Virtual Promises, Tangible Failures: Understanding Augmented Reality Service Failures in Online Retail

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Abstract

This study evaluates the impact of augmented reality (AR) on consumer expectations and responses to service failures in online retail. AR enables virtual product trials, significantly raising consumer expectations. However, when AR falls short, it triggers the 'AR Confidence Paradox,' where the mismatch between expected and actual service outcomes shifts typical attribution patterns seen in online retail from internal (self-blame) to external (retailer blame). To investigate how AR-induced failures influence consumer responses, our research employs a multi-method approach that includes sentiment analysis and quantitative experiments, with a total of 1,072 participants. Our results show that consumers using AR have significantly higher outcome expectations and when disappointed, attribute more responsibility to the retailer. We also find that preemptive recovery strategies effectively reduce negative impacts and enhance revisit intentions. Our findings contribute to literature on consumer expectations, responsibility attribution, and technology-induced service failures, offering practical strategies for improving AR implementations in e-commerce.

Keywords: augmented reality, service failure, responsibility attribution, revisit intention, online shopping

1. Introduction

The online retail space increasingly operates under a "buy to try" model, as evidenced by data showing that 60% of consumers purchase items primarily for evaluation, with 71% returning them due to sizing or fit problems. This prevalent shopping behavior not only underscores a significant challenge for e-commerce businesses but also carries considerable financial implications (KPMG, 2021; Bower & Maxham III, 2012). Unlike their brick-and-mortar counterparts, online retailers struggle with inherent limitations in the shopping experience, primarily due to consumers' restricted capacity to gain comprehensive insights about a product before purchasing (Heller et al., 2019). Predominantly, this issue arises from the lack of sensory engagement with products and direct interaction with sales personnel. As a result, the tactile aspects of shopping, such as physically trying on apparel or assessing the aesthetics of furniture within one's own living space, remain elusive (Beck & Crié, 2018). Consumers must rely solely on static imagery and textual descriptions, often leading to an incomplete perception that hinders their ability to judge the suitability of items in terms of fit, appeal, or contextual placement (Hilken et al., 2017). This significantly contributes to the trend of frequent returns, imposing a substantial financial burden on online retailers and directly challenging their primary goal of profit optimization. Consequently, e-commerce entities are compelled to develop strategies to reduce transactions that result in negative financial outcomes.

Augmented reality (AR) emerges as a significant technological advancement, specifically designed to address these challenges. AR merges virtual elements with the physical world, enabling consumers to virtually try out products like eyewear, furniture, cosmetics, or even apparel, thus catering to the intrinsic "need to touch" (Gatter et al., 2022). Leading companies such as IKEA and Amazon have successfully integrated AR technologies into their operations. Empirical research supports that incorporating AR into e-commerce platforms not only enhances customer satisfaction but also reduces return rates and strengthens conversion metrics (e.g., Tan et al., 2022; Hilken et al., 2017). However, alongside the expanded capabilities of these technological advancements, there might be a corresponding rise in consumer expectations. The introduction of virtual try-on features can significantly boost a consumer's confidence in their product choices (Rauschnabel et al., 2019), thereby elevating expectations placed upon the enterprise. This effect might be further enhanced as customers need to invest their data to access this more realistic product

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experience. Engaging in camera-based virtual fittings requires consumers to allow businesses access to their personal space, sharing deeply personal data like physical appearance or spatial information (Poushneh, 2018). Additionally, consumers must acquire the skills needed to navigate this new technology and devote time to virtually assessing products (Scholz & Duffy, 2018). This increased investment in the purchasing process (Christ-Bendemühl and Saarschmidt, 2022) potentially heightens the stakes for consumers, who then expect a more substantial or dependable return on their investment. Hence, we ask:

RQ1: How does augmented reality shape customer expectations of service outcomes?

However, when discrepancies in service occur, their consequences may be perceived as more severe in an AR environment compared to traditional settings. Although the benefits of AR, particularly in virtual try-ons, have been extensively researched, there remains a significant gap in understanding how consumers react to unmet expectations in AR services—a phenomenon we refer to as 'AR service failure.' Expanding on this concept, it's evident that such discrepancies can greatly impact a business. In the short term, disruptions in AR service can lead not only to lost revenue but also to additional costs. More critically, these immediate effects can evolve into long-term consequences, such as deteriorating customer-brand relationships (Valentini et al., 2020), which may deter customers from using the AR service again or even from returning to the online shop. Consequently, it is crucial for organizations to understand the impact of service lapses in AR contexts and strive to minimize them (Harris et al., 2006). This study examines customer reactions to AR-induced service failures and how responsibility is attributed differently from non-AR environments. According to attribution theory, the assignment of blame is key to understanding service evaluations and subsequent behaviors. Typically, customers might internalize blame in standard online shopping scenarios; however, with AR-induced failures, there is a likely shift towards externalizing blame towards the retailer due to heightened expectations. Given the notable research gap in understanding AR-related service failures and their mitigation, we pose the following research question:

RQ2: How do service failures in augmented reality impact revisit intentions, what mechanisms underlie this effect, and how can these be counteracted?

In answering these research questions, we contribute to theory by exploring how AR shapes consumer expectations before a purchase. We illustrate how unmet, elevated expectations can intensify user disconfirmation, emphasizing the need for effective expectation management in AR applications. We also explore how AR influences responsibility attribution in online retail, shifting blame from internal (self) to external (retailer), and delve into the dynamics of consumer behavior with immersive technology. Our findings highlight potential downsides, such as the mismatch between increased AR effort and service outcomes, which may deter repeat visits. Additionally, we introduce preemptive recovery strategies and adapt the "stealing thunder" concept from public relations to e-commerce, offering a proactive approach to mitigating potential negative outcomes and boosting intentions to reuse AR features after a failure. This contributes a new dimension to service recovery literature, emphasizing proactive over reactive measures.

2. Related work on augmented reality service failure

Service failure, a significant area of academic interest, arises when service delivery fails to meet customer expectations, leading to dissatisfaction and customer defection (Liang et al., 2013). Research has extensively covered various sectors including hospitality, aviation, and healthcare (e.g., Hess et al., 2003). As technology advances, the services field has expanded to encompass a variety of new offerings, including AR-based services in online retail. These innovative services allow customers to use smartphones to visualize products like furniture and clothing in their intended environment (Sun et al., 2022). We define a service failure in the context of AR services as a situation where the AR technology's service delivery does not achieve the expected outcome. This definition aligns with service failures in other technological contexts as outlined in various studies (e.g., Sun et al., 2021; Mozafari et al., 2022). It encompasses scenarios where the respective technology does not meet the established standards or expectations for its functionality, whether due to technical glitches, user errors, or external conditions that impact its performance. While current research on AR-based services in online retail predominantly highlights their positive aspects, investigations into the potential drawbacks or failures of this technology remain unexamined. Christ-Bendemühl and Saarschmidt (2022) provide initial insights, demonstrating that AR-based online services are perceived as less fair in terms of distribution, procedure, and pricing compared to traditional in-store alternatives. This perception largely stems from the increased effort required from consumers. Furthermore, they noted that customers whose expectations were not met were more prone to disseminating negative word-of-mouth (nWoM).

Similarly, Nugroho and Wang (2023) and El-Shamandi et al. (2022) have explored additional adverse effects, focusing on the perceived performance risks associated with AR services and their inability to accurately represent users' envisioned selves. Despite these insights into general adverse effects, a significant gap remains in research on the repercussions of actual service failures encountered by consumers in online commerce. However, this oversight is critical, as aiming for a zero-defect service is unrealistic—not only due to technological constraints but also because of improper user application. Furthermore, many AR systems currently suffer from insufficient controls and substandard graphic design. Therefore, it is imperative for marketers to understand these potential pitfalls and devise strategies to mitigate negative outcomes in order to effectively capitalize on AR-based services.

3. Theoretical Background

3.1. AR service failure, outcome expectations and customer response

Drawing from the conceptual framework of Oliver's Expectation Disconfirmation Theory (EDT) (1980), consumer satisfaction with a service encounter arises from juxtaposing expected performance with the actual perceived performance of a transaction. In the context of this study, an AR service failure is a situation where the AR technology's service delivery does not achieve the expected outcome, leading to a product's return. Such a failure inherently implies that the expected performance surpasses the actual performance. This notion aligns with prior research on general service failures (Van Vaerenbergh et al., 2014). Considering that a mere product image is perceived as less authentic and informative than images featuring a model, the AR paradigm, where the customer essentially becomes the model, amplifies this realism and informativeness, thereby elevating expectations (Rauschnabel et al., 2019). Factors such as the immersive nature of virtual try-ons, the fulfillment of the "need to touch," time investment, sharing of personal data, increased visual attention effort, and heightened expectations about product fit and appearance, collectively escalate the overall product expectations (Gatter et al., 2022; Christ-Bendemühl and Saarschmidt, 2022). This elevation in expectations post-virtual try-on could widen the gap between expected and actual performance. Therefore:

H1: Outcome expectations for online shopping are higher after using an AR service compared to not using it.

A single AR service failure can have far-reaching consequences for a company, triggering a cascade of negative effects (Valentini et al., 2020). These adverse experiences extend beyond the immediate transaction, potentially damaging broader brand perception and weakening the customer-company relationship (Keller, 2003). This weakened brand allegiance can facilitate customers' migration to competitors, especially given the low barriers in online shopping (Holloway & Beatty, 2003). Moreover, research indicates that negative reactions can be even more intense if expectations are not met. This phenomenon is rooted in the Expectancy Violation Theory, as described by Burgoon and Jones (1976), which emphasizes the role of negative expectancy violations in producing stronger emotional responses. Van Dijk and Zeelenberg (2002) also found that unmet expectations lead to particularly high disappointment, making individuals more likely to react negatively, such as by complaining or choosing not to revisit the online store. Therefore, we hypothesize:

H2: Customer revisit intentions are more negatively affected by service failures in AR settings compared to non-AR settings.

3.2. Responsibility attribution

When discussing service failure, responsibility attribution is always closely linked to the situation. People inherently tend to attribute responsibility to understand the causes of the error and regain control, which in turn influences their emotions, reactions, and future behavior (Tan et al., 2016). This process of attribution can be internal, where one blames oneself, or external, attributing fault to others, in this case the retailer (Zhu et al., 2013). Drawing from attribution theory, individuals continuously seek causative explanations for environmental events (Jörling et al., 2019). This theory posits that customers' future actions are shaped by their perceptions of responsibility, the likelihood of recurrence, and their perceived control over outcomes (Tsiros et al., 2004).

Focusing on the *transaction layer*—the environment where customer interactions and failure situations occur, whether online or offline—the attribution of responsibility differs significantly. In brick-and-mortar settings, characterized by direct human interactions, customers often attribute failures to external factors. Conversely, in online retail, where there is no physical interaction with products, customers are more inclined to recognize the inherent limitations of the digital medium and attribute failures internally (Harris et al., 2006).

Considering the *interface layer*, findings from various contexts involving technological service failures indicate that the introduction of technology can significantly impact responsibility attribution dynamics. Research on technologies with anthropomorphic elements, such as robots, shows varied perceptions of responsibility. Leo and Huh (2020) found that robot-related failures lead to less blame on service providers, while Belanche et al. (2020) observed that humans are held more accountable than robots for errors. Mozafari et al. (2022) highlighted a self-serving bias with service robots, attributing successes to personal efforts and failures to robots. Conversely, Jörling et al. (2019) discovered that customers often accept more responsibility for negative outcomes, regardless of the technology used, showing no self-serving bias. When examining technologies without anthropomorphic features, such as self-service technologies (SST), customers tend to internalize responsibility for failures, particularly due to their active involvement in the service process (Harris et al., 2006; Zhu et al., 2013). Since AR-based services are likely to engage customers more deeply and create a greater sense of responsibility, insights from research on SSTs could potentially be applied to this context as well. However, other research suggests that high levels of customer participation can sometimes also distort perceptions of effort relative to the outcome (e.g., Christ-Bendemühl and Saarschmidt, 2022), potentially leading to the attribution of failure towards the retailer. Furthermore, the enhanced visual product information provided by AR, offering a richer decision-making foundation, might amplify external responsibility attribution, especially when customers feel they have taken all possible measures to make an informed choice. Thus, while traditional online shopping often attributes service failures internally, integrating AR-based services could potentially shift blame externally, resulting in decreased customer intentions to revisit the online store. We hypothesize:

H3: External responsibility attribution explains the effects of an AR service failure on intention to revisit the online store.

3.3. Preemptive recovery/ Stealing thunder

To effectively address the drawbacks of AR services, it is crucial for providers and retailers to develop strategies that mitigate these negative impacts. This matter is crucial, as achieving a faultless service is impractical—not only because of technological limitations but also due to user errors. Moreover, numerous AR systems struggle with deficient controls and inferior graphic design. Moreover, many dissatisfied customers do not voice their complaints (DeWitt et al., 2008); especially in online shopping, where switching barriers are low, they often simply return the item and choose another retailer. This is particularly problematic because most service recoveries begin with the customer reporting a fault, initiating the service recovery process. This process typically includes post-fault recovery actions such as apologies or compensation (Van Vaerenbergh et al., 2019). However, some preliminary research is taking another approach to recovery by discussing strategies employed before a potential failure occurs to offset the anticipated negative effects of service failures—these are known as preemptive strategies or Stealing thunder (Cranage & Mattila, 2005). Stealing thunder is a communication strategy, where an organization proactively discloses an issue it is facing before it can be revealed by the media or other stakeholders. This approach, in contrast to letting others first disclose the information, has been shown to enhance the organization's credibility (Arpan & Roskos-Ewoldsen, 2005). Kim and Lee (2022) already found that this strategy can mitigate negative attributions and improve overall attitudes towards an organization, while Lee (2020) found that these proactive strategies allow organizations to control the narrative, which may help to soften the perception of the problem and explain what steps are being taken to solve it. Although the bulk of research on the Stealing thunder strategy is concentrated in the fields of communication, law, and crisis management, preliminary studies have explored its application in the context of service failure situations. Guchait et al. (2019) conducted such research within the hospitality industry, yielding positive results, suggesting the strategy's effectiveness in new settings. Considering that potential negative reactions primarily stem from heightened expectations around AR, it makes sense to confront this matter directly. Incorporating proactive expectation management into a preemptive recovery strategy can effectively mitigate potential negative outcomes. By proactively informing customers about potential issues or service disruptions, they are psychologically prepared for the experience. This forewarning helps manage their expectations and subsequently reduces potential dissatisfaction (Xu et al., 2020). In this context, stealing thunder does not involve highlighting potential deficiencies but rather focuses on transparent communication (Guchait et al., 2019) about possible eventualities. This approach of fast responsiveness can lead to fewer negative perceptions and more positive attitudes toward the retailer and ensure consumers are willing to engage with the

H4: A preemptive recovery (a) mitigates the effect of external responsibility attribution while (b) positively impacting revisit intentions.

H5: A preemptive recovery increases the intention to use the AR service again after failure situations.

4. Empirical examination

We conducted three studies (with one replication study, total N = 1072) to test our hypotheses. Study 1 explores the influence of AR services on outcome expectations and the sentiments associated with its use and any subsequent failure. Study 2 investigates the impact of an AR service failure on external responsibility attribution and intentions to revisit. Study 3 examines how a preemptive recovery strategy can mitigate potential negative effects and positively impact reusage intentions of AR features.

4.1. Study 1: Outcome expectations after AR usage in online shopping

4.1.1. Design and sample. We recruited participants from the United States through the Prolific crowdsourcing platform for our study. Participants were financially compensated and only required to be fluent in English, as the survey included open-ended questions. There were no other specific eligibility criteria. The initial sample consisted of 315 participants. The survey included some attention checks to ensure data quality. The participants who did not pass the attention check ("Which retailer is considered exemplary in this study?") and who did not complete the questionnaire conscientiously were excluded from further analyses. The effective sample contained 314 responses (M_{age}= 40 years; 48% female). The study used a single factor between subject design in which participants were randomly assigned to one of the two conditions (AR vs non-AR condition). In this research, participants engaged in a simulated shopping experience on the website of a notable eyewear retailer. The scenario process can be roughly divided into two stages: t_0 and t_1. t_0 refers to the purchase process before the failure, while t_1 refers to the period after the failure. The simulated shopping experience began with an initial exploration of the website and concluded with a broad overview of available eyewear options. After participants chose a specific pair of sunglasses, they were shown detailed information about its design, manufacturer, size, and price on the website. Additionally, participants in the AR group experienced a virtual try-on process for the selected glasses. The AR experience involved participants using their device's camera to visualize the selected eyewear on their own face. This process mimicked a real-life fitting by allowing participants to move their heads and see how the glasses adjusted in real-time. The participants were then instructed that they had placed an order for the selected glasses. They were then asked about their expectations regarding the outcome of their shopping experience using scales adapted from Lin and Lekhawipat (2016) (e.g., "I have high expectations for the outcomes of my online purchase.", α = .96). In addition, participants were presented with an open-ended question where they were asked, "Could you describe your experience with the ordering process? Please include any thoughts and feelings that arose during the process." Responses must contain a minimum of 100 characters. In the further course of the scenario (t_1), participants were informed that their order had arrived after a few days of waiting. Unfortunately, the actual glasses they received did not meet their initial expectations in terms of fit and appearance. Following this, participants were given another open-ended question where they were instructed to imagine themselves in the described situation and detail their feelings about the outcome of the shopping experience. Specifically, participants were asked to share their immediate thoughts and feelings. Again, responses must contain at least 100 characters. In addition, brand awareness, product involvement, tech self-efficacy, AR familiarity and common situational and demographic variables were measured.

Participants rated the scenarios as realistic, with an average realism rating of 6.11 (SD = 1.7), and no significant differences in realism perception across scenarios. The age and gender distribution of participants was consistent across scenarios, with no significant differences (all p-values > 0.1). To avoid biases related to brand recognition, we chose a German retailer expected to be relatively unknown to the US sample. Indeed, brand awareness of the featured retailer was low, with a familiarity score of 1.59 (SD = 1.31).

4.1.2. Method and results. For Study 1, we employed a mixed-methods approach, integrating both quantitative and qualitative techniques from computational text analysis. Initially, we aimed to explore the extent to which a virtual try-on influences outcome expectations following the ordering process. To this end, we conducted an ANOVA with outcome expectations as the dependent variable and AR and non-AR conditions as independent variables. Our findings indicate that consumers who experienced the AR service had higher outcome expectations (M = 5.78, SD = 0.11) compared to those who did not use the AR service (M = 4.94, SD = 0.11, $F(1,312) = 26.66$, $p<0.001$), thus confirming H1. To qualitatively reinforce these findings, we conducted a sentiment analysis on the responses from two open-ended questions: one immediately following the order process and another following the actual service failure. We utilized the National Research Council Canada (NRC) Word-Emotion Association Lexicon (EmoLex) for this analysis, employing the 'tidytext' and 'dplyr' packages in R. Developed through crowdfunding, EmoLex contains 14,182 words and their associations with the eight basic emotions identified in Plutchik's (1980) emotion wheel, making it a robust tool for textual analysis. While outcome expectations were surveyed using a Likert scale anchored at 1 and 7, the NRC EmoLex assigns specific emotions and sentiments to words and thus enables the quantitative analysis of emotional content in texts. The results are therefore presented in absolute numerical values that reflect the frequency with which certain emotions were identified in the participants' text responses. For the question about the ordering process, we specifically examined expressions of joy (M = 0.88, SD = 1.16) and anticipation (M = 1.18, SD = 1.46). For the service failure responses, we focused on detecting expressions of anger (M = 1.09, SD = 0.99) and sadness (M = 1.18, SD = 0.76). Joy and anticipation are sentiments that potentially result from positive expectations, while anger and sadness arise from the disappointment of unmet expectations (Dijk and Zeelenberg, 2002). ANOVAs were conducted to examine differences in sentiment between the AR and non-AR groups. For t_0, the purchase process before the failure, no significant difference in anticipation was observed between the AR and non-AR groups. However, a significant positive difference in joy was detected. This indicates that individuals experience more joy after using the AR service (M = 1.07, SE = 0.09) compared to ordering without it (M = 0.69, SE = 0.09, $F(1,289) = 8.197.1$, $p < 0.01$). For the period following the actual service failure (t_1), no significant difference in sadness was found between the AR and non-AR groups; however, a significant increase in anger was noted. This suggests that people feel more anger following a service failure if they have used the AR service (M = 1.18, SE = 0.07) compared to those who have not (M = 0.95, SE = 0.08, $F(1,304) = 4.485$, $p < 0.05$). Figure 1 shows an overview of the results.

4.1.2. Discussion. Our study confirms that outcome expectations are higher after using an AR service compared to not using one. This can be primarily attributed to factors such as the immersive nature of the virtual fitting, satisfaction of the "need to touch," time investment, sharing of personal data, and increased expectations of product fit and appearance (Gatter et al., 2022; Christ-Bendemühl and Saarschmidt, 2022). The sentiment analysis provides qualitative validation of these findings. Consistent with Affect-Expectations Theory (Klaaren et al., 1994), the analysis indicates that emotions and expectations are closely linked and influence how individuals anticipate future experiences. The positive impact on joy demonstrates that the use of an AR service enhances the customer experience, which in turn can elevate outcome expectations, as satisfied customers tend to hold more optimistic expectations. Conversely, the increase in anger highlights that frustration over a service failure is more intense after using the AR service, suggesting that higher expectations may lead to greater disappointment when those expectations are not met, which is in line with Dijk and Zeelenberg (2002). Having discovered that AR services increase the perception of one's own effort and, due to more realistic presentations, raise expectations of the outcome, Study 2 will explore customer responses to failure situations and the underlying mechanisms.

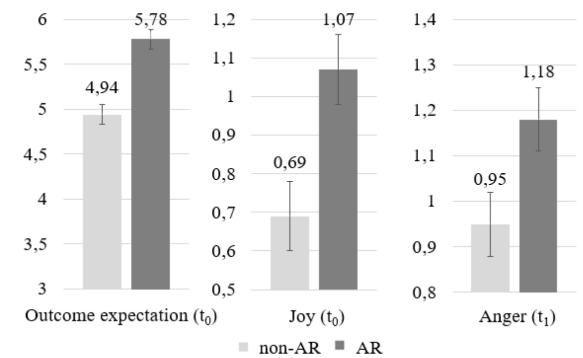

Figure 1. Predictive margins for Study 1

4.2. Study 2: Responsibility attribution and revisit intention

4.2.1. Design and sample. For the second study, a total of 229 participants from the United States were recruited through Prolific to complete the survey. Each participant received monetary compensation and there were no specific eligibility criteria required for participation. The same attention checks from Study 1 were implemented in this study; however, due to the longer questionnaire, an additional attention check ("Please click 4 here") was included. Additionally, participants were asked to choose if they were confronted with an AR scenario to ensure that they paid sufficient attention to the provided stimulus. The effective sample contained 226 responses (M_{age}= 42 years; 45.3% female). The study employed a single-factor between-subjects design, with participants randomly assigned to one of two conditions: AR vs. non-AR. Due to their proven success, the scenarios from Study 1 were retained for Study 2. Thus, each participant underwent the same simulated shopping experience involving the purchase of sunglasses, with the distinction that one group used a virtual try-on feature while the other did not. To ensure consistency, all participants then experienced the same service failure scenario, being informed that the glasses did not meet their expectations in terms of fit and appearance. Participants were then asked about their attribution of responsibility with scales adapted from Mozafari et al. (2022) (e.g., "The responsibility for the glasses not matching my expectations is (1) inside of me (7) outside of me", α = .78), determining whether they saw themselves as responsible or placed the responsibility on the retailer. Afterwards we collected the measures for revisit intention with scales from Chen et al., (2015) (e.g., "If I had to choose where to buy my next pair of glasses, I would choose [retailer] again.", α = .94). In addition, brand awareness, product involvement, tech self-efficacy and common situational and demographic variables were measured. All items met the required reliability and validity criteria.

4.2.2. Method and results. To examine the hypothesized relationships, we constructed a system comprising the following equations. We estimated these equations simultaneously using the 'SUEST' package in STATA 17.0. A seemingly unrelated regression (SUR) with bootstrapping (10.000 replication) was used. A SUR is particularly useful for models with mediators, i.e., when the regression equations are linked. The SUR estimator takes contemporaneous correlations into account and allows simultaneous estimation of the parameter, where the parameter of each equation considers the information of all other equations. This additional information ultimately results in more accurate estimators (Wolf et. al, 2021). We estimate the following equation system:

(1) $EXRESP_i = \beta_0 + \beta_1 SF_{ARi} + \beta_2 BAWE_i + \beta_3 PIN_i + \beta_4 TECH_i + \varepsilon_{1i}$

(2) $RIV_i = \gamma_0 + \gamma_1 SF_{ARi} + \gamma_2 EXRESP_i + \gamma_3 BAWE_i + \gamma_4 PIN_i + \gamma_5 TECH_i + \varepsilon_{2i}$

, where $EXRESP_i$ refers to external responsibility attribution and RIV represents customer retention. SF denotes the categorical variable Service Failure with the category AR (Service Failure without AR is used as the reference category). BAWE stands for brand awareness, PIN signifies product involvement, and TECH represents tech self-efficacy. The terms ε_{1i}, and ε_{2i} correspond to the error terms for subject i in the respective equations.

It is evident that an AR-induced service failure amplifies the external responsibility attribution (β_1 = 0.786; p < 0.001; SE = 0.186) when juxtaposed against a service error in an online shop environment where no virtual try-on is involved. This escalation in external responsibility attribution is accompanied with a decline in the intention to revisit the online shop (γ_2 = -0.256; p ≤ 0.01; SE = 0.072). Moreover, the empirical findings also show that experiencing a service failure subsequent to a virtual try-on not necessarily exerts a negative influence on the intention to shop at the respective online store again as there was no significant direct effect (if the perception of responsibility is not involved) (γ_1 = -0.351; p > 0.1; SE = 0.210), thereby not supporting H2. Mediation analysis further delineates the adverse ramifications of AR service failures on revisit intention, mediated by external responsibility attribution ($\beta_1 \gamma_2$ = -0.20, 95% CI= -0.348, -0.089), thus confirming H3.

4.2.3. Discussion. While responsibility for service failures in conventional online retail (Harris et al., 2006) or with comparable technologies tends to be attributed internally, our results indicate a reversal of this effect in the context of AR, with responsibility being attributed to the retailer. This shift highlights the impact of AR technology on consumer perceptions and the externalization of blame when expectations are not met. High levels of customer participation can sometimes distort perceptions of the effort relative to the outcome (Christ-Bendemühl and Saarschmidt, 2022), as increased involvement might lead customers to overestimate the effort they have invested. Additionally, the enhanced visual product information provided by AR offers a richer decision-making foundation (Rauschnabel et al., 2019), which could further amplify the attribution of responsibility to external factors, especially when customers feel they have taken all possible measures to make an informed choice. This dynamic, as proven in Study 1, leads to heightened expectations and, subsequently, a stronger reaction when those expectations are not met. We also demonstrate that a higher external responsibility attribution can lead to reduced revisit intentions for the online store, which may have serious consequences for the consumer-retailer relationship. This is particularly significant in the online retail sector, characterized by low barriers to switching, making it easier for dissatisfied customers to seek alternatives.

4.2.4. Replication. While we tested our hypotheses in Study 2 within the eyewear sector, specifically focusing on sunglasses from a retailer with low brand awareness, we conducted a replica study in the context of furniture with a retailer known for high brand awareness (N = 257, M_{age}= 32 years; 38.3% female). The results were also successfully replicated in this context. Study 3 will explore the strategies to prevent or buffer these negative consequences.

4.3. Study 3: Preemptive recovery

4.3.1. Design and sample. In the third study, we employed a single-factor between-subjects design to examine the impact of a preemptive recovery (vs. no preemptive recovery) on the consequences of an AR service failure. Specifically, we assessed how these strategies affect external responsibility attribution, revisit intention, and the intention to use the virtual try-on feature again. German participants were partly recruited from social media platforms and from the online research platform Prolific. We used the same attention checks as in Study 2. The effective sample contained 275 responses (M_{age}= 31 years; 38.1 % female). Similar to previous studies, all participants underwent a simulated purchasing process, this time involving a well-known furniture retailer—a scenario that was proven successful in the replication study. All participants utilized the virtual try-on feature. Following the visualized order, participants in the Preemptive Recovery group received an email stating: "*Thank you for using our AR try-on feature for your recent armchair purchase from [Retailer Name]. We hope you love it once it arrives! If it doesn't meet your expectations, we sincerely apologize and want you to know that we are constantly improving our AR-based service. As a token of our appreciation, we're offering you a 10% discount on your next order. Thank you for helping us improve the AR experience in the [Retailer Name] App*." Except for the notification, the scenarios were identical. As in the previous studies, the scenario concluded with participants being asked to imagine that the product arrives but fails to meet their expectations. We employed the same measurement scales as in Study 2, and all constructs consistently met validity and reliability requirements. The intention to reuse the virtual try-on feature was measured using a scale adapted from Nysveen et al. (2005) (e.g., "I will use the virtual try-on feature the next time I shop at [retailer's] website again.", α = .94).

4.3.2. Methods and results. We conducted ANOVAs with external responsibility attribution, revisit intention, and reusage intention as the dependent variables and the preemptive (PE) and non-preemptive conditions as independent variables. Results indicate that when a PE strategy is employed, responsibility is attributed less externally ($M_{non\text{-}PE}$ = 4.48, SE = 0.12, M_{PE} = 4.01, SE = 0.14, $F(1,274) = 6.08$, $p < 0.05$). Similar trends were observed for revisit intention and reusage intention. Specifically, our results show that the intention to revisit the online store ($M_{non\text{-}PE}$ = 2.82, SE = 0.11, M_{PE} = 3.60, SE = 0.10, $F(1,274) = 24.56$, $p < 0.001$) and re-usage intention of the virtual try-on feature ($M_{non\text{-}PE}$ = 4.65, SE = 0.11, M_{PE} = 5.54, SE = 0.10, $F(1,274) = 31.84$, $p < 0.001$) can be positively influenced by a preemptive recovery strategy, thereby confirming H4 and H5.

4.3.3. Discussion. Our results demonstrate that a preemptive recovery strategy can reduce negative perceptions and foster more positive attitudes towards the retailer, ensuring that subjects are willing to engage with the technology in the future. Unlike post-failure strategies, which are typically reactive and initiated by the customer in the context of technology-related service failures, preemptive recovery involves proactively informing customers about potential issues or disruptions. This proactive approach psychologically prepares customers for the experience, proving especially effective when negative reactions are driven by heightened expectations. By managing these expectations proactively, the adverse effects can be mitigated, hindering customer migration.

5. Theoretical and practical implications

While existing research on AR-based services largely emphasizes their positive impacts, our study uncovers the *AR Confidence Paradox*—a significant drawback where heightened expectations, fueled by AR's enhanced product visualization, can lead to greater disappointment and retailer blame when those expectations are unmet. This paradox underscores the dual nature of immersive technologies in consumer markets, where the benefits also come with inherent risks. In addressing RQ1, our findings reveal that AR significantly shapes customer expectations of service outcomes (H1). Concerning RQ2, we demonstrate that AR-induced service failures negatively impact revisit intentions by shifting responsibility attribution toward the retailer, and that these effects can be mitigated through preemptive recovery strategies (H3, H4, H5).

From a *theoretical* perspective, the current research contributes to three interrelated research streams: consumer expectations in digital environments, responsibility attribution in technological contexts, and consumer behavior in response to technology-induced service failures. We highlight the role of AR in shaping consumer expectations, demonstrating how technological advancements in e-commerce influence pre-purchase expectations. Our work extends EDT by illustrating how AR elevates consumer expectations, intensifying disconfirmation if those expectations are unmet. Utilizing a multi-method approach combining sentiment analysis and quantitative experimental methods, we provide a broader, more unfiltered view of consumer perceptions. This approach, unconstrained by pre-set scales, offers a dynamic framework for understanding how emotions influence consumer expectation formation, contributing further to Affect-Expectation Theory by deepening the link between emotions and expectations. We also explore the interplay between technology and consumer effort perceptions, showing that increased effort in AR settings, due to higher consumer investments, does not always yield improved service outcomes. This discrepancy can lead to negative responses, such as decreased revisit intentions. Additionally, we contribute to responsibility attribution literature by revealing that

AR-based services shift typical attribution patterns in online retail from internal (self-blame) to external (retailer blame). This suggests a unique dynamic in consumer behavior facilitated by immersive technology, influencing how responsibility for service failures is assigned. While existing literature has largely focused on post-recovery strategies, our study introduces and evaluates the concept of preemptive recovery strategies within AR services. We innovatively link the concept of Stealing thunder, traditionally rooted in public relations and crisis management, to a new discipline and context. Our research enhances the validity and generalizability of this concept by showing that managing expectations through proactive communication can mitigate the negative impacts of service failures. This adds a new dimension to service recovery literature, emphasizing proactive over reactive strategies, marking a shift in how businesses approach potential service disruptions.

From a *practical* perspective, our findings do not suggest that integrating AR should be avoided. Rather, we recognize the considerable potential of this technology to address the inherent disadvantages of online retail, specifically in providing a more realistic and sensory product evaluation. Retailers are naturally expected to develop robust and realistic AR capabilities, which are crucial to bridging the gap between expected and actual performance. Transparent communication about the capabilities and limitations of AR features is essential for setting realistic expectations. Brief tutorials or FAQ sections detailing AR accuracy can effectively manage these expectations. Moreover, preemptive communication strategies are vital. Retailers may proactively disseminate notifications or display messages even during the AR experience, clarifying that while the AR offers a reliable approximation, slight variations in color, scale, or fit might occur. Educating customers on proficient use of AR tools through tutorials or interactive guides that highlight best practices and common pitfalls is crucial. This reduces cognitive load for new users and enhances their experience. Additionally, integrating a feedback mechanism within the AR application allows immediate reporting of inaccuracies, with incentives such as discounts or loyalty points encouraging user feedback.

6. Limitations and future research

Our findings enhance the understanding of technology-related service failures, the complex mechanisms of responsibility attribution, and potential strategies for mitigating them. However, it is important to note that Our study primarily focuses on product groups that require a precise visual and spatial understanding to ensure the right fit and scale. It would be intriguing to explore whether similar results would be observed with products where the exact degree of fit is less critical, such as decorative items. Furthermore, while our study captures immediate reactions to AR experiences, it does not address the long-term consumer attitudes and behaviors that might evolve with prolonged use or repeated exposure to AR. Additionally, further research on AR onboarding and testing various methods to guide customers through the AR experience could help reduce the likelihood of service failures.

7. References

Arpan, L.M. & Roskos-Ewoldsen, D.R. (2005). Stealing thunder: analysis of the effects of proactive disclosure of crisis information. *Public Relations Review, 31*(3), 425-433.

Beck, M., & Crié, D. (2018). I virtually try it … I want it! Virtual Fitting Room: A tool to increase on-line and off-line exploratory behavior, patronage and purchase intentions. *Journal of Retailing and Consumer Services, 40*, 279–286

Belanche, D., Casaló, L. V., Flavián, C., & Schepers, J. (2020). Robots or frontline employees? Exploring customers' attributions of responsibility and stability after service failure or success. *Journal of Service Management, 31*(2), 267–289.

Bower, A. B., & Maxham III, J. G. (2012). Return Shipping Policies of Online Retailers: Normative Assumptions and the Long-Term Consequences of Fee and Free Returns. *Journal of Marketing, 76*, 110–124.

Burgoon, J. K., & Jones, S. B. (1976). Toward a theory of personal space expectations and their violations. *Human communication research, 2*(2), 131-146.

Chen, T., Peng, Z., Lim, K. H., & Hua, Z. (2015). Antecedents of consumers' intention to revisit an online group-buying website: A transaction cost perspective. *Information & Management, 52*(5), 588-598.

Christ-Brendemühl, S., & Schaarschmidt, M. (2022). Customer fairness perceptions in augmented reality-based online services. *Journal of Service Management*, *33*(1), 9-32.

Cranage, D.A. and Mattila, A.S. (2005). Service recovery and pre-emptive strategies for service failure: both lead to customer satisfaction and loyalty, but for different reasons. *Journal of Hospitality and Leisure Marketing, 13*, 161-181.

DeWitt, T., Nguyen, D. T., & Marshall, R. (2008). Exploring customer loyalty following service recovery: The mediating effects of trust and emotions. *Journal of service research, 10*(3), 269-281.

El-Shamandi Ahmed, K., Ambika, A., & Belk, R. (2023). Augmented reality magic mirror in the service sector: experiential consumption and the self. *Journal of Service Management, 34*(1), 56-77.

Gatter, S., Hüttl-Maack, V., & Rauschnabel, P. A. (2022). Can augmented reality satisfy consumers' need for touch?. *Psychology & Marketing, 39*(3), 508-523.

Guchait, P., Han, R., Wang, X., Abbott, J., & Liu, Y. (2019). Examining stealing thunder as a new service recovery strategy: impact on customer loyalty. *International*

Journal of Contemporary Hospitality Management, *31*(2), 931-952.
Harris, K. E., Mohr, L. A., & Bernhardt, K. L. (2006). Online service failure, consumer attributions and expectations. *Journal of Services Marketing, 20*(7), 453–458.
Heller, J., Chylinski, M., de Ruyter, K., Mahr, D., & Keeling, D. I. (2019). Touching the untouchable: exploring multi-sensory augmented reality in the context of online retailing. *Journal of Retailing, 95*(4), 219-234.
Hess Jr, R. L., Ganesan, S., & Klein, N. M. (2003). Service failure and recovery: The impact of relationship factors on customer satisfaction. *Journal of the academy of marketing science*, *31*(2), 127-145.
Hilken, T., de Ruyter, K., Chylinski, M., Mahr, D., & Keeling, D. I. (2017). Augmenting the eye of the beholder: exploring the strategic potential of augmented reality to enhance online service experiences. *Journal of the Academy of Marketing Science, 45*(6), 884–905.
Holloway, B. B., & Beatty, S. E. (2003). Service Failure in Online Retailing: A Recovery Opportunity. *Journal of Service Research, 6*(1), 92–105.
Jörling, M., Böhm, R., & Paluch, S. (2019). Service robots: Drivers of perceived responsibility for service outcomes. *Journal of Service Research*, *22*(4), 404-420.
Klaaren, K. J., Hodges, S. D., & Wilson, T. D. (1994). The role of affective expectations in subjective experience and decision-making. *Social Cognition, 12*, 77–101.
Keller, K. L. (2003). Brand Synthesis: The Multidimensionality of Brand Knowledge. *Journal of Consumer Research*, *29*(4), 595–600.
Kim, S., & J. Lee. (2022). How to Maximize the Effectiveness of Stealing Thunder in Crisis Communication: The Significance of Follow-Up Actions and Transparent Communication. *Corporate Communications: An International Journal 27*(3). 425–440.
KPMG. (2021). Online-Shopping. Retrieved 13.06.2023 from https://lmy.de/WHPQK
Lee, S. (2020). Stealing Thunder as a Crisis Communication Strategy in the Digital Age. *Business Horizons 63*(6), 801–810
Leo, X., & Huh, Y. E. (2020). Who gets the blame for service failures? Attribution of responsibility toward robot versus human service providers and service firms. *Computers in Human Behavior*, *113*, 106520.
Liang, D., Ma, Z., & Qi, L. (2013). Service quality and customer switching behavior in China's mobile phone service sector. *Journal of Business Research*, *66*(8), 1161-1167.
Lin, C., & Lekhawipat, W. (2016). How customer expectations become adjusted after purchase. International *Journal of Electronic Commerce*, *20*(4), 443-469.
Mozafari, N., Schwede, M., Hammerschmidt, M., & Weiger, W. H. (2022). Claim success, but blame the bot? User reactions to service failure and recovery in interactions with humanoid service robots. In *Proceedings of the 55th Hawaii International Conference on System Sciences*.
Nugroho, A., & Wang, W. T. (2023). Consumer switching behavior to an augmented reality (AR) beauty product application: Push-pull mooring theory framework. *Computers in Human Behavior*, *142*, 107646.
Nysveen, H., Pedersen, P. E., & Thorbjørnsen, H. (2005). Explaining intention to use mobile chat services: moderating effects of gender. *Journal of consumer Marketing*, *22*(5), 247-256.
Oliver, R. L. (1980). A Cognitive Model of the Antecedents and Consequences of Satisfaction Decisions. *Journal of Marketing Research, 17*(4), 460–46
Papageorgis, D., & McGuire, W. J. (1961). The generality of immunity to persuasion produced by pre-exposure to weakened counterarguments. *The Journal of Abnormal and Social Psychology*, *62*(3), 475.
Plutchik, R. (1980). A general psychoevolutionary theory of emotion. In R. Plutschik & H. Kellerman. (Eds.), *Theories of emotion,* (pp. 3-33). Academic press.
Poushneh, A. (2018). Augmented reality in retail: A trade-off between user's control of access to personal information and augmentation quality. *Journal of Retailing and Consumer Services, 41*, 169–176.
Rauschnabel, P. A., Felix, R., & Hinsch, C. (2019). Augmented reality marketing: How mobile AR-apps can improve brands through inspiration. *Journal of Retailing and Consumer Services, 49*, 43–53.
Scholz, J., & Duffy, K. (2018). We ARe at home: How augmented reality reshapes mobile marketing and consumer-brand relationships. *Journal of Retailing and Consumer Services, 44*, 11–23.
Sun, Y., Li, S., & Yu, L. (2022). The dark sides of AI personal assistant: Effects of service failure on user continuance intention. *Electronic Markets, 32*(1), 17–39.
Tan, C. W., Benbasat, I., & Cenfetelli, R. T. (2016). An exploratory study of the formation and impact of electronic service failures. *MIS Quarterly: Management Information Systems, 40*(1), 1–29.
Tan, Y. C., Chandukala, S. R., & Reddy, S. K. (2022). Augmented reality in retail and its impact on sales. *Journal of Marketing*, *86*(1), 48-66.
Tsiros, M., Mittal, V., & Ross, W. T. (2004). The Role of Attributions in Customer Satisfaction: A Reexamination. *Journal of Consumer Research*, *31*, 478–483
Van Dijk, W. W., & Zeelenberg, M. (2002). Investigating the appraisal patterns of regret and disappointment. *Motivation and Emotion, 26*, 321-331.
Van Vaerenbergh, Y., Orsingher, C., Vermeir, I., & Larivière, B. (2014). A Meta-Analysis of Relationships Linking Service Failure Attributions to Customer Outcomes. *Journal of Service Research, 17*(4), 381–398.
Van Vaerenbergh, Y., Varga, D., De Keyser, A., & Orsingher, C. (2019). The service recovery journey: Conceptualization, integration, and directions for future research. *Journal of Service Research, 22*(2), 103-119.
Valentini, S., Orsingher, C., & Polyakova, A. (2020). Customers' emotions in service failure and recovery: a meta-analysis. *Marketing Letters, 31*(2), 199–216.
Xu, X. A., Wang, L., Wang, L., & Xue, K. (2020). Effects of online service failure on customers' intentions to complain online. *Social Behavior and Personality: an international journal, 48*(10), 1-16.
Zhu, Z., Nakata, C., Sivakumar, K., & Grewal, D. (2013). Fix it or leave it? Customer recovery from self-service technology failures. *Journal of Retailing*, *89*(1), 15-29.