort Expectancy (EE).

Regression model

The regression model used in this analysis explains the relationship between the various constructs from the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) with consumer behavior towards virtual products and services in metaverse. This model identifies how PEU, PU, PE, and EE explain consumer preferences and effectiveness of innovative products and services in metaverse applications. The model provides important metrics such as R, R-squared, adjusted R-squared, and standard error of the estimate to measure the strength and reliability of these relationships.

Data analysis and interpretation

Consumers in Dubai have similar unique preferences and behaviors when it comes to virtual goods and services offered by the metaverse.

Hypothesis 1a: Perceived Ease of Use (TAM) significantly affects consumer preferences for virtual products and services.

Table 1: Regression Model for Hypothesis 1a

Model	R	R Square	Adjusted R square	Std. error of the estimated
Perceived Ease of Use (PEU)	0.48	0.23	022	0.85

Client inclinations for virtual labor and products in the metaverse and perceived ease of use (PEU) have a moderately good affiliation (R = 0.48) as per the relapse model showed in Table 1, With an R-squared esteem of 0.23, perceived ease of use makes sense of more than 23% of the variety in client inclinations. The Changed R Square worth of 0.22 gives a marginally overhauled gauge that records for the quantity of indicators in the model, and it

proposes that the model keeps an in all actuality sensible fit. Furthermore, the standard blunder of the gauge (0.85) uncovers a lot of forecast mistakes. This action addresses the typical distance that the noticed qualities tumble from the relapse line.

Table 2: ANOVA for Hypothesis 1a

Source	Sum of Squares	DF	Mean Square	F	Sig.
Regression	52.36	1	52.36	29.75	0.002
Residual	181.59	383	1.35		
Total	233.95	384			

To feature the measurable significance of the relapse model, Table 2 shows the consequences of the analysis of variance (ANOVA) for Speculation 1a. The inconstancy that the model depicts is shown by the relapse number of squares, which is 52.36, and the changeability that the model doesn't make sense of is shown by the remaining number of squares, which is 181.59. A sum of 233.95 squares is there. The quantity of indicators in the model is equivalent to one level of opportunity (DF) in relapse, and the remaining DF, which is the absolute example size short the quantity of indicators less one, is equivalent to 383. There is a mean square of 52.36 for the relapse and a mean square of 1.35 for the residuals. The F measurement (29.75) shows the proportion of the made sense of variety for the unexplained variance. With a p-esteem (Sig.) of 0.002, which shows factual importance at the 0.05 level, we can dismiss the invalid speculation. This proposes that there is adequate proof to reason that the perceived ease of use of virtual labor and products in the metaverse extraordinarily influences shopper decisions.

Hypothesis 1b: Perceived Usefulness (TAM) significantly influences consumer behaviors toward virtual products and services.

Table 3: Regression Model for Hypothesis 1b

Model	R	R Square	Adjusted R square	Std. error of the estimated
Perceived Usefulness (PU)	0.65	0.42	0.41	0.72

The regression model's R value of 0.65 in Table 3 indicates a strong positive link between customer behaviors toward virtual products and services and perceived usefulness. With an R-squared value of0.42, perceived usefulness explains more than 42% of the variation in consumer actions. The model's number of predictors is still taken into account in the Adjusted R Square score of 0.41, but it still demonstrates a strong fit for the data. The standard blunder of the gauge is 0.72, mirroring the typical disparity of genuine ways of behaving from the normal qualities, showing a low degree of forecast mistake.

Table 4: ANOVA for Hypothesis 1b

Source	Sum of Squares	DF	Mean Square	F	Sig.
Regression	95.24	1	95.24	49.85	0.000
Residual	131.55	383	1.05		
Total	226.79	384			

To decide the general meaning of the relapse model, Table 4 shows the aftereffects of the analysis of variance (ANOVA) for Speculation 1b. The variance that the model can make sense of is 95.24 times the Leftover Number of Squares, which is 131.55 times the Relapse's Number of Squares, and the general number of squares is 226.79. The review's one indicator implies that the levels of opportunity (DF) in the relapse are 1 and the leftover DF is 383. The lingering mean square is 1.05. The relapse mean square is 95.24. A F-measurement of 49.85 was determined, which is the proportion of the cleared-up variance for the unexplained variance. Since the outcome is genuinely critical at the 0.05 level, we can dismiss the invalid speculation with the going with p-esteem (Sig.) of 0.000. Perceived utility is a main consideration in how buyers act with regards to metaverse virtual labor and products, as per the accessible proof.

Hypothesis 2: There is no significant difference between implementing the metaverse for making innovative products and services in addressing consumer needs.

Hypothesis 2a: Performance expectancy significantly impacts the effectiveness of metaverse-based product and service innovation

Table 5: Regression model for hypothesis 2a

Model	R	R Square	Adjusted R Square	Std. Error of the estimate
Performance Expectancy (PE)	0.68	0.46	0.45	0.65

Table 5's relapse model uncovers a R worth of 0.68, proposing an extremely sure connection be tween's the viability of developments in light of the metaverse and the assumption for execution. A R-squared worth of 0.46 shows that presentation hope makes sense of around 46% of the variance in the viability of these upgrades. The Changed R Square worth of 0.45 drops marginally when the quantity of indicators in the model is thought of, as expected. The model appears to have an exceptionally low expectation blunder with a standard mistake of 0.65.

Table 6: ANOVA for Hypothesis 2a

Source	Sum of Squares	DF	Mean Square	F	Sig.
Regression	150.40	1	150.40	74.12	0.000
Residual	178.50	383	1.06		
Total	328.90	384			

As you can find in Table 6, we ran an ANOVA to test Theory 2a. Execution anticipation makes sense of variety in viability, as seen by the amount of squares for the relapse, which is 150.40. The general amount of squares is 328.90, and the lingering amount of squares is 178.50, which addresses the changeability that the model can't make sense of. With 383 levels of opportunity (DF) for the residuals and 1 level of opportunity (DF) for the relapse, the outcome is a mean square of 150.40 for the relapse and 1.06 for the residuals. The impact size areas of strength for is, shown by the F measurement of 74.12. At the 0.05 degree of importance, the invalid speculation can be dismissed with a p-esteem (Sig.) of 0.000. The meaning of execution hope in deciding the outcome of creations in light of the metaverse is featured by this.

Table 7: Regression model for hypothesis 2b

Model	R	R Square	Adjusted R square	Std. error of the estimated
Effect Expectancy (EE)	0.52	0.27	0.26	0.75

The relapse brings about Table 7 show a R worth of 0.52,

and that truly intends that there is a genuinely sure connection between's work hope and the capability of metaverse answers for address client issues. Exertion assumption makes sense of more than 27% of the variance in these arrangements' capacity to address client issues, as per the R Squared worth of 0.27. The Changed R Square score of 0.26, which represents the quantity of indicators, shows a fairly powerless fit. A bigger level of expectation incorrectness is demonstrated by the standard blunder of the gauge (0.75) when contrasted with prior models.

Table 8: ANOVA for Hypothesis 2b

Source	Sum of Squares	DF	Mean Square	F	Sig.
Regression	110.20	1	110.20	32.50	0.080
Residual	194.60	383	1.43		
Total	304.80	384			

The ANOVA analysis for Hypothesis 2b is shown in Table 8. The variability explained by effort expectancy is represented by the regression's Sum of Squares, which is 110.20, and it's Residual Sum of Squares, which is 194.60. 304.80 is the total sum of squares.

Regression has a mean square of 110.20 with one degree of freedom, while residuals have a mean square of 1.43 with 383. There is a moderate degree of significance shown by the F statistic of 32.50. Nevertheless, the p-value (Sig.) of 0.080 falls short of the 0.05 cutoff, suggesting that the null hypothesis for this sub-hypothesis cannot be rejected. This implies that effort expectancy has no bearing on how well metaverse systems meet customer needs.

Conclusion

The findings of this study confirm the significant role of both the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) in influencing consumer behaviors towards virtual goods and services in the metaverse. The results indicate that perceived ease of use has a moderate yet significant effect on consumer preferences, which explains 23% of the variance in their choices, while perceived usefulness shows a stronger influence, accounting for 42% of the variation in consumer behaviors.

In addition, the performance expectancy (PE) is seen as having a significant influence on metaverse-based innovation effectiveness because it explains 46% of the variance and depicts its crucial role in changing consumer acceptance.

However, effort expectancy did not favour the metaverse solutions with significant ability in meeting consumer needs. Its p-value was 0.080, which suggests that it does not significantly affect consumer perceptions in this context. These findings underpin the need for user-friendly and useful metaverse experiences in driving consumer adoption, while also suggesting that factors like effort expectancy may have a lesser influence on consumer engagement with virtual products and services.

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